

Norfolk Island and the Polynesian Narrative: New Evidence from a Marginal Mystery Island



Nicola Jorgensen

2024

The University of Sydney

Faculty of Arts and Social Sciences

A thesis submitted to fulfil requirements for the degree of Master of Arts (Research).

This research reported in this thesis was supported by the award of a Research Training Program scholarship to the Master of Arts (Research) Candidate.

*Cover image: Polynesian adze preform at the Mount Bates Saddle site.
Photograph by Nicola Jorgensen.*

Statement of Originality

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Nicola Jorgensen
SID: 440 282 437
Date: 27 July 2024

Authorship Attribution Statement

Portions of the methods and results chapters (Chapter 5 – Chapter 8) were derived from Jorgensen, Way and Flexner 2024 (Appendix V), on which I was lead author:

- Jorgensen, N, Way, AM & Flexner, J 2024, 'A 600-700-year-old basalt adze production site from Mount Bates, Norfolk Island', *Archaeology in Oceania*, vol. 59, no. 1, pp. 138-148. DOI: <https://doi.org/10.1002/arco.5307>.

I co-designed the study, analysed the data and wrote the drafts of the manuscript with the co-authors.

Authorship Attestation

As primary supervisor for the candidature upon which this thesis is based, I can confirm that the authorship attribution statements above are correct.

Dr James Flexner
Date: 28 May 2024

Acknowledgements

First and foremost, deepest thanks are due to my official supervisors Dr James Flexner, Dr Amy Mosig Way and Dr Sarah Kelloway, and unofficial supervisor Dr Nick Mortimer. Their support and guidance from the research proposal stage through to the final edits has been key to this project's successful completion. I have learned too much to list and couldn't have asked for a better supervisory team.

This project would not have been possible without many generous contributions from the Norfolk Island community. To Snowy Tavener, who first noticed strange chips of rock along a National Park walking track, thank you for sharing your knowledge and your support throughout this project. Our conversation on Norfolk back in 2020 was the catalyst for this research and I am deeply grateful. To Arthur Evans, thank you as well for your continued support and sharing your wealth of knowledge on everything Norfolk. To Troy Irvine, thank you for your generosity and your insights into Norfolk's Polynesian settlement. Further thanks to Damien Snell, Jane Evans, and many others who generously provided access to artefact collections and provided information that supported this research. Additional thanks are due to Tom Sapienza, Maree Evans, and Bethany Holland from the Kingston and Arthur's Vale Historic Area (KAVHA) management team for their advice and support.

The fieldwork for this project was facilitated locally by the Norfolk Island National Park team, including Nigel Greenup, Joel Christian, Mel Wilson and many others. I am thankful for their assistance and support throughout this project. The fieldwork was additionally supported by expedition funding from the Australian Museum, and I am grateful for the generous loan of the Australian Museum pXRF for the in-field analysis. Special thanks to the Evans family for hosting me during the fieldwork.

Thank you to Atholl Anderson, Jim Specht, Peter White and so many other researchers who paved the way for this project. Thank you as well to the many people who gave advice and support along this journey, including Elizabeth Carter, Michelle Richards, Joseph Lehner and Josh Symons.

To Peter, Charlotte, Courtney and Pip, thank you for encouraging me all the way to the finish line. And most importantly to my research assistant and mum Deborah Jorgensen, your archaeological expertise and sandwiches are unmatched. Thank you for always supporting me.

It has been a privilege to be able to do this research on the island where I was born and collaborate with such an incredible community. This thesis is dedicated to the people of Norfolk Island, thanks f'me.

Abstract

Norfolk Island was settled by Polynesian voyagers between c. 13th-15th centuries CE (Anderson & White 2001a), but the island is frequently omitted from many broader discussions of pre-European migration, settlement, and interaction in the Pacific. With limited material evidence, no extant population at the time of European arrival, and no formal incorporation into existing regional Pacific frameworks, this omission from broader discussions is understandable.

Pre-European habitation on Norfolk Island is not a novel concept but systematic archaeological investigation has been relatively limited over the past several decades (Anderson & White 2001b; Specht 1984). To date our understanding of the Polynesian settlement has been almost exclusively based on information from a single settlement site on the island's south coast (Anderson & White 2001b). This limits interpretations of the settlement's nature and extent, and of how Norfolk Island fits within the broader Polynesian narrative.

This thesis seeks to address two main factors limiting Norfolk Island's inclusion into broader Pacific discussions: scarce material evidence and lacking regional classification. Regarding the former, this document reports on a previously unrecorded stone-working site and several unreported stone artefacts from local private collections. This research utilises a multi-method investigatory approach, including archaeological survey and excavation, techno-typological lithic analysis and non-destructive geochemical analysis using a portable X-ray Fluorescence (pXRF) spectrometer. Based on the results from these lines of enquiry, it is proposed that Norfolk Island is best classified as part of a new Pacific subregion: the Southern Margin Mystery Islands. Encompassing Norfolk Island, the Auckland Islands and the Snares Islands, this subregion is temporally, geographically and culturally associated with Polynesia but sits outside of the region's generally accepted boundaries.

Table of Contents

Statement of Originality	ii
Authorship Attribution Statement	ii
Authorship Attestation	ii
Acknowledgements.....	iii
Abstract.....	iv
Chapter 1: Introduction.....	1
Overview	1
Research Aims and Methods	4
Thesis Structure	4
Chapter 2: Regional Background	6
A Brief History of Pacific Research.....	6
Oceanic Regional Frameworks.....	9
Polynesian Voyaging and Settlement	12
Limits to the Polynesian Triangle and the Outlier Phenomenon	15
Chapter 3: Interaction, Isolation, and Settlement Longevity on Pacific Islands	21
Interaction and the Lithic Record	21
Isolation and Settlement Longevity	25
Chapter 4: Norfolk Island Background	27
Geographical Setting.....	27
Geology	28
Natural Resources.....	31
European Settlement History	33
Evidence of Pre-European Settlement.....	34
Summary	39
Chapter 5: Fieldwork Methods	41
The Mount Bates Saddle Site.....	41
Survey and Test Excavation	42
Chapter 6: Fieldwork Results	46
Phase 1 Fieldwork (May 2021).....	46
Phase 2 Fieldwork (October 2022)	52
Chapter 7: Lithic Analysis and PXRF Methods.....	57

Lithic Analysis.....	57
Background to Portable X-Ray Fluorescence.....	59
Data Collection and Geochemical Analysis.....	63
Chapter 8: Lithic Analysis and PXRF Results.....	72
Mount Bates Saddle Site Lithic Analysis	72
Geochemical Provenancing	78
Summary of Results	104
Chapter 9: Discussion and Conclusions	105
Additional Evidence of Polynesian Occupation on Norfolk Island	105
Evidence of Interaction, Isolation and Social Complexity.....	110
Norfolk Island’s Place in Oceanic Regional Frameworks	112
Future Research Directions.....	114
Reference List	117
Appendix I: Mount Bates Saddle Site – Drawings.....	137
Appendix II: Mount Bates Saddle Site – Artefact Catalogue	151
Appendix III: University of Waikato Radiocarbon Dating Laboratory Report	209
Appendix IV: Geochemical Datasets.....	213
Appendix V: Jorgensen, Way & Flexner 2024 Publication	356

List of Figures

Figure 1: Dumont d’Urville’s regional division of the ‘Great Ocean’ into Micronesia, Melanesia, and Polynesia. Adapted with permission from basemap produced by Dr James Flexner.....	7
Figure 2: Current regional divisions of Micronesia, Melanesia, and Polynesia. Adapted with permission from basemap produced by Dr James Flexner.	9
Figure 3: Division between Near Oceania and Remote Oceania. Adapted with permission from basemap produced by Dr James Flexner.	11
Figure 4: Division of West Polynesia and East Polynesia. Adapted with permission from basemap produced by Dr James Flexner.	12
Figure 5: Potential trajectory of Polynesian migration. Voyaging model follows Montenegro, Callaghan and Fitzpatrick 2014, p. 243. Adapted with permission from basemap produced by Dr James Flexner	14
Figure 6: Locations of recorded Polynesian Outliers. Adapted from basemap produced by Dr James Flexner.....	19
Figure 7: Key locations on Norfolk Island. Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.	28
Figure 8: Map showing the four basalt flows comprising the majority of Norfolk Island’s terrestrial formation (Jones & McDougall 1973, p. 247). Image removed for copyright purposes.....	29
Figure 9: 1:25 000 scale topographic map of Norfolk Island (Geoscience Australia 2010).....	32
Figure 10: Approximate locations of twelve (numbered) local findspots reported by Jim Specht (1984, p. 2).	37
Figure 11: Location of the Mount Bates Saddle site (Jorgensen, Way & Flexner 2024, p. 142). Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.....	41
Figure 12: Mount Bates Saddle survey plan drawing.	43
Figure 13: Locations of Phase 1 survey and brief inspections. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.....	44
Figure 14: Section of the Mount Bates Saddle site along the Mount Bates Track. Scale marks the location of surface artefact concentration. View north. Photograph by N. Jorgensen. ...	47
Figure 15: Example of surface basalt artefacts intermixed with introduced calcarenite rubble and gravels. Photograph by N. Jorgensen.	47
Figure 16: Example of basalt flaked artefacts on the Mount Bates Track surface. Photograph by N. Jorgensen.....	47
Figure 17: Soil mound adjacent to Mount Bates Track, to the left of image. View north towards Mount Bates. Photograph by N. Jorgensen.....	47
Figure 18: Large basalt pieces embedded in Mount Bates Track – south of the MBS site. Photograph by N. Jorgensen.....	47

Figure 19: Single flake identified on the Mount Bates Track between Mount Pitt Road and the saddle. Unable to be relocated during later fieldwork. Photograph by N. Jorgensen.....	47
Figure 20: <i>Nerita atramentosa</i> shells amongst leaf litter. Photograph by N. Jorgensen.	48
Figure 21: Glass bottle in inspection area. Photograph by N. Jorgensen.....	48
Figure 22: Point of creek overflow into the ocean, boulder beach visible below. View north-west. Photograph by N. Jorgensen.	49
Figure 23: Terrain above the first creek cascade at Cockpit. View north. Photograph by N. Jorgensen.	49
Figure 24: Levelled and built-up area for vehicles, fuel line in foreground. View north. Photograph by N. Jorgensen.....	49
Figure 25: Example of boulder fracturing from machinery or heavy seas. Photograph by N. Jorgensen.	49
Figure 26: Adze recovered from subsurface context. Photograph by N. Jorgensen.....	50
Figure 27: Adze findspot location. Photograph by N. Jorgensen.	50
Figure 28: Collection of larger boulders. View north-west. Photograph by N. Jorgensen.....	51
Figure 29: Single piece of potentially workable stone. Photograph by N. Jorgensen.....	51
Figure 30: Location of Emily Bay settlement site in sand dunes behind Emily Bay. View north-east. Photograph by N. Jorgensen.	52
Figure 31: Convict drain channelled into calcarenite on the Slaughter Bay shorefront. View south. Photograph by N. Jorgensen.....	52
Figure 32: Northern end of surface collection transect. View south. Photograph by N. Jorgensen.	53
Figure 33: Adze preform recorded amongst area of highest surface artefact concentration. Photograph by N. Jorgensen.....	53
Figure 34: Mount Bates Saddle site stratigraphy, eastern profile. Layer I: moderately compact dark brown clay loam with introduced gravel and calcarenite rubble inclusions, Layer II: medium brown clay loam with large inclusion of natural decomposing basalt, Layer III: moderately friable red-brown clay loam with grey and yellow clay inclusions.	54
Figure 35: Location of test pit prior to excavation and sieve station set up. Photograph by N. Jorgensen.	55
Figure 36: Commencement of test excavation. Denser calcarenite inclusions visible at southern end of test pit (top of photo). Photograph by N. Jorgensen.....	55
Figure 37: Example of charcoal fragment sample (CH09). Photograph by N. Jorgensen.....	55
Figure 38: Completed test pit. Photograph by N. Jorgensen.....	55
Figure 39: The process of XRF analysis (McAlister 2011, p. 96). Image removed for copyright purposes.....	60
Figure 40: Bruker Tracer 5i pXRF instrument set up. Photograph by N. Jorgensen.....	65
Figure 41: Total Alkali-Silica (TAS) diagram (Le Maitre et al. 2002, p. 35). Image removed for copyright purposes.	69
Figure 42: Redrawn Pearce W-F diagram with limits shown (Richards 2019, p. 33). Image removed for copyright purposes.	70

Figure 43: Artefact types from the overall MBS assemblage.	73
Figure 44: Percentages of flakes in each size category at Emily Bay, the Mount Bates Saddle, and Tahanga Quarry.	74
Figure 45: Scatterplot of Mount Bates artefacts by Weight (g) and Length/Width ratio showing the position of the flakes in the four Categories. Vertical dashed lines mark the size class divisions.	75
Figure 46: Stages of reduction based on percentage of artefacts with full cortex (primary), some cortex (secondary) and no cortex (tertiary).	76
Figure 47: Adze preforms from the Mount Bates Saddle site. Left: MBS100 (rectangular-sectioned adze preform). Right: MBS256 (micro-adze preform). Adapted from 3D modelling by Thomas Peachey and Meagan Warwick.	78
Figure 48: Example of the size of one local collection. What is shown is only a sample of this single collection. Photograph by N. Jorgensen.	82
Figure 49: Findspot locations of artefacts subject to pXRF analysis. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.	83
Figure 50: Locations of comparative source datasets. Note that New Caledonia was later excluded and is not discussed in the following data analysis results. Adapted with permission from basemap produced by Dr James Flexner.	85
Figure 51: Pearce W-F diagram – artefacts only. Adapted from Richards 2019, p. 33.	87
Figure 52: Pearce W-F diagram – artefacts and Norfolk Island geological samples. Adapted from Richards 2019, p. 33.	88
Figure 53: Bivariate plot (Rb/Zr, Sr/Y) of MBS and private collection artefacts with Norfolk Island geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	91
Figure 54: Bivariate plot (Zr/Nb, Rb/Sr) of MBS and private collection artefacts with Norfolk Island geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	92
Figure 55: Bivariate plot (Zr/Y, Rb/Nb) of MBS and private collection artefacts with Norfolk Island geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	93
Figure 56: Bivariate plot (Zr/Y, Rb/Sr) of MBS and private collection artefacts with Norfolk Island geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	94
Figure 57: SB 0.09 – possible pounder handle. Photograph by N. Jorgensen.	95
Figure 58: UN ID 3 – broken cylindrical adze section. Photograph by N. Jorgensen.	96
Figure 59: ST-01 – subtriangular-sectioned adze. Photograph by N. Jorgensen.	97
Figure 60: SB 15 – complete flake. Photograph by N. Jorgensen.	98
Figure 61: SB 2.191 – possible hammerstone. The in-photo label is noted to display an incorrect ID number. Photograph by N. Jorgensen.	99
Figure 62: Bivariate plot (Rb/Zr, Sr/Y) of MBS and private collection artefacts with geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	100

Figure 63: Bivariate plot (Zr/Nb, Rb/Sr) of MBS and private collection artefacts with geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	101
Figure 64: Bivariate plot (Zr/Y, Rb/Nb) of MBS and private collection artefacts with geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	102
Figure 65: Bivariate plot (Zr/Y, Rb/Sr) of MBS and private collection artefacts with geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.	103
Figure 66: Known findspot locations of 24 locally provenanced artefacts from private collections. South coast of Norfolk Island, Kingston area. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.	108
Figure 67: Area of Slaughter Bay where artefacts have most frequently been exposed (polygon). Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.	109
Figure 68: Proposed Southern Marginal Mystery Islands (Norfolk Island, the Snares Islands and the Auckland Islands). Adapted with permission from basemap produced by Dr James Flexner.	114

List of Tables

Table 1: AMS radiocarbon dating for the Mount Bates Saddle side (data supplied by The University of Waikato Radiocarbon Dating Laboratory 10.01.2023).	56
Table 2: Calibration ranges in relation to Norfolk Island basalt samples (analysed by UQ). *Nb values not provided by QUT.	64
Table 3: Accuracy of NIST 688 standard check across analysis sessions. *Certified values not available.	66
Table 4: Precision of NIST 688 standard check across analysis sessions.	66
Table 5: Accuracy of pXRF measurements of Norfolk Island basalt samples. *Nb values not provided by QUT.	67
Table 6: Comparison of flake percentages in the four Categories. Note the Emily Bay and Tahanga Quarry percentages were recalculated following removal of Categories C and D... 75	
Table 7: MBS assemblage artefacts selected for pXRF analysis.	78
Table 8: Private collection artefacts selected for pXRF analysis. *Note those artefacts marked 'Kingston area' are the presumed findspots – the exact findspot information is unknown.	79
Table 9: Norfolk Island geological source samples.	84
Table 10: Non-local geological source samples. *Note that the New Caledonia samples are listed here for reference but are not included in the following data analysis results. Cluzel, Aitchison and Picard's (2001) ICP-MS dataset is provided in Appendix IV.....	85

Chapter 1: Introduction

Overview

This thesis seeks to define Norfolk Island's place in the Polynesian narrative and incorporate the island into broader discussions of pre-European migration, settlement, and interaction in the Pacific. Norfolk Island is located approximately equidistant from New Caledonia and New Zealand, and approximately 1,400 km east of the Australian coastline (Figure 1). The island has a multi-layered settlement history, beginning with a pre-European Polynesian occupation (spanning c. 13th-15th centuries CE) and followed by several phases of British and Pitcairner settlement up to the present day. A gap of at least two centuries separates the departure of the Polynesians and the arrival of the first British settlers. As such, studies on Norfolk Island's Polynesian settlement rely heavily on the material record.

Numerous stone artefact finds have been reported through the course of the island's historical settlement (e.g. King to Banks 25 October 1791 in Specht 1984, p. 12; McCarthy 1934). These reports prompted targeted survey by Jim Specht (1978, 1984) and archaeological investigations eventually culminated in the identification and excavation of a Polynesian settlement site at Emily Bay on the island's south coast (Anderson & White 2001b). Although these previous investigations have provided critical information on the island's pre-European period, including establishing the first associated settlement chronology, the material record remains relatively sparse. Attention has been almost exclusively focussed on the Kingston area on the island's south coast and, prior to this study, only one archaeological site had been identified.

The limited archaeological record and lack of inhabitants at the time of European arrival has left gaps in our understanding of the Polynesian settlement on Norfolk Island. It is most likely that the settlers travelled from New Zealand or the Kermadec archipelago in East Polynesia (Anderson & White 2001c; Specht 1984, 1993), but a homeland has yet to be definitively identified. Likewise, it is unclear where the Polynesian settlers went after they departed the island. Further mysteries surround the nature and extent of the settlement itself. Radiocarbon dating from the Emily Bay settlement site indicates that the Polynesian occupation spanned over two centuries (Anderson, Higham & Wallace 2001a). However, previous research has not identified any concrete evidence of Polynesian activity beyond the Emily Bay area. East Polynesian colonisation strategies at this time typically involved early widespread exploration of the landscape, and identification and exploitation of various resources (e.g. Walter, Jacomb & Bowron-Muth 2010; Walter et al. 2017). Given the cultural and temporal correlation, it is highly likely that these strategies were also carried out on Norfolk Island and more widespread evidence remains to be uncovered.

The sparse archaeological record also limits interpretations of potential isolation, interaction, and social complexity in Norfolk Island's pre-European period. To date such

interpretations have relied almost exclusively on excavated material from the Emily Bay site (Anderson & White 2001b). Studies of interaction and isolation in the wider Pacific have shown that the latter can certainly influence a settlement's longevity (e.g. Weisler 1995; Weisler 2008). It is likely that external networks were essential for new communities, providing critical resources and avenues for social reproduction. Isolation has been considered a likely contributor to Norfolk Island's abandonment after several centuries (Anderson & White 2001a). This interpretation of isolation is largely based on the island's geographic remoteness, an assumption of a small population, and a scarcity of imported material in the Emily Bay stone artefact assemblage. The latter end of the settlement also coincides with a significant curtailment of long-distance voyaging across East Polynesia (Rolett et al. 2015; Weisler 2002) which may have severed any external connections. Although these factors are certainly suggestive, further *in situ* material is needed to test this assumption of small settlement size and investigate the apparent lack of external interactions in the Polynesian period.

Geochemical provenancing has become a frequently utilised technique to understand interactions in pre-European contexts throughout Polynesia and the wider Pacific. By geochemically connecting an object to its source, researchers have been able to successfully reconstruct voyaging pathways and networks of interaction across the Pacific region (e.g. Clark et al. 2014; McCoy et al. 2020; Reepmeyer 2021; Sheppard, Trichereau & Milicich 2010). The movement of material in this sense is representative of the movement of peoples. Stone tool provenancing studies across this region have significantly advanced our understanding of pre-European settlement connectivity and how external connections, or lack thereof, influenced localised cultural development and social complexity (e.g. Mills et al. 2018; Rolett et al. 2015). The advent of portable X-ray Fluorescence (pXRF) instruments in particular has accelerated provenancing studies in the Pacific (e.g. Charleux et al. 2014; Kahn et al. 2013; Kirch et al. 2012; Richards 2021). Discussed further in Chapter 7, pXRF instruments are a portable, non-destructive, and often more accessible provenancing tool for researchers.

Stone is one of the most resilient materials found in archaeological contexts, and basalt and volcanic glass are commonly targeted for Pacific provenancing studies. Investigation of the Emily Bay site on Norfolk Island included geochemical analysis of several basalt and obsidian artefacts from the excavated stone assemblage (Anderson et al. 1997). The obsidian was primarily linked to a source on Raoul Island in the Kermadec archipelago, with a single piece tentatively linked to Mayor Island. The basalt was determined to have been sourced locally. The results supported a view of settlement isolation and to date no concrete evidence has been uncovered to suggest the Norfolk Island settlers were interacting with their neighbours. However, interpretations based on a small sample of a single site should be approached with caution. Ultimately, the recovery and analysis of further material is required to investigate levels of interaction or isolation in the Polynesian period, and how this may have influenced settlement longevity and social complexity.

Norfolk Island's frequent omission from discussions of pre-European migration, settlement, and interaction is perpetuated by its unclear alignment with regional Pacific frameworks. These frameworks provide a foundation for research on movement and cultural developments in pre-European contexts, and interpretations of material evidence. Pacific studies typically utilise one of two major regional frameworks. The tripartite division of Melanesia, Micronesia, and Polynesia, published in 1832 (Dumont D'Urville et al. 2003), has historically been used the most frequently. However, these regional divisions were created using racist assumptions and now serve more as geographical references than defined regions of cultural homogeneity. Polynesia can be described as a relatively cohesive unit in terms of cultural, linguistic, and genetic characteristics, but this level of homogeneity is not reflected in Micronesia or Melanesia (Addison & Matisoo-Smith 2010; Anderson & Sinoto 2002; Flexner, Bedford & Valentin 2019; Kirch & Green 2001).

An alternative regional model published by Roger Green (1991a) proposed to replace the tripartite framework with Near Oceania and Remote Oceania. Discussed further in Chapter 2, there are pros and cons to both frameworks. However, there is general consensus by all parties that Polynesia presents a useful and cohesive analytical unit, reflective of a common ancestral homeland (Green 1991a; Kirch & Green 1987, 2001). Due to this consensus and Norfolk Island's Polynesian past, this thesis utilises the tripartite terminology. References to Melanesia and Micronesia are for the purpose of geographical orientation and do not attempt to portray these as culturally singular regions.

This thesis seeks to expand Norfolk Island's known pre-European archaeological record and establish a regional classification for the island. In regard to the former, this thesis reports on a previously unrecorded stone-working site in the north-western uplands of Norfolk Island. Named the Mount Bates Saddle (MBS) site, this site comprises the second confirmed Polynesian site on the island (Jorgensen, Way & Flexner 2024). This study centres primarily on investigation of the MBS site, including the results of archaeological fieldwork, lithic analysis, and geochemical provenancing. To supplement these findings, several unreported stone artefacts from local private collections are also documented and analysed in this study. It is estimated that hundreds of stone artefacts exist in local collections. The artefacts included here constitute only a small sample of the available material.

Consideration of this new material, and the implications for interpretations of isolation, interaction and social complexity, facilitates discussion of Norfolk Island's regional classification. The island hosted a Polynesian occupation between c. 13th-15th centuries CE but is geographically situated outside of Polynesia's boundaries which span from Aotearoa (New Zealand) in the south, to Hawai'i in the north, and to Rapa Nui (Easter Island) in the east. This thesis considers how the island might then be regionally defined, with reference to the Polynesian Outliers, culturally Polynesian islands or localities existing outside of the Polynesian Triangle (Kirch 1984), and other comparable islands fringing the Triangle's southern limits. Drawing on existing studies and new archaeological evidence from this

research, this thesis proposes that Norfolk Island be classified as part of a new Pacific subregion: the Southern Marginal Mystery Islands. This subregion is proposed to encapsulate Norfolk Island, the Auckland Islands and the Snares Islands which were settled by culturally Polynesian voyagers but are located outside of the south-western limits of the Polynesian Triangle. By relation to the Triangle alone these islands may correspond to the Polynesian Outlier definition, but it is argued that their shared settlement chronologies, geographic positions and cultural ancestry are better suited to definition as a separate subregion. The results presented in this thesis, such as expanded evidence of Polynesian settlement on Norfolk Island and cross-comparison with those other islands and archipelagos in the proposed subregion, support such an interpretation.

Research Aims and Methods

The key aims of this research are to document and interpret new evidence from the Polynesian settlement on Norfolk Island, to further define the nature and extent of this settlement, and to use this information to classify Norfolk Island with reference to existing regional frameworks. The overarching intent is to better integrate the island into broader discussions of pre-European migration, settlement, and interaction in Polynesia and the wider Pacific.

To meet these aims, a multi-method approach is used consisting of:

- Archaeological survey, surface collection, and excavation at the MBS site
- Techno-typological analysis of the MBS lithic assemblage, following the typologies of Turner and Bonica (1994) and Clarkson, Shipton & Weisler (2014, 2015)
- Geochemical provenancing of a sample of the MBS lithic assemblage and select private collection artefacts, using a pXRF spectrometer
- Brief inspections of reported artefact findspots.

This research additionally reports radiocarbon dating results from excavated charcoal samples from the MBS site, which were analysed by The University of Waikato Radiocarbon Dating Laboratory.

Thesis Structure

This thesis is structured in nine chapters, with a reference list and additional appendices provided at the end of the document. Following this introductory chapter, Chapter 2 provides regional background to the research, including a synthesis of relevant studies of the pre-European history of the Pacific and discussion of Pacific regional frameworks. Chapter 3 provides further context in relation to studies of interaction and isolation, and their implications for settlement longevity on Pacific Islands. Chapter 4 looks more specifically at Norfolk Island, presenting information on the island's geography, geology, natural environment, and settlement history. This chapter also includes details on the island's previous pre-European archaeological studies, considering both their achievements and the research gaps they highlight.

Chapter 5 to Chapter 8 present the methods and results of this research. Due to the multidisciplinary approach, these chapters are separated to present the methods and results of fieldwork first (Chapter 5 and Chapter 6), followed by the methods and results of lithic and pXRF analysis (Chapter 7 and Chapter 8). Chapter 9 synthesises these results and information from preceding chapters to discuss the evidence of Polynesian occupation on Norfolk Island and how this situates the island in Oceanic regional frameworks. This chapter also presents the conclusions from this research and considers potential avenues for future research.

Chapter 2: Regional Background

A Brief History of Pacific Research

Historical developments in archaeological research across the Pacific region constitute the foundation for current theoretical frameworks. To understand these contemporary frameworks, it is important to acknowledge the ideas and methods from which they developed. Studies of pre-European Pacific history are traditionally Eurocentric, and this chapter reflects the dominance of this perspective in the literature. Discussion of how certain voices have been marginalised in the history of Pacific archaeology, such as those of indigenous and female scholars, is beyond the scope of this thesis (see instead Howes, Jones & Spriggs 2022). However, it is acknowledged that the discipline has been dominated by male-authored and Western-influenced perspectives.

Early European investigations into Pacific peoples' culture and origins began around the Age of Enlightenment, with large-scale voyaging into the Pacific region from the late 16th century CE (Kirch 2017, p. 12; Spriggs 2022a, p. 15-28). These voyages were primarily motivated by the expansion of empire and commercial reach but transitioned to include more scientific pursuits in the latter half of the 18th century. British explorer James Cook's 18th century voyages characterised this period of explorative natural science, though it is noted his voyages also sought to claim new territory for Britain (Beaglehole ed. 1967, ed. 1968, ed. 1969). Based on information gathered through extensive interactions with Pacific Islanders, Cook concluded that there were strong linguistic, physiological, and cultural affinities within the region that later became known as Polynesia. A similar connection was also noted between this region and the islands of Southeast Asia (Howard 1967, p. 50; Kirch 2017, p. 12-13; Thomas 1989, p. 29-30).

Later expeditions furthered these observations of regional homogeneity, and the 'Great Ocean' was divided into the first iterations of Micronesia, Melanesia, and Polynesia. This division was published by French naturalist and navigator Jules-Sébastien César Dumont d'Urville in 1832 and originally included Malaysia as an Oceanic region (Dumont d'Urville et al. 2003; Figure 1). The delineation of these regions had a basis in linguistics and geographic setting but was ultimately overshadowed by grouping the peoples of the region according to 19th century assumptions about race. Differences in physical appearances, particularly skin colour, and perceived levels of civility were at the forefront, with socio-political structures and physical environments incorporated as secondary, particularly in the boundary between Polynesia and Melanesia (Dumont d'Urville et al. 2003; Thomas 1989, p. 31).

Questions of population origins and voyaging trajectories gained momentum through the 19th century. A publication by Johann Reinhold Forster (1996 [original 1778]) theorised two lines of ancestral descent into the Pacific, one northern trajectory from Southeast Asia through Micronesia and Polynesia, and a second through Indonesia and the Melanesian islands (Spriggs 2022a, p. 18-19). American ethnographer Horatio Hale then posited a

linguistics-based theory of Polynesian origins deriving from Southeast Asia in 1846. Hale used ancestral language links between these two locales to construct a foundational model of west to east migration. Origins and voyaging remain core facets of contemporary studies of pre-European Pacific history and Hale's (1846) publication was a major early contribution to this field (Spriggs 2022a, p. 21-22).

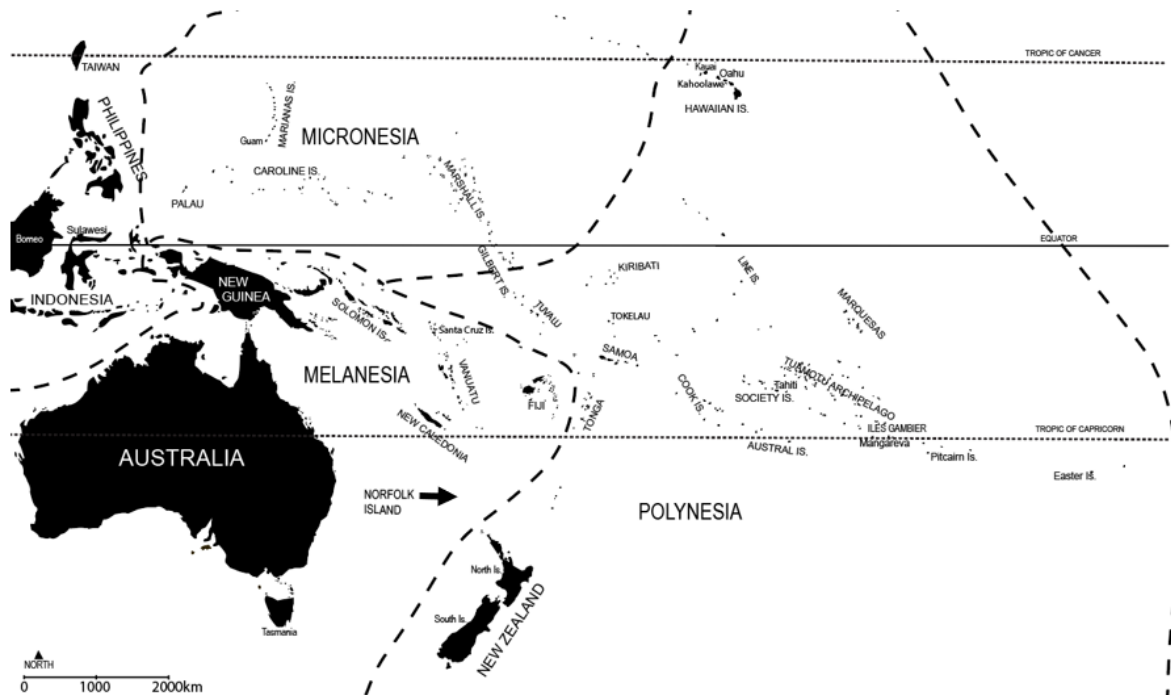


Figure 1: Dumont d'Urville's regional division of the 'Great Ocean' into Micronesia, Melanesia, and Polynesia. Adapted with permission from basemap produced by Dr James Flexner.

Interest in Pacific peoples and their origins continued through the 19th and early 20th centuries with the work of missionaries and colonial officials. The pursuit of colonialism and religious conversion required an understanding of existing cultures and significant information on languages, traditions, belief systems and oral histories were compiled throughout this period (Ellis 1830; Fornander 1969; Smith 1921 [1910]; Thrum 1916-1920; Williams 1840). Missionary works, such as those by Ellis (1830) and Williams (1840), tended to emphasise the heterogeneity and constant fluctuation of Pacific Island cultures. This rhetoric typically presented Western models of religion and governance as superior and unifying alternatives to traditional practices (Werner 2013).

Ethnographic and material research accelerated with the establishment of Pacific research institutions such as the Polynesian Society (New Zealand) and the Bishop Museum (Hawai'i) in the late 19th century. Material research focussed on developing classificatory systems and templates by which to categorise Pacific populations and establish cultural sequences. These early classificatory systems generally favoured large-scale architecture and stone tools due to a lack of ceramics in much of Polynesia and absence of written texts throughout Oceania (e.g. Brigham 1902; Routledge 1919). Pacific scholars continued to document and synthesise oral traditions through the late 19th and early 20th centuries. Considering oral

traditions in relation to material culture changes, linguistic relationships, and cultural practices provided significant information on social stratification, migration, and culture relationships during this period (e.g. Fornander 1969 and Hambrüch 1932, see also Howes 2022a).

Advances in pre-European Pacific history were facilitated by increasing fieldwork from the early 20th century. A key driver of this fieldwork was the recommendations of the first Pan-Pacific Scientific Conference, held in 1920. The unsolved 'problem' of Polynesian origins was a major consideration of the conference proceedings and one determined to be resolved through systematic survey and excavation (Gregory 1924; Kirch 2017, p. 17-18; Spriggs 2022b, p. 288-290). Despite the involvement of archaeologists in these early fieldwork expeditions, interpretations were mainly steered by ethnographers and physical anthropologists. This led to physical and behavioural characteristics featuring heavily, resulting in racially prejudiced arguments (e.g. Sullivan 1924).

The social and political context of the early 20th century significantly influenced studies of Polynesian origins and migration. This contextual effect is most evident in the alternate migration theory published by Polynesian scholar and Bishop Museum director Te Rangi Hiroa (also known as Sir Peter Buck) in 1938. Hiroa corroborated Polynesian origins in Southeast Asia but instead argued for a northern west to east migration that travelled through the lighter-skinned archipelagos of Micronesia. This theory aimed to circumvent association with the darker skinned Melanesians and the pervasive connotations of barbarism. Although Hiroa's theory was later disproven (Gifford 1951; Gifford & Shutler 1956), the context of limited empirical evidence and racial prejudice gave significant momentum to this argument.

The discipline of Pacific archaeology solidified and expanded through the latter half of the 20th century. Excavations increased and methods of investigation diversified. A major development came in the mid-20th century with the discovery of Lapita pottery during excavations in New Caledonia (Gifford & Shutler 1956). Fragments of this pottery had been previously recovered in New Guinea (Pösch 1907; Howes 2017), the Bismarck Archipelago (Meyer 1909; Howes 2017; Howes 2022b) and Tonga (McKern 1929), but their significance was not recognised at the time. Radiocarbon dating several decades later established an age of c. 2,800 BP for the New Caledonian pottery (Gifford & Shutler 1956) which was the first archaeological evidence of significant time depth for human occupation in the Pacific. The locations of the previously recovered pottery fragments also connected pre-European Melanesia and Polynesia, and critically contradicted Hiroa's migration theory.

With increasing excavations material studies expanded, and other typologies were developed based on ceramics (e.g. Mead et al. 1975), fishhooks (e.g. Emory, Bonk & Sinoto 1959) and stone adzes (e.g. Duff 1950). Studies expanded to incorporate floral and faunal remains and explored the role of ecological factors on settlement longevity (Shawcross 1967, 1972; Yen et al. 1972). The archaeology of settlement patterns also gained traction to

investigate socio-political structures (Green 1961; Green & Davidson 1969). Significant advancements were made with rapidly developing technologies such as radiocarbon dating, X-Ray Fluorescence (XRF) and other geochemical techniques. Geochemical analyses provide a means by which to compare material aspects and reconstruct spheres of interaction, migration, and exchange (Craig et al. 2007; Gliozzo et al. 2011; Kirch 1988a; Reepmeyer 2021; Spriggs 2019, p. 13-18). These techniques are extremely valuable for pre-European studies in the Pacific. The development and application of XRF and other geochemical techniques is discussed further in Chapter 7.

Oceanic Regional Frameworks

The regional divisions of Oceania have significant implications for all Pacific research. Regional boundaries provide an important framework to investigate movement and cultural developments in pre-European contexts, and to interpret material evidence. There are two major regional frameworks used in Pacific studies today. The division of the 'Great Ocean' into Melanesia, Micronesia and Polynesia (Dumont D'Urville et al. 2003) was the earliest model and as such has been the most frequently used in publications to date. The current boundaries of Micronesia and Polynesia show little change from Dumont D'Urville's 1832 publication, but the Melanesian region has significantly contracted, largely due to the exclusion of Australia (Figure 2). Continuous investigation of these regions' geographic, biological, linguistic, and cultural affinities has gradually refined their boundaries.

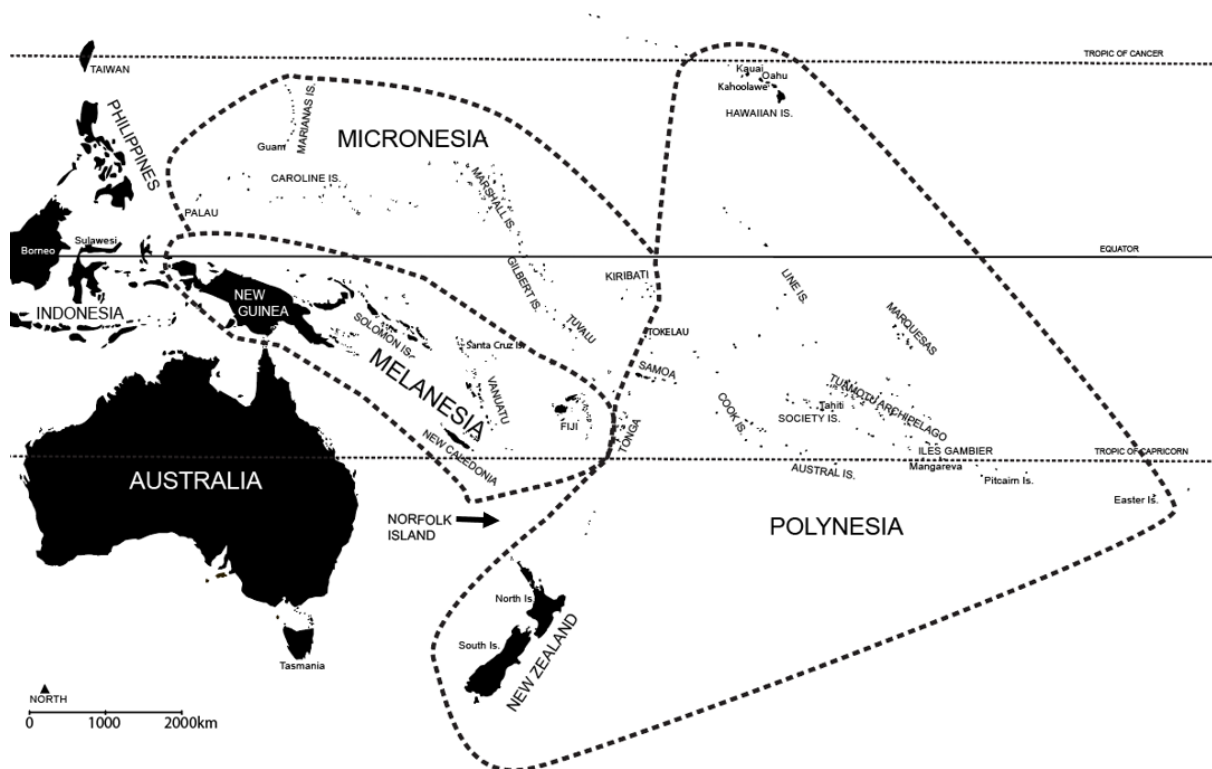


Figure 2: Current regional divisions of Micronesia, Melanesia, and Polynesia. Adapted with permission from basemap produced by Dr James Flexner.

Justification for the continued use of this tripartite framework has been heavily debated, in large part due to its racially biased origins. From a geological perspective, Melanesia, Micronesia, and Polynesia individually demonstrate some cohesiveness. The Melanesian islands are typically larger and older with relatively more complex geologies, Micronesia is characterised by low islands and coral atolls, and Polynesia by volcanic islands and archipelagos (Clark 2003, p. 157). In this sense, the use of Micronesia, Melanesia and Polynesia can circumvent the original racial connotations by application solely as a means of geographical reference.

Polynesia as a regional unit is relatively homogenous in terms of cultural, linguistic, and genetic characteristics, but this level of homogeneity is not reflected in Micronesia or Melanesia (Addison & Matisoo-Smith 2010; Anderson & Sinoto 2002; Flexner, Bedford & Valentin 2019; Kirch 2010). Melanesia in particular demonstrates high levels of cultural diversity and social complexity that are not defined by its geographical boundaries (Burley 2013; Green 1991a). The broader differences that separate these regions constitute a testable framework. However, care must be taken when utilising this tripartite terminology so as not to perpetuate the original racial ideologies.

In 1991, Roger Green published an alternative model which has been adopted by many modern studies (e.g. Anderson 2002; Kayser 2010; Kirch 2010). Green (1991a) proposed and advocated the replacement of Micronesia, Melanesia and Polynesia with the terms Near Oceania and Remote Oceania. This alternate regional framework intended to create distance from Dumont D'Urville's problematic definitions and create broader regional boundaries for more accurate cultural interpretations and comparisons. The division between Near and Remote Oceania is based on time depths and migratory chronologies rather than assumed cultural, societal, or biological markers (Kirch 2010, p. 133; Figure 3). Near Oceania was settled between c. 40,000-10,000 BP (Green 1991a. p. 496; Flexner Bedford & Valentin 2019, p. 405) and encompasses the majority of the islands previously labelled as Melanesia (Figure 3). It is generally accepted that migration into Remote Oceania started c. 3,000 BP and the occupation of this region was largely complete by c. 700 BP (Allen & Kahn 2010; Dye 2015; Horsburgh & McCoy 2017; Hunt & Lipo 2006; Mulrooney et al. 2011).

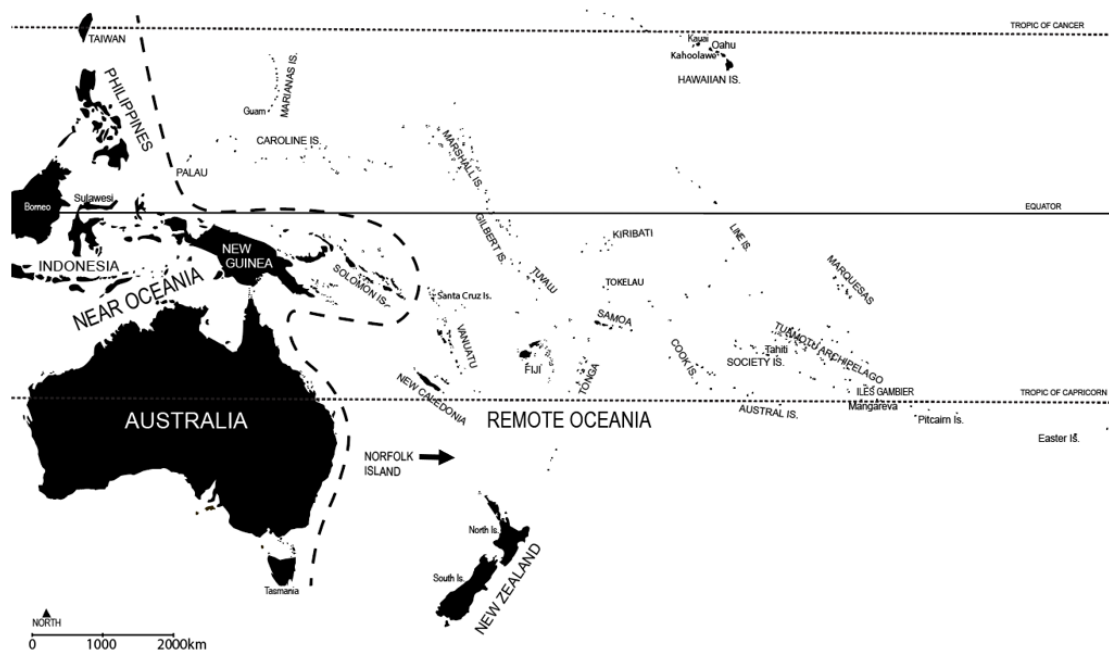


Figure 3: Division between Near Oceania and Remote Oceania. Adapted with permission from basemap produced by Dr James Flexner.

The implication of Green's model is that colonisation of Remote Oceania by Austronesian speakers occurred as a wave of advance. The result being a continuous, though largely non-directional, dispersal of colonists and similar cultural practices. However, some of this evidence has since been critiqued (Sheppard 2011). Sheppard instead proposed that the expansion into Remote Oceania favoured a leapfrog pattern and that this is evidenced by certain linguistic and biological disjuncture across the Bismarck archipelago and Solomon Islands. Sheppard's interest in this disjuncture concerns the division between two main language groups: the Austronesian speakers who are thought to have colonised Remote Oceania, and the non-Austronesian speakers who preceded them (Terrell, Kelly & Rainbird 2001). Although Green's boundary between Near and Remote Oceania is supported by the archaeological record and its geographic position, the linguistic division instead moves this boundary approximately 650km to the west (Sheppard 2011, p. 808).

Dumont D'Urville's regional divisions are still useful in certain contexts. Polynesia encompasses a considerable area of Remote Oceania and there is general consensus, including by Green (1991a, p. 491), that this region represents a useful and cohesive analytical unit. The homogeneity in this region refers to the interrelated languages, traditions, social structures, technologies, and biological markers that distinguish it from surrounding locales. Distribution of these shared traits across such an expansive region reflects a common ancestral homeland from which their colonisation began (Kirch & Green 1987, 2001). This thesis utilises the tripartite terminology for the purpose of situating Norfolk Island in relation to this existing framework and solidifying its place in the Polynesian narrative. References to Melanesia and Micronesia are intended only to reflect their geographic locations.

Polynesian Voyaging and Settlement

The Polynesian Triangle's published boundaries seldom vary from those shown in Figure 2. Although Polynesia represents a broadly cohesive unit, the region can be divided into East and West (Figure 4) based on the chronology of migration and settlement. West Polynesia comprises a collection of islands, including Tonga and Samoa (Anderson & O'Connor 2008; Kirch 2010; Kirch & Green 1987, 2001), whose settlement began with the first landing at Nukuleka (Tongatapu) c. 900 BCE (Burley 2023, p. 73-78). Speculation on motives for voyaging to this region ranges from overpopulation and resource stress, to targeted land claims and prestige-seeking, to simple curiosity and the pursuit of adventure (Burley 2023, p. 330-335).

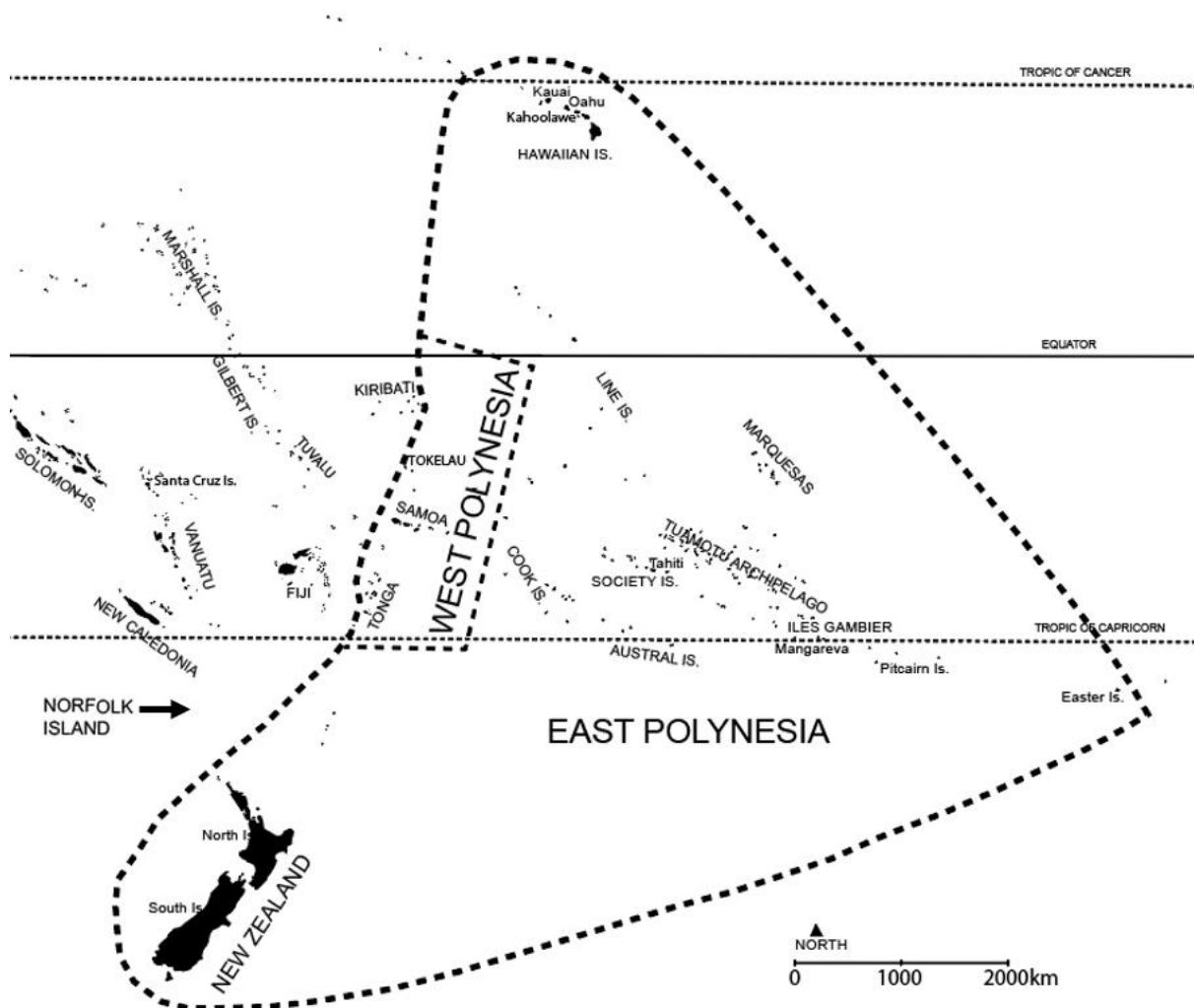


Figure 4: Division of West Polynesia and East Polynesia. Adapted with permission from basemap produced by Dr James Flexner.

Identifying the strategies used by the West Polynesian colonists may provide insight on the underlying motivations for such a journey. Pacific voyagers travelled significant distances to reach this region which indicates a considerable level of strategic planning. Burley (2023, p. 332-333) suggested that these voyagers gathered information from “gateway communities” along their route and may have used advance parties to inform their migration strategy. This

strategy appears to support the speed and success of the region's colonisation but remains tentative without additional evidence, particularly from those preceding communities in eastern Melanesia.

The West Polynesian settlers brought their Lapita cultural traditions with them, and these became the foundation from which the distinctly Polynesian 'template' emerged. A period of relative migratory stasis followed West Polynesia's settlement, spanning at least 1,000 years (Addison & Matisoo-Smith 2010; McCoy et al. 2020; Wilmshurst et al. 2011). This 'long pause' facilitated the development of unique cultural practices and technologies which were later distributed with voyagers into East Polynesia. A key development during this period was ocean faring canoes which were capable of long-distance voyages and facilitated the rapid colonisation of East Polynesia (Finney 2007; Irwin et al. 2023; Kirch 2010). Rare remains of two Polynesian canoes have been recovered from the Society Islands (Sinoto 1983) and New Zealand, respectively dated to c. 1050-1450 CE and c. 1400 CE (Johns, Irwin & Sung 2014).

Dispersal into East Polynesia began in the first millennium CE (Kirch 2017, p. 198-200; Spriggs & Anderson 1993; Wilmshurst et al. 2011). The relative homogeneity observed throughout this expansive region may be explained by a mass migration event distributing the cultural template developed in West Polynesia. Walter et al. (2017) describe the rapid appearance of numerous sites in the New Zealand archaeological record as evidence of such an event. This strategy may have involved exploratory voyaging ahead of larger-scale migration. ²³⁰TH dating of corals from Kamaka Island in the Mangareva lagoon (Kirch et al. 2021) for example alludes to a Polynesian visitation at least a century before permanent settlement. Localised diversity in the context of a mass migration event is thought to be more the result of *in situ* innovations, or introductions to established colonies following the initial settlement. However, the dispersal of Polynesian culture into the remote islands and localised diversification was more likely an ongoing process of introductions, involving numerous and diverse inter-island contacts preceding and following the initial dispersal (Green 1991b; Addison & Matisoo-Smith 2010).

Regardless of strategy, the movement across East Polynesia was clearly rapid. Radiocarbon dating initially placed the earliest East Polynesian settlement dates in the Marquesas, c. 300 CE (Spriggs & Anderson 1993, p. 211). However, a more recent review of available radiocarbon dates (Wilmshurst et al. 2011) found the earliest secure dates were much later, approximately 1025-1120 CE in the Society Islands. Given the location of the Society Islands, it can be assumed that voyaging out of West Polynesia began slightly earlier. This is supported by core analyses from the Cook Islands which found possible evidence of anthropogenic disturbance from as early as c. 800 CE (Sear et al. 2020). Uranium-thorium dating from Mangaia also supports human arrival in the Cook Islands before c. 1,000 CE (Niespolo, Sharp & Kirch 2019). With early colonisation sites in New Zealand, one of the last places the Polynesians settled, dated to c. 1250-1300 CE (Walter et al. 2017; Wilmshurst et

al. 2011), this indicates very rapid voyaging across this region. This would have resulted in a certain level of regional homogeneity, regardless of whether the cultural template was dispersed through a single event or multiple dispersals.

Colonisation dates suggest that central East Polynesia, centred around the Society Islands, acted as a secondary dispersal centre. Wilmschurst et al. (2011, p. 1816) posit that a second pause of approximately 70-265 years occurred in this subregion. Voyagers then dispersed in a radial fashion towards Hawai'i in the north, Rapa Nui in the east and New Zealand in the south (Horsburgh and McCoy 2017; Montenegro, Callaghan & Fitzpatrick 2014; Wilmschurst et al. 2011; Figure 5). Given the timing of Norfolk Island's Polynesian settlement (c. 13th-15th century CE) (Anderson, Higham & Wallace 2001a), the island was likely colonised as part of the broader southern dispersal from central East Polynesia. This wave of migration also included settlement of the Kermadecs, New Zealand, the Chatham Islands, the Snares and the Auckland Islands, which have been defined by Anderson (2000, 2005) as part of the 'South Polynesia' subregion. Culturally still part of East Polynesia, Anderson categorises this subregion by the islands' southern locations and close settlement chronologies. Norfolk Island, the Snares, and the Auckland Islands are noted to fall outside of the southern boundary of the Polynesian Triangle but are incorporated into Anderson's definition of the South Polynesia subregion.

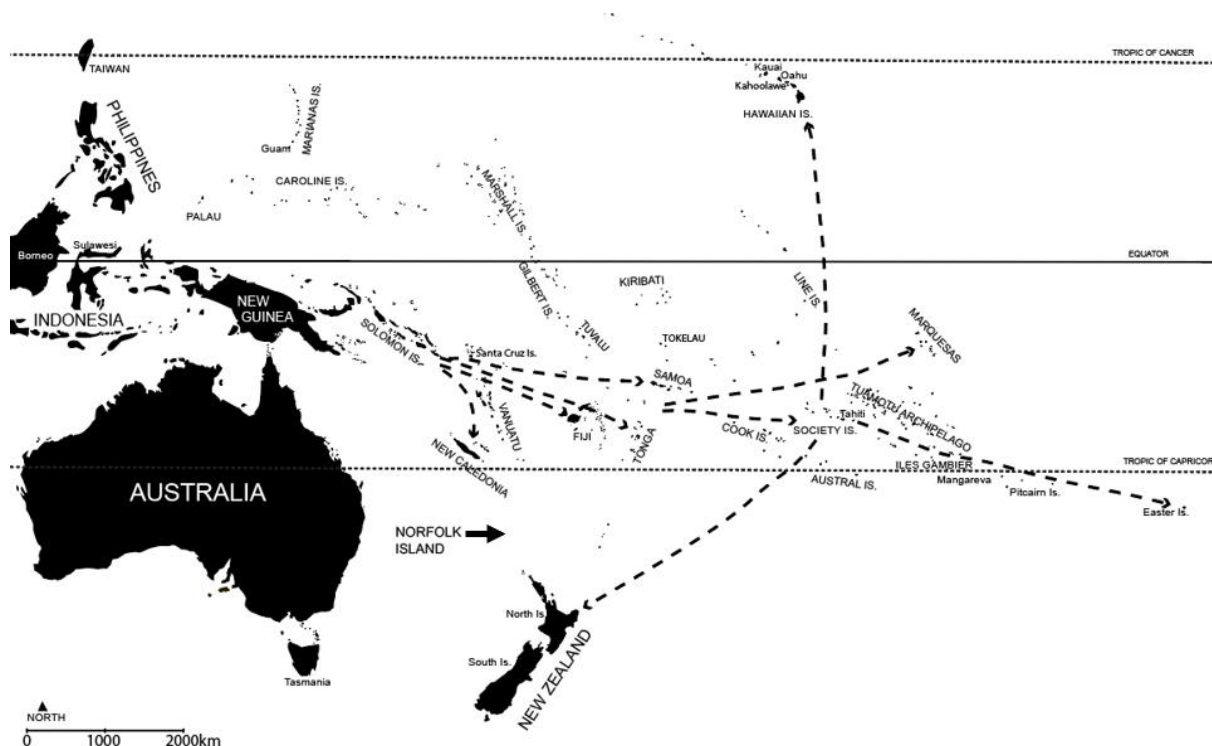


Figure 5: Potential trajectory of Polynesian migration. Voyaging model follows Montenegro, Callaghan and Fitzpatrick 2014, p. 243. Adapted with permission from basemap produced by Dr James Flexner

Polynesians first settled New Zealand c. 1250-1300 CE (Walter et al. 2017; Wilmschurst et al. 2011), similar timing to their arrival on Norfolk Island. The strategies used to colonise and

adapt to an unfamiliar environment, including rapid resource exploration and establishing connected settlements, demonstrate an unprecedented level of planning and coordination. New Zealand's climate provided a particular challenge for food resourcing, as only a limited number of staple Polynesian cultigens could survive the colder environment. Anderson and Petchey (2020, p. 352) estimated that sweet potato was only viable across 45% of the land area, and other staples such as taro and yams were restricted to 15% of the north island. Other key cultigens (e.g. breadfruit and bananas) could not be grown. These challenges may have factored into the migration's level of pre-planning. New Zealand's colonising strategies are discussed further in the following chapter.

Archaeological evidence from Raoul Island indicates Polynesians arrived in the Kermadecs in the 14th century CE and a short-lived occupation was confined to that century (Anderson 2005; Higham & Johnson 1996). The Auckland Islands hosted a similarly short settlement, between the 13th-14th centuries CE (Anderson 2005). Evidence of established settlement from the Snares is less substantial due to scarce research and radiocarbon dating issues. However, it is likely that those materials identified as pre-European on the Snares reflect a Polynesian presence associated with the settlement chronologies of southern New Zealand and the Auckland Islands (Anderson 2005; Anderson & O'Regan 2000). The reasons for these settlements' limited longevity are currently unknown. However, it is likely that the cold climate, winds and rough seas were a significant factor for the Aucklands and Snares (Anderson 2005), particularly limiting the settlers' ability to grow and otherwise resource food. The date of Polynesian arrival in the Chatham Islands is less certain and previous studies have estimated dates between 800 CE and 1450 CE (Matisoo-Smith et al. 1999, p. 187). A more recent review of colonisation dates in East Polynesia (Maxwell & Smith 2015) suggested that the Chatham Islands were not inhabited prior to the 13th century CE. Settlement dates and geographic locations for Norfolk, the Kermadecs, Chathams, Snares and Auckland Islands paint a picture of radial colonisation outward from New Zealand (Anderson 2005). However, the Kermadec archipelago is also geographically suited to direct colonisation from the Society Islands region.

Limits to the Polynesian Triangle and the Outlier Phenomenon

Polynesian settlement beyond the confines of the Triangle (as marked in Figure 4) is not a particularly new concept. Looking first to the eastern limits, the possibility of Polynesian contact with the Americas has been circulated since the mid-20th century. Thor Heyerdahl (1952) infamously proposed that Polynesian origins lay in South America and the region was instead settled from east to west. Heyerdahl used evidence from investigations on Rapa Nui, the Austral Islands and Marquesas to argue that cultural and technological characteristics were shared with areas of South America (Heyerdahl 1952). These claims garnered little academic support, mostly due to conflicting chronologies that rendered these assertions impossible with the available evidence.

Despite the controversy of Heyerdahl's proposition, material evidence of potential contact with the Americas has since emerged. The most compelling line of enquiry is the dispersal of sweet potato throughout Polynesia (Green 2005; Ladefoged, Graves & Coil 2005; Montenegro, Avis & Weaver 2008; Yen 1974). A key food resource for Polynesian settlers, Pacific variants of this tuber have been genetically traced to origins in South America (Yen 1963, 1971, 1974). Research by Yen (1974) concluded that historical introductions did occur, but an initial earlier dissemination had to have taken place. This is supported by records of the tuber in Polynesia at the time of European contact, and, more recently, carbonised remnants found in pre-European contexts (Green 2005; Hather & Kirch 1991; Ladefoged, Graves & Coil 2005; Montenegro, Avis & Weaver 2008). The most likely mechanism for pre-European introduction is Polynesian voyaging to and from the South American coast (Green 2005; Hather & Kirch 1991; Montenegro, Avis & Weaver 2008).

Other potential evidence of Polynesian voyaging to the Americas includes the emergence of plank canoes and curved shell and bone fishhooks on the Californian and Chilean coasts (Arnold 2007; Gamble 2002; Heizer 1949; Jones & Klar 2005; Rick et al. 2002), linguistic innovations in North American dialects (Jones & Klar 2005, 2009), and genetic admixture in the current Rapanui population (Horsburgh & McCoy 2017, p. 12; Moreno-Mayar et al. 2014). More tenuous evidence has been posited, including two "Polynesian" skulls found in Brazil (Horsburgh & McCoy 2017, p. 12-13; Malaspinas et al. 2014), Polynesian stone implements from South America (Horsburgh & McCoy 2017, p. 12; Ramírez-Aliaga 2011) and the introduction of *Gallus gallus* (chicken) to South America (Horsburgh & McCoy 2017, p. 12; Storey et al. 2013). However, these are considered less reliable as concrete evidence for pre-European cross-cultural contacts. Interpretations of these varied finds are continuously debated which is likely why there has been no conclusive revision to the eastern extent of the Polynesian Triangle. Barcham, Scheyvens and Overton (2009) proposed to extend the Triangle boundaries east across the western seaboard of the Americas, although this proposition is noted to heavily incorporate movements of contemporary Pacific Islanders. Further definitive pre-European finds would be needed for academic consensus on such a change.

As part of their revisions to the Polynesian Triangle, Barcham, Scheyvens and Overton (2009) also proposed extension westward to Perth, Australia. This includes a significant portion of the Australian mainland south of Brisbane. Although again designed more with contemporary movement of Pacific peoples in mind, it highlights a potential gap in the record for the western limits of pre-European Polynesian voyaging. Polynesian contact with the Australian east coast is a significantly under researched area.

A recent review by Rowland and Kerkhove (2022) suggested that groups from Melanesia, Polynesia, Norfolk Island or Lord Howe Island may have feasibly reached Australia. Lord Howe is excluded from this discussion as it currently has no evidence of pre-European

settlement. Macassan contact with the north-eastern coast of Australia over the last c. 400 years is established (Clark & May 2013; Ormond-Parker 2020; Rowland 2018). Regular interactions led to adoption of Macassan technologies and linguistic borrowings, as well as localised changes to economic and social practices (Clark & May 2013; Rowland 2018). Earlier Pacific contacts with the Australian east coast are also plausible. Possible Melanesian pottery found in the Torres Strait and Lizard Island (Tochilin et al. 2012) led McNiven et al. (2011, p. 5) to hypothesise Melanesian influences from as early as 3,000 years ago. A more recent study (Ulm et al. 2024) refined the dating of Lizard Island ceramics to between 2950–2545 and 1970–1815 years BP and presented significant evidence of Aboriginal Australians adapting Pacific Island technologies. Ongoing research in this area (e.g. Dousset & Piazza 2021; Fitzpatrick et al. 2018; McNiven et al. 2004; Ulm et al. 2024) continues to add to our understanding of Pacific influence on the north-east Australian coast.

Comparable cultural diffusion to Australia from Polynesia is more difficult to identify. An isolated Polynesian adze was recovered from a midden site at Dark Point in the early 20th century (Thorpe 1929) and provenanced by White, Reepmeyer and Clark (2014) to Norfolk Island. Although possibly indicative of a pre-European Polynesian contact, it is acknowledged that there are multiple potential explanations for how this object arrived at Dark Point (White, Reepmeyer & Clark 2014, p. 134-135). Other Polynesian stone implement finds are scarce, although Rowland and Kerkhove (2022) note that museums may hold further unprovenanced material.

White, Reepmeyer and Clark (2014, p. 135) further discuss a potential Polynesian catalyst for one-piece shell fishhooks appearing on the NSW southern coastline. These fishhooks have also been recorded on the north-east Queensland coast but a significant stretch of coastline between (from south of the Keppel Islands to north of Newcastle) has not yielded any similar technology (Walters 1988). Similarly, there is an apparent time gap of several centuries between these two locales. This geographical and temporal divide makes an interpretation of southern diffusion from a north-eastern introduction (i.e. Macassan) or innovation difficult. Although separate independent innovation is a possible explanation, White, Reepmeyer and Clark (2014, p. 135) suggest Polynesian introduction would be a simpler mechanism. The southern fishhooks date to approximately 700-500 BP (Walters 1988) or 800-900 BP (Attenbrow, Fullagar, R & Szpak 1998) which chronologically coincides with voyaging in southern Polynesia. However, there is little other evidence for potential Polynesian contact with Australia and this concept remains largely speculative. Detailed studies of east coast assemblages, museum collections, and oral histories are essential to explore this hypothesis further.

Norfolk Island is located outside of the Polynesian Triangle but was settled by Polynesian voyagers in the c. 13th-15th centuries CE. Several islands fringing the southern boundary of Polynesia share these characteristics, such as the aforementioned Auckland Islands and the

Snares Islands. Also skirting this southern boundary are the Antipodes Islands, Bounty Islands, Campbell Island and Lord Howe Island. However, no material evidence of pre-European habitation has been identified on these islands to date (Anderson 2003, 2005; Petchey et al. 2023, p. 10). Relatively little archaeological attention has been paid to these southern fringing islands in the history of Polynesian research. Like Norfolk Island, the Aucklands and Snares have comparatively little remnant archaeology and lack more complex or large-scale sites like those found in Hawai'i, New Zealand or Rapa Nui. Combined with their short settlement chronologies, this has likely contributed to the limited interest and investigation. However, these islands present an interesting case in terms of limits, appearing to represent the geographical and chronological edge of south-western Polynesian exploration. Given their marginal locations the settlements may also provide valuable insight on socioeconomic systems and connectivity in remote south-west Polynesia.

Polynesian Outliers are defined as islands or localities demonstrating a Polynesian cultural presence but existing outside of the Triangle as defined above (Kirch 1984). In this sense Norfolk Island may form part of this framework. Eighteen Outliers have been established to date, sixteen located within Melanesia and two within Micronesia (Besnier et al. 1998; Kirch 1984; Kirch 2017, p. 130; Figure 6). Settlement dates for the Outliers vary, spanning from c. 1,000 BP on Nukuoro and Kapingamarangi (Davidson 1992; Leach & Ward 1981; Zinger et al. 2020, p. 63) to c. 3,000 BP on Tikopia (Kirch 2017, p. 131, Kirch & Swift 2017, p. 326; Zinger et al. 2020, p. 64), though the latter is noted to be non-Polynesian settlement date.

Research on Polynesian Outliers has typically focussed on their cultural formation and place in the chronology of Polynesian settlement (Besnier et al. 1998; Kirch 1984; Kirch & Swift 2017; Flexner, Bedford & Valentin 2019; McCoy et al. 2020). There is a unifying element to the Outliers in that they appear culturally and linguistically distinct from the regions in which they are located. However, as a group there is considerable heterogeneity in terms of material culture, biological diversity, and socio-political customs. Frequent contrasts between material evidence and language in Outlier settlements highlight the complexity of their formation. Davidson (2012, p. 1) proposed that Nukuoro would have likely not been classified as a Polynesian Outlier if a Polynesian-speaking group had not been present at European contact. Material assemblages in this case reflected Micronesian forms as much as Polynesian (Davidson 2012, p. 1; Zinger et al. 2020, p. 70). This duality can also be seen on Outliers in the South Vanuatu region. Lithic assemblages from Aniwa and Futuna are dominated by Melanesian style adzes (Flexner, Bedford & Valentin 2019, p. 416) and the socio-political systems on Aniwa and Futuna (southern Vanuatu), and West 'Uvea (Loyalty Islands, New Caledonia) mirror the structures of neighbouring non-Polynesian settlements (Besnier et al. 1998, p. 835; Flexner, Bedford & Valentin 2019). The discrepancies between the material and linguistic evidence on Outliers are an important consideration for their study, particularly in cases where no extant population remains.

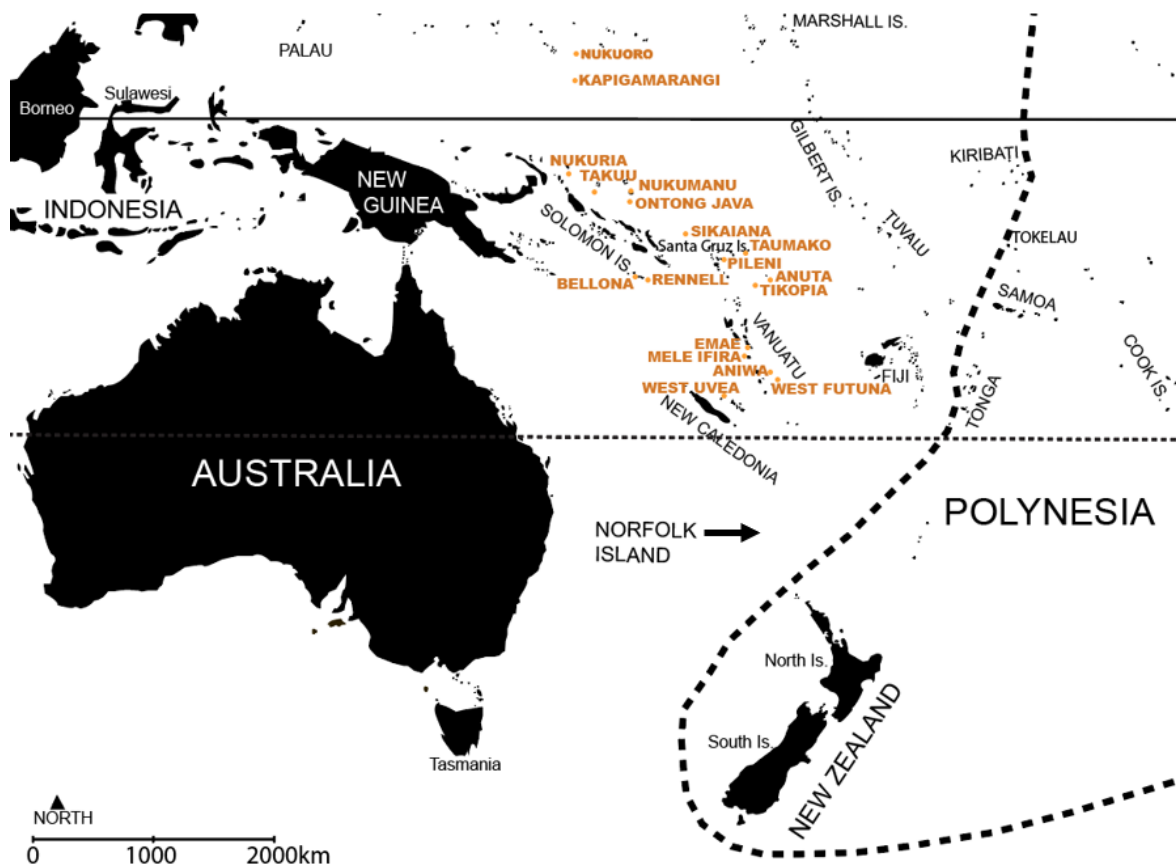


Figure 6: Locations of recorded Polynesian Outliers. Adapted from basemap produced by Dr James Flexner.

Arguments have been made for a “remnant” settlement hypothesis in which the Outliers were settled as part of the initial wave of Polynesian dispersal (Hudjashov et al. 2018; Wilson 2012). However, the evidence ultimately points to Polynesian settlement of the Outliers from already established colonies in West Polynesia (McCoy et al. 2020; Zinger et al. 2020). The general heterogeneity between Outliers suggests different patterns of migration and settlement across the group. Successive arrivals from numerous locations are considered a likely scenario (Zinger et al. 2020, p. 63; Kirch 2017, p. 130-134).

Tikopia provides stratified evidence of a three-phase pre-European settlement history, with Polynesian intrusions not presenting significantly until the last phase (Kirch & Yen 1982, p. 341-343). Initial settlement assemblages from between c. 1046-1031, 1029-769 BCE (Kirch & Swift 2017, p. 325) (the Kiki Phase) contain high levels of exotic materials, suggesting an early network of multiple external contacts (Kirch & Yen 1982, p. 327). The second (Sinapupu) phase, from between c. 117 BCE-310 CE (Kirch & Swift 2017, p. 332), is marked by a significant change in ceramic traditions and decreasing long-distance interactions (Kirch & Yen 1982, p. 329-331; Kirch 1984, p. 231-233; McCoy et al. 2020). The marked change from the Kiki Phase may indicate some form of cultural substitution (Kirch & Yen 1984, p. 329) but this remains only speculation. From c. 1158-1212 CE (Kirch & Swift 2017, p. 333), ceramics disappear from the Tikopian archaeological record and new materials are introduced, in particular basalt adzes of West Polynesian style (Kirch 1984, p. 233) and

Tongan obsidian (McCoy et al. 2020). This third phase of occupation (the Tuakamali Phase) is highly suggestive of a significant Polynesian intrusion into an existing non-Polynesian settlement (Kirch & Yen 1982, p. 331-334, 341-343). The uptake of volcanic glass imports from Tonga in this period may reflect influence from the Tongan State's concurrent push for territorial expansion. The result of this influence or intrusion was dominant Polynesian language and cultural systems whilst retaining certain Melanesian characteristics. This multi-layered settlement history may be a model for contemporary cultural diversity on Outliers more broadly. Polynesian settlers adapting to existing local frameworks could explain the emergence of these somewhat "hybrid" societies (Flexner, Bedford & Valentin 2019).

Discussion of the Outliers' place in the Polynesian narrative has prompted an alternative East Polynesian origin theory. The Northern Outliers-East Polynesian (NO-EPn) Hypothesis (Wilson 2012, 2018, 2021) proposes dispersal into East Polynesia from the Northern Outliers rather than the Tonga-Samoa region. This northern group captures those Outliers north-west of Taumako, mainly fringing the Solomon Islands as well as those further north (Nukuoro and Kapingamarangi). Wilson's model is based heavily on several linguistic affinities shared solely between these Outliers and populations throughout East Polynesia. Support is drawn from settlement chronologies and a genetic link between Luangiua in the Central Northern Outliers and the Society Islands (Hudjashov et al. 2018; Wilson 2018, p. 394). Although an intriguing premise, further evidence is needed to explore the validity of the NO-EPn Hypothesis and close some of the major gaps in the archaeological record.

To establish a regional classification for Norfolk Island, consideration must be given to these existing frameworks. With regard to the Polynesian Outliers, and Anderson's (2005) South Polynesia subregion, the island may best be classified as part of a smaller separate subregion which captures those culturally Polynesian islands specifically situated outside of the south-western Triangle limits. This thesis argues that Norfolk Island, the Auckland Islands and the Snares Islands share certain characteristics that separate them from these already defined regional classifications. As such it is proposed that they form the Southern Marginal Mystery Islands, a new Pacific subregion directly associated with East Polynesia but located outside of the Triangle's south-western boundary. Norfolk Island's place in the Polynesian narrative is explored throughout this thesis and discussed in detail in Chapter 9.

Chapter 3: Interaction, Isolation, and Settlement

Longevity on Pacific Islands

Interaction and the Lithic Record

Repeated through Polynesia is a pattern of early external networking as settlements formed and established. Rolett et al. (2015, p. 459) refer to this pattern as the 'archaic interaction sphere hypothesis', in which extensive interactive networks were maintained from colonisation up to c. 1450 CE. Rolett et al.'s (2015) model typically presents as pulses of exotic lithic materials early in a settlement's sequence, then decline and cessation of imports around the 15th-16th centuries CE. In some cases, locally available materials became substitutes for previous imports. The reasoning behind this intense early networking is multi-faceted but may in part have been an intentional colonising strategy. Material evidence from Pacific Islands suggests that external networks supported burgeoning communities, contributed to the rise of elite centres, and influenced social and economic development (Kirch 1988b; Weisler 2008; Williamson & Sabbath 1984). The significant change in the archaeological record c. 15th-16th centuries CE corresponds to a significant curtailment of long-distance voyaging across Polynesia (Rolett et al. 2015, p. 459; Weisler 2002).

Studies on the movement of people throughout Oceania often utilise geochemical provenancing techniques on stone artefacts as a proxy for human activity (e.g. Clark, Shipton & Weisler 2014; McCoy et al. 2020; Reepmeyer 2021; Sheppard, Trichereau & Milicich 2010). Tracing the movement of lithic materials allows for reconstruction of migratory trajectories and networks of interaction and exchange. The nature of the lithic object (e.g. basalt adzes or volcanic glass artefacts) may also indicate the associated motivation for its transfer, such as for resource provisioning or socio-political alliances. By reconstructing these elements, the role of external influence on localised cultural development becomes more visible.

Henderson Island in the Pitcairn group remained connected to its parent community on Mangareva (c. 400km to the west) for several centuries after settlement (Weisler 2008, p. 539). Lithic imports from both Mangareva and Pitcairn Island are frequent in the early record, particularly fine-grained basalt as both raw material, oven stones preforms and adzes (Weisler 1995, p. 393-4). Given Henderson Island's resource paucity, and notable lack of volcanic stone for tool making, these connections may have been a crucial support for the settlement's formative period. From approximately 1500 CE, foreign imports disappear from the record and adzes manufactured on local *Tridacna* shell become more frequent (Weisler 2008, p. 539). The apparent severance of external connections may have been a factor in the eventual abandonment of Henderson Island within the next two centuries (Weisler 1995, p. 401-2; Weisler 2008, p. 539).

The early lithic record in New Zealand also demonstrates a model of early strategic networks to support the establishment of new communities. The colonisation or 'Early' phase of New Zealand's settlement spans from the initial arrival (c. 1250 CE) to approximately 1500 CE and is characterised by high levels of mobility and settlement connectivity (Walter, Jacomb & Bowron-Muth 2010; Walter et al. 2017). The rapid occupation of the north and south islands was a highly systematic approach that quickly established connected centres across a diverse range of ecological niches. Lithic assemblages from this Early period typically demonstrate high raw material diversity, with materials often transferred over considerable distances (Anderson 2000; Walter, Jacomb & Bowron-Muth 2010; Walter et al. 2017). This not only supports a model of early explorative actions but also the connectivity between settlements as resources were transferred and exchanged. These connections were likely important avenues for resource sharing and socio-political networking.

Obsidian studies in New Zealand highlight the relationship between emerging socio-political stratification and changing modes of interaction. Mayor Island Obsidian (MIO) is a characteristic material found in Early site assemblages in New Zealand (Walter, Jacomb & Bowron-Muth 2010, p. 504-7). This material was transferred extensively throughout New Zealand and to the neighbouring Kermadec Islands, Chatham Islands and possibly Norfolk Island prior to 1500 CE (Anderson 2000; Anderson & McFagden 1990; Anderson et al. 1997; Furey Ross-Sheppard & Prickett 2015; Turner, Anderson & Fullagar 2001, p. 63; Walter, Jacomb & Bowron-Muth 2010; Walter et al. 2017). The distribution of this material up to 2,000km from the source (Walter, Jacomb & Bowron-Muth 2010, p. 504), and its abundance in distant assemblages, implies high value and relatively unrestricted access to the source during this period. The intense and extensive distribution of MIO significantly decreased around 1500 CE and MIO is not found in assemblages beyond New Zealand after this date (Walter, Jacomb & Bowron-Muth 2010, p. 504).

The approximate date of New Zealand's transition to the 'Late' phase of occupation is generally agreed to be roughly 1500 CE (Walter, Jacomb & Bowron-Muth 2010). A key feature of this phase was the emergence of earthwork fortifications (pā). These fortifications mark the rise of highly stratified societies where elite groups controlled access to certain resources and prime agricultural areas (McCoy et al. 2014, p. 467-8). Divided control of resources spurred intense inter-group warfare during this period and trading likely became a strategy to obtain resources without instigating conflict (McCoy et al. 2014, p. 473). However, the lithic evidence also suggests formalised trade and distribution networks were maintained for socio-political purposes. Studies of MIO from Late period sites found this material remained well-distributed amongst North Island groups (McCoy & Carpenter 2014; McCoy et al. 2014). In contrast to the emergent resource exclusivity, the evidence suggests direct access to the MIO source was still possible for many of these groups. McCoy and Carpenter (2014) posit that this reflects concerted efforts to maintain ties between ancestrally connected communities.

Given the visual uniqueness of MIO, it is possible that this material was also traded or gifted between groups as a prestige item (McCoy & Carpenter 2014, p. 9). This is also a possibility for imports of southern nephrite to the North Island. Beyond a high utilitarian value, nephrite objects also had certain ceremonial and ritual applications (Walter, Jacomb & Bowron-Muth 2010, p. 508). Exchange of prestige goods between elite groups may have been an important strategy to maintain socio-political alliances in New Zealand.

Evidence for elite gift exchange is also found elsewhere in Polynesia, on both inter-island and inter-archipelago scales. Mo'orea Island (Society Islands) was likely part of an inter-island gifting network, exchanging stone adzes with elite rulers in Tahiti and the Leeward Islands (Kahn et al. 2013). Similar studies in the Hawaiian archipelago also found relatively high levels of imported materials in Maui (Kirch et al. 2012) and Moloka'i Island (Mills et al. 2018) assemblages despite considerable local basalt availability. The frequency of the imported materials was found to be significantly higher in elite context assemblages on Maui Island (Kirch et al. 2012, p. 1060). The level of intra-island and intra-archipelago exchange in Hawai'i appears to have exceeded local resourcing requirements and was certainly more frequent between elite groups. As such, these networks appear to represent socio-politically motivated interactions.

The contribution of external interactions to rising socio-political stratification is also visible on Rurutu in the Austral archipelago. Colonised c. 1200-1300 CE, Rurutu became a highly nucleated chiefly centre in central East Polynesia after c. 1450 CE (Rolett et al. 2015). Key exports from Rurutu during the first centuries of colonisation were basalt and adze preforms from the Vitaria Adze Quarry. This material was traced as far as the Tuamotu and Southern Cook Islands, as well as to other islands in the Austral archipelago (Rolett et al. 2015, p. 469-70). The manufacturing scale at this quarry complex, as well as the distribution network, suggests basalt and adzes from Vitaria were considered high value. After c. 1450 CE this value appears to translate to elite control of the resource and emergence of a chiefly hierarchy. The elite association is clear in the proximity of high-status residences and sacred places to the quarry complex, including the significant Marae Tararoa chiefly burial area (Rolett et al. 2015, p. 470).

On the Polynesian Outliers, geochemical sourcing studies (e.g. Hermann et al. 2023; McCoy et al. 2020) are one important recent line of enquiry to investigate spheres of interaction and their relation to settlement chronology and cultural formation. On Tikopia, geochemical provenancing of stratified volcanic glass and obsidian (McCoy et al. 2020) showed changing interactions over time which in turn lent support to the island's three phase settlement sequencing. The frequency of obsidian from the Admiralty Islands and volcanic glass from Vanuatu in the initial settlement phase suggests the Tikopian settlers maintained a strong connection with related communities in this region until long-distance interactions decreased around the turn of the millennium (McCoy et al. 2020, p. 7). Volcanic glass from the third settlement phase was traced to Tonga which supports the model of late Polynesian intrusion into an existing population. Surprisingly, the Tongan imports were rather

infrequent relative to the clear Polynesian influence on language and culture during this period (McCoy et al. 2020, p. 7-8). This disparity led McCoy et al. (2020, p. 7-8) to suggest this may indicate strategic and politically motivated voyages were taking place on behalf of the Tongan state.

Zinger et al. (2020) proposed three theoretical models of interaction to potentially explain the formation of contemporary Outlier societies and suggested that these interaction spheres may have operated concurrently. These spheres range from local interactions between Polynesian arrivals and existing non-Polynesian settlements, to sustained contacts between Polynesian arrivals and neighbouring islands, to Outlier populations being one element of an extensive exchange network (Zinger et al. 2020, p. 69-71). Material, linguistic, and ethnographic evidence from the Outliers suggests that these settlements were by no means isolated, and their interactive networks were significantly influential to their cultural evolution (Flexner, Bedford & Valentin 2019; Kirch 2017, p. 130-134).

Long-distance voyaging networks have been reconstructed through geochemical analysis of artefacts from the Emae (Vanuatu), Taumako (Solomon Islands) and Kapingamarangi (Caroline Islands) Outliers (Hermann et al. 2023). A recent study by Hermann et al. (2023) identified patterns of lithic material movement reflecting migratory trajectories as well as post-settlement spheres of interaction, reaching distances of up to 2,500 km. Connections between Outliers, as well as to and from Outliers and regions like West Polynesia and Micronesia, may have been important avenues for obtaining resources and maintaining social and political ties (Hermann et al. 2023, p. 6-7).

Long-distance interactions are not exclusive to the Polynesian Outliers. Provenancing studies on basalt from Eiao Island in the Marquesas archipelago identified this material as far as the Line Islands, approximately 2,400 km north-west, and the Gambier Islands, approximately 1,750 km south-south-east (Weisler 2008, p. 540; Charleaux et al. 2014). Similar long-distance basalt transfers have been identified in the Phoenix and Line Islands archipelagos (Di Piazza & Pearthree 2001), the Society Islands (Kahn et al. 2013), the Cook Islands (Weisler & Kirch 1996), the Austral Islands (Rolett et al. 2015) and the Tuamotu archipelago (Collerson & Weisler 2007).

External networks played a major role in the formation of many Polynesian and Outlier island settlements. Beyond a colonising strategy to establish and grow new communities, these networks were also avenues for social and economic reproduction. Although long-distance voyaging curtailment in the 15th-16th century CE significantly diminished many long-distance connections, these interactions continued in different ways. Changes in modes of interaction, as shown through geochemical studies of the lithic record, provide an important lens through which to view large scale changes like the rise of stratified complex societies. Geochemical provenancing has proven to be a valuable technique to reconstruct interaction networks in pre-European Pacific contexts and understand their influence on localised cultural development.

Isolation and Settlement Longevity

Considering the significant role that interaction appears to have played in the formation and development of Pacific Island societies, this raises the question of whether isolation may have negatively influenced a settlement's longevity. There are at least 13 islands in Polynesia which had pre-European settlements but were abandoned by the time of European arrival (Anderson 2001; Kirch 1998b). This collection of islands includes Norfolk Island and Raoul Island in Anderson's (2005) South Polynesia subregion, and the aforementioned Henderson Island in the easterly Pitcairn group. Termed 'mystery islands' (Kirch 1988b), the reasons for their abandonment, or possible population extinction, continue to be an area of investigation. Whilst more attention has been given to those mystery islands in the subtropical zone, by definition the southern Auckland and Snares Islands also fall into this classification.

Isolation has been a much-considered factor in investigations of why these settlements ended. The termination of settlements on Norfolk, Raoul and Henderson coincides with the curtailment of long-distance Polynesian voyaging which suggests a distinct correlation between severance of external networks and settlement decline. Unlike Henderson Island, Norfolk and Raoul have considerably less archaeological evidence for interaction in their initial colonisation phases. Imported materials in these assemblages are of a low enough frequency to suggest they arrived with the colonisers, rather than represent any particular interaction or exchange network (Anderson et al. 1997; Higham & Johnson 1996). These islands may have been immediately isolated from their neighbours after colonisation whereas Henderson Island demonstrates a clearer pattern of interaction, isolation then abandonment (Weisler 2008, p. 539). Although the evidence of early interaction is varied, the coincidence of contracting networks and island abandonment suggests isolation did play a role.

Contracting voyaging networks may have removed important resourcing avenues which in the long-term rendered settlements non-viable, particularly if local agricultural ventures proved unsuccessful (Anderson 2001, 2002). Demographic growth was also important, if not critical, for settlement longevity (Williamson & Sabath 1984) and curtailed interaction spheres may have removed opportunities for population replenishment (Anderson 2002, p. 384).

Isolation is likely only one of a series of complex influences that can lead to a settlement's abandonment and may not necessarily be the determining factor. Human occupation in the Pacific Islands entailed considerable environmental change, in terms of both landscape modification and resource depletion. Patterns of anthropogenic environmental change on abandoned islands do not appear to vary from those with sustained settlements but the impacts are often more visible (Anderson 2002, p. 382-3). This may be a product of some size scale difference between remote abandoned islands and larger continuous island records. Significant environmental change may have created unsuitable settlement

conditions on some islands and isolation then contributed to the speed and severity of the process (Rolett & Diamond 2004). However, this is clearly not a model for all such islands. For example, settlement continued on Rapa Nui despite the island's remoteness and severe environmental degradation (Hunt & Lipo 2006).

A critical requirement for settlement longevity was the availability of local food resources, particularly in the early stages of colonisation. Small size islands typically correlate with low species diversity which would have presented a challenge for colonists (Kirch 1988b, p. 28). Insufficient resources and resulting over-exploitation would have been unsustainable in the long-term, particularly if agricultural pursuits could not meet the population's needs and external provisioning networks no longer operated. Environmental and resourcing pressures would have been greater on small islands in remote contexts (Fitzhugh and Hunt 1997), and many of the 'mystery islands' meet these criteria. The curtailment of voyaging likely added an additional stress to already challenging environments (Anderson 2001, p. 14).

Spheres of interaction and exchange in the Pacific led to the evolution of many complex and self-sufficient societies. However, the history of social-political evolution in places like New Zealand and Hawai'i suggests isolation strategies may have also supported formalised group identities and power centres. Retraction of exchange networks and restriction of access to certain resources may reflect intentional isolation to assert control by certain groups. Limiting or severing certain interactions allowed for resource domination, management of external conflicts, and maintenance of insular cultural practices used to form distinct group identities (Boomer & Bright 2007; Fitzpatrick & Anderson 2008).

In sum, isolation appears to have had a complex influence during the establishment and formation of island settlements. On the mystery islands, isolation likely contributed to the abandonment of certain settlements. However, insularity may have equally facilitated the rise of more complex societies, as seen on other islands across Polynesia. Pacific Island settlements demonstrate variable levels of connectivity and insularity across their lifespans, and it is clear that isolation and interaction should not be separated in discussions of cultural formation.

Chapter 4: Norfolk Island Background

Geographical Setting

Norfolk Island is situated approximately 750 km equidistant between New Zealand and New Caledonia and 1,400 km east of the Australian coast (Figure 6). Three islands form the Norfolk Island archipelago. Norfolk Island is the largest of these islands at approximately 35 km² followed by Phillip Island (c. 2 km²) then Nepean Island (c. 0.04 km²) (Abell & Falkland 1991, p. 1). As no evidence of pre-European habitation has been identified on Phillip Island or Nepean Island, this chapter is primarily focussed on Norfolk Island.

A volcanic high island, Norfolk Island was formed through multiple eruptive phases spanning approximately 3.0-2.3 mya (Green 1973, p. 259; Jones & McDougall 1973). The majority of the island's landmass is an elevated but deeply incised volcanic plateau that surrounds the peaks of Mount Pitt and Mount Bates in the island's north-west. This elevated terrain drops steeply to flat coastal lowland in the Kingston area on the south coast. A series of sandy beaches span the Kingston coastline, with an offshore coral reef enclosing a lagoon that stretches from Emily Bay in the east to the western edge of Slaughter Bay. Outside of the Kingston area, coastal cliffs ring the majority of the plateau's perimeter, broken up by a handful of sand and boulder bays that are carved into the surrounding steep terrain.

Norfolk Island's volcanic geology is shared with offshore Phillip Island which lies approximately 6 km to the south. Initially determined by geologists to be a single landmass, extensive post-eruption submergence and rising sea levels eventually separated these two islands (Abell & Falkland 1991, p. 11). Though never subject to human habitation, Phillip Island was used to keep rabbits, goats and pigs by British settlers (DCCEEW 2022). Between Norfolk Island and Phillip Island lies Nepean Island, an aeolianitic calcarenite formation located 800 m south of the Kingston coast. Like Phillip Island, Nepean Island was never historically settled, and no evidence of a pre-European presence has been identified there to date.

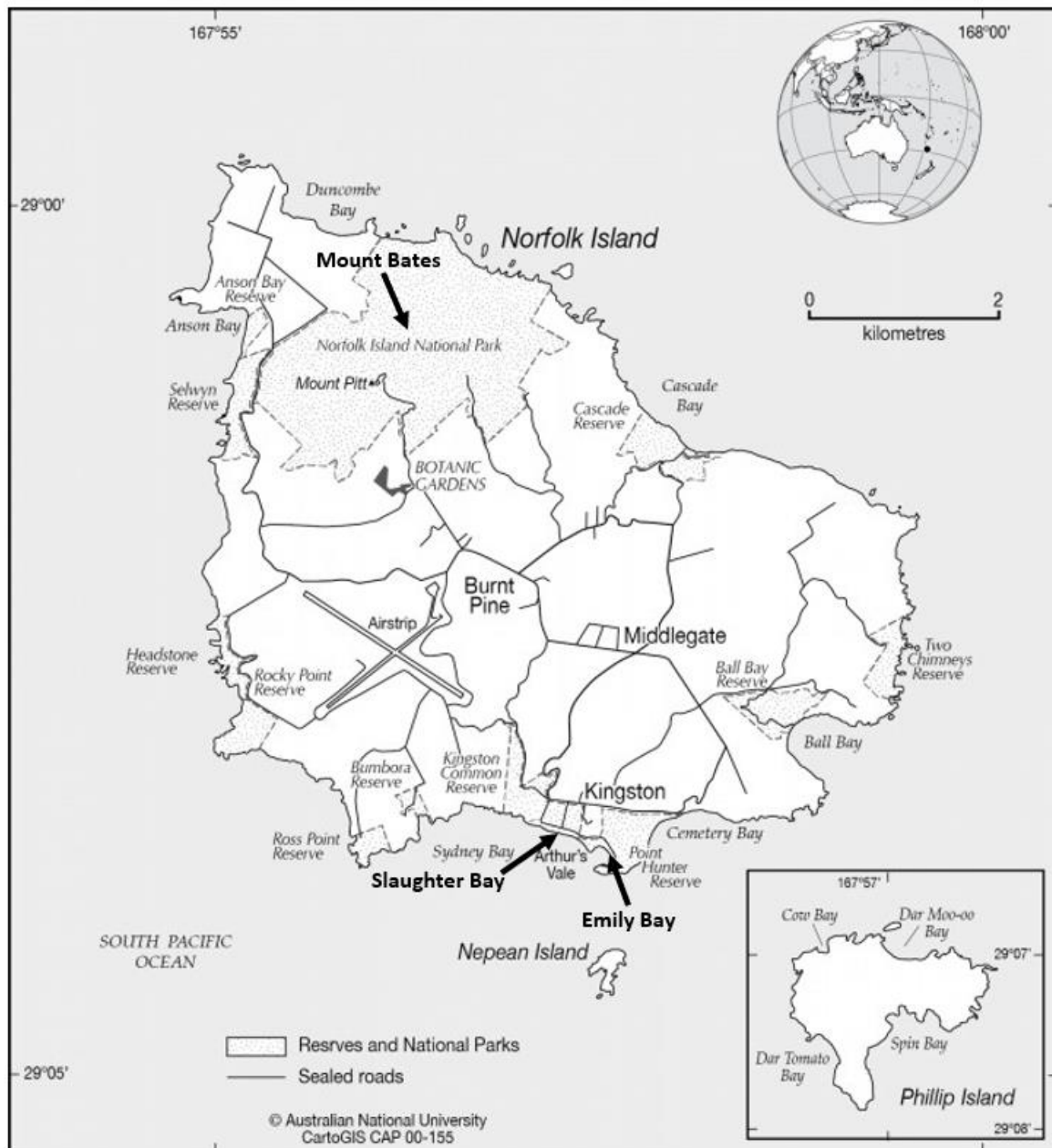


Figure 7: Key locations on Norfolk Island. Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.

Geology

Norfolk Island and Phillip Island are the only extant subaerial exposures of the Norfolk Ridge, a continental ridge extending between New Zealand and New Caledonia at the eastern edge of the Zealandia continent (Mortimer et al. 2014; Mortimer & Scott 2020). Norfolk Island is a volcanic high island with a terrestrial landmass comprised of four major subaerial basaltic lava flows and interbedded tuffs that create an apron around the peaks of Mount Pitt and Mount Bates. These four flows were categorised by Jones and McDougall (1973, p. 244) as Duncombe Bay Basalt, Cascade Basalt, Steels Point Basalt and Ball Bay Basalt (Figure 8) based on stratigraphic, geochronological, and palaeomagnetic polarity

data, and the locations of their coastal extrusions. Extended periods of stasis between eruptions are visible as layers of erosion and *in situ* soil development in the coastal stratigraphy.

Figure 8: Map showing the four basalt flows comprising the majority of Norfolk Island's terrestrial formation (Jones & McDougall 1973, p. 247). Image removed for copyright purposes.

The coastal distributions of these basalts suggests that Steels Point Basalt is the dominant upper layer across the island's southern plateau (Jones & McDougall 1973, p. 248; Figure 8). Few inland extrusions were accessible during Jones and McDougall's study but dating of several samples taken from the northern summit area found a chronological correlation with the Cascade Bay Basalt. Based on this data it was suggested that Cascade Bay Basalt is the underlying geology for the mountainous region (Jones & McDougall 1973, p. 248). Mount Pitt and Mount Bates are considered remnant cones of the island's main eruptive centre (McDougall & Aziz-Ur-Rahman 1972, p. 369) and the Duncombe Bay Basalt, Cascade Basalt and Steels Point Basalt flows appear to have originated from this centre. The eruption point for the Ball Bay Basalt however remains unclear. These rocks are the oldest in the local

basalt sequence (McDougall & Aziz-Ur-Rahman 1972, p. 369) and are confined to a discrete section of the east coast. Analyses have found it more likely that the Ball Bay Basalt is associated with a secondary eruptive centre, possibly located offshore from the Ball Bay coastline (Abell & Falkland 1991, p. 14; Green 1973, p. 260; Hutton & Stephens 1956, p. 256; Jones & McDougall 1973, p. 248-249).

Norfolk Island's volcanic rocks include tholeiite through to alkali olivine basalts with occasional grading into tholeiitic andesites and hawaiites (Green 1973; White, Reepmeyer & Clark 2014, p. 132). All contain olivine phenocrysts (Pees et al. 2003, p. 117). Though fine to medium grain basalts dominate, the latter is often coarse enough to be termed doleritic (Jones & McDougall 1973, p. 240; Pees et al. 2003, p. 117) and this coarser material tends to be more concentrated in the island's centre (Green 1973, p. 260-1; White, Reepmeyer & Clark 2014, p. 132). Aside from some variation in grain size, petrographically there is relative uniformity across the local basalts (Green 1973, p. 260). Outcrops are largely confined to the island's coastal perimeter, but several heavily weathered extrusions exist in inland locations (Green 1973, p. 260; Jones & McDougall 1973, p. 239). Exposure to a subtropical climate has contributed to deep geological weathering across the island, in some locations more than 60 metres deep (Laing 1912, p. 325; McDougall & Aziz-Ur-Rahman 1972, p. 369; Pees, Duvall & Girault 2003, p. 112). The known age range of Norfolk Island basalts is 3.12-2.36 Ma (late Pliocene to early Pleistocene). This is based on the K-Ar work of Jones and McDougall (1973), with ages recalculated using decay constants of Steiger and Jager (1977).

Geological studies to date have observed little variation in chemical composition between Norfolk Island's lava flows but the island's basaltic geochemistry as a whole is distinctive in relation to comparable basalts of the wider Pacific. Norfolk Island basalts are characterised by their moderate to high Nb and Al_2O_3 concentrations, and high $\text{Na}_2\text{O} / \text{K}_2\text{O}$ ratios (Green 1973, p. 262; Jones & McDougall 1973, p. 240). Nb levels are noted to be a critical distinction between Norfolk Island and Northland New Zealand basalts (White, Reepmeyer & Clark 2014, p. 132). High levels of Al_2O_3 and low levels of TiO_2 also contribute to the island's distinct geochemical signature (Green 1973, p. 262; Jones & McDougall 1973, p. 240). Some variation in trace element compositions was noted between local tholeiites and alkali olivine basalts (Green 1973, p. 265-266). Although the trace element ranges are generally consistent with standard basalt ranges, trace analyses have successfully differentiated Norfolk Island basalts from comparable Pacific material in the past (Green 1973, p. 267; White, Reepmeyer & Clark 2014).

The dominant volcanic geology transitions to cross-bedded calcarenite through the island's southern coastal lowland. Formed through aeolian deposits in the Late Quaternary (Abell 1993, p. 126; Hayward 2018, p. 6; Pees, Duvall & Girault 2003, p. 109-11), this geology is limited to the Kingston area on Norfolk Island and is shared with offshore Nepean Island. Calcarenite outcroppings were quarried extensively for infrastructure during the island's historical settlements, but remnants of these formations remain around the Kingston foreshore.

Natural Resources

Norfolk Island is subtropical, with a mild climate and average annual rainfall of 1324 mm (Abell 1993, p. 125). Today the landscape is dominated by open pasture with intermittent woodland, the result of extensive land clearance for historical settlement and agriculture. As such, reconstructing the island's original environment at the time of Polynesian arrival relies heavily on early colonial observations. Early records of the island's vegetation describe widespread dense forest dominated by the Norfolk Island Pine (*Araucaria heterophylla*) and interwoven with thick nets of vines that hampered the first British explorations (King 1788 in Hunter 1793, p. 234-5, 246). Hardwood forests prevailed in higher areas, intermixed with a variety of shrubs, palms and tree ferns (Anderson & White 2001a, p. 4). Part of this original rainforest vegetation still remains within the Norfolk Island National Park and Botanic Garden in the island's north-west.

Edible plants at the time of British settlement included the King fern, *Hibiscus* species, Norfolk palm hearts, sow thistle, fruits such as the Pepper tree, and various coastal herbs (Anderson & White 2001a, p. 4; Macphail, Hope & Anderson 2001, p. 124). An unusual inclusion on this list of edible species was a plantation of bananas (King 1788 in Hunter 1793, p. 252) in what is now known as Arthur's Vale in the coastal lowland area. A journal record from 1798 indicated that these bananas were found growing in "regular rows" and were thus interpreted as a sign of pre-European habitation (Collins 1798, p. 174). However, the nature of how and when the bananas arrived on Norfolk Island has yet to be determined. As noted by Anderson and White (2001a, p. 6), the possibility of their introduction between 1774 and 1788 cannot be ruled out.

Permanent freshwater creeks exist south of the peaks of Mount Pitt and Mount Bates, reaching the coastline near Rocky Point, Point Ross, Cascade Bay, and Emily Bay (Figure 9). The latter creek line originally fed into a swampland behind the Kingston foreshore but has since been channelled to facilitate historical development. Remnants of ancient streambeds are also evident as deep incisions across the volcanic plateau, dried over time due to the onset of climate change and gradual depletion of the underlying water table (Abell & Falkland 1991, p. 15). In terms of aquatic food resources, eels were recorded by British colonists in many of the freshwater creeks (King 1788 in Hunter 1793, p. 296) and the surrounding ocean held an abundance of fish and other marine life (King 1788 in Hunter 1793, p. 237, 256, 296, 298). King (1788 in Hunter 1793, p. 237) described numerous turtles on the sands of Emily Bay (originally named Turtle Bay) but their numbers have decreased significantly since British settlement began. Marine resources were a critical resource for the growing British colony but were not always accessible due to rough sea conditions (Hunter 1793, p. 160).



Figure 9: 1:25 000 scale topographic map of Norfolk Island (Geoscience Australia 2010).

Seabirds were another critical food resource for the early British settlers. Accounts from James Cook and his landing party recorded the abundance of species such as shearwaters and boobies, and Lieutenant King noted frequent encounters with pigeons and parrots during inland explorations in 1788 (Cook 1774 in Beaglehole 1961, p. 565; King 1788 in Hunter 1793, p. 245). When the supply ship the *Sirius* wrecked on the reef offshore of Slaughter Bay in 1790, the settlers turned to hunting the Providence petrel (*Pterodroma solandri*) which nested in great numbers around the mountain slopes. Captain Hunter (1793, p. 182) noted: “They were, at the end of May, as plentiful as if none had been caught, although for two months before had been not less taken than from two to three thousand birds every night...”. Despite this abundance, it is estimated that over 172,000 Providence petrels were killed in a single season in 1790 (Hicks 1988, p. 168) and overhunting eventually led to the population being declared locally extinct (Fletcher 1975, p. 196).

European Settlement History

Consideration of the integrity of extant Polynesian sites on Norfolk Island requires an evaluation of the potential impacts of subsequent historical events. Claimed as British territory by James Cook in 1774 (Hoare 1999, p. 3), Norfolk Island's historical settlement is typically divided into three phases: the First (British) Settlement, the Second (British) Settlement, and the Third (Pitcairner) Settlement. Often only referred to as the First, Second and Third Settlements, these names do not adequately account for the original Polynesian settlement that preceded them. This terminology is reused here for consistency with previous literature, but phases are bracketed with their cultural origin.

The First (British) Settlement commenced in March 1788 to maintain a British presence on the island and supply additional resources to the newly established colony of Sydney in New South Wales (Hoare 1999, p. 6). Settlers comprised a mix of free citizens and convicts (Hoare 1999, p. 6-7). Local industries were predominantly agricultural and large swathes of land were cleared for crops and grazing (Gibbs, Duncan & Varman 2017, p. 87; Hoare 1999, p. 10). Three hectares were cleared specifically for local flax production (Hoare 1999, p. 22), which was intended to be one of the primary industry foci of the First (British) Settlement (Beaglehole 1961, p. 565-8). In 1793 two Māori men, Huru and Tuki, were captured and brought to Norfolk Island to teach flax processing methods but this proved largely unsuccessful as they had little experience with the traditionally female practice (Hoare 1999, p. 11).

The First (British) Settlement spread across the island though largely avoided the slopes of Mount Pitt and Mount Bates (Gibbs, Duncan & Varman 2017, p. 86). The settlement's administrative centre was established at Kingston and buildings were constructed with locally quarried limestone and timber (Hoare 1999, p. 23). Development at Kingston involved draining the swampland which originally extended from Cemetery Bay on the south-east coast, behind the Kingston foreshore, and west into Arthur's Vale (Macphail, Hope & Anderson 2001, p. 125). High operation costs and geographical remoteness eventually led to the end of the First (British) Settlement in 1814 and all buildings were burned to the ground to avoid future occupancy by another nation (Gibbs, Duncan & Varman 2017, p. 88; Hoare 1999, p. 34).

Over a decade later, the Second (British) Settlement began in 1825 (Hoare 1999, p. 37). This settlement was primarily a penal colony and quickly became infamous for its harsh conditions and punishment systems. Prison complexes and associated infrastructure such as barracks, administrative and hospital buildings were constructed in the Kingston area, but various agricultural and industrial programs extended across the island (Gibbs, Duncan & Varman 2017, p. 89-90; Hoare 1999, p. 39). The scale of the buildings required substantial amounts of limestone which was quarried from both the Kingston foreshore and Nepean Island. The cessation of prisoner transportation to New South Wales triggered the end of the Second Settlement in 1856 (Gibbs, Duncan & Varman, p. 90).

The Third (Pitcairner) Settlement replaced the Second (British) Settlement in 1856 (Hoare 1999, p. 71) and has continued to the present day. The original settlers of this period were descendants of English mutineers of the *HMS Bounty* and Tahitian women who had previously resided on Pitcairn Island, and their descendants still constitute part of the island's resident population. Agricultural pursuits have remained a primary industry during this settlement period, mainly for local sustainability but occasionally for exportation (e.g. NIHS 1994, p. 17).

Within the span of the Third (Pitcairner) Settlement, Norfolk Island hosted two short-lived subset occupations. The Melanesian Mission operated between 1866-1920 and was established as a training centre for students from various islands across Melanesia (Gibbs, Duncan & Varman 2017, p. 91; Hoare 1999, p. 88-91). Prior to its establishment on Norfolk Island, the Melanesian Mission headquarters were based at Mission Bay in the New Zealand North Island (Nash 2012, p. 476). The mission occupied 418 hectares surrounding the current St Barnabas Chapel in the island's west and in 1899 it was estimated that 210 students were present, in addition to staff and missionaries (Hoare 1999, p. 89). The second subset settlement spanned 1942-1946 (Gibbs, Duncan & Varman 1991, p. 82) when WWII armed forces occupied the island for surveillance operations. This temporary occupation was largely focussed on the elevated terrain around Mount Pitt and Mount Bates, and established various campsites, lookouts, and access tracks across the mountain slopes (NIHS 1994). Remnants of earthworks for the installation of radar equipment and gun pits are still visible around the summit areas.

The current landscape on Norfolk Island has been shaped through these successive periods of clearance and development. The Kingston area continues to be the administrative centre, but urban and commercial development is now focussed in the island's interior. Patches of the original subtropical rainforest remain but the island is typically characterised by its open spaces for crops and livestock amongst a low density urban and residential sprawl. Although historical development may have directly impacted the pre-European archaeological record, a perhaps more significant byproduct of this development is high levels of soil erosion. Excavations at Cemetery Bay in the coastal lowland found the upper 65 cm of the soil profile was most likely deposited from the surrounding hills (Anderson, Smith and White 2001b, p. 12). Subsurface testing at lower elevations at Watermill Valley and Cascade also identified 40-80 cm of undifferentiated brown soil (Specht 1984, p. 7, 11) which may have accumulated downslope through colluvial action. Given the extensive historical land clearance, it is likely that this erosion is prevalent across the island's steep slopes.

Evidence of Pre-European Settlement

Early observations

No people were present on Norfolk Island at the time of British arrival. As such, investigations into the island's first inhabitants have relied solely on the material remnants of their occupation. The first evidence of a possible pre-European occupation was

encountered during the First (British) Settlement (1788-1814). The presence of bananas in Arthur's Vale would have necessitated human introduction prior to 1788 and as such were an early indication of a preceding arrival (Collins 1798 in Fletcher 1975, p. 153; King in Hunter 1793, p. 241). Stone implements were also turned up in the island's interior (King to Banks 25 October 1791 in Specht 1984, p. 12) and several adzes were found around the banana plantation (McCarthy 1934, p. 269). When at least one of these finds was shown to Huru and Tuki they "recognised it with extreme joy" as an adze like those from Northland, New Zealand (King 1793 in McCarthy 1934, p. 267). Canoe fragments were also found on the shores of Ball Bay and Anson Bay, on the east and west of the island respectively (Figure 7). The fragments retrieved from Ball Bay were thought to match New Zealand watercraft (Phillip to Sydney 12 February 1790 in Britton 1892, p. 296) and, together with the evidence of the bananas and stone implements, this led King to theorise an early local settlement from New Zealand (King 24 May 1793 in McCarthy 1934, p. 267).

Other pre-European evidence from the First (British) Settlement included a turtle with evidence of a puncture wound (King September 1788 in Hunter 1793, p. 331), a carved piece of wood reminiscent of Tongan design (Phillip to Sydney 12 February 1790 in Britton 1892, p. 296) and coconuts on the shores of Ball Bay and Anson Bay (King September 1788 in Hunter 1793, p. 331, 265). It cannot be said that these were all certainly definitive remnants of a pre-European habitation. Although coconuts were found outside of their natural terrestrial range, these are now known to frequently wash up at Ball Bay and Anson Bay due to ocean currents. It is possible that the canoe fragments arrived in a similar manner. However, intentional voyaging is considered much more likely in this context.

Further suggestions of a pre-European presence were recorded in early accounts without the connection being realised. Although the majority of the island was densely vegetated, inland explorations found an area of approximately 40 hectares to the south of Mount Pitt which was overgrown with vines but otherwise a relatively open space (Ross 1791). Named Queensborough (originally Charlotte's Field) (Gibbs, Duncan & Varman 2017, p. 87) this area may represent earlier land clearance by pre-European inhabitants. Rats were also reported frequently due to their constant attacks on food stocks and crops. Not associated with earlier arrivals at the time, it is now known that these adversaries included the Polynesian rat (*Rattus exulans*) which was commonly introduced to new locations via Pacific voyagers.

History of archaeological investigations

Systematic archaeological investigation did not commence until the 1970s but the idea of pre-European settlement on Norfolk Island began to formally circulate in 1929. Thorpe (1929) reported on a Polynesian adze retrieved from a midden in Dark Point, New South Wales, and noted similarities to a recent example found at Emily Bay. Based on the early finds from British settlement and the recent Emily Bay find, Thorpe considered Norfolk Island a "promising spot for Polynesian relics" (1929, p. 124) and potentially the origin point of the Dark Point adze. This connection was later proven through geochemical provenancing

(White, Reepmeyer & Clark 2014). Further stone artefacts were later reported by Frederick McCarthy (1934), including a collection of unfinished adzes and flakes from the Emily Bay sand dunes. As they shared characteristics with New Zealand forms, the adzes were determined to most likely be of Polynesian origin (McCarthy 1934, p. 270). McCarthy (1934, p. 267-8) also described a ground-edged basalt implement from the island's interior but this he considered more resemblant of Melanesian implements.

Sporadic but continued local reporting of stone artefacts inspired the first systematic archaeological investigation in 1976 (Specht 1978, 1984). An island-wide survey program targeted local findspots to seek *in situ* evidence of pre-European settlement and recorded the locations of numerous surface finds across the island. Collation of these findspots illuminated particular concentrations of adzes, flakes, and chipped stone fragments from along the Kingston foreshore (Figure 10). A small test excavation program above the high tide mark at Slaughter Bay did not yield any artefactual material but did uncover a deep natural surface of basalt cobbles beneath the sands interpreted as an old beach surface (Specht 1984, p.9). No modification was found on these cobbles but it cannot be ruled out that this may have been a raw material source for local stone working. Several test pits in the Kingston area and other locations did not recover any subsurface artefactual material but the concentration of surface artefacts around the southern foreshore suggested that a site once existed in this area (Specht 1993, p. 155).

The stone implements recorded as part of this investigation mostly favoured central and eastern Polynesian forms. However, several were recorded as Melanesian and two appeared more akin to Australian styles (Specht 1978, p. 221; Specht 1984, p. 26-32). Situated equidistant between New Caledonia and New Zealand, it is feasible that Norfolk Island was reached by Pacific voyagers from either or both of these culturally distinct locations. In regard to a possible Melanesian arrival, later finds reported by Specht (1993) included a shell armband fragment and a shell adze blade, items unusual in Polynesian contexts but common in Melanesia (Specht 1993, p. 152).

The Melanesian material evidence on Norfolk Island could indicate early visitation but it is equally possible that these items arrived after 1788. Settlers and visitors may have obtained such objects as souvenirs, and the Melanesian Mission would have provided a direct avenue for introduction. From at least 1881 the mission also operated a local museum (*The Church of England Messenger and Ecclesiastical Gazette for the Diocese of Melbourne and Ballarat*, 8 February 1881, p.11) which undoubtedly included various objects collected by missionaries on their Pacific travels. Although there are no records of stone working by mission students on Norfolk Island, it is also possible that this was occurring given this practice was happening concurrently elsewhere in the Pacific. A pre-European arrival from Australia is considered less likely as evidence of Aboriginal Australian material on Norfolk Island is limited and can equally be associated with a post-1788 introduction. Although the number of Aboriginal people who visited Norfolk Island after 1788 is unknown, Aboriginal

women were documented as servants and men as convicts during the Second (British) Settlement (Anon. 1847 in Specht 1984, p. 29).

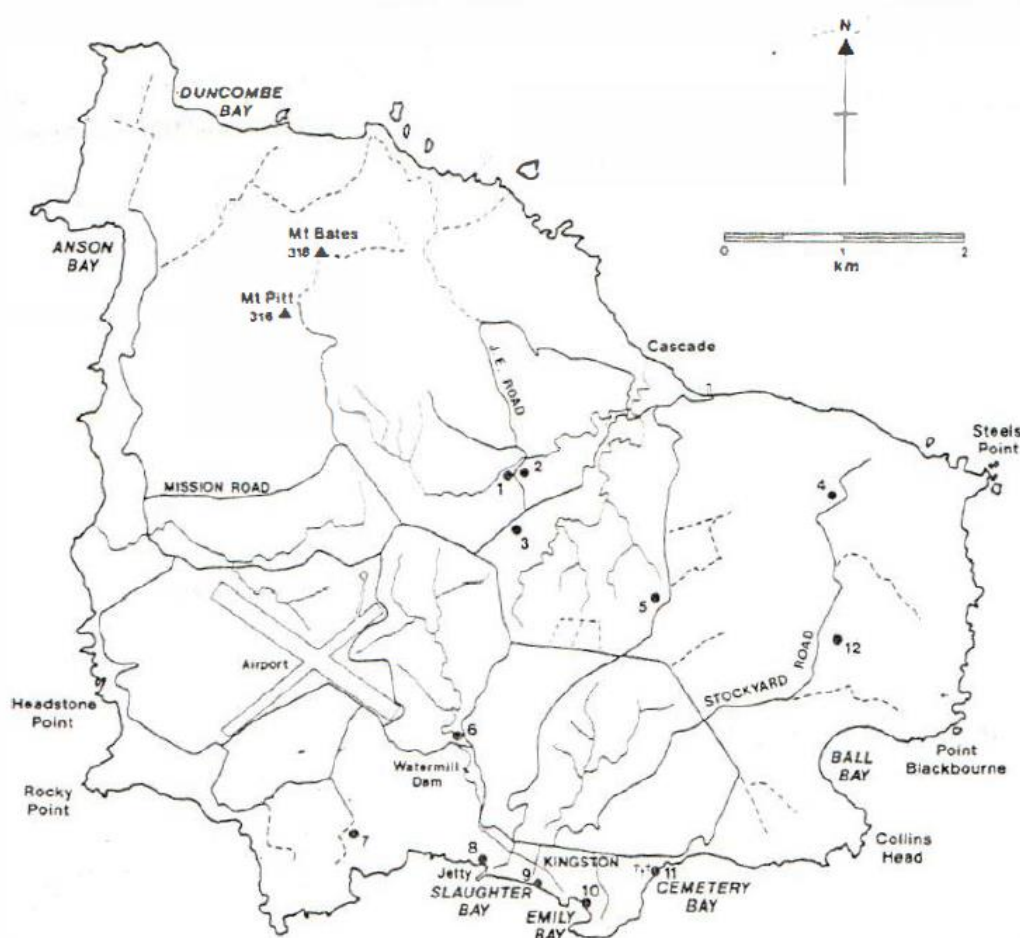


Figure 10: Approximate locations of twelve (numbered) local findspots reported by Jim Specht (1984, p. 2).

The weight of the material evidence from these early investigations ultimately favoured a Polynesian origin for the island's pre-European inhabitants, although a Melanesian arrival could not be ruled out. Specht (1978, p. 223) placed the earliest date for a Polynesian arrival between 900 and 1100 CE by comparing local adze forms to dated examples from the wider Pacific. Later radiocarbon dating of charcoal associated with *Rattus exulans* bones from Cemetery Bay refined the estimated Polynesian arrival dates to c. 1100-1200 CE (Meredith et al. 1985). Based largely on stylistic characteristics of the local adzes, New Zealand and the Kermadec archipelago were considered viable origin points for these Polynesian voyagers (Specht 1984, p. 39; Specht 1993, p. 147).

The Norfolk Island Prehistory Project

Concrete evidence of the elusive pre-European settlement was eventually uncovered during several phases of archaeological fieldwork between 1995 and 1999 (Anderson & White

2001b). Part of the Norfolk Island Prehistory Project, this program set out to “determine the fact, extent and nature of pre-European settlement in the Norfolk Island archipelago” (Anderson & White 2001a, p. 1). Excavations in the sand dunes at the western end of Emily Bay uncovered the structural remains of a Polynesian settlement, including postholes from a wooden domestic structure, numerous earth ovens, and an area of calcarenite paving determined to be an East Polynesian style marae (Anderson & Green 2001). Radiocarbon dating of associated charcoal deposits established an occupational timeframe between the early 13th and early 15th centuries (Anderson, Higham & Wallace 2001a).

The Emily Bay settlement site covers an area of approximately 3,000 m² though this may be smaller than its original footprint due to post-depositional disturbances associated with subsequent occupations and erosional processes (Anderson, Smith & White 2001b, p. 32). A single cultural layer was identified throughout the site which suggests a single phase of occupation. However, repeat visitations between the 13th and 15th centuries CE may have occurred. Due to the shallow chronology of the site, it is unlikely that repeat occupations would present as distinct stratigraphic layers. Anderson and Green (2001, p. 40-1) suggested that the Emily Bay site was more likely occupied intensively for several decades with frequent short-term visitations over the 200-year span. However, it was noted that this interpretation is limited by the available evidence from a single site (Anderson & Green 2001, p. 40-41).

In addition to structural remains, a diverse array of shell, bone and lithic material was recovered from Emily Bay. Several obsidian flakes (n=24) were retrieved from between and above the paved calcarenite surface, a non-local material and one of only two lithologies present at the site (Turner, Anderson & Fullagar 2001). All but one of the obsidian artefacts were geochemically provenanced to Raoul Island in the Kermadec archipelago (Anderson et al. 1997). The remaining flake was tentatively linked to Mayor Island, New Zealand, but geochemical sourcing for this artefact was inconclusive (Anderson et al. 1997; Turner, Anderson & Fullagar 2001, p. 63). This provenancing was supported by genetic analysis of excavated *Rattus exulans* bones. The genetic diversity in the Norfolk Island population was found comparable to those on Raoul Island, the Chatham Islands, and New Zealand (Matisoo-Smith et al. 2001). Although the local diversity may indicate *in situ* development following multiple introductions, it was considered more likely that this diversity was present before arrival on Norfolk Island (Matisoo-Smith et al. 2001, p. 84).

The lithic assemblage from Emily Bay was dominated by basalt, determined to originate from Norfolk Island (or perhaps offshore Phillip Island) (Anderson et al. 1997). The basalt assemblage included over three thousand flakes, nine preforms and five adzes, all associated with on-site adze manufacture (Turner, Anderson & Fullagar 2001). The Emily Bay site represents a secondary adze manufacturing centre, focussed on later stage reduction and fine working. Tools in the broader site assemblage were predominantly stone but several bivalve shells contained starch residues and displayed usewear consistent with

scraping (Schmidt, Anderson & Fullagar 2001, p. 71-72). A small range of bone artefacts were also retrieved, including three Polynesian style fishhooks and a harpoon point (Schmidt, Anderson & Fullagar, p. 73).

Faunal remains were relatively scarce at the Emily Bay site and largely comprised of fish, bird, rat and turtle bones (Holdaway & Anderson 2001; Smith, Clark & White 2001; Walter & Anderson 2001). These were retrieved in much lower quantities than would be expected given the early historical accounts of the available resources, but this may be attributed to their disposal somewhere further from the settlement area. Petrel species appear to have been a major contribution to the local Polynesian diet as was the larger Booby (*Sula dactylatra*) (Holdaway & Anderson 2001, p. 89). Providence Petrels were harvested in great numbers during the First (British) Settlement and noted to flock around the slopes of Mount Pitt and Mount Bates (Hunter 1793, p. 182). The presence of this species at Emily Bay may indicate that the Polynesians were traversing the landscape for resources, or perhaps this species was more widespread prior to European arrival.

Other faunal remains included fish, predominantly large benthic feeders, sea urchins, and molluscs (Campbell & Schmidt 2001; Walter & Anderson 2001). In comparison to other food resources, molluscs did not contribute significantly to the local Polynesian diet (Campbell & Schmidt 2001, p. 113). As most shellfish on Norfolk Island are below the typical edible size range, they were likely a relatively inefficient food resource. The archaeological record indicates that seabirds contributed more to the local diet than marine resources (Holdaway & Anderson 2001, p. 96-7). *Rattus exulans* bones were relatively frequent but there is no evidence to suggest that these were being consumed (Smith, Clark & White 2001, p. 77).

The excavation of the Emily Bay settlement site was a major step forward in confirming the timing and nature of Norfolk Island's pre-European settlement. Smaller excavations were undertaken at Bumboras Bay, Ball Bay, Cemetery Bay, and Slaughter Bay as part of the Norfolk Island Prehistory Project but no further intact cultural deposits were identified (Anderson, Smith & White 2001b).

Summary

Archaeological investigations on Norfolk Island have established that Polynesians settled Norfolk Island between the 13th-15th centuries CE. However, like many Pacific islands, the local archaeological record remains relatively thin. Questions still remain regarding the extent of Polynesian habitation on the island, where the original settlers came from, and what motivated the settlement's eventual abandonment after approximately two centuries.

For Polynesian settlers, the availability of local resources may have posed certain challenges. Norfolk Island's native edible plant species are limited and lack common Pacific Island staples such as the coconut or breadfruit. Shellfish species are also typically small and not a viable primary food resource in comparison to the larger species found on other Pacific

Islands. Seabirds and fish were plentiful but the ongoing rough sea conditions would have restricted access to offshore fishing. It remains unclear as to why the Polynesian people left Norfolk Island before European arrival, but it is possible that the availability and accessibility of resources was a factor.

The material evidence from Norfolk Island points towards New Zealand or Raoul Island in the Kermadecs as a departure point for the Polynesian settlers. However, further evidence is needed to confirm migratory origins or the presence of any external networks. Multiple stone artefacts have been reported by locals since the Norfolk Island Prehistory Project ended, particularly from the Kingston area, but additional *in situ* deposits have remained a target for researchers. The following chapters report on new evidence associated with the Polynesian occupation on Norfolk Island, uncovered during this research project.

Chapter 5: Fieldwork Methods

The Mount Bates Saddle Site

Archaeological investigation outside of coastal contexts on Norfolk Island has been relatively scarce. Given the previous findings from the Kingston area, attention has understandably been directed at these coastal lowlands. However, a local report of unusual stone fragments led to identification of a surface artefact scatter, named the Mount Bates Saddle (MBS) site, in the interior north-western uplands of the island in 2020. The MBS site sits at an elevation of approximately 280 m in a saddle landform between Mount Pitt and Mount Bates, approximately 5.5 km north-west of the Emily Bay settlement site (Figure 11).

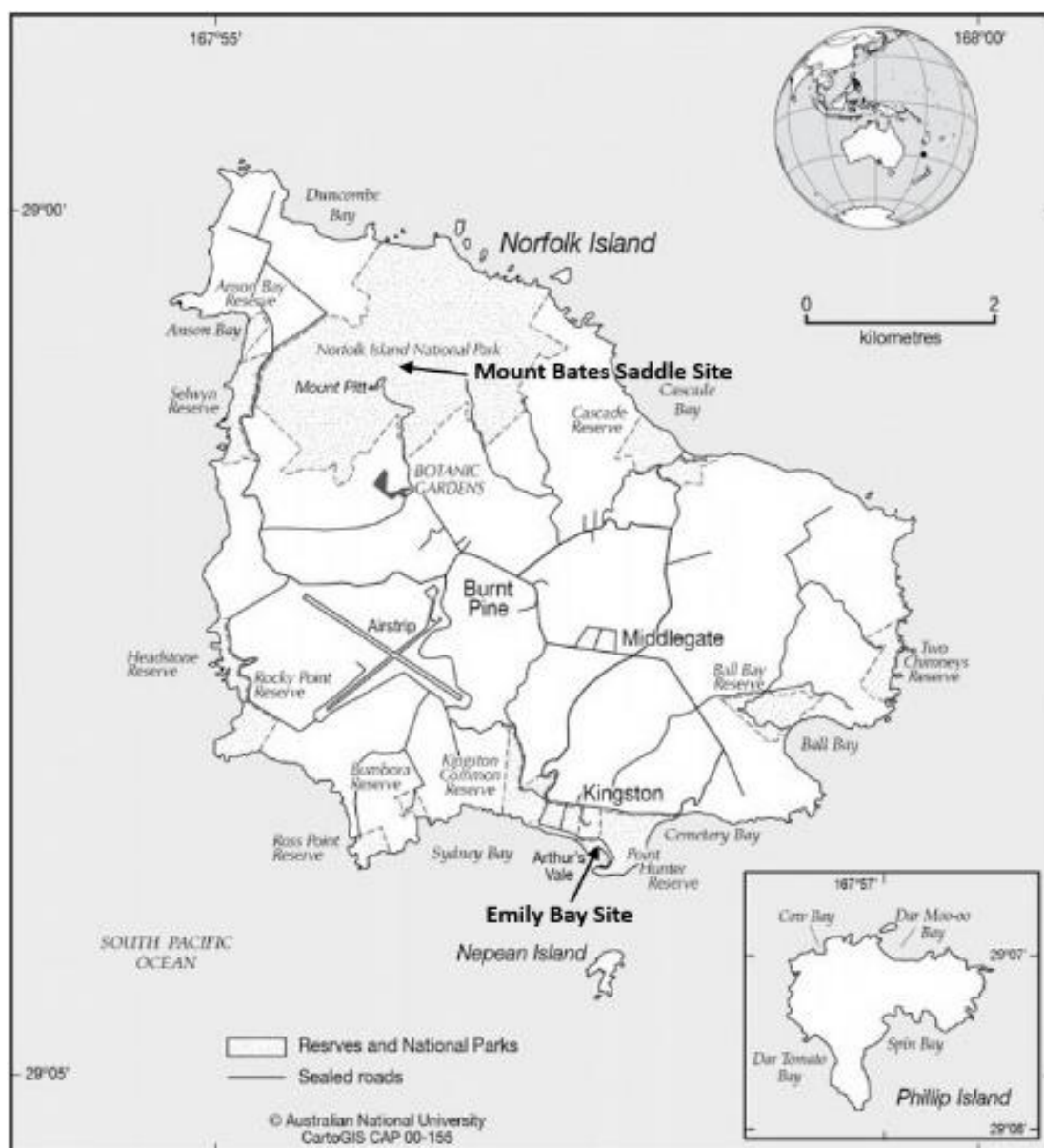


Figure 11: Location of the Mount Bates Saddle site (Jorgensen, Way & Flexner 2024, p. 142). Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.

The stone artefacts were found eroding from a section of the Mount Bates Track, a popular walking track in the Norfolk Island National Park. This track extends from the peak of Mount Bates in the north to an access point at Mount Pitt Road in the south and was initially installed during WWII to enable access to the radar station and associated facilities on Mount Bates. Construction of the track included some earthworks for levelling and deposition of a layer of calcarenite rubble for stabilisation. The exposure of these artefacts appears to be a relatively recent occurrence, first noticed in 2018.

Survey and Test Excavation

Two phases of investigatory fieldwork were carried out at the MBS site in May 2021 (Phase 1) and October 2022 (Phase 2). Phase 1 archaeological survey examined the extent of the Mount Bates Track, from its southern intersection with Mount Pitt Road to the peak of Mount Bates (Figure 13). This survey established the boundaries of the lithic surface expression and considered the potential for subsurface deposits. Surface artefacts were limited to the width of the track as it was bounded to the east and west by steep mountainous terrain with limited ground visibility. The total survey area was approximately 700 m long and 6 m wide, although the width varied along the length of the track. The MBS site was delineated as the visible extent of surface artefacts. The site was recorded with a plan drawing (Figure 11; Appendix I), photography, and a non-differential GPS.

Brief inspections were also conducted at Rocky Point, an interior location in Powder Valley, Emily Bay, Slaughter Bay, Cockpit and Ball Bay in May 2021 (Figure 13). These inspections were not a formal component of the Phase 1 investigations but were included to provide updated information on several additional areas of archaeological potential. The inspection at Rocky Point was based on previous reports of potential non-European material in this area. During the survey in 1976, Specht observed a scatter of seashells, predominantly *Nerita atramentosa*, as well as several *Rattus* sp. bones and basalt pebbles on a cliff top between Rocky Point and Headstone (Specht 1984, p. 7). The brief inspection in May 2021 attempted to relocate this scatter or similar surface material that may corroborate pre-European activity. The inspections at Powder Valley, Emily Bay, and Slaughter Bay targeted locations where locals had previously reported surface stone artefact finds. No secure finds have been previously reported from Cockpit or Ball Bay, but these areas were also inspected due to the presence of fresh water sources and their potential to be landing places. None of these inspections located any cultural material.

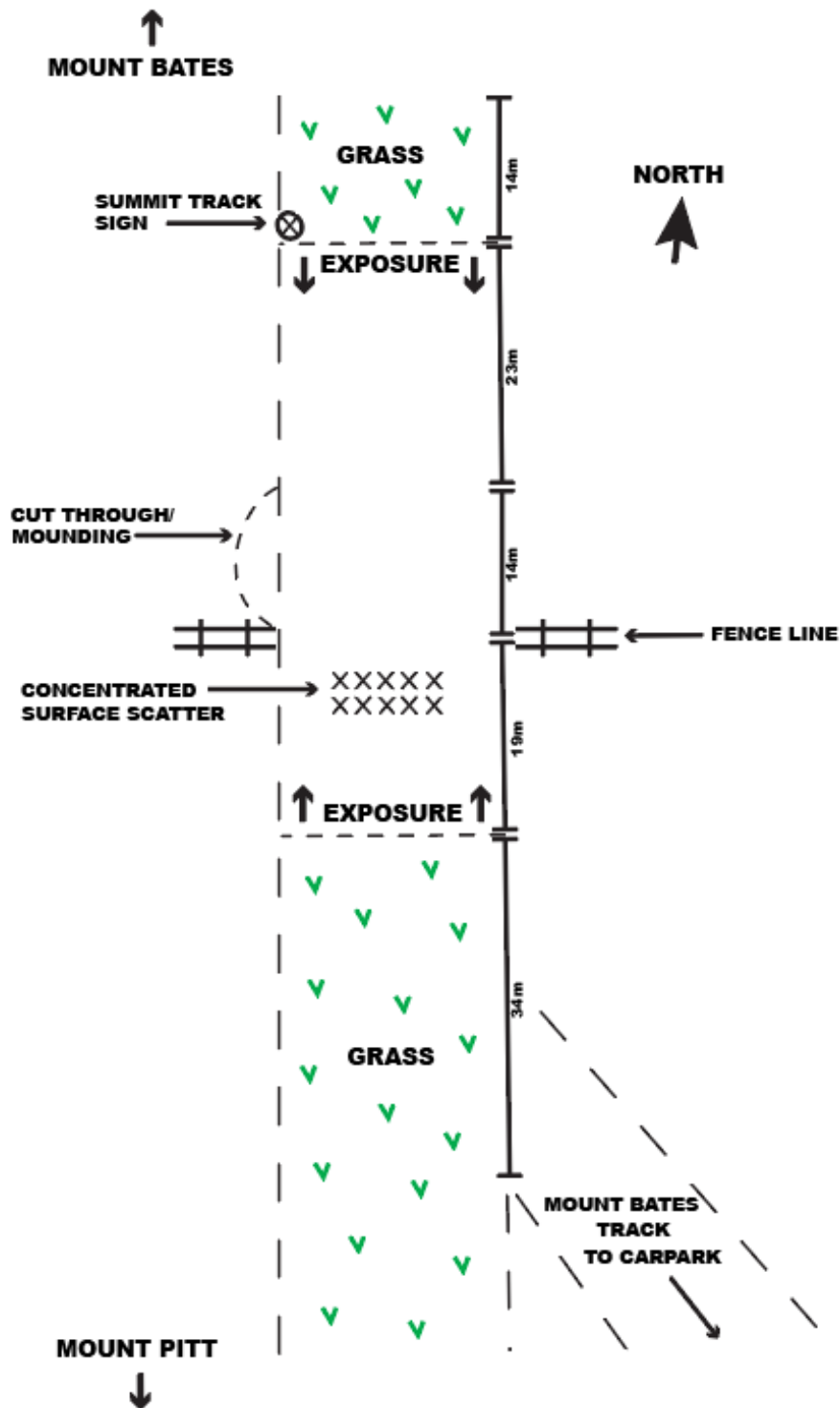


Figure 12: Mount Bates Saddle survey plan drawing.



Figure 13: Locations of Phase 1 survey and brief inspections. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.

Phase 2 involved four days of surface collection and test excavation at the MBS site. The locations of all surface artefacts were mapped from a transect baseline and assigned a unique numerical ID prior to collection. All surface material was then bagged for later analyses. Test excavation was limited to a single 1 m x 1 m test pit, excavated by hand in 5cm arbitrary levels until the base of the artefact bearing deposit was reached. Where possible, artefacts were pedestaled and left *in situ* until the base of the spit was reached. These artefacts were then mapped onto a scale plan drawing to record their spatial patterning in each spit. Artefacts less than 5 cm were typically too small to pedestal efficiently and so were not captured on the plan drawings. The Phase 2 plan drawings are provided in Appendix I. Each excavated artefact was also assigned a unique numerical ID and bagged with basic provenance information for further analyses.

All excavated material was dry sieved through a 5 mm mesh. Artefacts retrieved during sieving were bagged according to spit and later given individual numerical IDs during cataloguing. Scale drawings and photographs were maintained throughout the test excavation program and details on the soil profile and depths were recorded. Where charcoal fragments were encountered, these were collected and placed in aluminium foil prior to bagging. After completion of the Phase 2 fieldwork, several charcoal samples were sent to The University of Waikato Radiocarbon Dating Laboratory in New Zealand for radiocarbon dating. All excavated material, including the stone artefact assemblage, soil and charcoal samples, was left with the Norfolk Island National Park office for storage and future management. The artefacts are now housed in the Norfolk Island Museum.

Chapter 6: Fieldwork Results

Phase 1 Fieldwork (May 2021)

Archaeological survey

Phase 1 survey at the MBS site recorded a lithic surface expression spanning approximately 56 m x 6 m. The site boundary was delineated around an area of ground exposure along the Mount Bates Track (Figure 14). This exposure was the spatial extent of visible artefacts. It is possible that the actual site boundaries extend further but grass coverage obscured any surface visibility. The length of the site follows the track on an approximately north-south alignment, forming part of the saddle landform joining Mount Bates and Mount Pitt. The MBS site is located on the northern slope of the saddle landform, ascending on a moderate incline towards the peak of Mount Bates. The width of the site generally corresponds to the width of the narrow track. No survey was undertaken to the east or west of the Mount Bates Track due to the steep terrain and limited visibility.

The survey identified a high concentration of surface artefacts in the southern portion of the ground exposure (Figure 14 to Figure 16). Evidently eroding from the underlying layer, these artefacts were intermixed with gravels and calcarenite rubble (materials used in previous historical track works) (Figure 15). From this apparent centre, artefact density rapidly dispersed in all directions to the edges of the ground exposure. A brief visual inspection assessed that these artefacts were all made on fine-grained basalt. A soil mound is present immediately north of a wooden fence line that intersects the track (Figure 17). This mound was likely deposited during historical earthworks in the vicinity rather than a natural formation. No artefacts were identified on visual inspection of this mound.

Surface visibility between the MBS site and Mount Pitt Road was relatively good, interspersed with patches of grass and introduced gravels. Several large pieces of basalt were found embedded in the track (Figure 18). From discussions with the National Park staff, it is understood that these were introduced for track stabilisation. A single basalt flake was identified on this section of the track (Figure 19) but was not relocated during later surface collection. Surface visibility north of the MBS site was essentially nil due to grass and gravel coverage. Survey in this area did not identify any artefactual material and the peak of Mount Bates appeared relatively modified, particularly from WWII earthworks. Some larger pieces of volcanic rock were inspected along the track as possible source material, but all appeared too low quality to be suitable for stone tool production.



Figure 14: Section of the Mount Bates Saddle site along the Mount Bates Track. Scale marks the location of surface artefact concentration. View north. Photograph by N. Jorgensen.



Figure 15: Example of surface basalt artefacts intermixed with introduced calcarenite rubble and gravels. Photograph by N. Jorgensen.



Figure 16: Example of basalt flaked artefacts on the Mount Bates Track surface. Photograph by N. Jorgensen.



Figure 17: Soil mound adjacent to Mount Bates Track, to the left of image. View north towards Mount Bates. Photograph by N. Jorgensen.



Figure 18: Large basalt pieces embedded in Mount Bates Track – south of the MBS site. Photograph by N. Jorgensen.



Figure 19: Single flake identified on the Mount Bates Track between Mount Pitt Road and the saddle. Unable to be relocated during later fieldwork. Photograph by N. Jorgensen.

Brief inspections

Several brief inspections were undertaken concurrently with the Phase 1 survey of the MBS site. These inspections were included for context on additional areas of archaeological potential. Locational data for the previously recorded material at Rocky Point (Specht 1984, p. 7) was limited and brief inspection did not relocate the scatter as described. Given the time elapsed since the original survey this was not surprising. A thick layer of leaf litter blanketed much of the ground surface and limited visual coverage. Several discarded *Nerita atramentosa* shells were observed (Figure 20) but these may have been a more recent occurrence. These shells appeared highly dispersed, but the extent of this potential scatter was unclear due to the leaf litter. No *Rattus* sp. bones or basalt cobbles were found in association. In this same area were several fragments of modern plastic and a 20th century glass bottle (Figure 21).



Figure 20: *Nerita atramentosa* shells amongst leaf litter. Photograph by N. Jorgensen.



Figure 21: Glass bottle in inspection area. Photograph by N. Jorgensen.

Ball Bay and the waterfront adjacent to Cockpit consist of boulder beaches which may have made canoe landings more difficult, relative to the sandy shores on the south coast. Both locations are also largely bounded by steep slopes. However, the fresh water sources would have likely been visible from the ocean (Figure 22) which may have attracted settlers – either via landings in these locations or expeditions from the south side of the island.

Cockpit consists of two descending cascades where the creek line drops down to a shallow pool then drops a second time to the boulder beach shorefront below. Earthworks have modified some of the original landform at Cockpit, primarily to facilitate agriculture during the colonial periods. The freshwater creek has remained relatively *in situ* where it flows north-east from the road to the ocean drop off. No evidence of stone-working or pre-European habitation were identified at Cockpit, but it is considered a feasible place for early settlement.

Given the slope of the surrounding terrain (Figure 23) it is possible that historical vegetation clearance has resulted in erosional landslip and buried or moved deposits. This was found to be the case at Cemetery Bay on the south coast where deposited soils from the surrounding slopes exceeded 1 m depth (Anderson, Smith & White 2001b, p. 12-13). Jim Specht

conducted minor test excavation at Cockpit (referred to as ‘Cascade’) and found “40cm of undifferentiated brown soil” (Specht 1984, p. 7) without reaching bedrock. This may represent downslope soil deposition, but further stratigraphic information would be required to confirm.



Figure 22: Point of creek overflow into the ocean, boulder beach visible below. View north-west. Photograph by N. Jorgensen.



Figure 23: Terrain above the first creek cascade at Cockpit. View north. Photograph by N. Jorgensen.

At Ball Bay, historical works have modified much of the original terrain immediately adjacent to the ocean and fresh water source. The central section of Ball Bay contains modern infrastructure for fuel storage and unloading ships. It is assumed that the slope originally descended relatively steeply to the boulder beach here, but this section has been levelled and built up to create a platform for vehicles and unloading (Figure 24). The basalt boulders at Ball Bay and adjacent to Cockpit may have provided suitable source material for stone tool production. Evidence of this at Ball Bay is difficult to determine as many boulders have been broken by machinery and heavy seas. Figure 25 shows how these machine-made or natural fractures mimic cultural processes. No artefactual evidence was identified at Ball Bay, but this bay remains an area of interest for pre-European activity.



Figure 24: Levelled and built-up area for vehicles, fuel line in foreground. View north. Photograph by N. Jorgensen.



Figure 25: Example of boulder fracturing from machinery or heavy seas. Photograph by N. Jorgensen.

A discrete interior location in Powder Valley was inspected based on a subsurface stone adze find (Figure 26). This Polynesian-style adze was reportedly turned up during machine excavations. The extent of these machine earthworks is unknown, but they are assumed to

not be extensive as the area is used for livestock and there are no built structures. During colonial settlement this broader area was used for farming and extensively cleared of vegetation. The location of the adze findspot was in a small circular clearing with an approximately 30 m diameter (Figure 27). The vegetation was heavily overgrown, with dense grass reaching waist height. Ground visibility was nil and no further artefactual material was found. Although the location was not able to be verified, locals reported that a natural freshwater spring once existed in the vicinity of this findspot. Given this potential factor and the rarity of subsurface stone artefact finds on Norfolk Island, this location also remains an area of interest for potential pre-European activity.



Figure 26: Adze recovered from subsurface context. Photograph by N. Jorgensen.



Figure 27: Adze findspot location. Photograph by N. Jorgensen.

Local reports of potentially viable source material led to inspection of a second discrete inland location on the north-east slopes of Mount Bates. Known locally as Marsh's Quarry, this location was proposed to be a rock source for local gravel crushing in recent years. This venture was discontinued before any rock retrieval took place. In its current condition, Marsh's Quarry is a collection of larger rounded boulders and loose rocks that appear to be collecting downslope (Figure 28). The rocks were predominantly angular and subangular pieces with a considerable size range. A single broken angular piece appeared to have a relatively consistent and moderately fine grain that may have been suitable for stone working (Figure 29). However, no other material like this could be found during the inspection. Most of the rock at Marsh's Quarry was soft volcanic material and therefore it was not deemed a likely raw material source for stone tool manufacture.



Figure 28: Collection of larger boulders. View north-west.
Photograph by N. Jorgensen.



Figure 29: Single piece of potentially workable stone.
Photograph by N. Jorgensen.

No additional artefactual material was identified at Emily Bay or Slaughter Bay, but the Kingston foreshore is known to be an area of previous Polynesian settlement and activity (Anderson & White 2001b; Figure 30). The full extent of the Emily Bay settlement area requires further testing, particularly west towards Slaughter Bay. Although multiple stone artefact finds have been reported from the beach surface at Slaughter Bay, *in situ* deposits here have yet to be identified.

The impacts of the colonial settlement infrastructure and natural erosion, particularly heavy wave action, in this area may have removed deposits that once existed. However, stone artefacts continue to be exposed sporadically across this shorefront. Local Troy Irvine was present for the Slaughter Bay inspection and delineated a discrete area in the centre of Slaughter Bay beach where artefacts were regularly appearing. These artefacts were presenting in both the sandy context and amongst the calcarenite bedrock. A convict drain has been channelled through the calcarenite surface in this same area (Figure 31). This apparent correlation may indicate that historical infrastructure has displaced or disturbed associated *in situ* deposits. Alternatively, depending on how far north the drain extended, it is possible that artefacts have been redeposited from a northern location around the current penal buildings.



Figure 30: Location of Emily Bay settlement site in sand dunes behind Emily Bay. View north-east. Photograph by N. Jorgensen.



Figure 31: Convict drain channelled into calcarenite on the Slaughter Bay shorefront. View south. Photograph by N. Jorgensen.

Phase 2 Fieldwork (October 2022)

Surface collection

Considerably fewer artefacts were visible on the ground surface at the commencement of Phase 2 fieldwork at the MBS site. The recorded dimensions of the ground exposure appeared the same, but surface artefacts were now only visible south of the wooden fence line. Several factors are understood to have contributed to this reduced surface expression. There had been significant rainfall on Norfolk Island since the survey which is expected to have loosened and moved some of the upper soil layers. Existing rills in the track surface evidence the presence of erosive water action. It is possible that some surface artefacts were moved by these same processes, but artefact movement was more likely caused by vehicles and local collection. A total of 455 surface artefacts had been removed from the site through surface collection by the time of Phase 2 fieldwork. These were made available for analysis and form part of the recorded MBS lithic assemblage.

Surface artefacts were collected over a section of the ground exposure measuring approximately 22 m long and 3.2 m wide (Figure 32). Grass coverage bounded the collection area to the south, east and west. All artefacts, including a surface level adze preform (Figure 33), were collected between the wooden fence line and the southern edge of the ground exposure.



Figure 32: Northern end of surface collection transect. View south. Photograph by N. Jorgensen.



Figure 33: Adze preform recorded amongst area of highest surface artefact concentration. Photograph by N. Jorgensen.

Test excavation

Three distinct stratigraphic layers were identified within the 1 m x 1 m test pit. Culturally sterile soils were reached at 30 cm depth and excavation continued to 35 cm to confirm this sterility. High artefact densities were recorded from surface level to a depth of 20 cm. A representative stratigraphic profile is provided in Figure 34 below.

The top layer (Layer I) consisted of moderately compact dark brown clay loam. Soils were intermixed with dispersed introduced road gravels and calcarenite rubble inclusions. The calcarenite was a distinctive feature of this layer (Figure 36) and dispersed gradually towards the transition with underlying Layer II. This material was laid when the track was initially installed and is not associated with pre-European activities. Layer I's depth was variable in profile, ranging from 1 cm at its shallowest point up to 11 cm. Although there was some fluctuation across the layer, the depth generally increased following the descending slope gradient. This indicates downslope soil movement which is also supported by the calcarenite rubble's spatial distribution, and the profile of leveling fill for the track. These calcarenite inclusions were dense in the southern portion of the pit and increasingly dispersed to the north where the layer was shallowest. Colluvial and erosional processes appear to be gradually moving material downslope, with ongoing vehicle and pedestrian movement likely contributing to the deposit's mobility. Stone artefacts were frequent throughout Layer I, but densities were higher towards the transition with Layer II.

Layer II soils were a medium brown clay loam with large inclusions of natural decomposing basalt, which were too soft to be suitable for stone tool manufacture. As such, this decomposing basalt is unlikely to have been deposited by people, but rather appears to be part of the natural landform. In contrast to the above layer, Layer II was deepest at the northern end of the pit and the profile thinned as it followed the downslope. The *in situ* decomposing basalt inclusions have evidently had a stabilising effect on the deposit. This material was concentrated in the northern end of the pit, particularly the north-east corner, and decreased towards the southern edge. These inclusions were confined to this stratigraphic layer and in places spanned the depth of the profile.

Historical impacts do not appear to have not extended deeper than Layer I. Although some grading was evident in the transition between Layer I and Layer II, no calcarenite was present in the underlying layer. In the north-eastern section of the pit, Layer II depressed into Layer III in a shallow irregular formation. This depression does not appear to be a cultural feature, but it is possible that it facilitated increased preservation of some artefacts *in situ*. Layer II was interpreted as representing the original cultural layer, with significant artefact densities and limited evidence of post-depositional disturbance. Charcoal fragments were also found across this layer (e.g. Figure 37) but not in any well-bounded concentrations.

The third and final layer (Layer III) was the culturally sterile soil layer, consisting of a moderately friable red-brown clay loam with grey and yellow clay inclusions. The transition from Layer II was defined but irregular. A small number of basalt fragments (n=6) were found in the top 5cm of this layer. Given their small size and proximity to Layer II, these artefacts were most likely vertically displaced into this layer post-deposition. Minor charcoal fragments were also retrieved from Layer III, but again not in any significant concentrations.

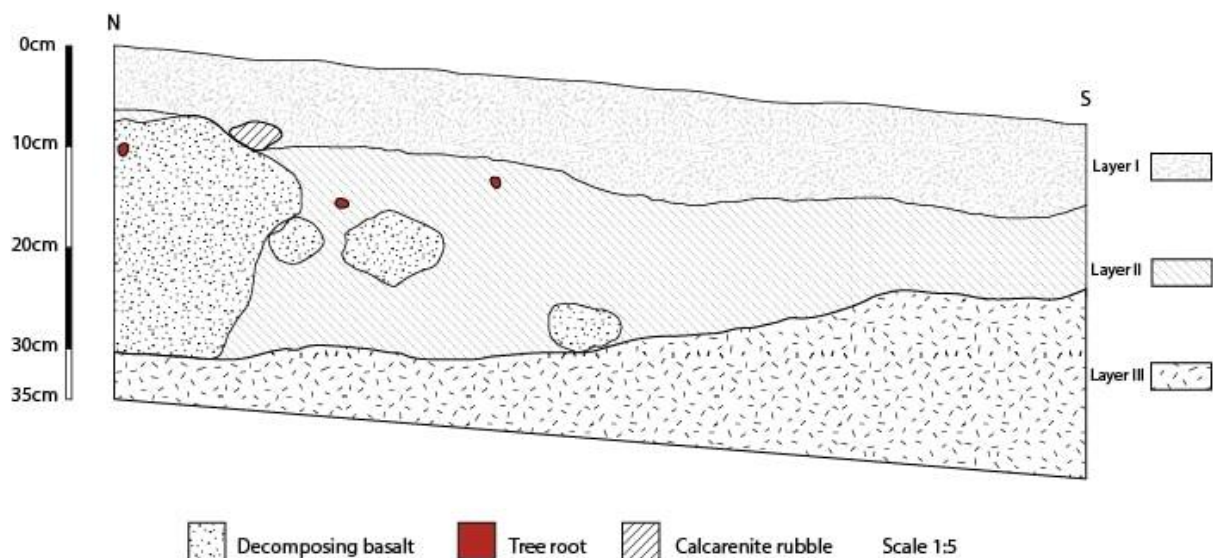


Figure 34: Mount Bates Saddle site stratigraphy, eastern profile. Layer I: moderately compact dark brown clay loam with introduced gravel and calcarenite rubble inclusions, Layer II: medium brown clay loam with large inclusion of natural decomposing basalt, Layer III: moderately friable red-brown clay loam with grey and yellow clay inclusions.



Figure 35: Location of test pit prior to excavation and sieve station set up. Photograph by N. Jorgensen.



Figure 36: Commencement of test excavation. Denser calcarenite inclusions visible at southern end of test pit (top of photo). Photograph by N. Jorgensen.



Figure 37: Example of charcoal fragment sample (CH09). Photograph by N. Jorgensen.



Figure 38: Completed test pit. Photograph by N. Jorgensen.

Charcoal samples

Twenty-one charcoal samples were retrieved during the excavation. All samples were dispersed charcoal fragments spanning the depth of the test pit; no significant concentrations were encountered. Four of these samples (CH08 [Wk55374], CH14 [Wk55375], CH17 [Wk55376] and CH18 [Wk55377]) were radiocarbon dated at The University of Waikato Radiocarbon Dating Laboratory in New Zealand. Half of each of the four samples were sent to be processed by the laboratory and the other half of each sample was retained with the excavation assemblage on Norfolk Island. Results confirmed a date range of 1290-1430 calCE (95.4% probability) for the MBS site. Details of the AMS radiocarbon dating is provided in Table 1 below and Appendix III.

The wood species for the four samples is currently unknown and therefore the Waikato results may only represent maximum ages for the site. However, these calibrated dates align with previous radiocarbon dating from the Emily Bay settlement site (c. 800-600 calBP; Anderson, Higham & Wallace 2001a). The date range across the three stratigraphic layers is also relatively narrow which indicates a singular period of activity. It is assumed that the associated burning event occurred naturally in the landscape rather than by cultural activity

due to the dispersal of the fragments. However, the limitations of the small excavation are noted and expanded testing may provide further data.

Table 1: AMS radiocarbon dating for the Mount Bates Saddle side (data supplied by The University of Waikato Radiocarbon Dating Laboratory 10.01.2023).

Stratigraphic Layer	Approx. Depth	Internal ID	Waikato Lab ID	Material	Uncalibrated ¹⁴ C Age	Calibrated Age (68.3% probability)	Calibrated Age (95.4% probability)	% Modern Carbon (F ¹⁴ C%)
I	0-50mm	CH08	Wk-55374	Charcoal	599 ± 23 BP	1320-1420 calCE	1320-1430 calCE	92.8 ± 0.3%
II	50-100mm	CH14	Wk-55375	Charcoal	636 ± 23 BP	1320-1400 calCE	1320-1410 calCE	92.4 ± 0.3%
II	100-150mm	CH17	Wk-55376	Charcoal	686 ± 23 BP	1290-1390 calCE	1290-1400 calCE	91.8 ± 0.3%
Transition of II-III	200mm	CH18	Wk-55377	Charcoal	647 ± 23 BP	1320-1400 calCE	1300-1410 calCE	92.3 ± 0.3%

Chapter 7: Lithic Analysis and PXRF Methods

Lithic Analysis

The MBS site is considered a Polynesian adze production site due to the recovery of two Polynesian style adze preforms (see Figure 47). As such, the lithic analysis focussed on assessing what stages of adze manufacturing were present at the site.

Technological analysis of the MBS flake assemblage followed the methods developed by Turner and Bonica (1994) from experimental adze replications in New Zealand and archaeological data from the Tahanga basalt adze production complex. These methods were employed for the analysis of the Emily Bay assemblage which included a large basalt flake assemblage and several adzes at various stages of production (Turner, Anderson & Fullagar 2001). The Turner and Bonica method categorises flakes by weight, dorsal characteristics, and morphological features to distinguish between three key stages of adze reduction: initial roughing out of blanks, preform shaping and fine working. The two adze preforms were also considered in accordance with definitions provided by Clarkson, Shipton and Weisler (2014, 2015).

As part of the analysis, the MBS site assemblage was compared to the Emily Bay and Tahanga quarry assemblages. Although the limited sample data from the MBS site necessitates some caution with cross-comparisons, Turner and Bonica's typology provides a relevant experimental framework for analysis and interpretation, and Emily Bay and Tahanga quarry provide broadly comparative datasets from similar time periods with which to compare the MBS results.

Raw material, artefact type (e.g. flake, core, angular fragment), weight and provenance were recorded for all artefacts retrieved during the Phase 2 fieldwork (n =1288). In addition, the following attributes were recorded for complete flakes (n=115):

- flake dimensions (percussion length, width and thickness)
- platform dimensions (width and thickness)
- platform type (plain, flaked, complex, crushed, cortical or focal)
- exterior platform angle,
- cortex percentage, and
- the presence or absence of retouch and usewear visible to the naked eye.

No platform measurements were recorded for focal or crushed platforms. Weight was recorded with a digital scale (0.01 g accuracy) and dimensions were recorded with digital callipers (0.01 mm accuracy). Where measurements were taken, these were recorded to two decimal places. The full catalogue of stone artefacts from the MBS site is provided in Appendix II. All cataloguing took place on Norfolk Island.

Following Turner and Bonica (1994, p. 7), weight was used to separate flakes into seven size categories. These categories broadly correlate decreasing size with advancement through the adze manufacturing sequence. Size 1 (>300g) and Size 2 (201-300g) flakes typically comprise the first reductions, including roughing out of blanks over 2,500g, and are often found at the location of the raw material source (Turner & Bonica 1994, p. 7). This initial reduction stage can also include Size 3 (101-200g) and Size 4 (51-100g) flakes, associated with roughing out of blanks under 2,500g and 2,000g respectively. However, experimentation found that these size categories were also frequent during preform shaping. To establish the associated reduction stage, dorsal characteristics must additionally be considered for Size 3 and Size 4 flakes. Size 5 (21-50g) and Size 6 (3-20g) flakes are more frequently associated with preform shaping. The smallest flakes, Size 7 (<3g), were numerically dominant in the experimental assemblages and produced at much higher frequencies during fine working (Turner & Bonica 1994, p. 7). However, these flakes are difficult to assign to a particular manufacturing stage as they occur throughout the adze reduction sequence, and they were excluded from the Emily Bay assemblage analysis (Turner, Anderson & Fullagar 2001, p. 55). Size 7 flakes were also excluded from this analysis for comparative purposes.

Turner and Bonica (1994, p. 8) developed six categories in relation to dorsal surface features. These categories were established based on variations of cortex coverage and dorsal scarring as relating to the level of reduction. Time constraints during analysis did not allow for the recording of dorsal scarring for the MBS site assemblage. Recorded dorsal surface features were instead limited to cortical coverage as representing primary (100% cortex), secondary (1-99% cortex) and tertiary (0% cortex) reduction. The three reduction categories used for the MBS assemblage analysis broadly correspond to Turner and Bonica's (1994, p. 8) typology as follows: primary = CO (cortex and no scarring), secondary = CP + CS (cortex and primary scarring + cortex and secondary scarring), tertiary = OO + OP + OS (no cortex and no scarring + no cortex and primary scarring + no cortex and secondary scarring).

Flakes with primary cortex are associated with initial roughing out and the production of blanks. Secondary flakes are also produced during initial roughing out as well as during preform shaping and fine working of large preforms. The tertiary reduction stage comprises flakes devoid of cortex. These flakes are associated with later manufacturing activities, including preform and adze shaping, and fine working. However, as cortex coverage can vary throughout the reduction sequence depending on various factors, interpretations of the assemblage based on the presence or absence of cortex are treated with caution.

Reconstruction of the adze manufacturing sequence at the MBS site also considered flake shape and termination. Turner and Bonica (1994, p. 8-9) describe six categories based on these morphological features. Category A flakes are distinguished by step and hinge terminations, related frequently to unsuccessful shaping of preform sides and reworking of adzes and preforms. Category B flakes are elongated (length>width) with feather terminations, often associated with knapping skill and high stone quality. Category C and

Category D flakes are shattered fragments resulting from heavy percussive force during various stages of manufacture. Category E flakes are also commonly correlated with heavy percussive force, featuring plunging terminations and pronounced bulbs of percussion. These flakes are frequent in early reduction stages but can be produced during adze and preform reworking. Category F flakes are expanded with feather terminations and are most frequent at the fine working stage. However, all stages of reduction of thin flake blanks produced these flakes during experimentation. Analysis of the MBS assemblage utilised a modified version of Turner and Bonica's six category system. Due to their fragmented form, Category C and Category D flakes pose problems for cross-assemblage comparisons. Although all flakes and fragments from the MBS site were catalogued, these two flake categories were excluded from the assemblage analysis.

Turner and Bonica (1994, p. 9-10) include a further typological category for 'Special Flake Types'. These flakes include attributes such as evidence of hammer dressing, grinding, retouch or usewear and represent the final stages of adze and preform modification, as well as use. No flakes in the MBS assemblage met the Special Flake Type criteria. Minor retouch was recorded on two flakes, but this was not sufficient to draw any meaningful interpretation. As such, classification by Special Flake Types was excluded from this analysis.

Background to Portable X-Ray Fluorescence

Portable X-Ray Fluorescence (pXRF) was the chosen technique for the geochemical analysis component of this research. PXRF spectroscopy is a valuable tool for the archaeological discipline as it allows for samples to be analysed rapidly and non-destructively *in situ* and can produce quantitative data with a relatively high degree of analytical precision and accuracy. The aim of geochemical analysis was to ascertain the provenance of a select number of basalt artefacts from the Mount Bates Saddle site and private collections. Establishing whether basalt artefacts were sourced locally or imported provides avenues to investigate local resourcing strategies and external interaction networks. This section reviews XRF theory, the technique's application in Pacific archaeological studies, and the viability of the pXRF spectrometric approach for this study.

XRF theory and Pacific archaeology

Initially developed for geological applications, XRF spectrometers are used to characterise a material or object's chemical composition. In XRF analysis, X-rays irradiate a sample and these X-rays excite electrons in the sample's atoms. Through this excitation, an inner shell electron is ejected and replaced by an outer shell electron (Figure 39). This outer to inner shell electron movement results in emission of X-rays that are characteristic of the atom. Thus, XRF analysis can characterise a sample's elemental composition and abundance (Shackley 2011, p. 16).

Figure 39: The process of XRF analysis (McAlister 2011, p. 96). Image removed for copyright purposes.

XRF spectrometry has been used in archaeological applications for several decades to examine the composition, origins and movements of cultural materials. Archaeological studies utilising XRF spectrometers have largely focussed on lithic artefacts and associated raw stone. However, this technique has been successfully applied to studies of other materials such as ceramics (e.g. Ceccarelli et al. 2016; Forster & Grave 2013; Kelloway et al. 2019), coins (e.g. Charalambous, Markou & Kassianidou 2020; Roxburgh 2021) and paintings (e.g. Mauran et al. 2019; Molari & Appoloni 2023).

Portable XRF spectrometers were commercially available by the 1970s, but fully handheld models were not produced until 1994 (Portable Spectral Services 2023). The pXRF spectrometers discussed in this section refer to the post-1994 handheld instruments. These lightweight handheld spectrometers were a major advancement for *in situ* field analyses and were quickly adopted into Pacific archaeological research. Investigating origins and colonisation strategies has been a key focus of Pacific archaeological research since its inception (see Chapter 2) and incorporating instrumentation such as pXRF spectrometers accelerated studies of colonisation patterns, resourcing strategies, and interactive networks throughout this region.

Provenancing studies have commonly targeted volcanic glass, particularly obsidian, as the prevalence of this material in pre-European contexts in the western Pacific presents a reliable baseline for comparative investigations. Obsidian has a high level of matrix homogeneity compared to other stone types found in this region, resulting in measured data with relatively high levels of accuracy and precision. Obsidian studies utilising pXRF techniques have successfully differentiated between raw material sources and reconstructed spheres of interaction in pre-European western Pacific contexts (e.g. Burley, Sheppard & Simonin 2011; Galipaud et al. 2014; McCoy et al. 2020; Neri et al. 2015; Sheppard, Trichereau & Milicich 2010).

Although similar studies have been carried out on volcanic glass in Polynesia (e.g. Furey, Ross-Sheppard & Prickett 2015; Sheppard et al. 2011), the comparatively limited distribution of such material in this region has necessitated an increasing focus on basalt. Basalt is one of the most ubiquitously distributed materials across Polynesia and thus is a key indicator of interaction networks and resourcing strategies at both the local and regional scale. Whilst volcanic glass studies have been conducted in some parts of Polynesia, particularly Hawai'i (e.g. McCoy et al. 2011) and New Zealand (e.g. Furey, Ross-Sheppard & Prickett 2015), sources are less frequent in this region compared to basalt. Basalt pXRF-based studies in Polynesia have proven successful in reconstructing social links and exchange networks and have contributed to our understanding of stone sourcing, industry, and exchange in this region (e.g. Charleux et al. 2014; Kahn et al. 2013; Kirch et al. 2012; Richards 2021; see Chapter 3). PXRF spectrometry also characterised a basalt adze from Norfolk Island, found in a midden context at Dark Point on the Australian east coast (White, Reepmeyer & Clark 2014). Although the events surrounding the Dark Point adze's deposition are unclear, the results demonstrate the potential of pXRF as a technique to analyse Norfolk Island basalts.

Accuracy, precision and reliability

The increasing application of pXRF spectrometry to archaeological contexts has spurred growing debate over the validity of the resultant data. Major considerations in pXRF analysis are levels of instrument precision, accuracy and reliability, and the extent to which sample variables can affect the data obtained. Precision is defined as the level of agreement between elemental data from a series of measurements under identical conditions, whereas accuracy is the degree to which measured values correspond to the actual values of the sample (Frahm 2012). Reliability is reliant on levels of accuracy and precision though also considers the ongoing reproducibility of the obtained measurements under varying analytical conditions (Frahm 2012; Speakman & Shackley 2013). Reliability can be a concern for pXRF as measurements on different instruments under different conditions can produce variable results, and a single instrument can encounter drift over extended periods of analysis (Goodale et al. 2012). This can result in distinct datasets that are internally valid but not reproducible, and therefore unreliable (Frahm 2012; Speakman & Shackley 2013). However, this is not particular to the portable spectrometers and these factors must equally be considered for desktop instruments. Such outcomes can be avoided provided the spectrometer is empirically calibrated using international standards and the analytical methods follow strict laboratory standard protocols, including check standards to monitor for drift (Goodale et al. 2012; Shackley 2011).

XRF spectrometry is not the sole or even most high-powered technique available for geochemical provenancing studies. Comparable laboratory techniques such as Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Neutron Activation Analysis (NAA) generally provide higher levels of analytical precision and accuracy than XRF, as well as

greater detection sensitivity (Johnson 2011; Pearce 1996). However, these techniques require sample destruction and do not facilitate sample analysis *in situ* which was a critical requirement for this research. Laboratory XRF instruments, including both energy-dispersive (ED) and wavelength-dispersive (WD), are sufficiently accurate, precise and reliable for geological source determinations. However, there remains scepticism as to whether the pXRF spectrometers produce equivalent results, or whether they sacrifice accuracy and precision for the sake of portability and analytical speed.

XRF instrument assessments have systematically evaluated portable XRF performance in comparison to laboratory XRF instruments. Comparative analyses of obsidian (Craig et al. 2007; Drake, Nazaroff & Prufer 2009) and other igneous rock (Craig & Glascock 2018; Goodale et al. 2012; Steiner, Conrey & Wolff 2017; Williams-Thorpe 2008; Williams-Thorpe, Potts & Webb 1999) samples generally demonstrate good to strong correlations between pXRF and desktop EDXRF data and more variable results between pXRF and desktop WDXRF. Although the pXRF results for individual elements often vary from the results of both EDXRF and WDXRF techniques, the differences between pXRF and EDXRF data are often consistently dissimilar (Craig & Glascock 2018; Drake, Nazaroff & Prufer 2009). The correlation between these two datasets can therefore be tightened by applying the right statistical treatments. Comparing pXRF to laboratory WDXRF, these individual differences in the elemental data are more random and therefore more difficult to align (Goodale et al. 2012). There is general agreement from these inter-instrument evaluations that pXRF spectrometers have a comparative lack of overall accuracy but are still suitable for lithic source determinations. This is largely due to the instrument's high precision and sufficient accuracy for those trace elements most useful for geological source attribution (including Rb, Zr and Sr). The difference in results between portable and XRF laboratory instruments does not and should not prevent researchers from using pXRF in such studies.

The constraints of non-destructive analysis

Non-destructive techniques, such as pXRF analysis, are typically a requirement for the analysis of cultural material. Non-destructive analyses introduce additional variables associated with a sample's macroscopic characteristics, and their potential effect on the measured data must be considered. The nature of the analysed sample, such as morphology and texture, can have a significant impact on the results - as for most analytical chemistry techniques. Variations in weathering and surface morphology in lithic samples in particular can influence non-destructive geochemical analyses. Assessments of chemical variation in lithic samples as a result of weathering have found major elements are more variable than trace elements due to a higher amount of elemental mobility (Gauthier & Burke 2011; Lundblad, Mills & Hon 2008; Lundblad et al. 2011; Pearce 1996; Williams-Thorpe 2008).

However, this variability is not always cause for exclusion of weathered samples from geochemical studies. Aluminium (Al) and titanium (Ti) are lighter elements that can be

prone to weathering effects yet are relatively less mobile. With appropriate analytical controls Al and Ti can be valuable elements for provenancing studies, the latter commonly used in basalt discriminations. Silicon dioxide (SiO₂) can also be an important indicator of sample metamorphism, with variation increasing in conjunction with levels of sample weathering (Gauthier & Burke 2011; Le Bas et al. 1986; Lundblad et al. 2011; Pearce 1996). Although the most accurate and precise results are achieved on freshly cut (non-weathered) surfaces, adequate measurements can still be obtained using non-destructive methods (Lundblad, Mills & Hon 2008). Due to the compounding and variable effects of rock types and environmental conditions, the degree to which weathering will affect analyses is often unpredictable. Samples must therefore be analysed with a knowledge of the depositional context.

The impact of variable surface morphology on data from non-destructive methods follows a similar trend to weathering (Lundblad et al. 2011). Sample surface relief must be <3 mm to achieve planar contact with the instrument window and produce viable results (Williams-Thorpe 2008). Best practice additionally requires samples to be >10 mm thick to satisfy XRF infinite thickness parameters (Lundblad, Mills & Hon 2008; Shackley 2011; Williams-Thorpe 2008). Beyond weathering and surface morphology, certain surface contaminants can also affect measurements using non-destructive techniques (Lundblad et al. 2011). However, the extent to which these contaminants significantly impact overall results is dependent on the contaminant and is project specific.

Despite ongoing debate about the validity of pXRF-obtained data, it is generally accepted that pXRF instruments produce sufficiently precise and accurate measurements for provenance studies on volcanic stone, where appropriate controls and methodologies are employed. Techniques such as ICP-MS and NAA may provide higher data accuracy and precision but require destructive methods which are not suitable for cultural materials. Previous studies have also proven that basalt, including Norfolk Island basalts, can be effectively provenanced using non-destructive pXRF techniques. Moreover, critical evaluations of inter-instrument performance must consider the nature of the study to which the technique is applied as an instrument's limitations do not necessarily render it unsuitable for the study's objectives. PXRF spectrometry is a sufficient and effective method to meet the objectives of this research.

Data Collection and Geochemical Analysis

Instrumentation and calibration

Geochemical data was collected with a portable Bruker Tracer 5i XRF spectrometer. This instrument contains an automated 5 position primary beam filter wheel with pre-installed filters. Equipped with a rhodium (Rh) X-ray tube, the instrument generates 6-50 kV with a maximum current of 200 µA and is fitted with a 20mm² silicon drift detector and an 8µm Be detector window. The basalt calibration used is based on 90 samples from the Sydney Basin, northern NSW and south-east Queensland (Attenbrow et al. 2017, p. 177-178) and

measures samples with three beams over 150 seconds. Although based on Australian samples, this calibration has sufficient elemental ranges for the analysis of Norfolk Island basalts. To ensure the viability of the calibration for this analysis, two Norfolk Island basalt samples were analysed by XRF at the Queensland University of Technology in Brisbane. The samples were selected from interior and coastal contexts to capture potential chemical variations in the natural geology or from the environmental context.

The major and trace elemental results for the two Norfolk Island samples in relation to the calibration ranges are shown in Table 2. These elements and oxides are all typically used in the discrimination of basalt sources. It is noted that Nb values were not provided for the Norfolk Island basalt samples. However, geochemical analyses of Norfolk Island basalt boulders by Anderson et al. (1997) measured Nb between 33.5 and 38.2 ppm. These concentrations fit comfortably within the calibration range. Na has not been included in the table below as this element cannot be measured with the pXRF instrument.

*Table 2: Calibration ranges in relation to Norfolk Island basalt samples (analysed by UQ). *Nb values not provided by QUT.*

Element	Calibration detection range	Norfolk Island basalt sample 1, Mount Bates	Norfolk Island basalt sample 2, Slaughter Bay
MgO (%)	0.04-14.08	8.03	8.12
Al ₂ O ₃ (%)	1.84-19.11	16.42	15.37
SiO ₂ (%)	8.89-100	48.94	49.06
P ₂ O ₅ (%)	0.02-1.8	0.51	0.36
K ₂ O (%)	0.33-6.9	1.05	1.14
CaO (%)	0.28-40.91	9.12	8.19
TiO ₂ (%)	0.044-3.892	1.97	1.89
MnO (%)	0.028-0.316	0.14	0.13
Fe ₂ O ₃ (%)	1.46-15.48	10.12	10.44
Ba (ppm)	86-1577	269	179
V (ppm)	7-298	123	133
Ni (ppm)	5-423	105	136
Cu (ppm)	7-305	51	50
Zn (ppm)	22-265	89	101
Rb (ppm)	9-238	14	18
Sr (ppm)	36-2028	704	666
Y (ppm)	4-69	15	19
Zr (ppm)	39-1911	170	149
Nb (ppm)	1-246	*	*

Artefact assemblage

The artefacts analysed with the pXRF instrument included 23 flakes and the two adze preforms from the MBS site, and 31 artefacts from private collections. A selection criteria determined which artefacts were analysed to ensure a reliable and consistent dataset. Artefact surfaces had to be large enough to cover the instrument window, have minimal

surface irregularity to achieve planar contact with the window, and be greater than 10 mm thick to satisfy the XRF infinite thickness parameters (Lundblad, Mills & Hon 2008, Shackley 2011, Williams-Thorpe 2008). The MBS artefacts were washed in water and dried prior to the analysis to remove any major surface contaminants. No sample preparation was required for the private collection artefacts as they had all been previously cleaned. Additional details on the private collection artefacts are included in the following chapter.

Data collection

The pXRF spectrometer was operated whilst in the instrument stand with the window facing upwards to ensure maximum stability during measurements. The set up used for the duration of the analyses is shown in Figure 40. Artefacts were measured three times in different locations to account for possible matrix heterogeneity. The three locations were largely chosen at random but avoided areas with higher visible inclusions and levels of weathering (such as cortical surfaces).



Figure 40: Bruker Tracer 5i pXRF instrument set up. Photograph by N. Jorgensen.

Check measurements were undertaken throughout the analysis sessions to ensure the instrument was performing consistently. To monitor for instrument drift, a basalt National Institute of Standards and Technology (NIST) standard (NIST 688) was measured two to three times per analysis session. Comparison of this pXRF measured data to the standard's certified data provides a measure of accuracy for the instrument. Likewise, the instrument's precision is assessed as relative standard deviation amongst the standard measurements.

PXRF analysis of the Mount Bates Saddle artefacts took place over two sessions. The check standard results are provided in Table 3 and Table 4 below.

Table 3: Accuracy of NIST 688 standard check across analysis sessions. *Certified values not available.

Element	Mean pXRF measured data (ppm)	Certified standard data (ppm)	Relative error (%)
MgO	59133	84600	-30.1
Al ₂ O ₃	151588	173500	-12.6
SiO ₂	430078	483500	-11.0
P ₂ O ₅	1231	1330	-7.4
K ₂ O	2575	1900	35.5
CaO	116563	121700	-4.2
TiO ₂	11783	11680	0.9
MnO	1642	1670	-1.7
Fe ₂ O ₃	112799	103500	9.0
V	131	250	-47.6
Ni	113	150	-24.5
Cu	75	96	-22.4
Zn	84	58	45.4
Rb	2	1.91	16.8
Sr	142	169.2	-16.1
Y	22	*	*
Zr	49	*	*
Nb	9	*	*
Ba	127	200	-36.4

Table 4: Precision of NIST 688 standard check across analysis sessions.

Element	Mean pXRF measured data (ppm)	Standard deviation	Relative Standard Deviation (%)
MgO	59133	3411	5.8
Al ₂ O ₃	151588	2350	1.6
SiO ₂	430078	9030	2.1
P ₂ O ₅	1231	130	10.6
K ₂ O	2575	51	2.0
CaO	116563	765	0.7
TiO ₂	11783	152	1.3
MnO	1642	41	2.5
Fe ₂ O ₃	112799	2038	1.8
V	131	16	12.1
Ni	113	5	4.3
Cu	75	3	3.9
Zn	84	5	5.7
Rb	2	1	26.9
Sr	142	2	1.5
Y	22	2	6.7
Zr	49	2	3.2

Element	Mean pXRF measured data (ppm)	Standard deviation	Relative Standard Deviation (%)
Nb	9	1	13.6
Ba	127	12	9.5

During the geochemical analyses, precision remained relatively high and stable. However, accuracy was low. Whilst the high precision allows for suitable comparisons between measurements taken on the pXRF instrument, the low accuracy affects the viability of comparisons to data collected by other means. To investigate the reasons for this low accuracy, particularly in the mid-Z elemental range, pXRF and desktop XRF measurements were compared for two Norfolk Island basalt samples (Table 5). This also provided comparative results for Y and Zr which could not be assessed with the available trace data for NIST 688. The two basalt samples were sourced from Slaughter Bay (coastal context) and Mount Bates (inland context). Desktop XRF measurements were provided by QUT.

The Mount Bates sample comparisons showed a marked increase in accuracy compared to the NIST 688 results, particularly for Rb which had 0% relative error. Accuracy was also considerably higher for both Zn and Sr, though Zn and Y still demonstrated high relative error percentages. Accuracy similarly improved for Zn and Sr in the Slaughter Bay sample. However, the overall level of accuracy for Rb, Zn and Y still remained relatively low.

The lower accuracy for certain mid-Z range elements in the Norfolk Island samples may reflect sample preparation. The pXRF measurements were taken on cut surfaces of the raw material whereas the QUT analyses utilised crushed rock samples. Additional pXRF measurements were taken on a crushed portion of the same Norfolk Island samples and these showed decreased accuracy and precision, and overall lower measurements across the suite of elements, when compared to the desktop XRF data. The comparatively lower accuracy for NIST 688 may also relate to the nature of the sample. Although NIST 688 was cut basalt rock, the standard was considerably thinner than the Norfolk Island samples and barely exceeded the minimum thickness threshold. Variable analytical depth may have therefore been a factor in the certified standard's low accuracy.

Lower pXRF instrument accuracy is not unexpected given the similar results from inter-instrument studies (see above section). To manage this variable and given the relatively high and consistent precision during analyses, data analysis focussed on elemental ratios in the mid-Z range. The data analysis process is outlined in further detail below.

Table 5: Accuracy of pXRF measurements of Norfolk Island basalt samples. *Nb values not provided by QUT.

Element	Sample 1, Mount Bates			Sample 2, Slaughter Bay		
	Mean pXRF measured data (ppm)	QUT XRF data (ppm)	Relative error (%)	Mean pXRF measured data (ppm)	QUT XRF data (ppm)	Relative error (%)
MgO	65326	80300	-18.65	70753	81200	-12.87
Al ₂ O ₃	160342	164200	-2.35	150513	153700	-2.07

Element	Sample 1, Mount Bates			Sample 2, Slaughter Bay		
	Mean pXRF measured data (ppm)	QUT XRF data (ppm)	Relative error (%)	Mean pXRF measured data (ppm)	QUT XRF data (ppm)	Relative error (%)
SiO ₂	509427	489400	4.09	498876	490600	1.69
P ₂ O ₅	4828	5100	-5.33	3221	3600	-10.52
K ₂ O	11270	10500	7.33	12621	11400	10.71
CaO	92762	91200	1.71	85225	81900	4.06
TiO ₂	18120	19700	-8.02	18527	18900	-1.98
MnO	1443	1400	3.07	1486	1300	14.33
Fe ₂ O ₃	94055	101200	-7.06	105427	104400	0.98
V	167	123	36.04	183	133	37.34
Ni	95	105	-9.21	111	136	-18.38
Cu	57	51	11.11	58	50	16.67
Zn	64	89	-27.72	74	101	-26.73
Rb	14	14	0.00	14	18	-20.37
Sr	679	704	-3.60	626	666	-5.96
Y	20	15	35.56	23	19	19.30
Zr	172	170	1.37	138	149	-7.61
Nb	23	*	*	24	*	*
Ba	244	269	-9.17	149	179	-16.95

Data analysis

The geochemical data were initially assessed on major element and oxides' weight percentage (wt%) totals. Measurements that did not reach a minimum majors total of 85 wt% were excluded as non-viable. The remaining artefact dataset included a minimum of three measurements for a total of 56 artefacts. As a guide, laboratory-based XRF analysis of standard samples are typically expected to have minimum major totals above 98.5% to be considered viable. This was scaled down to account for the variables that can affect unprepared pXRF obtained measurements and the lack of Na concentrations, whilst still maintaining relative accuracy and precision. Major total measurements between 85-95 wt% account for 98% of the analysed assemblage and as such their interpretations must be approached with caution.

Determination of rock type

The analysed artefacts were first plotted in a Pearce W-F diagram to determine rock type. TiO₂, SiO₂ and K₂O are commonly used for discrimination between volcanic rock types. Many studies use the Total Alkali-Silica (TAS) diagram (Figure 41) for this discrimination. However, this requires Na₂O for bivariate plotting which the pXRF cannot measure. The accuracy of K₂O and SiO₂ also has limits for pXRF and they are more likely to be mobile as a result of weathering. This was a key consideration for this analysis as most artefacts were weathered to some degree and had to be measured non-destructively.

The Pearce W-F diagram (Pearce 1996; Winchester & Floyd 1977; Figure 42) provides an effective alternative to the TAS diagram for non-destructive pXRF studies (Richards 2019). This method incorporates trace element ratios which improves the accuracy of the output. TiO_2 can be a more mobile oxide within the suite measurable with the pXRF. However, the Bruker Tracer 5i measurements demonstrated a consistent level of precision and accuracy for TiO_2 (Table 3, Table 4). The Pearce W-F diagram relies on those elements and oxides with more reliable values for pXRF and provides sufficient discrimination for volcanic rock types.

Figure 41: Total Alkali-Silica (TAS) diagram (Le Maitre et al. 2002, p. 35). Image removed for copyright purposes.

Figure 42: Redrawn Pearce W-F diagram with limits shown (Richards 2019, p. 33). Image removed for copyright purposes.

Provenance determination

Statistical analyses of the geochemical data, to determine provenance, employed bivariate scatter plots, created through the JMP® (Version 16) software. Principal Component Analysis (PCA) was also undertaken using the full suite of analysed elements. The PCA results supported the bivariate plot results and so only the latter are presented here. Only those elements from the mid-Z range were targeted for these bivariate plots. PXRF measurements generally produce more accurate and precise results for these elements, including Y, Zr, Rb, Sr and Nb, in many cases comparable to desktop XRF instruments (Drake, Nazarov & Prufer 2009; Goodale et al. 2012). Furthermore, basalt objects from archaeological contexts are prone to some geochemical alteration over time due to surface weathering. The extent to which this affects the measured concentrations depends largely on the depth of the weathered layer. In these scenarios, the mid-Z elements generally remain more reliable as they are less affected by the weathering process (Gauthier & Burke 2011; Lundblad, Mills & Hon 2008; Lundblad et al. 2011; Pearce 1996; Williams-Thorpe 2008). The major elements tend to be more mobile and as such their measured outputs are more likely to be affected. It is noted that variable analytical depth is also a factor in the level of output affectation for all elements.

Sample thickness and variable surface morphology can also affect the accuracy and precision of pXRF measurements. However, in cases of such sample variability, reliable results can still be achieved by employing ratios within the mid-Z elemental range (Gauthier & Burke 2011, p. 283-4; Lundblad, Mills & Hon, p. 3; Lundblad et al. 2011, p. 73; Richards 2019, p. 34). Bivariate plotting of the geochemical data in this analysis utilises elemental

ratios to account for these potential variables. Anderson et al. (1997) used mid-Z elemental ratios (Nb/Sr and Zr/Sr) to establish a likely local provenance for seven basalt flakes from the Emily Bay settlement site. White, Reepmeyer & Clark (2014) also used the mid-Z elements to provenance a basalt adze from NSW to Norfolk Island and geochemically discriminate Norfolk Island basalts within a broader dataset. These elements, ratios and methods are employed in this analysis to ensure inter-study comparability.

Chapter 8: Lithic Analysis and PXRF Results

Mount Bates Saddle Site Lithic Analysis

Flake assemblage

This section presents the results of lithic analysis of the MBS flake assemblage with comparison to assemblages from Emily Bay and the Tahanga quarry complex. The MBS assemblage consisted of 1,288 basalt artefacts from the MBS site which included 833 artefacts retrieved during Phase 2 fieldwork, and an additional 455 from prior local collection. Of the 1,288 artefacts, 1,286 (99.8%) were flakes and flake fragments and the remaining two (0.2%) were adze preforms. A total of 711 artefacts were retrieved from a subsurface context. This suggests a high density of 711 artefacts per square metre. However, it is noted that this interpretation is limited by the small size of the excavation and this density is unlikely to be consistent across the extent of the site. Regardless, this density from a single test pit indicates concentrated activity at this location.

The overall MBS assemblage was dominated by medial (27.9%) and angular (25.3%) fragments (Figure 43). The prevalence of transversely broken artefacts (including angular, distal, medial, and proximal fragments) indicates significant post-depositional impacts on the assemblage, and possibly an element of manufacturing breakage. These artefacts outnumber unbroken artefacts at a ratio of 4.6:1. 78% of those retrieved from a subsurface context were from the upper 10 cm of the deposit. This correlates with the evidence of historical disturbance in Layer I. Surface fragmentation was 8.5% higher than the buried deposit, the expected product of higher exposure to direct anthropogenic impacts post-deposition.

The broken artefact assemblage also included longitudinal cone split artefacts which more likely represent breakage during manufacture. Though only making up 7.6% of the assemblage, these artefacts indicate on-site tool manufacture. 54% of these longitudinally split artefacts were retrieved from an *in situ* context. Figure 43 shows the breakdown of artefact types from the full MBS assemblage.

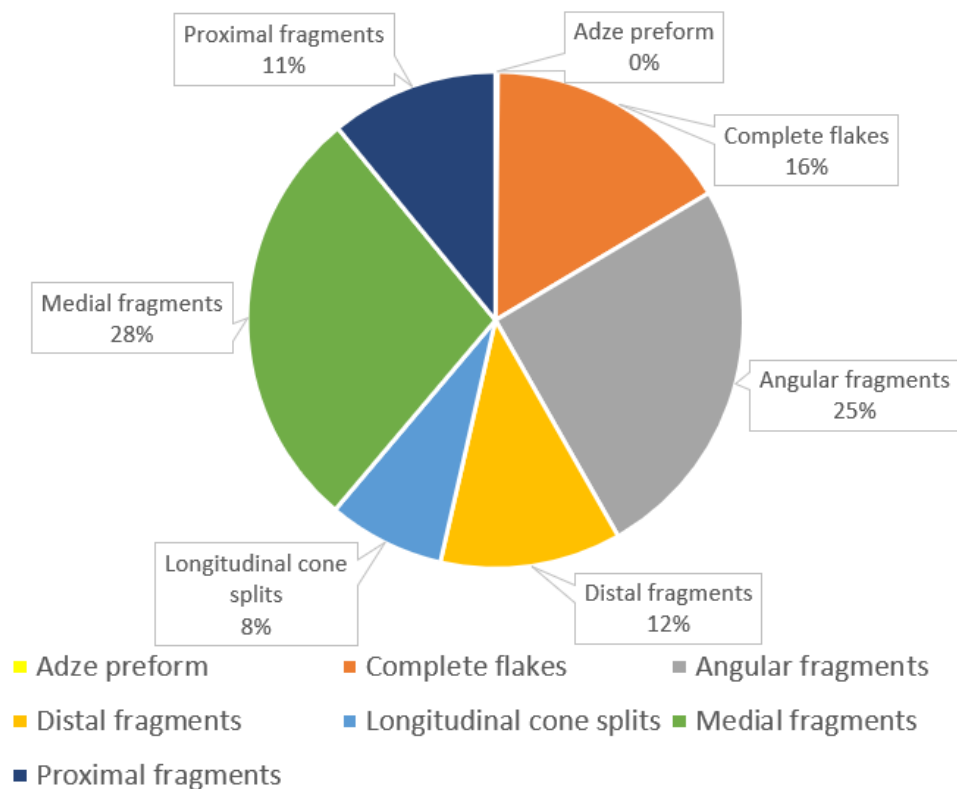


Figure 43: Artefact types from the overall MBS assemblage.

A sample was then selected in line with parameters set by Turner and Bonica (1994) to allow a comparative analysis with Emily Bay and the Tahanga site in New Zealand. This involved the removal of broken artefacts and flakes from the smallest flake size category (Size 7) (see Chapter 7). These exclusions resulted in a comparative assemblage of 115 complete flakes, retrieved from surface and subsurface contexts. Surface and subsurface artefacts are considered here as one deposit as the total assemblage showed little variation between them beyond breakage rates.

Following the methods outlined in Chapter 7, the 115 complete flakes retrieved from the MBS site were separated into the remaining six size categories (1-6). No Size 1 flakes were present in the MBS assemblage but seven Size 2 flakes (6.1%) suggest some on site reduction of blanks exceeding 2,500g. Size 3 and Size 4 flakes were more frequent (10.4% and 9.6% respectively) which may indicate preferential roughing out of smaller blanks (see Figure 44). The high frequencies of Size 5 and Size 6 (20.9% and 53% respectively) flakes support a greater focus on preform shaping at the MBS site.

The MBS assemblage size data positions the site earlier in the reduction sequence than Emily Bay. At Emily Bay, preform shaping flakes (Size 5 and Size 6) constituted 96.5% of the assemblage and larger flakes (Size 2- Size 4) only 3.6%. This contrasts with 73.9% preform shaping flakes and 26.1% larger flakes at Mount Bates. The MBS site more closely resembles the Tahanga quarry complex in regard to these larger flakes (Size 2 – Size 4) (see Fig 44). At Tahanga, these flakes constituted 34.5% of the assemblage and are associated with

roughing out activities expected at a quarry site. These flakes in the MBS assemblage are likewise associated with roughing out, although their potential association with preform shaping cannot be ruled out. A visualisation of the site sequencing is provided in Figure 44.

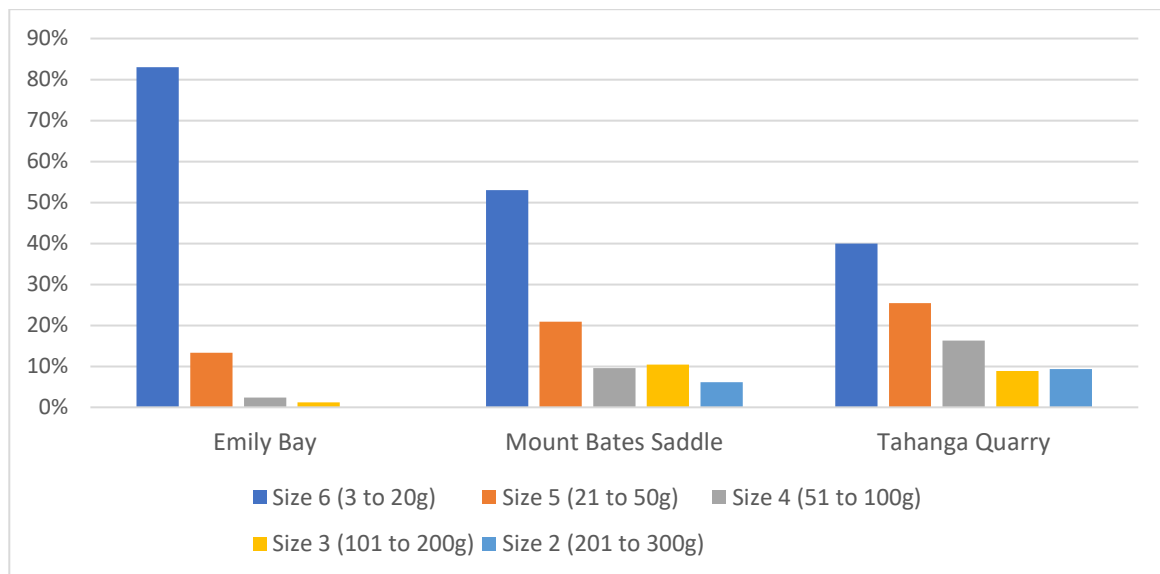


Figure 44: Percentages of flakes in each size category at Emily Bay, the Mount Bates Saddle, and Tahanga Quarry.

Regarding flake shape and termination, the MBS site and Emily Bay share a high frequency of Category A flakes. Experimentation found that poor-quality material increased the frequency of this flake type. However, the MBS material appears to be a fine basalt grain with no visible inclusions or irregularities that would create fracturing faults. Rather than low quality stone, or less knapping skill, the frequency of Category A flakes is more likely attributed to higher rates of preform shaping. Unsuccessful terminations are common during this stage of manufacture, particularly when shaping preform sides. Category A flakes are also produced frequently during preform and adze reworking, but no other evidence of such activities was identified in the assemblage.

Higher rates of successful terminations are inferred by the frequency of Category B and Category F flakes, with expanded Category F flakes comprising the majority of the assemblage (Table 6). Size 2 and Size 3 flakes (>100g) appear to have a higher rate of Category F flakes (Figure 45), but these are present across the assemblage size categories. Both Category B and Category F flakes appear to increase numerically with decreasing flake size (Figure 45). However, this is likely the result of the limited sample. Further material would be needed to determine if this correlation is occurring. The frequency of these flake types and their spread across the size categories again suggests a greater focus on preform shaping at the MBS site. The prevalence of preform shaping is further supported by low levels of Category E flakes (Table 6). These flakes are frequently produced through heavy percussive force during early stages of manufacture (i.e. roughing out) or through adze and preform reworking.

The level of reworking at Emily Bay contrasts strongly with the MBS site. Reworking activities were considered relatively frequent at Emily Bay (Turner, Anderson & Fullagar 2001, p. 56). Flakes demonstrating reworking were recorded as ‘special flake types’ and accounted for 36.7% of the Emily Bay assemblage. Adzes and preforms from this site also provided additional evidence of reworking, discussed further below. In contrast, no reworking flakes, or reworked preforms or adzes, were present in the MBS assemblage.

Table 6: Comparison of flake percentages in the four Categories. Note the Emily Bay and Tahanga Quarry percentages were recalculated following removal of Categories C and D.

Description	Mount Bates Saddle (%)	Emily Bay (%)	Tahanga Quarry NZ (%)
Category A: Step/hinge termination	32.7	35.5	16.2
Category B: Feather termination + length>width	22.1	25.5	54.8
Category E: Plunging termination	1.8	14.2	9.6
Category F: Feather termination + width>length	43.4	24.7	19.4

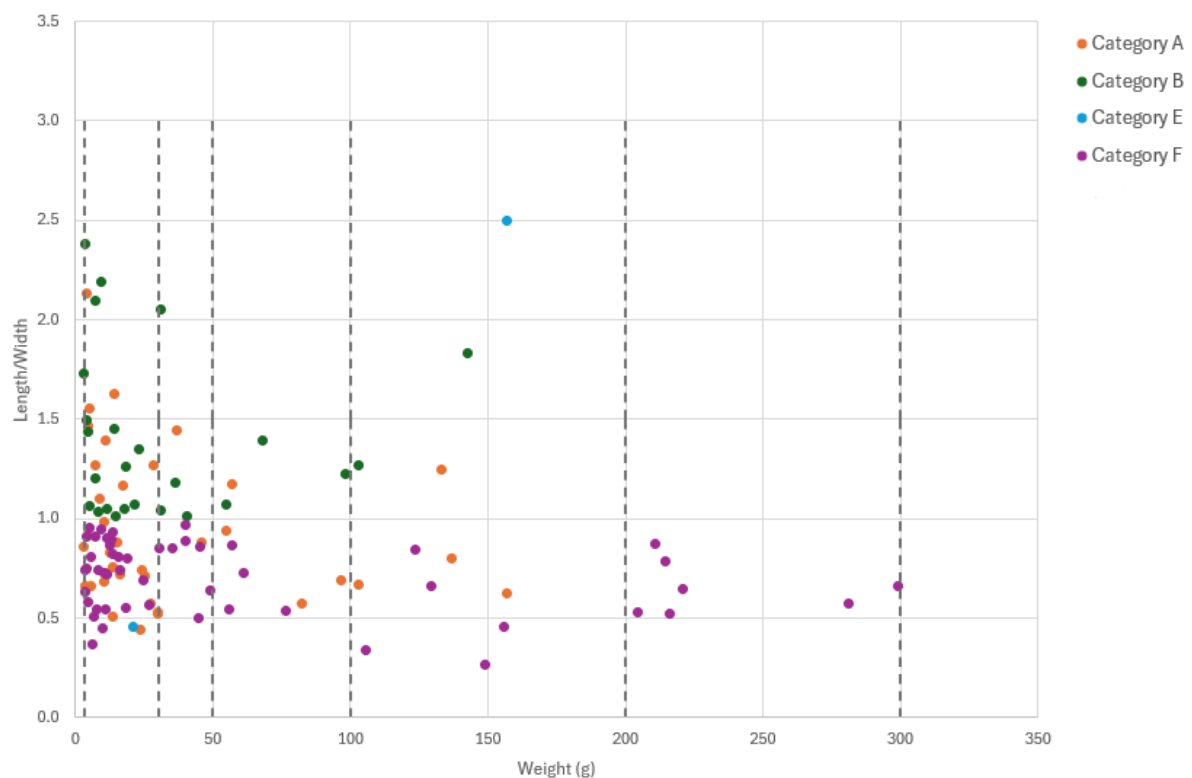


Figure 45: Scatterplot of Mount Bates artefacts by Weight (g) and Length/Width ratio showing the position of the flakes in the four Categories. Vertical dashed lines mark the size class divisions.

No fully cortical flakes were present in either the MBS or Emily Bay assemblages. This suggests a tight correlation in reduction sequencing between the two sites. However, the variability of cortex coverage throughout the manufacturing stages makes interpretations

based on this evidence alone tenuous. The absence of any fully cortical (primary) flakes at the MBS site is notable as it indicates the first removals took place elsewhere. This contrasts to Tahanga where 23% of the flake assemblage contained fully cortical dorsal surfaces. Fully cortical flakes are most frequent at the source of the raw material. The lack of any primary flakes in the MBS assemblage supports interpretation that this location was not a quarry site.

Secondary (partially cortical) flakes constitute 10.4% of the MBS assemblage, with tertiary (non-cortical) flakes dominating at 89.6%. These flakes are clearly not associated with the first removals but tying them to a particular reduction stage must also consider size, shape, and termination. Cortex decreases through the size categories which may suggest a range of manufacturing stages (excluding the first removals). However, experimentation found partially cortical flakes could be produced down to the fine working stage. Similarly, tertiary flakes may also be produced during earlier roughing out activities. Given the evidence from the previous typological categories, we can speculate that the majority of these partially and non-cortical flakes were produced during preform shaping. However, this interpretation is limited by the variability of cortex through the manufacturing sequence. Interpretations based on cortical coverage alone are noted to be problematic and so are treated here with caution. Further data on dorsal scarring would be required to further this interpretation.

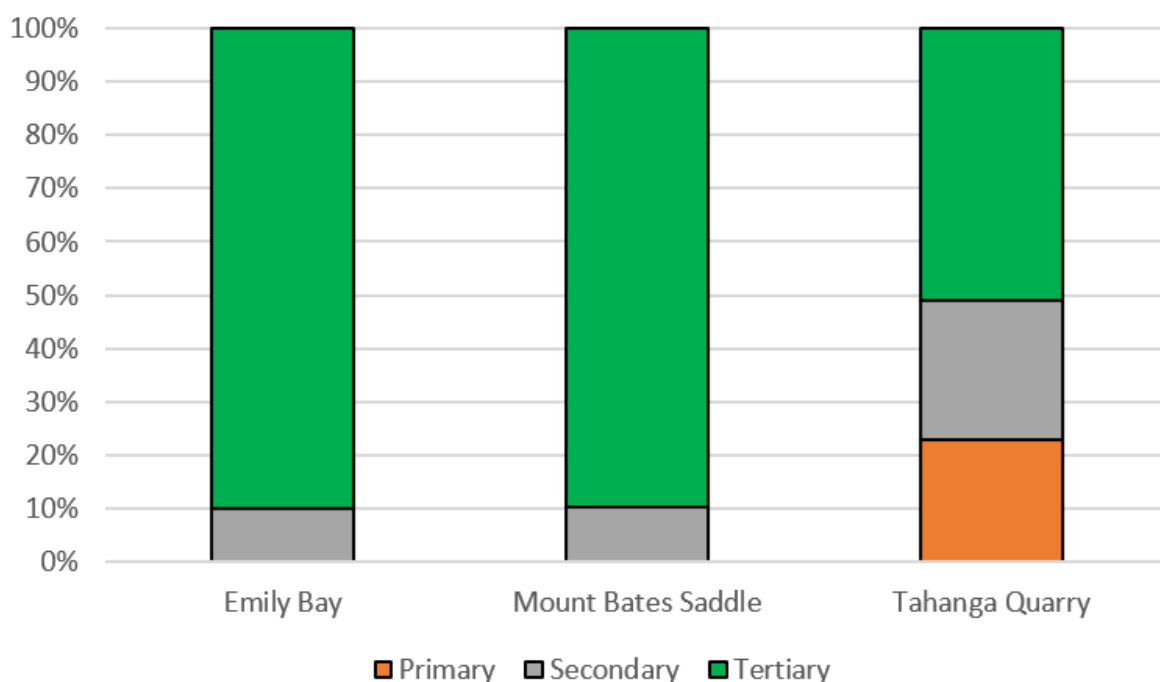


Figure 46: Stages of reduction based on percentage of artefacts with full cortex (primary), some cortex (secondary) and no cortex (tertiary).

Polynesian adze preforms

The total MBS site assemblage included two basalt adze preforms (Figure 47), one recovered from surface level (MBS100) and the other (MBS256) from a depth of

approximately 15 cm below the surface. Following Clarkson, Shipton and Weisler's (2014, 2015) definitions, MBS100 was classified as a rectangular-sectioned adze preform and MBS256 as a micro-adze preform. Both were distinctly Polynesian forms and were a significant factor in the site's interpretation as a Polynesian stone working site.

MBS256 demonstrated several key characteristics of a micro-adze, such as its small size (weighing 178.8g) and unworked front ventral surface. The final form of the micro-adze is more reliant on grinding and an unmodified ventral surface is a relatively common feature (Clarkson, Shipton & Weisler 2014, p. 364). Micro-adzes are typically <300g which places MBS100 in the same category (weighing 178.4g). However, MBS100 features more precise flaking and a distinct expanded blade typical of the rectangular-sectioned form (Clarkson, Shipton & Weisler 2014, p. 364). Given the ventral surface on MBS256, it is assumed that both preforms were produced from flake blanks at the MBS site.

Both preforms appear to be in their almost finished forms, prior to the final stages of grinding, hammer dressing and/or reworking. This late-stage rejection may be related to shaping problems as a series of step and hinge terminations are visible along the sides of the preforms. These terminations would have restricted subsequent removals. The high frequency of Category A flakes correlates to this shaping evidence on the preform sides and together provide a strong argument for preform shaping at the MBS site.

The Emily Bay assemblage contained nine preforms and five adze pieces, all but one of which were broken. These preforms and adzes were most commonly rectangular sectioned but other examples included quadrangular, triangular, and lenticular forms (Turner, Anderson & Fullagar 2001, p. 58, 62). The single complete preform was recorded as triangular-sectioned but like MBS100 falls within the size range typical of a micro-adze (weighing 240g) (Turner, Anderson & Fullagar 2001, p. 62). On site use of adzes at Emily Bay is inferred by reworking on 50% of the fourteen adze and preform pieces. Two adze pieces also demonstrated evidence of expedient use (Turner, Anderson & Fullagar 2001, p. 58, 62). No expedient forms were recovered from the MBS site, and there was no evidence of reworking in the overall assemblage.

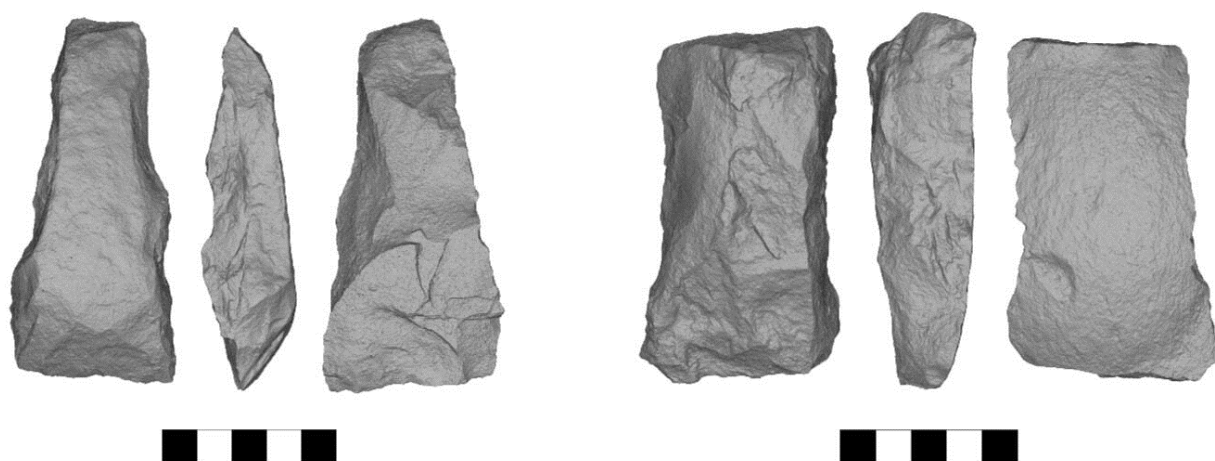


Figure 47: Adze preforms from the Mount Bates Saddle site. Left: MBS100 (rectangular-sectioned adze preform). Right: MBS256 (micro-adze preform). Adapted from 3D modelling by Thomas Peachey and Meagan Warwick.

Geochemical Provenancing

Stone artefacts from the MBS site and private collections

A representative sample of stone artefacts from the MBS assemblage were subject to geochemical analysis. This sample included twenty-three (n=23) flakes and flake fragments, and the two (n=2) adze preforms. A summary of the MBS artefacts subject to this analysis is provided in Table 7 below.

Table 7: MBS assemblage artefacts selected for pXRF analysis.

Artefact ID	Artefact type	Provenance	Measured surface condition
MBS-S 5005	Complete flake	Surface	Weathered (non-cortical)
MBS 279	Flake fragment	Subsurface	Weathered (non-cortical)
MBS 291	Complete flake	Subsurface	Weathered (non-cortical)
MBS-S 5009	Flake fragment	Surface	Weathered (non-cortical)
MBS 288	Flake fragment	Subsurface	Weathered (non-cortical)
MBS 245	Flake fragment	Subsurface	Weathered (non-cortical)
MBS 212	Complete flake	Subsurface	Weathered (non-cortical)
MBS 294	Complete flake	Subsurface	Weathered (non-cortical)
MBS 215	Complete flake	Subsurface	Weathered (non-cortical)
MBS 237	Complete flake	Subsurface	Weathered (non-cortical)
MBS 217	Complete flake	Subsurface	Weathered (non-cortical)
MBS 210	Complete flake	Subsurface	Weathered (non-cortical)
MBS 200	Complete flake	Subsurface	Weathered (non-cortical)
MBS-S 5003	Flake fragment	Surface	Weathered (non-cortical)
MBS-S 5039	Flake fragment	Surface	Weathered (non-cortical)
MBS 100	Rectangular-sectioned adze preform	Surface	Weathered (non-cortical)
MBS 256	Micro-adze preform	Subsurface	Weathered (non-cortical)
MBS-S 5015	Complete flake	Surface	Weathered (non-cortical)
MBS 23	Flake fragment	Surface	Weathered (non-cortical)
MBS 68	Flake fragment	Surface	Weathered (non-cortical)
MBS 14	Complete flake	Surface	Weathered (non-cortical)
MBS 204	Flake fragment	Subsurface	Weathered (non-cortical)
MBS 202	Complete flake	Subsurface	Weathered (non-cortical)
MBS 226	Flake fragment	Subsurface	Weathered (non-cortical)

Artefact ID	Artefact type	Provenance	Measured surface condition
MBS 233	Complete flake	Subsurface	Weathered (non-cortical)

A number of private collection artefacts were also incorporated into the geochemical analysis. Although lacking the contextual information of *in situ* finds like from the MBS site, these artefacts may provide insight on locations of further sites or potential external connections prior to European arrival. Locally collected artefacts are important to consider but their limitations must be noted. Primarily, it cannot be said for certain that these artefacts originated from a pre-European context or were anything but the result of historical souveniring. “Souveniired” artefacts can provide certain valuable information, particularly in relation to indigenous agency at the time of European contact and evolving relationships to stone objects over time (see Richards & Gunther 2019). However, exploring these concepts is beyond the scope of this thesis.

Due to the limitations on data retrieved from out of context surface collected artefacts, as well as time constraints at the time of analysis, these artefacts were not catalogued in detail. Brief information on these artefacts is provided in Table 8 below. The private collection artefacts listed here represent only a sample of what is available (see Figure 48). It is estimated that hundreds of artefacts exist in multiple local private collections.

*Table 8: Private collection artefacts selected for pXRF analysis. *Note those artefacts marked ‘Kingston area’ are the presumed findspots – the exact findspot information is unknown.*

Artefact ID	Artefact type	Collection	Findspot location	Findspot setting	Context	Measured surface condition
AE-01	Possible adze	Arthur (Onion) Evans	Emily Bay	Coastal	Surface	Weathered (non-cortical), heavily water-rolled, possibly polished
SB 5.186	Broken adze (chisel?) section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), heavily water-rolled
UN ID 1	Adze	Troy Irvine	Slaughter Bay	Coastal	Surface	Polished, weathered (non-cortical), heavily water-rolled
UN ID 2	Complete flake	Troy Irvine	Emily Bay	Coastal	Surface	Weathered (non-cortical), heavily water-rolled
SB 5. 111	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 2.38	Flake fragment	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
TC 6	Broken adze preform section	Troy Irvine	Kingston area*	Assumed coastal	Surface	Weathered (non-cortical), possibly water-rolled
TC 21	Possible core	Troy Irvine	Kingston area*	Assumed coastal	Surface	Weathered (non-cortical), heavily water-rolled

Artefact ID	Artefact type	Collection	Findspot location	Findspot setting	Context	Measured surface condition
SB 0.09	Possible pounder handle	Troy Irvine	Slaughter Bay	Coastal	Surface	Polished, weathered (non-cortical), heavily water-rolled
SB 2.137	Complete flake	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), possibly water-rolled
SB 2.45	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), heavily water-rolled
SB 2.83	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), possibly water-rolled
SB 2.107	Flake fragment	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), possibly water-rolled
SB 2.138	Flake fragment	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
TC 7	Flake fragment	Troy Irvine	Kingston area*	Assumed coastal	Surface	Weathered (non-cortical), heavily water-rolled
SB 2.200	Complete flake	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 2.142	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 1.79	Adze preform	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), minor water-rolling
SB 2.178	Broken adze (chisel?) preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 2.40	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 2.50	Complete flake	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), minor water-rolling
SB 2.51	Retouched flake	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), minor water-rolling
SB 5.37	Broken adze (chisel?) preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Polished, weathered (non-cortical), water-rolled
SB 5.95	Broken adze preform section	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
EB 1.06	Flake fragment	Troy Irvine	Emily Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
UN ID 3	Broken cylindrical adze section	Troy Irvine	Headstone	Interior	Surface	Polished. Patches of surficial iron oxidation.

Artefact ID	Artefact type	Collection	Findspot location	Findspot setting	Context	Measured surface condition
SB 2.191	Possible hammerstone	Troy Irvine	Slaughter Bay	Coastal	Surface	Weathered (cortical)
ST-01	Subtriangular-sectioned adze	Neil (Snowy) Tavener	Powder Valley	Interior	Subsurface	Polished. Some surface abrasion and mineralisation.
JE-01	Rectangular-sectioned micro-adze	Jane Evans	Cemetery Bay	Coastal	Surface	Polished.
SB 21 M	Broken adze preform section	Damien (Derms) Snell	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled
SB 15	Complete flake	Damien (Derms) Snell	Slaughter Bay	Coastal	Surface	Weathered (non-cortical), water-rolled



Figure 48: Example of the size of one local collection. What is shown is only a sample of this single collection. Photograph by N. Jorgensen.

A total of fifty-six ($n=56$) artefacts were analysed with the pXRF instrument and compared to several geological source samples (see below section). Twenty-five ($n=25$) of these artefacts were excavated at the MBS site and thirty-one ($n=31$) originated from private collections. Their approximate findspot locations are shown in Figure 49 below.

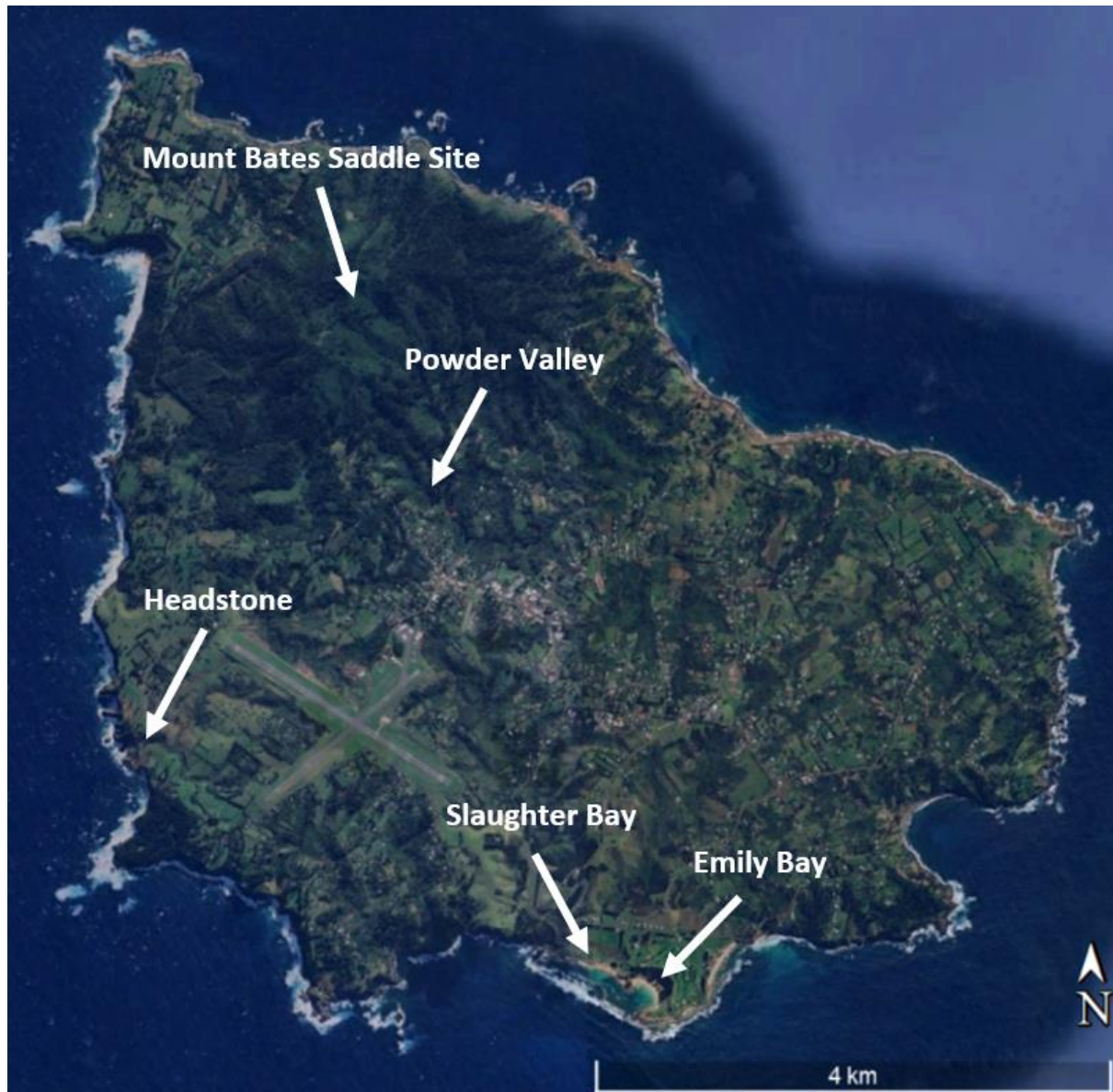


Figure 49: Findspot locations of artefacts subject to pXRF analysis. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.

Comparative source datasets

A Norfolk Island source dataset was compiled using seventy-nine subaerial geological samples ($n=79$) and seven ($n=7$) artefacts from the Emily Bay excavation which were previously provenanced to Norfolk Island (Anderson et al. 1997). An additional eight ($n=8$) samples from Phillip Island were also included. This dataset included measurements taken with the Bruker Tracer 5i pXRF as part of the Phase 2 fieldwork, and measurements from

previous studies (both published and unpublished). Further details on this dataset are provided in Table 9, and Appendix IV.

Table 9: Norfolk Island geological source samples.

Data Source	Sample Location
PXRF measurements taken with Bruker Tracer 5i	Palm Glen (n=1)
	Cockpit (n=2)
	Anson Bay (n=3)
	Phillip Island (n=2)
	Mount Bates (n=2)
	Bumboras (n=1)
	Ball Bay (n=4)
	Slaughter Bay (n=1)
	Cascade Beach (n=2)
	Music Valley (n=2)
	Cemetery Bay (n=1)
XRF measurements provided by Queensland University of Technology (QUT)	Mount Bates (n=1)
	Slaughter Bay (n=1)
XRF measurements provided by Oliver Nebel (unpublished data)	Norfolk Island (various unspecified locations) (n=39)
	Phillip Island (various unspecified locations) (n=4)
XRF measurements published by Green (1973)	Steels Point (n=4)
	Duncombe Bay (n=1)
	Cascade (n=7)
	Ball Bay (n=3)
	Internal property (exact location unknown) (n=1)
	Phillip Island (n=2)
XRF measurements published by Anderson et al. (1997)	Ball Bay (n=3)
	Emily Bay (excavated artefacts) (n=7)
Total number of geological samples	n=94

Geological samples were also included from New Zealand, the Kermadec Islands and Pitcairn Island to identify if material from these locations was present. Norfolk Island's potential pre-European connections with New Zealand and/or the Kermadec Islands have been discussed previously (Anderson and White 2001b; Anderson et al. 1997; Chapter 4). Samples from these locations were included to explore these potential connections. Pre-European contact with Pitcairn Island is considered a highly unlikely scenario. However, many contemporary Norfolk Islanders have ancestral connections with Pitcairn and local collections often include stone artefacts collected there. Geological samples from Pitcairn were included as a means to identify and exclude any of this material.

Several New Caledonian samples were initially included in this dataset to test the potential for a Melanesian connection. Melanesian contact prior to European arrival is not an impossibility given New Caledonia's proximity, and local finds resembling Melanesian forms. However, there are very few basalts on New Caledonia and their geochemical characterisation is essentially non-existent. The 12 samples initially included likely represent a very limited sample of the local geology. As a continental island New Caledonian basalts are likely to be highly variable and it is unlikely that these samples would be characteristic. The values were also obtained using ICP-MS methods which poses issues for cross-method

data comparisons, particularly given the low accuracy of the pXRF instrument. Due to these factors and the lack of any meaningful statistical correlations in bivariate plotting, the New Caledonian samples were subsequently excluded. The ICP-MS data for these samples is included in Appendix IV for reference.

The geological samples from New Zealand, the Kermadec Islands and Pitcairn Island were sourced from the open access GEOROC (Geochemistry of Rocks of the Oceans and Continents) database (<https://georoc.eu/>, accessed November 2023), filtered by XRF methods and comparable rock types. The New Caledonian data was sourced from a publication by Cluzel, Aitchison and Picard (2001). A summary of these geological samples can be found below.

*Table 10: Non-local geological source samples. *Note that the New Caledonia samples are listed here for reference but are not included in the following data analysis results. Cluzel, Aitchison and Picard's (2001) ICP-MS dataset is provided in Appendix IV.*

Sample Location	Number	Data Source
New Zealand	821	GEOROC Database
Kermadec Islands	217	GEOROC Database
Pitcairn Island	31	GEOROC Database
New Caledonia*	12	Cluzel, Aitchison and Picard (2001)

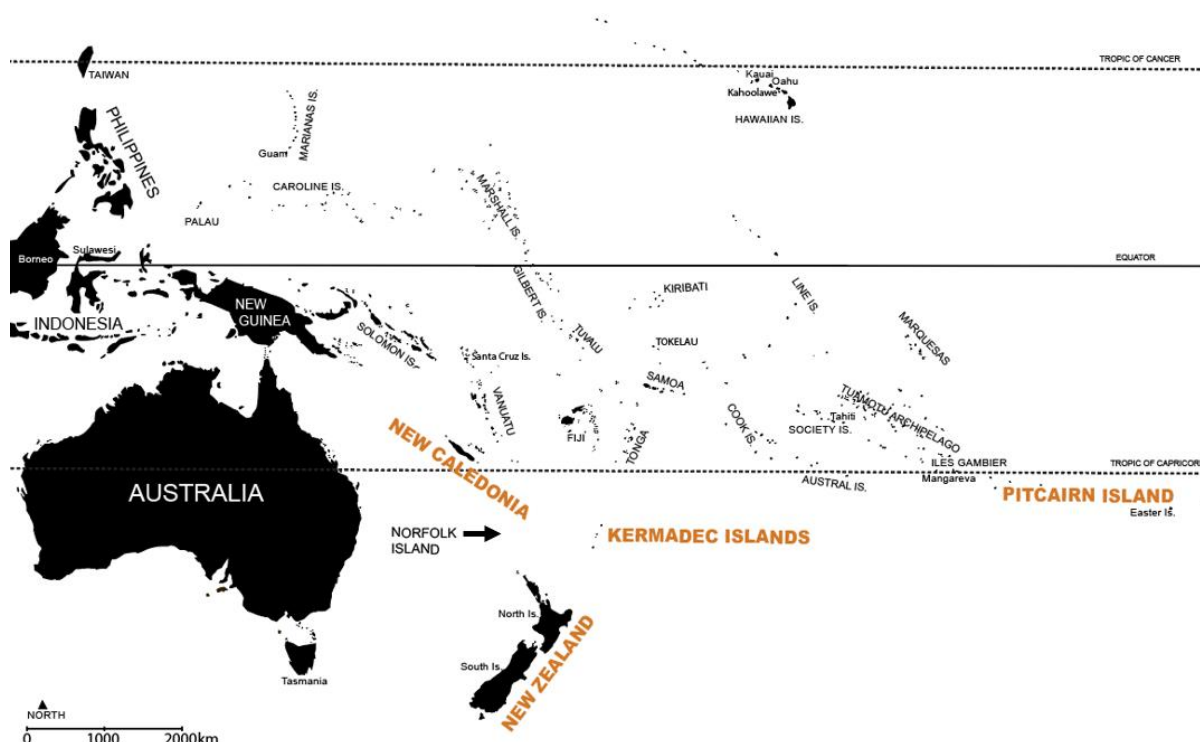


Figure 50: Locations of comparative source datasets. Note that New Caledonia was later excluded and is not discussed in the following data analysis results. Adapted with permission from basemap produced by Dr James Flexner.

Discrimination of volcanic rock types

The Pearce W-F diagrams below (Figure 51 and Figure 52) plot the MBS and private collection artefacts in isolation and with a sample of the Norfolk Island source group. The

Green (1973) and QUT data had to be excluded from the Figure 52 diagram due to a lack of Nb values.

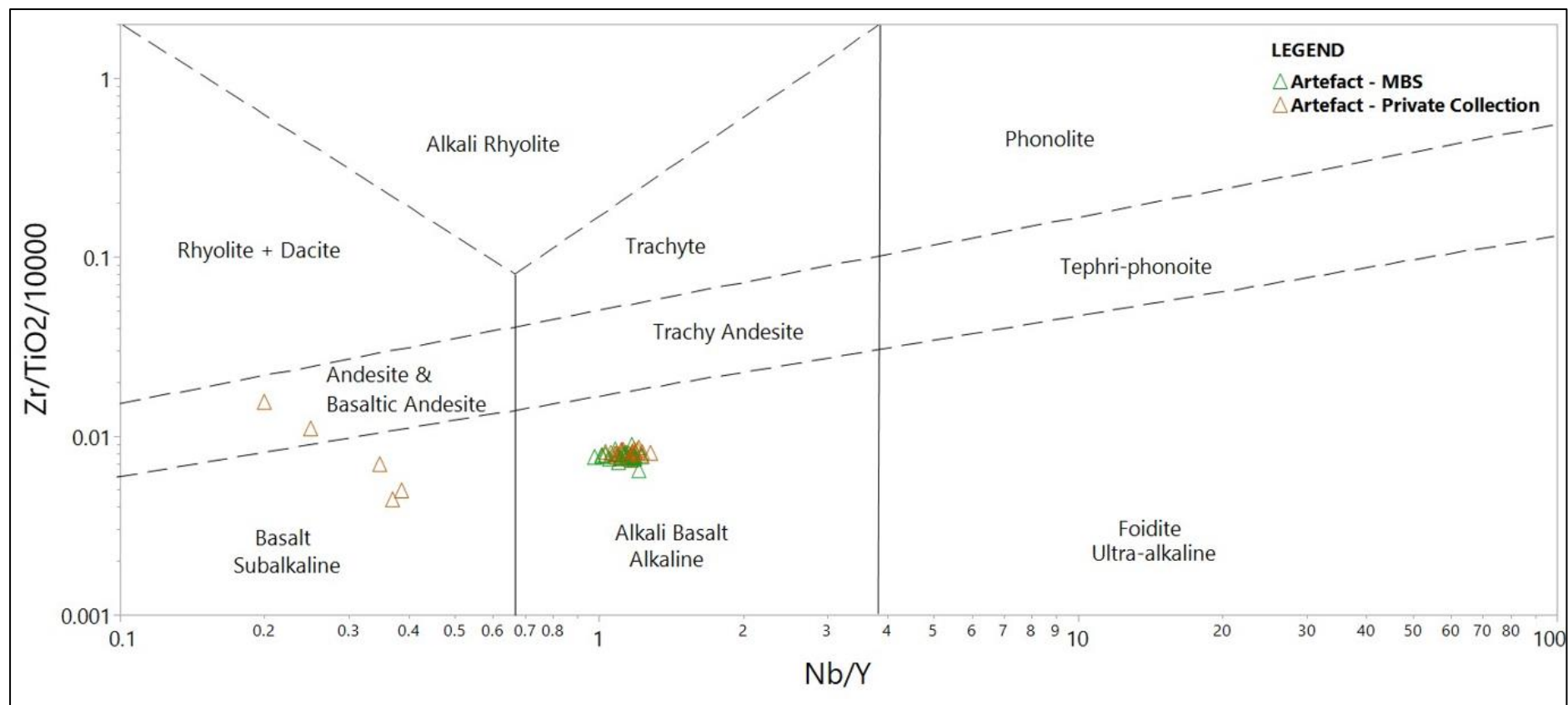


Figure 51: Pearce W-F diagram – artefacts only. Adapted from Richards 2019, p. 33.

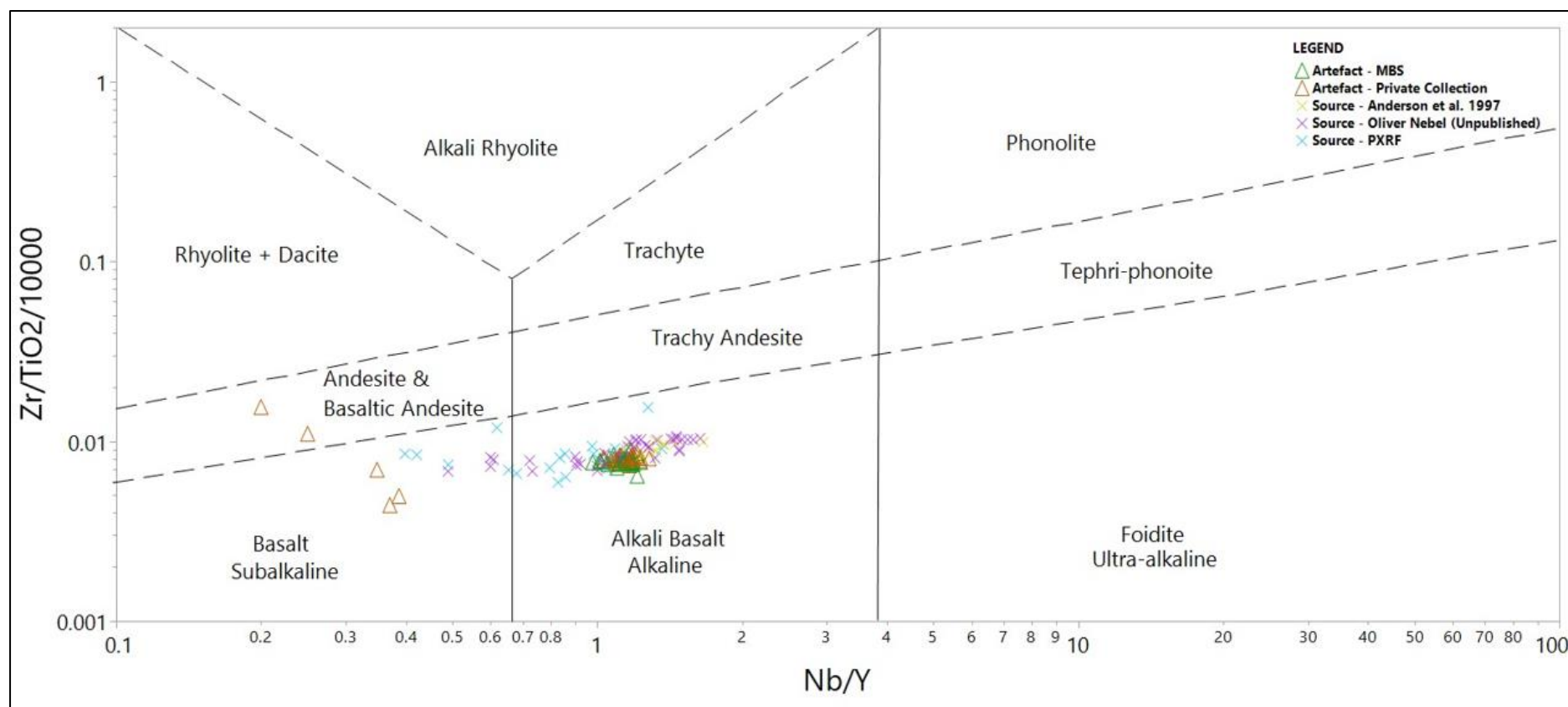


Figure 52: Pearce W-F diagram – artefacts and Norfolk Island geological samples. Adapted from Richards 2019, p. 33.

Both the artefacts and the geological samples fall mainly within the basalt and alkali basalt ranges. The Phillip Island material did not show any marked separation from the Norfolk Island samples. This is consistent with the findings of previous geological studies on Norfolk Island which found relative chemical consistency across the island's geology (Green 1973; Jones & McDougall 1973; Chapter 4). Figure 51 demonstrates that all of the MBS artefacts group tightly by rock type in the alkali basalt range. This is consistent with the majority of the local geological samples (Figure 52). These results support interpretation that the MBS artefacts were manufactured on local basalt. The geochemical results also correspond to the field observation that the MBS assemblage appears to be a single consistent lithology.

The majority of the private collection artefacts (n= 26, 84%) group similarly by rock type with the MBS artefacts and the Norfolk Island samples. However, the remaining five (n=5) artefacts appear distinctively separate (Figure 51). These artefacts (SB 0.09, UN ID 3, SB 2.191, ST-01 and SB 15; Figure 57 to Figure 61) instead span the 'basalt' (n=3) and 'andesite & basaltic andesite' (n=2) ranges. The Pearce W-F diagram alone is not enough to confirm this marks the presence of foreign material. The separation of these rock types may simply be the result of the inherent variation within the local geology, and it is noted that the number of geological samples is limited. Figure 52 shows that the Norfolk Island source material extends into the basalt range and Norfolk Island basalts are known to feature some grading into tholeiitic andesites (Green 1973). These outlier artefacts are discussed in greater detail below.

Source matches

Source matching for the 56 artefacts employed a number of bivariate plots utilising trace element ratios (Figure 53 to Figure 56, and Figure 62 to Figure 65). Plots using Nb values excluded the Green (1973) and QUT sample data as they did not report Nb.

Norfolk Island provenance

Compared first to the Norfolk Island source samples (Figure 53 to Figure 56), most artefacts appear to correspond to a local source. All of the MBS artefacts group tightly with the Norfolk Island material, as do the same 26 private collection artefacts that plotted together in the Pearce W-F diagram. The grouping of the MBS artefacts with the Norfolk Island samples supports their manufacture on local material and corresponds to the discriminations in the Pearce W-F diagram. The consistent close grouping of these artefacts across the bivariate plots also supports manufacture on a single lithology, most likely from a single source.

These 26 private collection artefacts included: five (n=5) complete flakes, five (n=5) flake fragments, one (n=1) possible core, three (n=3) complete adzes, one (n=1) complete adze preform, and eleven (n=11) broken sections of either adzes or adze preforms. The majority of these objects were collected on Slaughter Bay (n=19), with the remaining findspots being Emily Bay (n=3), Cemetery Bay (n=1) and unknown locations tentatively assigned to the

Kingston area (n=3). These findspots along the Kingston coastline surround the Emily Bay settlement site (Figure 49). The Emily Bay findings indicated a heavy focus on local adze manufacture, utilising local basalt from an unknown source. The local provenancing for these 26 artefacts in conjunction with their findspot locations is likely evidence of further Polynesian adze manufacturing in the Kingston area, beyond the current recorded extent of the Emily Bay settlement site.

As can be seen in the following plots, the remaining five private collection artefacts (SB 0.09, UN ID 3, SB 2.191, ST-01 and SB 15) appear to separate to varying degrees from the main Norfolk Island group. These artefacts are discussed further in the following section.

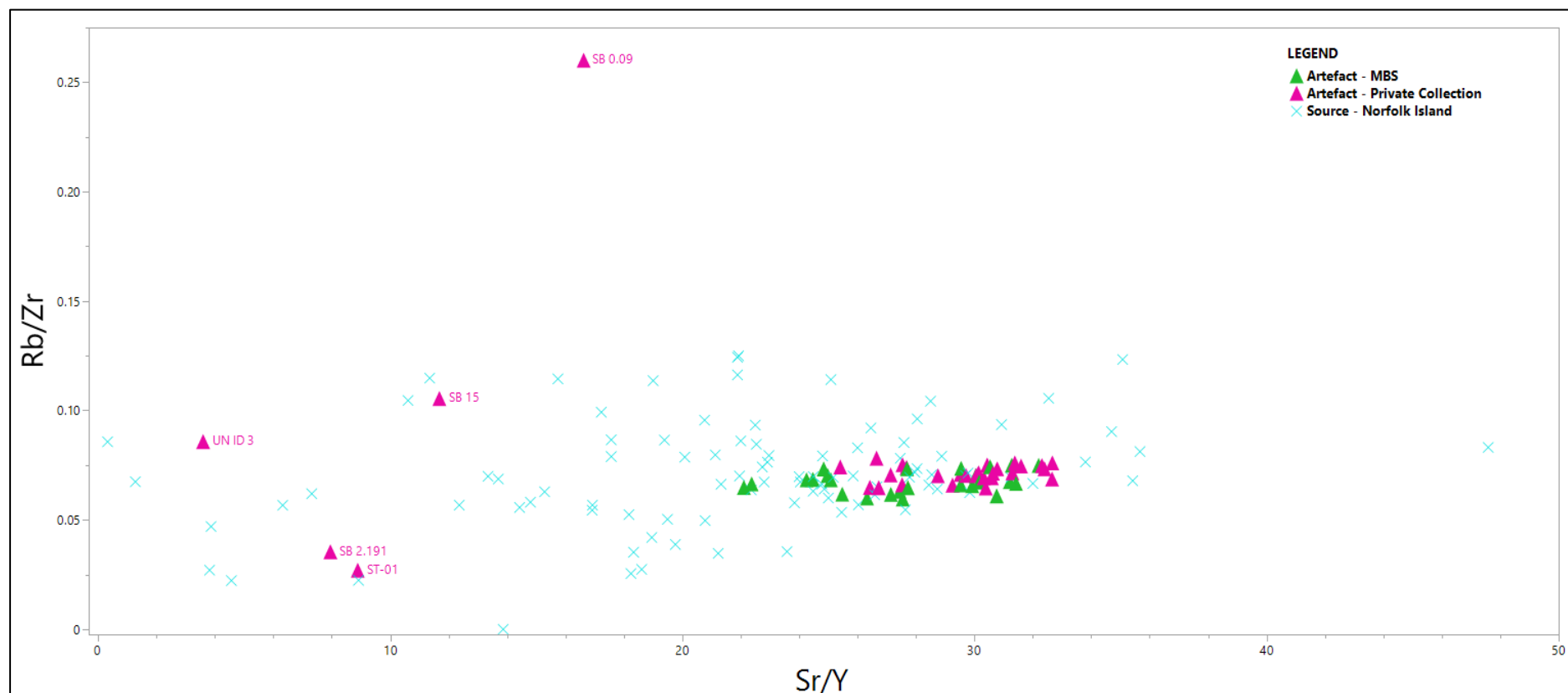


Figure 53: Bivariate plot (Rb/Zr , Sr/Y) of MBS and private collection artefacts with Norfolk Island geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

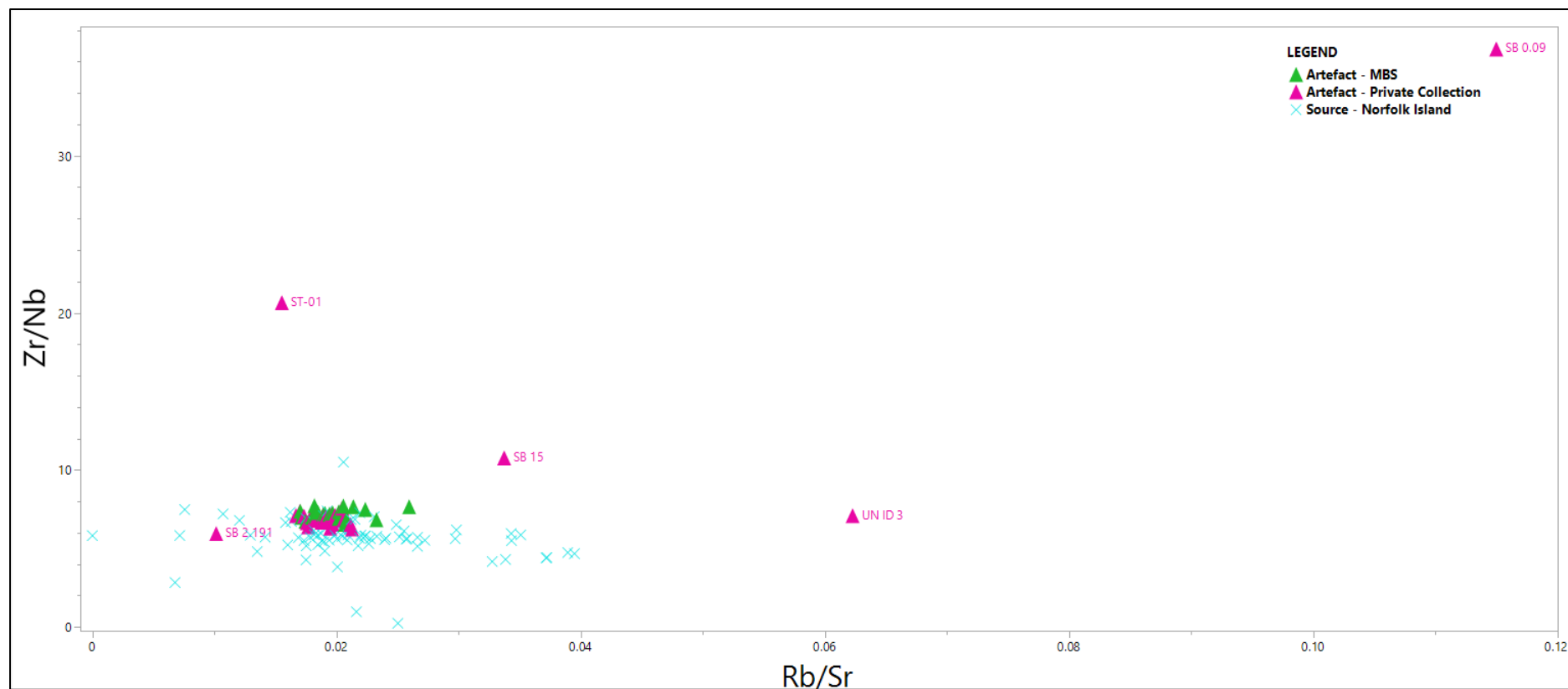


Figure 54: Bivariate plot (Zr/Nb, Rb/Sr) of MBS and private collection artefacts with Norfolk Island geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

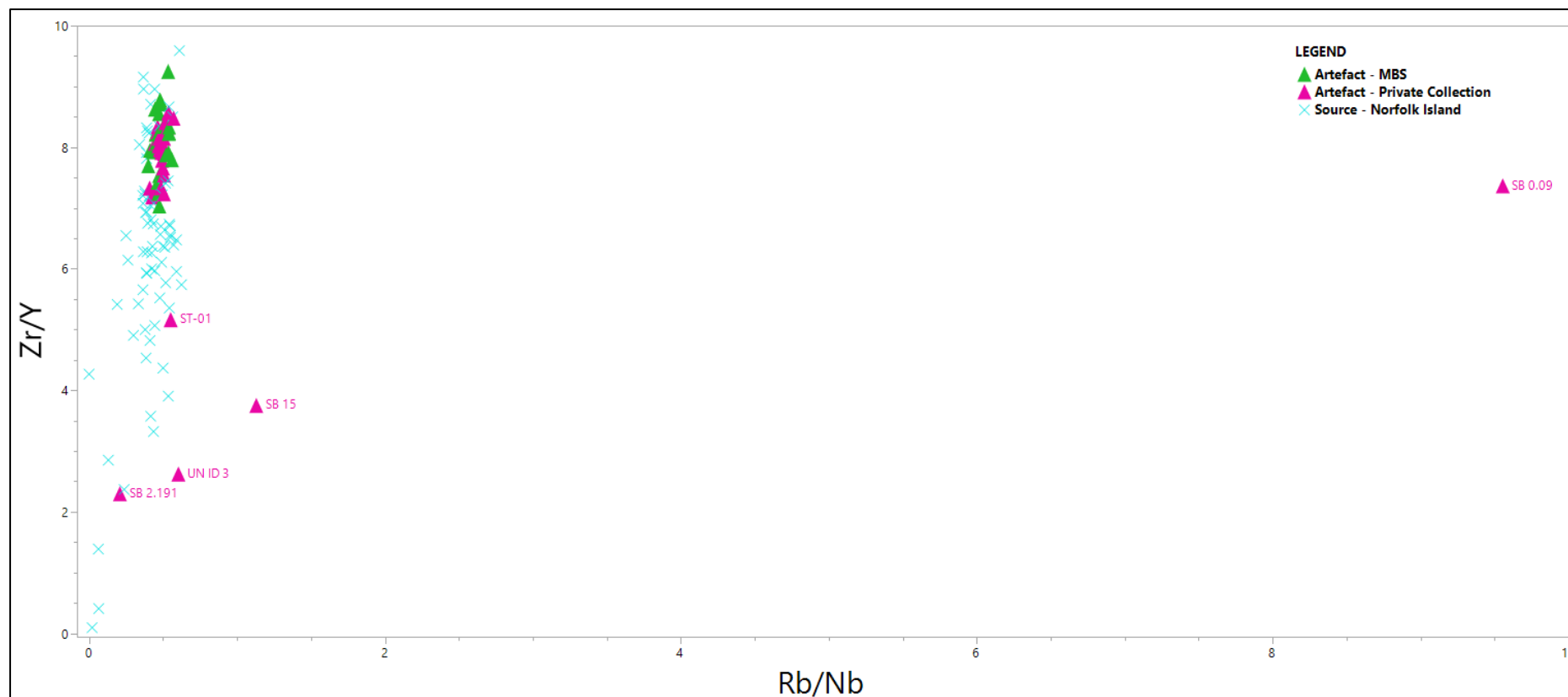


Figure 55: Bivariate plot (Zr/Y, Rb/Nb) of MBS and private collection artefacts with Norfolk Island geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

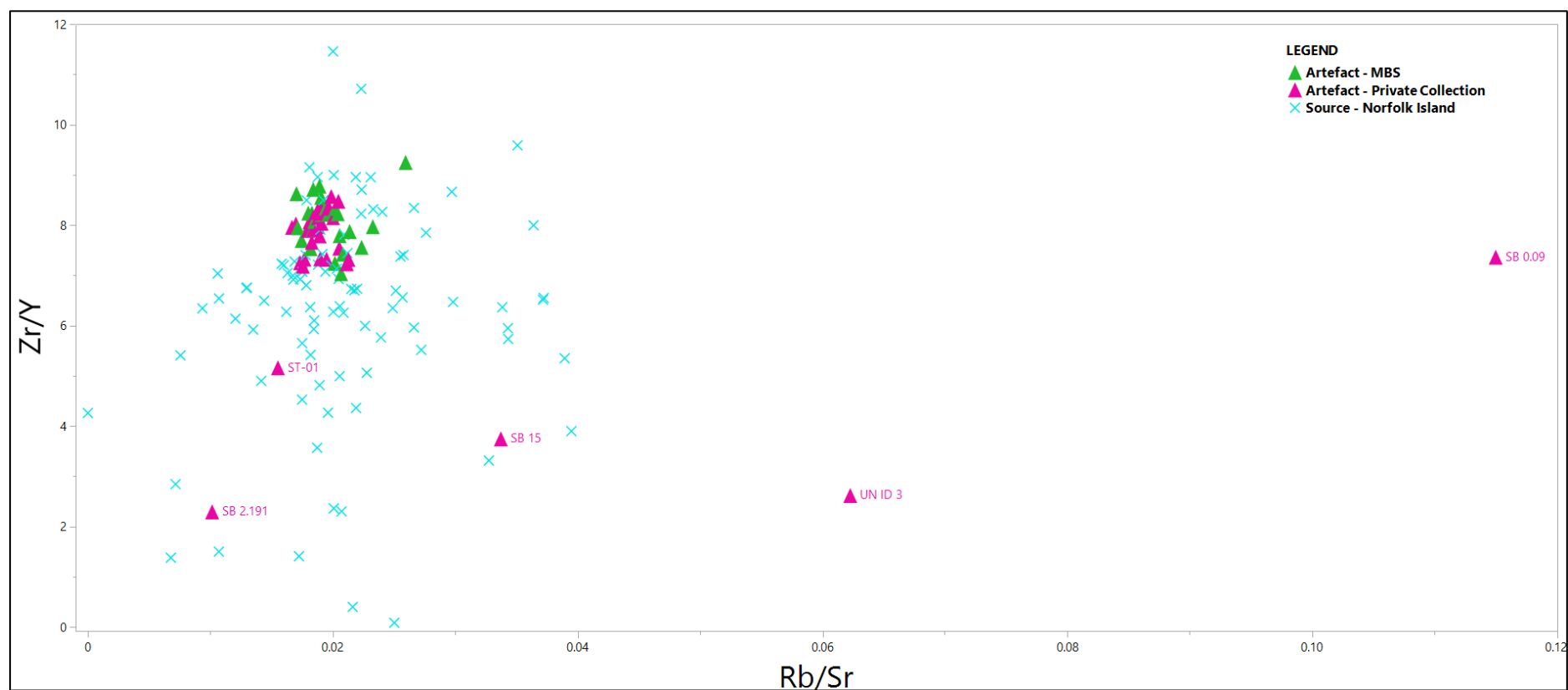


Figure 56: Bivariate plot (Zr/Y , Rb/Sr) of MBS and private collection artefacts with Norfolk Island geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

Possible non-local provenance

Five artefacts from a single private collection (Troy Irvine) show potential for a non-local provenance. To investigate this possibility the same bivariate plots were rerun including the geological samples from New Zealand, the Kermadec Islands and Pitcairn Island. As noted above, no meaningful conclusions could be drawn from the New Caledonian data and therefore it was excluded. Results are provided in Figure 62 to Figure 65 below.

SB 0.09 (Figure 57) is distinctively and consistently separated from the Norfolk Island source samples. There is a suggestive overlap with New Zealand but no definitive correlation. These results suggest SB 0.09 may not be associated with the Polynesian occupation. Further investigation of a possible New Zealand connection is warranted but there is a current lack of distinct correlation with this data. Further complexity is added by the nature of the object, most likely a broken pounder handle. Numerous pounders resembling SB 0.09 have been found on both Tahiti and Pitcairn Island (Richards 2021, p. 92). Given the *HMS Bounty* mutineers settled with Tahitians on Pitcairn prior to their relocation to Norfolk Island in 1856, SB 0.09 may have arrived with these settlers or in the decades following. To test the possibility of a Tahitian origin, additional plots were run including 13 Tahitian samples sourced from the GEOROC database. No overlap was found with these geological samples which may indicate an alternative provenance or simply limited sample data.

SB 0.09 may have also been brought to the island by a settler or visitor at any point from the first British settlement in 1788. The polished surfaces suggest that the handle was broken from a complete pounder, possibly after its arrival on Norfolk Island. The data ultimately indicates that SB 0.09 was likely manufactured on foreign material and brought to Norfolk Island. It's connection to the Polynesian settlers however remains tenuous.



Figure 57: SB 0.09 – possible pounder handle. Photograph by N. Jorgensen.

UN ID 3 (Figure 58) tentatively associates with geological samples from both New Zealand and the Kermadec Islands. Although Figure 63 shows an overlap with material from Pitcairn Island, the more common association appears to be New Zealand or the Kermadecs. Visually this object immediately appears separate to the Norfolk Island basalts. UN ID 3 contains a distinct green colouration that is not present in the local geology. From the geochemical data it is difficult to assign a provenance for this object. However, it can be said that UN ID 3 was not manufactured on local material.

The findspot location may be a clue to determining how this object ended up on Norfolk Island. UN ID 3 is one of the few artefacts not collected from the Kingston area. Instead this object was found at Headstone, inland from the coastal cliffs in the south-west (Figure 49). This findspot is in close vicinity of the Melanesian Mission which operated between 1866-1920 and was previously based at Mission Bay in the New Zealand North Island. It is possible that UN ID 3 was brought to the island by a student or other person associated with this mission, including visitors. Association with the Melanesian Mission creates a much larger possible source area for this object. This may explain why no direct correlation was found for UN ID 3. As with SB 0.09, connecting this object to the Polynesian settlement with the current data is dubious. However, the possible overlap with the New Zealand and Kermadec samples would benefit from further investigation.



Figure 58: UN ID 3 – broken cylindrical adze section. Photograph by N. Jorgensen.

The provenance for the remaining three private collection artefacts (ST-01, SB 2.191 and SB 15) is more difficult to interpret. ST-01 (Figure 59) falls mainly within the fringes of the Kermadec and Norfolk Island samples, but also has some overlap with New Zealand. ST-01 contains a very slight greenish hue which may suggest a non-local origin. However, the possibility of manufacture on local basalt cannot be completely ruled out.

If this adze was imported, its complete polished form makes historical souveniring a feasible avenue. However, this interpretation is complicated by the findspot. ST-01 is the only private collection artefact in this study that was retrieved from a subsurface context. Turned up during agricultural earth-moving in Powder Valley (Figure 49), ST-01 may be a marker of extended Polynesian activity. Based on a single artefact and limited geochemical data however this interpretation is shaky. Further analyses of ST-01 and local geological samples, as well as retrieval of additional material from this location, would be required to inform this hypothesis.



Figure 59: ST-01 – subtriangular-sectioned adze. Photograph by N. Jorgensen.

The provenance of SB 15 (Figure 60) is equally unclear from the geochemical plots. Of the geological samples there appears to be more overlap with New Zealand but Figure 62 suggests possible association with the Kermadecs or even the Norfolk Island fringe. The nature of this artefact (complete flake with no clear visual markers of a non-local material) and findspot location (Slaughter Bay) suggest that it was associated with the nearby Polynesian settlement. It is unlikely that this more unassuming artefact would have been transported as a souvenir. The amount of local basalt working at the Emily Bay settlement site points more towards a local provenance for SB 15. However, an external provenance cannot be ruled out. Further analyses of SB 15 and investigation of the potential New Zealand or Kermadec connection is warranted. If this material is determined to be foreign this may indicate local manufacture on non-local material, in turn suggesting a potential external connection for the Polynesian settlers.



Figure 60: SB 15 – complete flake. Photograph by N. Jorgensen.

SB 2.191 (Figure 61) again plots in tentative association with the Norfolk Island and Kermadec samples. However, a meaningful correlation is difficult to establish from these results. The separation of SB 2.191 is considered more likely the result of interference from the material matrix. Although the instrument precision and wt% totals were considered sufficient for this object's measurements, the stone was mottled with siliceous inclusions and abundant small feldspar phenocrysts. The object (a possible hammerstone) was also largely if not completely cortical which immediately presents weathered irregular surfaces. The weathering effect is demonstrated by SB 2.191's high SiO_2 content, higher than all other measured artefacts.

Although the mid-z range elements were selected for their lower mobility in response to weathering, their measured values were significantly lower than other artefacts in this dataset. The combined non-optimal sample characteristics may explain the low trace values and the resulting separation of SB 2.191. Although a local origin is most likely, the current data is insufficient to determine a provenance for this artefact. Higher powered, and possibly destructive, techniques would be required to extract meaningful geochemical data from an object such as this.



Figure 61: SB 2.191 – possible hammerstone. The in-photo label is noted to display an incorrect ID number. Photograph by N. Jorgensen.

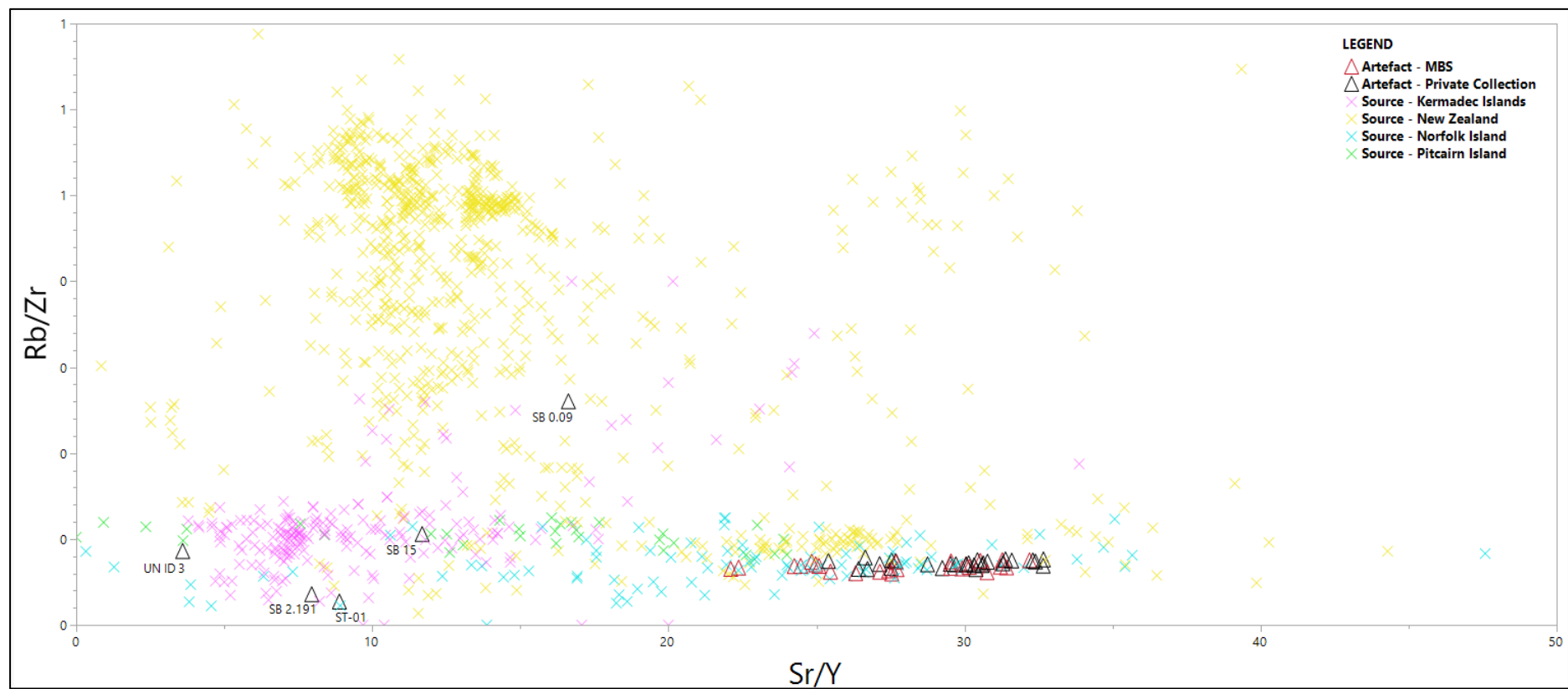


Figure 62: Bivariate plot (Rb/Zr, Sr/Y) of MBS and private collection artefacts with geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

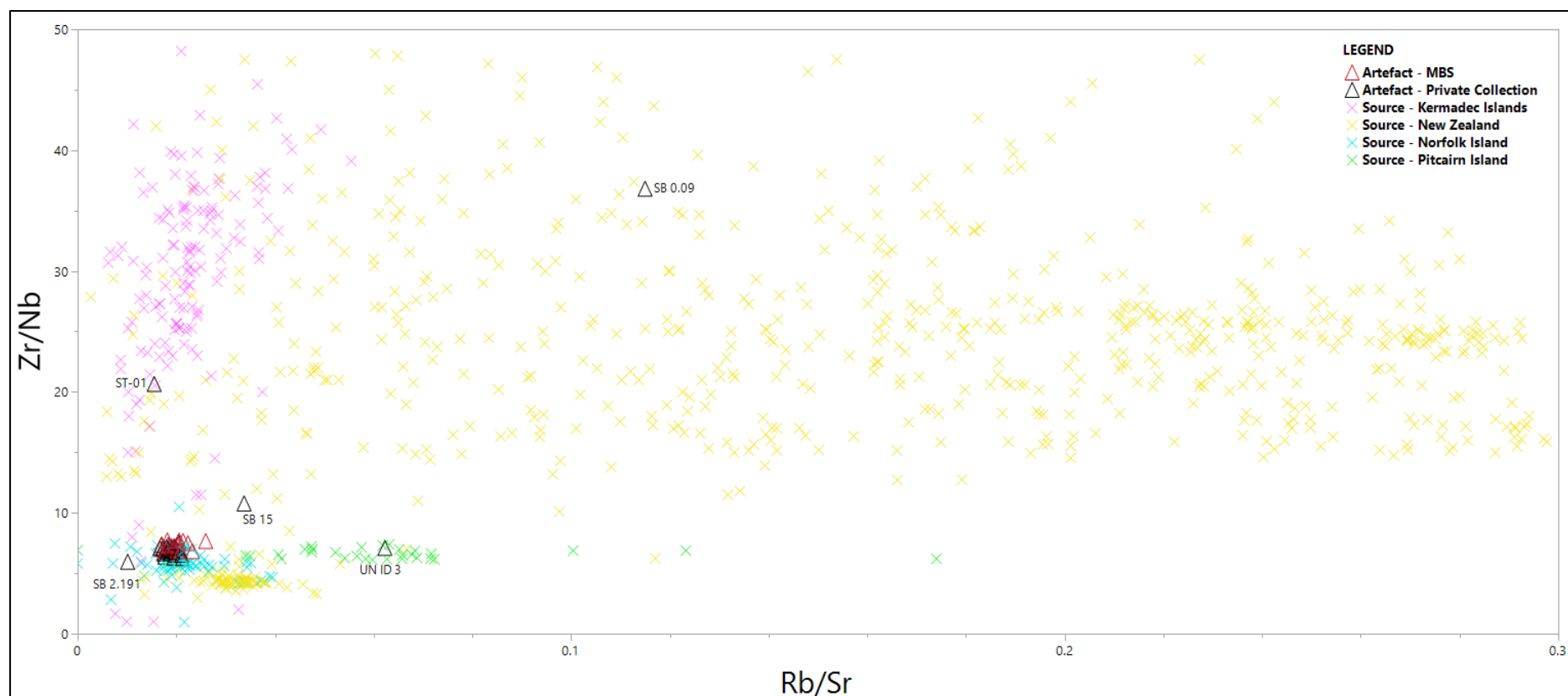


Figure 63: Bivariate plot (Zr/Nb, Rb/Sr) of MBS and private collection artefacts with geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

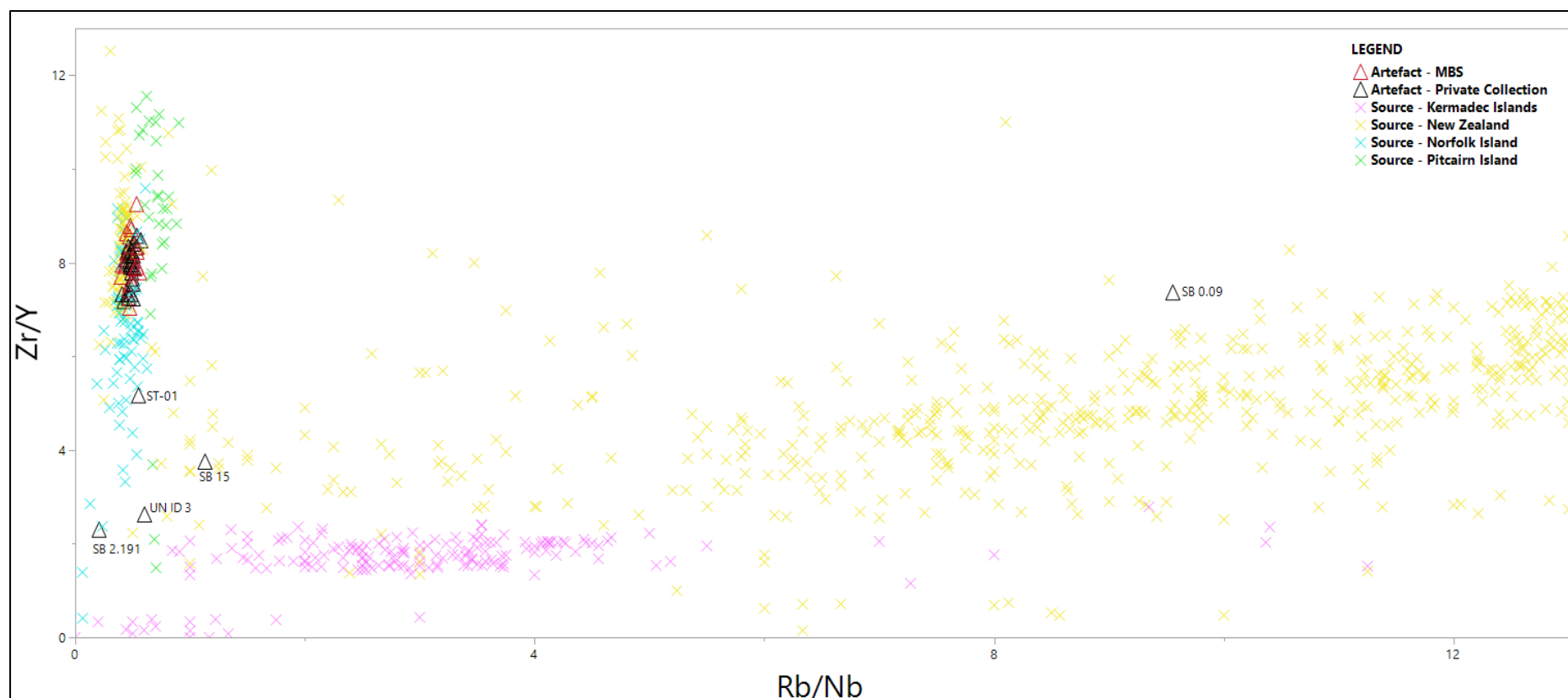


Figure 64: Bivariate plot (Zr/Y, Rb/Nb) of MBS and private collection artefacts with geological samples. Note that Green (1973) and QUT data has been excluded due to lack of Nb values. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

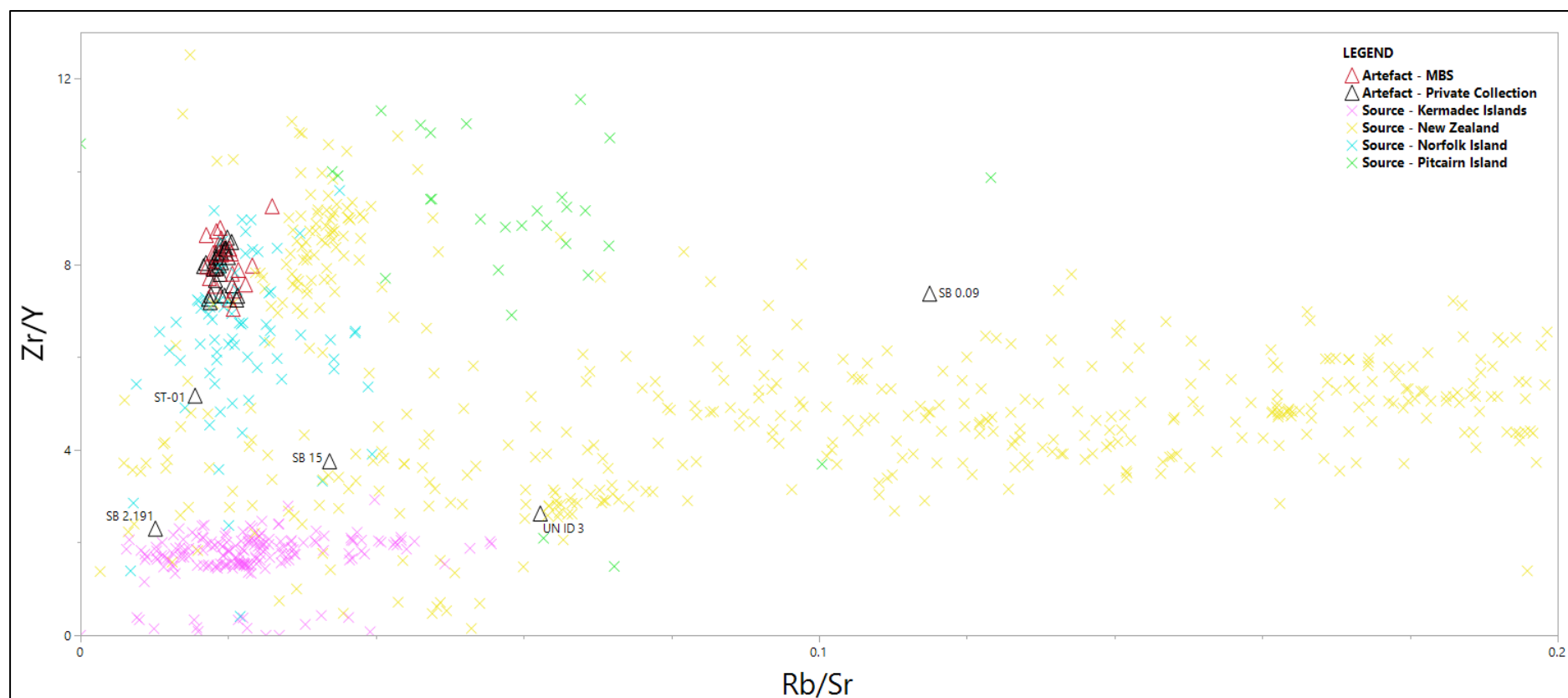


Figure 65: Bivariate plot (Zr/Y , Rb/Sr) of MBS and private collection artefacts with geological samples. SB 0.09, UN ID 3, ST-01, SB 15 and SB 2.191 labelled.

Summary of Results

The results of fieldwork, typological analysis and geochemical provenancing presented in this thesis expand upon previous evidence of Polynesian occupation on Norfolk Island c. 600-700 BP. There remains a possibility for imported artefacts associated with the Polynesian settlement to be present within private collections. However, these results more clearly demonstrate the presence of adze manufacture on local basalt. Although only a sample of the MBS site assemblage was subject to geochemical analysis, the nature and location of the site implies that the local provenancing applies to the total assemblage. These results are discussed further in the following chapter.

Chapter 9: Discussion and Conclusions

Additional Evidence of Polynesian Occupation on Norfolk Island

The MBS site provides concrete evidence of expanded Polynesian occupation on Norfolk Island around the 13th-14th centuries CE (see also Jorgensen, Way & Flexner 2024). The nature of the lithic assemblage indicates that this location was an off-quarry Polynesian stone adze manufacturing workshop. The site is currently defined as the extent of the visible surface expression recorded in May 2021 (c. 56 m x 6 m). However, given the limitations in visibility beyond the ground exposure, and the density of lithic material in the 1 m x 1 m test pit, it is possible that the MBS site extends beyond these boundaries. Further excavations would be required to test the actual extent of the site.

The information obtained to date through survey and excavation provides a characteristic but not exhaustive example of the site's formation. It is assumed that the stratigraphic profile from the 1 m x 1 m test pit applies generally to the full site but given the slope gradient (12.5:1 incline ratio) and nature of the landform there are likely some fluctuations in layer depths and interfaces across the site. Test excavation found that Layer II represents the pre-European cultural layer, commencing at a variable depth between 1-11 cm below the ground surface. Stone artefacts have remained relatively *in situ* in this layer due to the stabilising effect of the decomposing basalt inclusions and higher soil compaction. Some post-depositional artefact movement is evident from the smaller (<20g) artefacts retrieved from Layer III and the presence of artefacts both in Layer I and scattered on the track surface. Vertical displacement into Layer III was most likely caused by natural processes such as wetting and drying soil cycles, gravity over time, and bioturbation (e.g. vegetation roots and insects). Displacement into Layer I more likely reflects a combination of historical and natural processes. Erosional processes are considered the most significant contributor to the surface exposure of so many artefacts.

The scale of earthworks during the track's initial installation is unknown but it does not appear as though these have had a significant impact on the cultural layer. It is possible that an upper portion of the site may have been impacted but the terrain at the excavation location appeared relatively continuous, with no obvious evidence of removal of sediment for levelling. More likely the deposited calcarenite layer had a stabilising effect and securely capped the underlying deposit for several decades.

Radiocarbon dating places the MBS site within the same window of occupation as the Emily Bay settlement site, though spanning a comparatively shorter number of years. Given the date range and nature of the assemblage, the MBS site likely represents a single knapping event or a series of these events within a window of less than a century. The charcoal samples retrieved during excavation were dispersed and fragmentary. These fragments may have originated from natural forest fires in the vicinity but cultural fires, for example resulting from clearing for Polynesian gardening activities, outside of the excavation area

are also a possible source. Expanded excavations would be required to confirm if any significant charcoal deposits are present.

Comparing the evidence from this new site to Emily Bay, it is possible that the Emily Bay settlement site was the final destination for adze preforms prepared at Mount Bates. The typological analysis of the MBS assemblage positions the site midway between a currently unknown quarry site and a site for adze polishing, use and reuse. The lack of any fully cortical flakes at MBS is a key indication that the first removals occurred elsewhere on the island. A focus on secondary blank reduction at the MBS site is consistent with modelling from the Tahanga Quarry in New Zealand where most of the initial reductions occurred at the quarry itself. Although a quarry site has yet to be identified on Norfolk Island, it is assumed that the MBS material was sourced from nearby and brought to the site in partially cortical pieces. No outcrops are known to exist on the immediate slopes surrounding the MBS site, however, there has been no systematic survey of this terrain.

At Emily Bay, the primary focus was late-stage adze manufacture, including fine working, and adze and preform reworking (Turner, Anderson & Fullagar 2001). It was concluded that roughing out activities occurred elsewhere on the island and preforms were transported to Emily Bay to be finished (Turner, Anderson & Fullagar 2001, p. 62). MBS may represent one site where this earlier stage of roughing out and preform production occurred, thereby positioning MBS immediately before Emily Bay in the site sequencing. The lack of suitable areas for grinding and polishing at Mount Bates also supports the transfer of these tools to another location for completion. The Kingston coastline has easy access to water and suitable grinding materials such as sand and calcarenite platforms and preforms from MBS may have been brought to this area for polishing.

In addition to providing evidence for an earlier stage in Norfolk Island adze manufacture, MBS also provides evidence that the Polynesian settlers were exploring and exploiting resources across the island. The MBS and Emily Bay sites are located at almost opposite ends of the island and occupy two very different landscape contexts, a coastal lagoon bay versus an interior elevated mountain saddle. This suggests the Polynesians were exploring a range of ecological niches across the landscape. The extent of this exploration in turn suggests a certain longevity to the occupation, with settlers able to find and exploit more obscure resources. Unlike Emily Bay, the material assemblage from Mount Bates consists solely of basalt artefacts – all associated with the production of stone adzes. Investigations did not identify any structural features or other evidence of prolonged habitation. Although interpretations are restricted by the small scale of the excavation, the nature of the landscape supports more short-term activity at the MBS site. The main barriers to long-term settlement in this location would have been the absence of a freshwater source as well as the distance from marine resources. It is worth noting that although they are located at almost opposite ends of the island, the MBS and Emily Bay sites are only 5.5 km apart.

Despite the steep mountain terrain, Polynesian settlers could have feasibly visited the MBS site from Emily Bay and returned within a day, or perhaps camped overnight in the vicinity.

From the sequencing of the MBS site, it appears that Polynesians were primarily drawn to this area for the basalt source that is assumed to exist somewhere around the neighbouring slopes. Whether this site represents a single event after discovery of this source or repeat visitations and knapping events is a matter for further research. Identification of this basalt source would provide key evidence to understand the level of activity at this site. Beyond stone resourcing, the Polynesians may have also been in this area to obtain food resources. The avifaunal assemblage from Emily Bay contained high amounts of Providence petrel (*Pterodroma solandri*) bones, with the overall assemblage dominated by various petrel and shearwater species (Holdaway & Anderson 2001). As noted by Captain Hunter (1793, p. 182), these birds were nesting and flocking in significant numbers around the mountain slopes during the First (British) Settlement. Although a direct correlation cannot be made between the MBS site and hunting activities, the site certainly establishes that Polynesian people were accessing a known petrel nesting location.

Geochemical analysis of 25 artefacts from the MBS assemblage determined them all to be of local provenance. This is not a surprising result given the visual consistency of the assemblage lithology, and the nature and location of the site. This finding contributes little to interpretations of the settlement's isolation versus interactions but does correlate with the basalt provenancing results from Emily Bay (Anderson et al. 1997; Turner, Anderson & Fullagar 2001), supporting a broader local tool production system. The additional local provenancing of 26 artefacts from private collections suggests expanded Polynesian activity along the Kingston coastline. It is noted that three of these artefacts (TC 6, TC 7, and TC 21) are only tentatively assigned to the Kingston area as their exact findspot locations are unknown. The remaining 23 artefacts were collected from the sandy beaches at Slaughter Bay (n=19), Emily Bay (n=3) and Cemetery Bay (n=1) which span the southern lowland foreshore (Figure 66).

In terms of spatial distribution, the Emily Bay surface finds correlate broadly to the location of the settlement site. Collected from the beach surface, it is assumed they were all found out of context. Some post-depositional movement of materials associated with the settlement site is expected. Although the bulk portion of the Emily Bay site is *in situ*, it is likely that road and drainage installations, heavy seas, bioturbation (e.g. tree roots and burrowing animals), and the inherent mobility of the dunes, have all contributed to some dispersal of cultural material.

The adze collected from Cemetery Bay (JE-01) marks an addition to a number of sporadic possible pieces of evidence of Polynesian occupation in this area. Jim Specht (1984, p.9) mentions reports of stone artefacts from Cemetery Bay and several reports of similar artefacts have also been made in the years since, both verified (Specht 1993) and unverified. Sand has been quarried from the dune system behind the Cemetery Bay beachfront since

the 1940s (Extent 2020, p. 22) and reports of artefact finds are typically associated with the quarrying area (e.g. Specht 1993, p. 150). In 1990, Robert Varman (1990, p. 43) recommended that no further sand quarrying should take place at Cemetery Bay due to the likelihood of subsurface pre-European deposits.

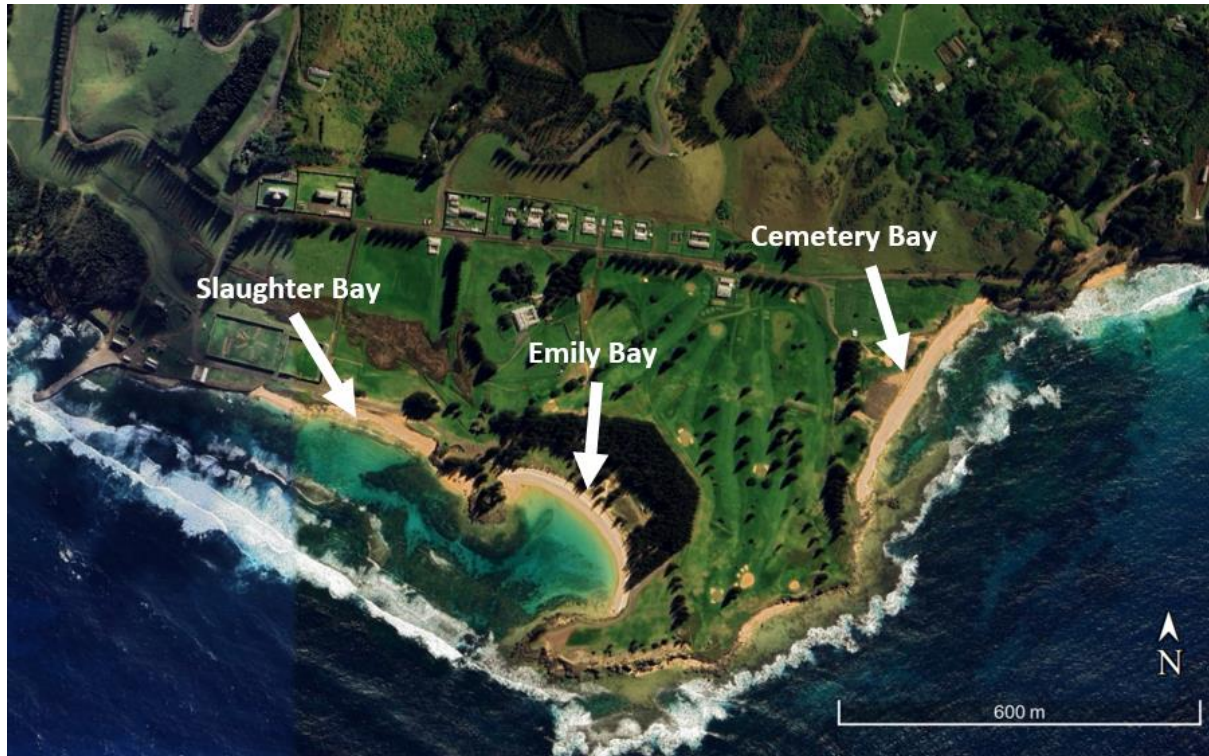


Figure 66: Known findspot locations of 24 locally provenanced artefacts from private collections. South coast of Norfolk Island, Kingston area. Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.

Several test pits were excavated at Cemetery Bay as part of the Norfolk Island Prehistory Project (Anderson, Smith & White 2001b) to further investigate previous reports of a potential cultural layer (Specht 1984; Meredith, Specht & Rich 1985; Varman 1990). This layer consisted of a distinct charcoal band, dated to c. 715-450 BP (Anderson, Higham & Wallace 2001a) and some associated shell and bone material. No definitive evidence of pre-European occupation was found during this excavation but a cultural association for this layer was considered probable (Anderson, Smith & White 2001b, p.14). The lack of conclusive Polynesian materials suggested that Cemetery Bay was more likely the fringe of a settlement centre nearby (Anderson, Smith & White 2001b, p.14). The single adze reported here from Cemetery Bay may fit this model of fringe activity associated with the Emily Bay centre. However, the possibility for more concentrated cultural deposits in this area remains likely. The Norfolk Island Prehistory Project hand excavated a 3 m² trench and monitored excavation of a c. 5 m diameter pit (Anderson, Smith & White 2001b) which is not extensive enough to characterise this full stretch of coastline. Further excavations in this area may uncover further cultural material.

The relatively regular exposure of stone artefacts at Slaughter Bay is of considerable interest in terms of identifying further *in situ* sites. Artefacts have been collected across the extent

of Slaughter Bay, including from the sandy beach, calcarenite surfaces, intertidal zone, and occasionally from the sea floor itself. Although like at Emily Bay these are likely out of context, there is an evident concentration of these artefacts in the central portion of the beach (Figure 67). As discussed in Chapter 6, there may be a direct correlation between the appearance of these artefacts and the convict drain which runs on an approximate north-south trajectory through this area.



Figure 67: Area of Slaughter Bay where artefacts have most frequently been exposed (polygon). Adapted from basemap sourced from Google Earth Pro, version 7.3.6.9345, 20 December 2023.

Polynesian activity along Slaughter Bay is not a novel concept. Jim Specht (1978, 1984) also reported frequent local stone artefact finds from along Slaughter Bay. Although his minor excavation above the high tide mark did not yield any cultural material, Specht remained convinced that a site once existed in this area (Specht 1993). This was of course prior to the identification of the nearby settlement site at the western end of Emily Bay (Anderson & White 2001b; Figure 67). The Norfolk Island Prehistory Project carried out some additional subsurface testing at Slaughter Bay, restricted to the eastern end closest to Emily Bay. A series of auger holes and test trenches, predominantly north of the road, again did not identify any definitive cultural horizons (Anderson, Smith & White 2001b, p. 17-20). The stratigraphy more reflected disturbance from historical activities in the area.

Despite these results, the program concluded that Slaughter Bay may have hosted settlement on a similar scale to Emily Bay (Anderson, Smith & White 2001b, p. 19; Anderson, Higham & Wallace 2001a, p. 40-41). Given the frequency of artefacts being exposed along this beach, Slaughter Bay appears to have been an area of more intensive activity than Cemetery Bay. Whether any *in situ* deposits remain in this area is uncertain as

there have been considerable ground disturbances from the consecutive historical settlements. The frequent exposure of artefacts in the central portion of Slaughter Bay suggests potential for *in situ* materials in the vicinity but further subsurface testing would be required to investigate this.

The colonising strategies occurring elsewhere in southern Polynesia around the time of Norfolk Island's settlement demonstrate an early focus on identifying usable local resources. Norfolk's Polynesian settlement chronology is too short to be able to divide into different phases, but the MBS site demonstrates that settlers were exploring the broader landscape and various landforms. Confirmation of this second site in the north-western uplands opens up the entire island to the possibility of Polynesian settlement and resourcing activities. The nature of the assemblage also narrows down the area in which the quarry site may be located. It is noted that the full extent of the MBS site has not been investigated. Expanded excavations would likely provide further information on the nature of this site and its connection to the Emily Bay settlement site.

The locally provenanced artefacts from the Kingston area also suggest that there is more to uncover on the south coast, and that the Emily Bay settlement centre may not be the only one. Building on the findings of Varman (1990), Specht (1978, 1984, 1993) and the Norfolk Island Prehistory Project (Anderson & White 2001b), Slaughter Bay may certainly yield more evidence of pre-European settlement or intensive activities. Whether *in situ* deposits still exist remains to be seen. However, the growing assemblage of local finds strongly supports extended Polynesian habitation in this area. The current evidence for Cemetery Bay is more constrained but this may simply be due to limited subsurface investigations. Interpretations of the Kingston area more broadly are limited by the small amount of excavation, and the restriction of such investigations to discrete areas. Expanded excavations across the length of the southern coastal lowland would likely provide more evidence of Polynesian habitation.

Evidence of Interaction, Isolation and Social Complexity

Isolation has been a common factor in discussions of why the Polynesian settlement on Norfolk Island ended. As discussed in Chapter 3, external networks may have been critical to establishing and growing new Polynesian settlements, and isolation may have contributed to the island's abandonment. The influence on local social complexity is more multi-faceted, with interaction and isolation appearing to both factor into the rise of elite centres and stratified hierarchies across Polynesia. The structured domestic area and associated marae at Emily Bay suggests some social complexity within the Polynesian settlement. However, the extent of socio-political stratification and the role of interaction or isolation on its possible development remains largely unclear.

Looking first to evidence of external interactions, the geochemical results from this study generally confirm established interpretations. Previous studies (Anderson & White 2001b;

Anderson et al. 1997; Specht 1978, 1984, 1993) have drawn tentative links to New Zealand and the Kermadec archipelago and the methods of this study aimed to test these possible connections. Although five artefacts in the total analysed assemblage appeared to be geochemical outliers, the results were not conclusive enough to determine source locations. These artefacts all demonstrated some overlap with source data from the Kermadec archipelago or New Zealand, although SB 0.09 appeared to avoid a Kermadec association. However, three of these artefacts (ST-01, SB 15 and SB 2.191) may also be of local origin. No obvious correlations were made with any of these potential source locations and their connections to the Polynesian settlement are largely dubious. The distinctively green broken adze (UN ID 3) is the most definitive non-local object, but a Polynesian correlation is difficult given its findspot near the Melanesian Mission centre.

These results highlight two important issues for both this study and similar studies in this discipline: the limitations of the pXRF instrument and the scarcity of geochemical source characterisations. Although pXRF techniques have had suitable success in similar studies throughout the Pacific (see Chapter 7), the low accuracy of the instrument used here has implications for both the results and reproducibility of this data. The level of instrument precision allowed for reliable comparisons between measurements taken on the pXRF. Therefore, the local provenancing results are relatively sound as the bulk of this data was collected on this one pXRF instrument. However, comparisons with outsourced datasets (such as the source sample measurements obtained from GEOROC) are less certain. The lack of distinct correlations between these five outlier artefacts and any of the external source data may be a product of this low accuracy.

To refine investigations of interaction networks in Norfolk Island's pre-European period, further characterisation of potential sources is needed. Geochemical source characterisations for Norfolk Island, Pitcairn Island and the Kermadec Islands are extremely limited, and essentially non-existent for New Caledonia. The last targeted geochemical studies for Norfolk Island are from the 1970s and provide limited chemical characterisation to support a detailed provenancing study. Although this study contributes new pXRF measured data of rock samples from Norfolk Island, this dataset is limited (21 samples) and the low instrument accuracy limits its reusability in future studies.

Even if these five outlier artefacts were confirmed to originate from New Zealand or the Kermadec archipelago, and be associated with the Polynesian occupation, the quantity is not substantial enough to indicate interaction post-settlement. More likely, as noted for externally provenanced obsidian from Emily Bay (Anderson et al. 1997), these would reflect transport with the original settlers. A homeland has yet to be established for the Norfolk Island settlers but New Zealand or the Kermadecs are most likely given their comparable settlement chronologies and relative geographical locations.

Anderson and White (2001c) posited that isolation may have been an important factor in the eventual abandonment of Norfolk Island. The social and economic isolation may have

restricted settlement growth to the extent that long-term settlement eventually became unfeasible. This was likely compounded by a lack of established horticulture and a comparatively limited range of natural food resources. The results of this study suggest that insufficient stone resources were not a factor in the settlement's abandonment. However, identification of a quarry site would be essential to corroborate this.

The role of stone resourcing and tool production on Norfolk Island may be expanded upon with additional excavations and identification of further *in situ* sites, particularly quarry sites. The MBS and Emily Bay assemblages suggest that tool production was generally for local use rather than for socio-economic purposes like gifting and exchange. Other than the single adze recovered from Dark Point on the Australian east coast, no stone artefacts from Norfolk Island have been identified on any neighbouring islands. This indicates that Norfolk material was not being exchanged but it should be noted that this may also reflect gaps in the archaeological record due to limited investigations. In terms of social complexity, there is a spatial correlation between general basalt adze manufacture and the domestic and religious spaces at Emily Bay but no strong evidence to suggest elite control of resources. Identifying the local stone source (or sources) may provide further information on the level of local social complexity and whether stone resourcing and tool manufacture influenced its development. With the current available evidence, there is little to suggest that spheres of interaction contributed to social complexity on Norfolk Island.

Norfolk Island's Place in Oceanic Regional Frameworks

The new evidence presented in this study expands the known range of Polynesian occupation on Norfolk Island. There is no suggestion from the MBS site or these lithic materials that groups from other regions, such as Melanesia or Australia, were occupying the island prior to European arrival. Although Melanesian style implements have been recorded on the island previously (McCarthy 1934; Specht 1978, 1984, 1993), and New Caledonia is within feasible voyaging reach, there is currently no strong evidence to indicate arrivals or occupation from this region. With this in mind, consideration must be given to Norfolk Island's regional classification. The purpose of classifying Norfolk Island within the existing regional frameworks is to bring the island into broader discussions of movement and cultural developments within the Pacific.

As discussed in Chapter 2, Norfolk Island falls outside of the current boundaries of the Polynesian Triangle but demonstrates clear evidence of Polynesian habitation. By this definition Norfolk may be classified as a Polynesian Outlier. However, incorporating the island into Outlier studies presents a challenge. The trajectory of Polynesian arrival on Norfolk Island does not fit easily with the Outlier settlement narrative. The Outliers are more associated, in terms of geography and formation processes, with West Polynesia, whereas Norfolk is positioned at the south-western edge of the East Polynesian expansion. This distance reflects separate colonisation narratives and has implications for divergent localised cultural development.

A key characteristic of the Outliers, and a common focus of their study, is their interaction with outside settlements, particularly non-Polynesian communities. The nature and level of interactions between Outliers and these other communities often significantly influenced the formation of their cultural identities. Norfolk Island by comparison still does not demonstrate any concrete evidence of external interactions post-settlement. The material record more reflects a cultural identity transferred from an East Polynesian homeland. Although Outliers as a whole are a heterogeneous group, Norfolk does not fit easily into discussions of their settlement and cultural development.

Situated in the south-west Pacific with Polynesian occupation spanning c. 13th-15th century CE (Anderson, Higham & Wallace 2001a; Chapter 6; Appendix III), Norfolk Island is better classified as part of a group of marginal islands fringing the southern boundary of Polynesia. Inclusive of the Auckland Islands and the Snares Islands, this group appears to represent the southern and western fringes of East Polynesian voyaging. Incorporating elements of Kirch's (1988b) mystery islands and Anderson's (2003, 2005) South Polynesia, these islands are best classified as a new subregion: the Southern Marginal Mystery Islands.

Geographically and temporally, they are similarly positioned in the trajectory of Polynesian voyaging. All are considered part of the later southern wave of East Polynesian migration that colonised New Zealand and the Kermadec archipelago. It is possible that Norfolk Island was settled from either New Zealand or the Kermadec archipelago, but the Aucklands and Snares were certainly reached from New Zealand. Whether the Polynesians travelled further west towards the Australian coast, or south towards Antarctica remains to be seen.

These islands all hosted short-lived and relatively small-scale Polynesian settlements, and no extant populations remained at the time of European arrival. A possible exacerbating factor for settlement abandonment on these islands is a lack of external support networks. No definitive evidence has been uncovered on Norfolk, the Aucklands or Snares to suggest that the Polynesians were interacting with any of their neighbours post-settlement. Long-distance voyaging was also significantly curtailed in this region around the time the islands were settled which supports this interpretation. Settlement longevity may have also been affected by environmental challenges on each of these islands. Particularly short occupations on the Aucklands and Snares likely reflects the difficult climatic conditions and associated constraints on horticulture and food resources at that latitude. Whilst Norfolk Island is differently positioned in a subtropical zone, there is also a limited range of natural food resources and currently no evidence of Polynesian horticultural practices. The evidence of local stone tool production from the Emily Bay and MBS sites indicates that raw material availability was not a settlement constraint on Norfolk Island. Local materials were also used for stone working on the Auckland and Snares Islands, but studies are too limited to determine if there were suitable stone sources to supply the respective settlements.

These strains of evidence combined indicate sufficient temporal, geographic and cultural homogeneity between these islands to classify them as a single subregion, directly

associated with the adjacent Polynesian Triangle but falling outside of its current boundaries. The islands currently proposed to form part of the Southern Marginal Mystery Islands group are shown in Figure 68. There is currently no archaeological evidence to suggest Polynesians settled or visited other nearby islands, such as Lord Howe, the Antipodes, the Bounty Islands or Campbell Island. However, Māori oral traditions present a case for ancestral voyages to Antarctica (see Wehi et al. 2022) so journeys to these other islands may have occurred and would be a matter for further research. The absence of material remains may simply reflect limited investigation in the region, or perhaps visits were short enough to not leave an archaeologically visible footprint behind.

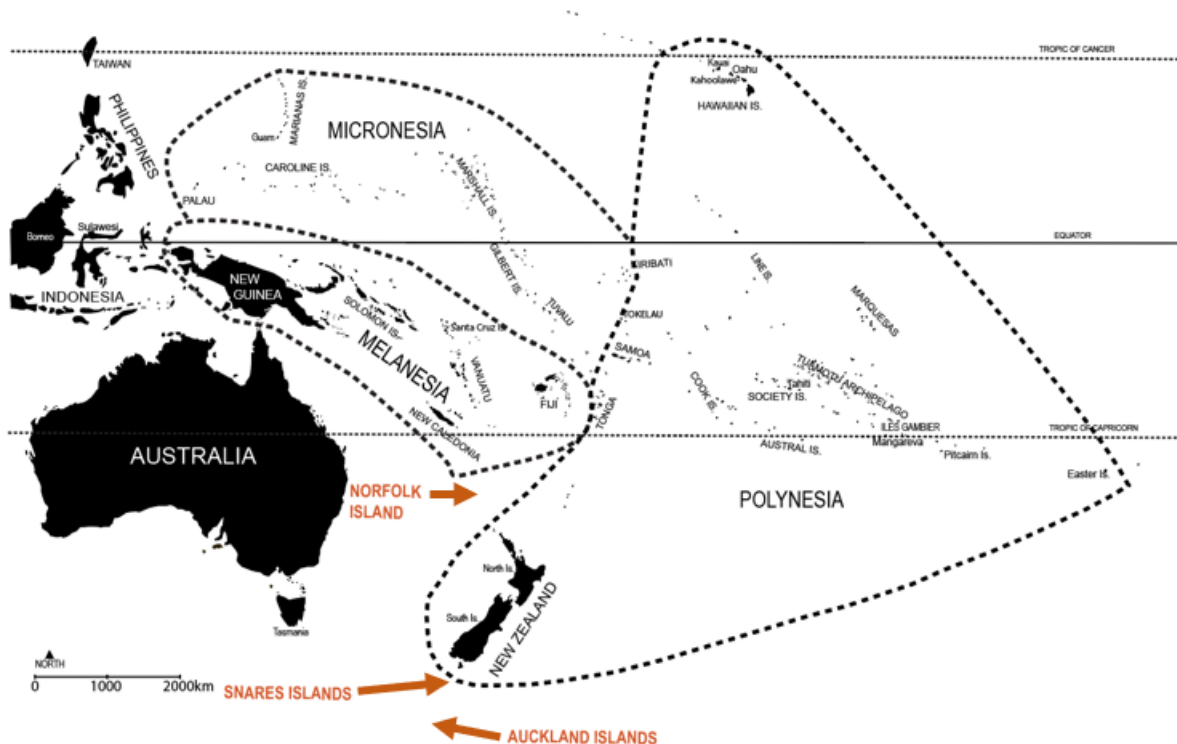


Figure 68: Proposed Southern Marginal Mystery Islands (Norfolk Island, the Snares Islands and the Auckland Islands). Adapted with permission from basemap produced by Dr James Flexner

Future Research Directions

This research highlights certain possibilities for future research. The information obtained to date from the new MBS site has allowed for particular interpretations of the site itself and the broader Polynesian occupation on Norfolk Island. However, it is noted that the excavation was restricted in size and only tested 0.3% of the total recorded extent of the site. Expanded excavations at the MBS site should be a focus of future research to understand the full nature and extent of the site. The recorded boundaries of the MBS site are currently based on the visible surface scatter and may not be an accurate delineation of the subsurface deposit.

Additional excavations would likely recover further artefactual material to add to the current site assemblage. More precise data on quantity and distribution of stone artefacts,

in conjunction with the site extent, would provide a better understanding of production scale and frequency of site use. It is also possible that additional cultural materials or features may be uncovered. Expanded excavations at Mount Bates are critical to test the results of this study and further characterise the site.

As has been the recommendation of previous studies, future research should also target identifying a stone quarry site. More than one quarry site may exist on the island, but none have been identified to date. The MBS results suggest a raw material source is located nearby which refines a likely quarry location to the surrounding mountain slopes. No known outcrops suitable for stone working have been recorded in this area but systematic survey is sorely lacking. Survey of the slopes surrounding MBS may reveal the location of the stone quarry and associated primary flaking floors.

Artefacts in private collections are more difficult to assign to an occupational period as their deposition context is now lost. However, detailed recording and analyses of local private collection artefacts may highlight locations for further investigation. This study has already shown a concentration of surface findspots at Slaughter Bay and it is likely that excavations through this area would recover additional material. Although lacking contextual data, artefacts in private collections number in the hundreds. With a robust research framework, these collections are certainly worth investigating further.

Beyond investigating evidence of Polynesian settlement on Norfolk Island, future research should also focus on comprehensive geochemical source characterisations, for both Norfolk Island and the surrounding locales. This study has shown that source characterisations in the target regions, particularly the Kermadec Islands and New Caledonia, are considerably lacking. This is a limitation for ongoing questions such as where the settlers' homeland was, and who might they have interacted with, if anyone, during settlement. Without more robust geochemical source characterisation for both Norfolk Island and these surrounding locations, it is difficult to make more definitive conclusions about these details of the settlement. Melanesian arrivals on Norfolk also remains a possibility, albeit tenuous, which is hard to investigate further with the current New Caledonian datasets. Establishing comparable source datasets from these regions would contribute significantly to future detailed provenancing studies in and beyond Norfolk Island.

Whilst this thesis presents sufficient evidence to define the Southern Marginal Mystery Islands, additional research would help to solidify this as a cohesive subregion. Further to more archaeological investigation on Norfolk Island, as outlined above, targeted research on the archaeologies and oral histories for the Auckland and Snares would certainly contribute to solidifying this framework. Characterising the pre-European settlements, or lack thereof, on those islands fringing the south-western boundary of Polynesia will add to our understanding of Polynesian voyaging and settlement in this marginal fringe context. The Southern Marginal Mystery Islands subregion presents a defined framework to investigate some of the major geographical limitations that affected pre-European settlement in the

south-west Pacific. Consolidating our understanding of this subregion will add considerably to broader discussions of how settlements formed and operated in such contexts, and the geographical limits of Polynesian voyaging.

Reference List

- Abell, R 1993, 'Aquifer vulnerability on small volcanic islands in the southwest Pacific region – an example from Norfolk Island', *Journal of Australian Geology and Geophysics*, vol. 14, pp. 123-133.
- Abell, R & Falkland, A 1991, 'The hydrogeology of Norfolk Island South Pacific Ocean', *BMR Bulletin*, vol. 234, pp. 1-57.
- Addison, DJ, & Matisoo-Smith, E 2010, 'Rethinking Polynesian origins: a West-Polynesia Triple-I Model', *Archaeology in Oceania*, vol. 45, pp. 1-12.
- Allen, MS & Kahn, JG 2010, 'Central East Polynesia: An introduction', *Archaeology in Oceania*, vol. 45, no. 2, pp. 49–53.
- Anderson, A 2000, 'Implications of prehistoric obsidian transfer in South Polynesia', *Indo-Pacific Prehistory Association Bulletin 20*, Melaka Papers, vol. 4, pp. 117-123.
- Anderson, A 2001, 'No Meat on that beautiful shore: The prehistoric abandonment of subtropical Polynesian islands', *International Journal of Osteoarchaeology*, vol. 11, pp. 14-23.
- Anderson, A 2002, 'Faunal collapse, landscape change and settlement history in Remote Oceania', *World Archaeology*, vol. 33, no. 3, pp. 375-390.
- Anderson, A 2003, *Prehistoric archaeology in the Auckland Islands, New Zealand Subantarctic region*, Report to Department of Conservation, Wellington.
- Anderson, A 2005, 'Subpolar settlement in South Polynesia', *Antiquity*, vol. 79, pp. 791-800.
- Anderson, A, Ambrose, W, Leach, F & Weisler, M 1997, 'Material sources of basalt and obsidian artefacts from a prehistoric settlement site on Norfolk Island, South Pacific', *Archaeology of Oceania*, vol. 32, pp. 39-46.
- Anderson, A & Green, R 2001, 'Domestic and religious structures in the Emily Bay settlement site, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 43-52.
- Anderson, A & Petchey, F 2020, 'The transfer of kumara ('Ipomoea batatas') from East to South Polynesia and its dispersal in New Zealand', *Journal of the Polynesian Society*, vol. 129, no. 4, pp. 351-381.
- Anderson, A, Higham, T, & Wallace, R 2001a, 'The radiocarbon chronology of the Norfolk Island archaeological sites', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 33–42.

- Anderson, A, Kennett, DJ & Conte, E 2012, 'The prehistory of Rapa Island', in A Anderson and DJ Kennett (eds.), *Taking the High Ground: The archaeology of Rapa, a fortified island in remote East Polynesia*, ANU Press, Canberra, Australia, pp. 247-256.
- Anderson, A & McFagden, B 1990, 'Prehistoric two-way voyaging between New Zealand and East Polynesia: Mayor Island Obsidian on Raoul Island, and possible Raoul Island Obsidian in New Zealand', *Archaeology in Oceania*, vol. 25, no. 1, pp. 37-42.
- Anderson, A & O'Connor, S 2008, 'Indo-Pacific migration and colonization: Introduction', *Asian Perspectives*, vol. 47, pp. 2-11.
- Anderson, A & O'Regan, G 2000, 'To the final shore; prehistoric colonisation of the Subantarctic islands in South Polynesia', in A Anderson & T Murray (eds.), *Australian archaeologist: collected papers in honour of Jim Allen*, Coombs Academic Publishing, Canberra, ACT.
- Anderson, A & Sinoto, Y 2002, 'New radiocarbon ages of colonization sites in East Polynesia', *Asian Perspectives*, vol. 14, no. 2, pp. 242-257.
- Anderson, A, Smith, I & White, P 2001b, 'Archaeological fieldwork on Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 11-32.
- Anderson, A, & White, P 2001a, 'Approaching the prehistory of Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 1-10.
- Anderson, A, & White, P (eds.) 2001b, *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27.
- Anderson, A, & White, P 2001c, 'Prehistoric settlement on Norfolk Island and its Oceanic context', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 135-141.
- Arnold, JE 2007, 'Credit where credit is due: The history of the Chu Mash oceangoing plank canoes', *American Antiquity*, vol. 72, pp. 196-209.
- Attenbrow, V, Corkill, T, Pogson, R, Sutherland, L & Grave, P 2017, 'Non-destructive provenancing of ground-edged mafic artefacts: A Holocene case study from the Sydney Basin, Australia', *Journal of Field Archaeology*, vol. 43, no. 3, pp. 173-186.
- Attenbrow, V, Fullagar, R & Szpak, C 1998, 'Stone files and shell fish-hooks in southeastern Australia', in R Fullagar (ed.), *A Closer Look: Recent Australian Studies of Stone Tools*, Archaeological Computing Laboratory, School of Archaeology, University of Sydney, Sydney, Australia, pp. 127-148.

- Barcham, M, Scheyvens, R & Overton, J 2009, 'New Polynesian Triangle: Rethinking Polynesian migration and development in the Pacific', *Asia Pacific Viewpoint*, vol. 50, no. 3, pp. 322-337.
- Beaglehole, JC (ed.) 1961, *The Journals of Captain James Cook on his Voyages of Discovery, Volume II. The Voyage of the Resolution and Adventure 1772–1775*, Hakluyt Society, Cambridge.
- Beaglehole, JC (ed.) 1967, *The Journals of Captain James Cook on His Voyages of Discovery: The Voyage of the Resolution and Discovery, 1776-1780*, Hakluyt Society, Cambridge.
- Beaglehole, J. C. (ed.) 1968, *The Journals of Captain James Cook on His Voyages of Discovery: The Voyage of the Endeavour, 1768-1771*, Hakluyt Society, Cambridge.
- Beaglehole, J. C. (ed.) 1969, *The Journals of Captain James Cook on His Voyages of Discovery: The Voyage of the Resolution and Adventure, 1772-1775*, Hakluyt Society, Cambridge.
- Besnier, N, Love, JW, Lieber, MD, Moir, BG, Donner, W, Rossen, JM, Firth, R, Feinberg, R & Thomas, A 1998, 'Polynesian Outliers', in AL Kaeppler & JW Love (eds.), *Australia and the Pacific Islands*, Garland Publishing Inc., New York and London, pp. 833-836.
- Boomer, A & Bright, AJ 2007, 'Island archaeology: In search of a new horizon', *Island Studies Journal*, vol. 2, no. 1, pp. 3-26.
- Brigham, WT 1902, 'Stone implements and stone work of the ancient Hawaiians', *Bernice P. Bishop Museum Memoir*, vol. 1, no. 5, Bishop Museum Press, Honolulu.
- Britton, A (ed.) 1892, *Historical Records of New South Wales, Volume I, Part 2, Phillip 1783–1792*, Government Printer, Sydney, NSW.
- Burley, DV 2013, 'Fijian polygenesis and the Melanesian/Polynesian divide', *Current Anthropology*, vol. 54, no. 4, pp. 436-462.
- Burley, DV 2023, *The birth of Polynesia: An archaeological journey through the Kingdom of Tonga*, Archaeology Press, Simon Fraser University, Canada.
- Burley, DV, Sheppard, PJ & Simonin, M 2011, 'Tongan and Samoan volcanic glass: pXRF analysis and implications for constructs of ancestral Polynesian society', *Journal of Archaeological Science*, vol. 38, no. 10, pp. 2625-2632.
- Campbell, CR & Schmidt, L 2001, 'Molluscs and echinoderms from the Emily Bay settlement site, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 109-114.
- Ceccarelli, L, Rossetti, I, Primavesi, L, & Stoddart, S 2016, 'Non-destructive method for the identification of ceramic production by portable X-rays Fluorescence (pXRF). A case

- study of amphorae manufacture in central Italy', *Journal of Archaeological Science*, vol. 10, pp. 253-262.
- Charalambous, A, Markou, E, & Kassianidou, V 2020, 'Compositional analysis of sixth-fifth century BC silver coins from the Larnaca Hoard (IGCH 1272) (Cyprus) using pXRF spectrometry', *American Journal of Numismatics (1989-)*, Second Series, vol. 32, pp. 1-30.
- Charleux, M, Mcalister, A, Mills, PR & Lundblad, S 2014, 'Non-destructive XRF analyses of fine-grained basalts from Eiao, Marquesas Island', *Journal of Pacific Archaeology*, vol. 5, no. 1, pp. 75-89.
- Clark, G 2003, 'Dumont d'Urville's Oceania', *The Journal of Pacific History*, vol. 38, no. 2, pp. 155-161.
- Clark, M & May, SK (2013) (eds.), *Macassan history and heritage: Journeys, encounters and influences*, ANU Press, Canberra, ACT.
- Clark, GR, Reepmeyer, C, Melekiola, N, Woodhead, J, Dickinson, WR & Martinsson-Wallin, H 2014, 'Stone tools from the ancient Tongan state reveal prehistoric interaction centres in the Central Pacific', *PNAS*, vol. 111, no. 29, pp. 10491-10496.
- Clarkson, C, Shipton, C & Weisler, M 2014, 'Determining the reduction sequence of Hawaiian quadrangular adzes using 3D approaches: a case study from Moloka'i. *Journal of Archaeological Science*, vol. 49, pp. 361-371.
- Clarkson, C, Shipton, C & Weisler, M 2015, 'Front, back and sides: experimental replication and archaeological analysis of Hawaiian adzes and associated debitage', *Archaeology in Oceania*, vol. 50, pp. 71-84.
- Cluzel, D, Aitchison, JC & Picard, C 2001, 'Tectonic accretion and underplating of mafic terranes in the Late Eocene intraoceanic fore-arc of New Caledonia (Southwest Pacific): geodynamic implications', *Tectonophysics*, vol. 340, pp. 23-59.
- Collerson, KD & Weisler, MI 2007, 'Stone adze compositions and the extent of ancient Polynesian voyaging and trade', *Science (American Association for the Advancement of Science)*, vol. 317, no. 5846, pp. 1907-1911.
- Collins, D 1798 *An Account of the English Colony in New South Wales [Volume I]: With Remarks on the Dispositions, Customs, Manners &c. of the Native Inhabitants of that Country. To Which are Added, Some Particulars of New Zealand: Compiled by Permission, From the Mss. of Lieutenant-Governor King*, Reed, Sydney.
- Craig, F & Glascock, MD 2018, 'Destructive and nondestructive geochemical analysis of vesicular basalt from bedrock outcrops in the Salt-Gila Basin, Arizona: Evaluating the potential of nondestructive portable X-ray fluorescence spectroscopy for

- archaeological provenance analyses', *Journal of Archaeological Science; Reports*, vol. 19, pp. 769-780.
- Craig, N, Speakman, R, Popelka-Filcoff, R, Glascock, M, Robertson, J, Shackley, M & Aldenderfer, M 2007, 'Comparison of XRF and PXRF for analysis of archaeological obsidian from southern Peru', *Journal of Archaeological Science*, vol. 34, pp. 2012-2024.
- Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2022, *Phillip Island*, viewed 5 July 2023, <https://www.dcceew.gov.au/parks-heritage/national-parks/norfolk-island-national-park/culture-and-history/phillip-island>.
- Davidson, JM 1992, 'New evidence about the date of colonisation of Nukuoro Atoll, a Polynesian Outlier in the Central Caroline Islands', *Journal of the Polynesian Society*, vol. 101, pp. 293-298.
- Davidson, JM 2012, 'Intrusion, integration and innovation on small and not-so-small islands with particular reference to Samoa', *Archaeology in Oceania*, vol. 47, pp. 1-13.
- Di Piazza, A & Pearthree, E 2001, 'Voyaging and basalt exchange in the Phoenix and Line archipelagos: the viewpoint from three mystery islands', *Archaeology in Oceania*, vol. 36, pp. 146-152.
- Dousset, L & Di Piazza, A 2021, 'Mapping prehistoric sailing routes to Lizard Island and beyond', *Journal of Pacific Archaeology*, vol. 12, no. 1, pp. 16-31.
- Drake, B, Nazaroff, A & Prufer, K 2009, 'Error assessment of portable X-ray fluorescence spectrometry in geochemical sourcing', *SAS Bulletin*, vol. 32, no. 3, pp. 14-17.
- Duff, R 1950, *The Moa-Hunter Period of Maori Culture*, Department of Internal Affairs, Wellington, New Zealand.
- Dumont D'urville, J-S B-C S, Ollivier, I, de Biran, A & Clark, G 2003, 'On the islands of the Great Ocean', *The Journal of Pacific History*, vol. 38, no. 2, pp. 163-174.
- Dye, TS 2015, 'Dating human dispersal in Remote Oceania: A Bayesian view from Hawai'i', *World Archaeology*, vol. 47, no. 4, pp. 661-676.
- Ellis, W 1830, *Polynesian Researches*, Fisher, Son and Jackson, London.
- Emory, KP, Bonk, WJ, Sinoto, YH 1959, *Hawaiian Archaeology: Fishhooks*, Special Publication 47, Bishop Museum Press, Honolulu.
- Extent 2020, *Kingston and Arthur's Vale Historic Area (KAVHA): Archaeological Zoning and Management Plan – Volume 1. Text*, Report for the Department of Infrastructure, Transport, Regional Development and Communications.
- Finney, B 2007, 'Tracking Polynesian Seafarers', *Science*, vol. 317, pp. 1873-1874.

- Fitzhugh, B & Hunt, TL 1997, 'Introduction: Islands as laboratories: Archaeological research in comparative perspective', *Human Ecology*, vol. 25, no. 3, pp. 379-383.
- Fitzpatrick, SM & Anderson, A 2008, 'Islands of Isolation: Archaeology and the Power of Aquatic Perimeters', *Journal of Island and Coastal Archaeology*, vol. 3, no. 1, pp. 4-16.
- Fitzpatrick, A, McNiven, IJ, Specht, J & Ulm, S 2018, 'Stylistic arrangements of stone arrangements supports regional cultural interactions along the northern Great Barrier Reef, Queensland', *Australian Archaeology*, vol. 84, no. 2, pp. 129-144.
- Fletcher, BH (ed.) 1975, *D. Collins. An Account of the English Colony in New South Wales, volume I (1798), volume II (1802)*, Reed, Sydney.
- Flexner, JL, Bedford, S & Valentin, F 2019, 'Who was Polynesian? Who was Melanesian? Hybridity and ethnogenesis in the South Vanuatu Outliers', *Journal of Social Archaeology*, vol. 19, no. 3, pp. 403-426.
- Fornander, A. 1969, *An Account of the Polynesian Race: Its Origin and Migrations and the Ancient History of the Hawaiian People to the Times of Kamehameha I*, Tokyo: Charles E. Tuttle Company.
- Forster, N & Grave, P 2013, 'Effects of elevated levels of lead in ceramics on provenancing studies using non-destructive PXRF: a case study in Byzantine Cypriot glazed ceramics', *X-ray Spectrometry*, vol. 42, no. 6, pp. 480-486.
- Frahm, E 2012, 'Evaluation of archaeological sourcing techniques: reconsidering and re-deriving Hughes' four-fold assessment scheme', *Geoarchaeology: An International Journal*, vol. 27, pp. 166-174.
- Furey, L, Ross-Sheppard, C & Prickett, KE 2015, 'Obsidian from Macauley Island: a New Zealand connection', in T Trnski & HA Schlumpf (eds.), *Bulletin of the Auckland Museum: Kermadec Biodiscovery Expedition 2011*, vol. 20, pp. 511-518.
- Galipaud, J-C, Reepmeyer, C, Torrence, R, Kelloway, S & White, P 2014, 'Long distance connections in Vanuatu: New obsidian characterisations for the Makue site, Aore Island', *Archaeology in Oceania*, vol. 49, pp. 110-116.
- Gamble, LH 2002, 'Archaeological evidence for the origin of the plank canoe in North America', *American Antiquity*, vol. 67, no. 2, pp. 301-315.
- Gauthier, G & Burke, A 2011, 'The effects of surface weathering on the geochemical analysis of archaeological lithic samples using non-destructive polarized energy dispersive XRF', *Geoarchaeology: An International Journal*, vol. 26, no. 2, pp. 269-291.
- Geochemistry of Rocks of the Oceans and Continents (GEOROC) database, accessed November 2023, <https://georoc.eu/>.

- Geoscience Australia 2010, *Norfolk Island 1:25 000 Scale Topographic Map, Norfolk Island*, map, Geoscience Australia, Canberra.
- Gibbs, M, Duncan, B & Varman, R 2017, 'The free and unfree settlements of Norfolk Island: an overview of archaeological research' *Australian Archaeology*, vol. 83, no. 3, pp. 82-99.
- Gifford, EW 1951, *Archaeological Excavations in Fiji*, University of California Press, Berkley.
- Gifford, EW & Shutler Jr, D 1956, *Archaeological Excavations in New Caledonia*, University of California Press, Berkley.
- Gliozzo, E, Kockelmann, W, Bartoli, L & Tykot, RH 2011, 'Roman bronze artefacts from Thamusida (Morocco): chemical and phase analyses', *Nuclear Instruments and Methods in Physics Research B*, vol. 269, pp. 277-283.
- Goodale, N, Bailey, D, Jones, G, Prescott, C, Scholz, E, Stagliano, N, Lewis, C 2012, 'pXRF: a study of inter-instrument performance', *Journal of Archaeological Science*, vol. 39, pp. 875-883.
- Green, RC 1961, 'Moorea archaeology: A preliminary report', *Man*, vol. 61, pp. 169-173.
- Green, RC 1991a, 'Near and Remote Oceania – disestablishing “Melanesia” in culture history', in A Pawley (ed.), *Man and a Half: Essays in Pacific Anthropology and Ethnobiology in Honour of Ralph Bulmer*, Polynesian Society, Auckland, New Zealand, pp. 491-502.
- Green, RC 1991b, 'The Lapita cultural complex: current evidence and proposed models', *Bulletin of the Indo-Pacific Prehistory Association*, vol. 11, pp. 295-305.
- Green, RC 2005, 'Sweet Potato transfers in Polynesian prehistory', in: C Ballard, P Brown, RM Bourke, T Harwood (eds.), *The Sweet Potato in Oceania: A Reappraisal*, University of Sydney Press, New South Wales, Australia.
- Green, RC & Davidson, J (eds.) 1969, *Archaeology in Western Samoa*, Vol 1. Bulletin of the Auckland Institute and Museum 6, Auckland Institute and Museum, Auckland, New Zealand.
- Green, T 1973, 'Petrology and geochemistry of basalts from Norfolk Island', *Journal of the Geological Society of Australia*, vol. 20, no. 3, pp. 259-272.
- Gregory, HE 1924, 'The Pacific Science Congress', *The Scientific Monthly*, vol. 19, no. 3, pp. 271-280.
- Hale, H 1846, *Ethnography and Philology, United States Exploring Expedition*, vol. 6, Sherman, Philadelphia.

- Hambruch, P 1932, *Ergebnisse der Südsee-Expedition 1908–1910. II. Ethnographie: B. Mikronesien. Ponape. 1. Teilband. Allgemeiner Teil: Geschichte, Geographie, Sprache, Eingeborene*, De Gruyter & Co Hamburg: Friederichsen.
- Hather, J & Kirch, PV 1991, 'Prehistoric sweet potato (*Ipomoea batatas*) from Mangaia Island, Central Polynesia', *Antiquity*, vol. 65, pp. 887-893.
- Hayward, BW 2018, 'Elevation of lava flow quench zone confirms tectonic stability of Norfolk Island', *Geocene*, vol. 16, pp. 5-9.
- Heizer, RF 1949, 'Curved single-piece fishhooks of shell and bone in California', *American Antiquity*, vol 15, no. 2, pp. 89-97.
- Hermann, A, Gutiérrez, P, Chauvel, C, Maury, RC, Liorzou, C, Willie, E, Phillip, I, Forkel, R, Rzymiski, C & Bedford, S 2023, 'Artifact geochemistry demonstrates long-distance voyaging in the Polynesian Outliers', *Science Advances*, vol. 9, no. 16, pp. 1-12.
- Heyerdahl, T 1952, *American Indians in the Pacific: The Theory Behind the Kon-Tiki Expedition*, Allen and Unwin, London.
- Higham, T & Johnson, L 1996, 'The prehistoric chronology of Raoul Island, the Kermadec Group', *Archaeology in Oceania*, vol. 31, pp. 207-213.
- Hicks, J 1988, 'The natural history of Norfolk Island', in R Nobbs (ed.) *Norfolk Island and its First Settlement, 1788-1814*, Library of Australian History, Sydney, NSW.
- Hiroa, TR 1938, *Vikings of the Sunrise*, New York: Frederick A. Stokes.
- Hoare, M 1999, *Norfolk Island: A Revised and Enlarged History 1774-1998*, Central Queensland University, Rockhampton, QLD.
- Holdaway, RN & Anderson, A 2001, 'Avifauna from the Emily Bay settlement site, Norfolk Island: a preliminary account', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 85-100.
- Horsburgh, KA & McCoy, MD 2017, 'Dispersal, Isolation, and Interaction in the Islands of Polynesia: A Critical Review of Archaeological and Genetic Evidence', *Diversity*, vol. 9, no. 3, pp. 1-12.
- Howard, A 1967, 'Polynesian origins and migrations', in GA Highland, RW Force, A Howard, M Kelly & YH Sinoto (eds.), *Polynesian Culture History*, Special Publication 56, Bishop Museum Press, Honolulu, pp. 45-101.
- Howes, H 2017, 'Early German-language Analyses of Potsherds from New Guinea and the Bismarck Archipelago', *Journal of Pacific Archaeology*, vol. 8, no. 1, pp. 35-46.

- Howes, H 2022a, 'Shell trumpets sounding in the stone city: Paul Hambruch and Nan Madol', in H Howes, T Jones & M Spriggs (eds.). *Uncovering Pacific Pasts: Histories of Archaeology in Oceania*, ANU Press, Canberra, ACT.
- Howes, H 2022b, 'Global journeys of Lapita potsherds from the Bismarck Archipelago' in H Howes, T Jones & M Spriggs (eds.). *Uncovering Pacific Pasts: Histories of Archaeology in Oceania*, ANU Press, Canberra, ACT.
- Howes, H, Jones, T & Spriggs, M (eds.) 2022, *Uncovering Pacific Pasts: Histories of Archaeology in Oceania*, ANU Press, Canberra, ACT.
- Hudjashov, G, Endicott, P, Post, H, Nagle, N, Ho, SY, Lawson, DJ & Saag, L 2018, 'Investigating the origins of eastern Polynesians using genome-wide data from the Leeward Society Isles', *Scientific Reports*, vol. 8, no. 1, pp. 1-12.
- Hunt, TL & Lipo, CP 2006, 'Late colonization of Easter Island', *Science (American Association for the Advancement of Science)*, vol. 311, pp. 1603–1606.
- Hunter, J 1793, *An historical journal of the transactions at Port Jackson and Norfolk Island*, University of Sydney Library, Sydney.
- Hutton, JT & Stephens, CG 1956, 'The paleopedology of Norfolk Island' *Journal of Soil Science*, vol. 7, no. 2, pp. 255-267.
- Irwin, G, Flay, RGJ, Dudley, L & Johns, D 2023, 'The sailing performance of ancient Polynesian canoes and the early settlement of East Polynesia', *Archaeology in Oceania*, vol. 58, pp. 74-90.
- Johns, DA, Irwin, GJ & Sung, YK 2014, 'An early sophisticated East Polynesian voyaging canoe discovered on New Zealand's coast', *PNAS*, vol. 111, no. 41, pp. 14728-14733.
- Johnson, P 2011, 'Elemental analysis of fine-grained basalt sources from the Samoan Island of Tutuila: Applications of Energy-Dispersive X-Ray Fluorescence (EDXRF) and instrumental Neutron Activation Analysis (NAA) toward an intra-island provenance study', in M Shackley (ed.), *X-Ray Fluorescence Spectrometry (XRF) in Geoarchaeology*, Springer, New York.
- Jones, TL & Klar, KA 2005, 'Diffusionism reconsidered: linguistic and archaeological evidence for prehistoric Polynesian contact with Southern California', *American Antiquity*, no. 70, vol. 3, pp. 457-484.
- Jones, TL & Klar, KA 2009, 'On linguistics and cascading inventions: A Comment on Arnold's Dismissal of a Polynesian Contact Event in Southern California', *American Antiquity*, vol. 74, no. 1, pp. 173-182.
- Jones, J & McDougall, I 1973, 'Geological history of Norfolk and Philip Islands, southwest Pacific Ocean', *Journal of Geological Society of Australia*, vol. 20, no. 3, pp. 239-254.

- Jorgensen, N, Way, A & Flexner, J 2024 'A 600-700-year-old basalt adze production site from Mount Bates, Norfolk Island', *Archaeology in Oceania*, vol. 59, no. 1, pp. 138-148.
- Kahn, JG, Sinton, J, Mills, PR & Lundblad, SP 2013, 'X-ray fluorescence analysis and intra-island exchange in the Society Island archipelago (Central Eastern Polynesia)', *Journal of Archaeological Science*, vol. 40, pp. 1194-1202.
- Kayser, M 2010, 'The human genetic history of Oceania: Near and Remote views of dispersal', *Current Biology*, vol. 20, no. 4, pp. R194-R201.
- Kelloway, SJ, VanValkenburgh, P, Astuhuamán Gonzáles, C, Gonzáles Lombardi, A & Bedoya Vidal, D 2019, 'International pots of mystery: Using PXRF spectroscopy to identify the provenance of botijas from 16th century sites on Peru's north coast', *Journal of Archaeological Science*, vol. 27, pp. 101974.
- Kirch, PV 1984, 'The Polynesian Outliers: Continuity, change and replacement', *The Journal of Pacific History*, vol. 19, no. 4, pp. 224-238.
- Kirch, PV 1988a, 'Long-distance exchange and island colonization: the Lapita case', *Norwegian Archaeological Review*, vol. 21, no. 2, pp. 103-117.
- Kirch, PV 1988b, 'Polynesia's Mystery Islands', *Archaeology*, vol. 41, no. 3, pp. 26-31.
- Kirch, PV 2010, 'Peopling of the Pacific: a holistic anthropological perspective', *Annual Review of Anthropology*, vol. 39, pp. 131-148.
- Kirch, PV 2017, *On the Road of the Winds: An Archaeological History of the Pacific Islands before European Contact*, University of California Press, Berkeley.
- Kirch, PV & Green, RC 1987, 'History, phylogeny, and evolution in Polynesia', *Current Anthropology*, vol. 33, no. 1, pp. 161-186.
- Kirch, PV & Green, RC 2001, *Hawaiiiki, Ancestral Polynesia: An Essay in Historical Anthropology*, Cambridge University Press, Cambridge.
- Kirch, PV, Mills, PR, Lundblad, SP, Sinton, J & Kahn, JG 2012, 'Interpolity exchange of basalt tools facilitated via elite control in Hawaiian archaic states', *PNAS*, vol. 109, no. 4, pp. 1056-1061.
- Kirch, PV, Molle, G, Niespolo, EM & Sharp, WD 2021, 'Coordinated ¹⁴C and ²³⁰Th dating of Kitchen Cave rockshelter, Gambier (Mangareva) Islands, French Polynesia: Comparing ²³⁰Th coral dates with Bayesian model ages', *Journal of Archaeological Science*, Reports 35, Article 102724, pp. 1-13.
- Kirch, PV & Swift, JA 2017, 'New AMS radiocarbon dates and a re-evaluation of the cultural sequence of Tikopia Island, Southeast Solomon Islands', *Journal of the Polynesian Society*, vol. 126, no. 3, pp. 313-336.

- Kirch, PV & Yen, DE 1982, *Tikopia: The Prehistory and Ecology of a Polynesian Outlier*, Bernice P. Bishop Museum Bulletin 238, Bishop Museum Press, Honolulu.
- Ladefoged, TN, Graves, MW & Coil, JH 2005, 'The introduction of sweet potato in Polynesia: Early remains in Hawai'i', *Journal of the Polynesian Society*, vol. 114, no. 4, pp. 359-373.
- Laing, R 1912, 'Chief physiographic features of Norfolk Island', *Philosophical Institute of Canterbury*, 6 November, pp. 323-326.
- Le Bas, M, Maitre, R, Streckeisen, A & Zanettin, B 1986, 'A chemical classification of volcanic rocks based on the total alkali-silica diagram', *Journal of Petrology*, vol. 27, no. 3, pp. 745-750.
- Le Maitre, RW (ed.), Streckeisen, A, Zanettin, B, Le Bas, MJ, Bonin, B, Bateman, P, Bellieni, G, Dudek, A, Efremova, S, Keller, J, Lameyre, J, Sabine, PA, Schmid, R, Sorensen, H & Woolley, AR 2002, *Igneous rocks: A classification and glossary of terms: Recommendations of the International Union of Geological Sciences Subcommission on the Systematics of Igneous Rocks*, figure, 2nd edition, Cambridge University Press, Cambridge, p. 35.
- Leach, F & Ward, G 1981, *Archaeology on Kapingamarangi Atoll: a Polynesian outlier in the Eastern Caroline Islands*, Department of Anthropology, University of Otago, Dunedin, New Zealand.
- Lundblad, S, Mills, P & Hon, K 2008, 'Analysing archaeological basalt using non-destructive Energy-Dispersive X-Ray Fluorescence (EDXRF): Effects of post-depositional chemical weathering and sample size on analytical precision', *Archaeometry*, vol. 50, no. 1, pp. 1-11.
- Lundblad, S, Mills, P, Drake-Raue, A & Kikiloi, S 2011, 'Non-destructive EDXRF analyses of archaeological basalts', in M Shackley (ed.), *X-Ray Fluorescence Spectrometry (XRF) in Geoarchaeology*, Springer, New York, NY.
- Macphail, MK, Hope, GS & Anderson, A 2001, 'Polynesian plant introductions in the Southwest Pacific: initial pollen evidence from Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 123-134.
- Malaspinas, A-S, Oscar, L, Schroeder, H, Rasmussen, R, Raghavan, M, Moltke, I, Campos, PF, Sagredo, FS, Rasmussen, S, Gonçalves, VF, Albrechtsen, A, Allentoft, ME, Johnson, PLF, Li, M, Reis, S, Bernardo, DV, DeGiorgio, M, Duggan, AT, Bastos, M, Wang, Y, Stenderup, J, Moreno-Mayar, JV, Brunak, S, Sicheritz-Ponten, T, Hodges, E, Hannon, GJ, Orlando, L, Price, TD, Jensen, JD, Nielsen, R, Heinemeier, J, Olsen, J, Rodrigues-Carvalho, C, Lahr, MM, Neves, WA, Kayser, M, Higham, T, Stoneking, M, Pena, SDJ & Willerslev, E 2014, 'Two ancient human genomes reveal Polynesian ancestry among

- the indigenous Botocudos of Brazil', *Current Biology*, vol. 24, no. 21, pp. R1035–R1037.
- Matisoo-Smith, E, Horsburgh, KA, Robins, JH & Anderson, A 2001, 'Genetic variation in archaeological *Rattus exulans* remains from the Emily Bay settlement site, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 81-84.
- Matisoo-Smith, E, Sutton, DG, Ladefoged, TN, Lambert, DM & Allen, JS 1999, 'Prehistoric mobility in Polynesia: MtDNA variation in *Rattus exulans* from the Chatham and Kermadec Islands', *Asian Perspectives*, vol. 38, no. 2, pp. 186-199.
- Mauran, G, Lebon, M, Déroit, F, Caron, B, Nankela, A, Pleurdeau, D & Bahain, J 2019, 'First in situ pXRF analyses of rock paintings in Erongo, Namibia: results, current limits, and prospects', *Archaeological and Anthropological Sciences*, vol. 11, pp. 4123-4145.
- Maxwell, JJ & Smith, IWG 2015, 'A reassessment of settlement patterns and subsistence at Point Durham, Chatham Island', *Archaeology in Oceania*, vol. 50, pp. 162-174.
- McAlister, A 2011, 'Methodological issues in the geochemical characterisation and morphological analysis of stone tools: A case study from Nuku Hiva, Marquesas Islands, East Polynesia', figure, PhD thesis, viewed 8 August 2023, University of Auckland, <http://hdl.handle.net/2292/10279>, p. 96.
- McCarthy, F 1934, 'Norfolk Island: additional evidence of a former native occupation', *The Journal of the Polynesian Society*, vol. 43, no. 4, pp. 267-270.
- McCoy, MD & Carpenter, J 2014, 'Strategies for obtaining obsidian in pre-European contact era New Zealand', *PloS one*, vol. 9, no. 1, pp. 1-13.
- McCoy, MD, Cervera, C, Mulrooney, MA, McAlister, A & Kirch, PV 2020, 'Obsidian and volcanic glass artifact evidence for long-distance voyaging to the Polynesian Outlier island of Tikopia', *Quaternary Research*, vol. 98, pp. 1-9.
- McCoy, MD, Ladefoged, TN, Codlin, M & Sutton, DG 2014, 'Does Carneiro's circumscription theory help us understand Maori history? An analysis of the obsidian assemblage from Pouerua Pa, New Zealand (Aotearoa)', *Journal of Archaeological Science*, vol. 42, pp. 467-475.
- McCoy, MD, Mills, PR, Lundblad, S, Rieth, T, Kahn, JG & Gard, R 2011, 'A cost surface model of volcanic glass quarrying and exchange in Hawai'i', *Journal of Archaeological Science*, vol. 38, no. 10, pp. 2547-2560.
- McDougall, I & Aziz-Ur-Rahman 1972, 'Age of the Gauss-Matuyama Boundary and of the Kaena and Mammoth Events', *Earth and Planetary Science Letters*, vol. 14, pp. 367-380.

- McKern, WC 1929, *Archaeology of Tonga*, Bernice P. Bishop Museum Bulletin 60, Bishop Museum Press, Honolulu.
- McNiven, IJ, von Gnielinski, F & Quinnell, M 2004, 'Torres Strait and the origin of large stone axes from Kiwai Island, Fly River estuary (Papua New Guinea)', *Memoirs of the Queensland Museum*, Cultural Heritage Series, vol. 3, no. 1, pp. 201–219.
- McNiven, IJ, David, B, Richards, T, Aplin, K, Asmussen, B, Mialanes, J, Leavesley, M, Faulkner, P & Ulm, S 2011, 'New direction in human colonisation of the Pacific: Lapita settlement of south coast New Guinea', *Australian Archaeology*, vol. 72, pp. 1–6.
- Mead, SM, Birks, L, Birks, H & Shaw, E 1975, *The Lapita Pottery Style of Fiji and Its Associations*, Polynesian Society Memoir No. 38, Polynesian Society, Wellington, New Zealand.
- Meredith, CW, Specht, JR & Rich, PV 1985, 'A minimum date for Polynesian visitation to Norfolk Island, South-west Pacific, from faunal evidence', *Search*, vol. 16, pp. 304–306.
- Mills, P, Lima, P, Brandt, L, Kahn, J, Kirch, PV & Lundblad, S 2018 'Paired geochemical and technological analyses of basalt adze debitage at the Hālawa Dune Site, Moloka'i Island, Hawai'i: Basalt adze debitage at the Hālawa Dune Site', *Archaeology in Oceania*, vol. 53, no. 2, pp. 78–91.
- Molari, R & Appoloni, CR 2023, 'A study of portable X-ray fluorescence (pXRF) of the painting "Still Life with Vase, Plate and Flowers" (1886–1888)', *Applied Radiation and Isotopes*, vol. 196, pp. 1–6.
- Montenegro, A, Avis, C & Weaver, A 2008, 'Modeling the prehistoric arrival of the sweet potato in Polynesia', *Journal of Archaeological Science*, vol. 35, pp. 355–367.
- Montenegro, A, Callaghan, RT & Fitzpatrick, SM 2014, 'From west to east: environmental influences on the rate and pathways of Polynesian colonisation', *SAGE Publications*, vol. 24, no. 2, pp. 242–256.
- Moreno-Mayar, JV, Rasmussen, S, Seguin-Orlando, A, Rasmussen, M, Liang, M, Flåm, ST, Lie, BA, Gilfillan, GD, Nielsen, R, Thorsby, E, Willerslev, E & Malaspinas, A-S 2014, 'Genome-wide ancestry patterns in Rapanui suggest pre-European admixture with Native Americans', *Current Biology*, vol. 24, no. 21, pp. 2518–2525.
- Mortimer, N & Scott, JM 2020, 'Volcanoes of Zealandia and the Southwest Pacific', *New Zealand Journal of Geology and Geophysics*, vol. 63, no. 4, pp. 371–377.
- Mortimer, N, Gans, PB, Palin, JM, Herzer, RH, Pelletier, B & Monzier, M 2014, 'Eocene and Oligocene basins and ridges of the Coral Sea-New Caledonia region: Tectonic link between Melanesia, Fiji, and Zealandia', *Tectonics*, vol. 33, pp. 1386–1407.

- Mulrooney, MA, Bickler, SH, Allen, MS & Ladefoged, TN 2011, 'High-precision dating of colonization and settlement in East Polynesia', *PNAS*, vol. 108, no. 23, pp. E192–E194.
- Nash, J 2012, 'Melanesian Mission place names on Norfolk Island', *The Journal of Pacific History*, vol. 47, no. 4, pp. 475–489.
- Neri, LAM, Pawlik, AF, Reepmeyer, C, Mijares, ASB, Paz, VJ 2015, 'Mobility of early islanders in the Philippines during the Terminal Pleistocene/ Early Holocene boundary: pXRF-analysis of obsidian artefacts', *Journal of Archaeological Science*, vol. 61, pp. 149–157.
- Niespolo, EM, Sharp, WD & Kirch, PV 2019, '230Th dating of coral abraders from stratified deposits at Tangatatau Rockshelter, Mangaia, Cook Islands: Implications for building precise chronologies in Polynesia', *Journal of Archaeological Science*, vol. 101, no. 4, pp. 21–33.
- Norfolk Island Historical Society (NIHS) 1994, *Report on the Human History and Historic Sites of the Norfolk Island National Park*, March 1994.
- Ormond-Parker, L 2020, 'Aboriginal trade with Macassan seafarers', *Agora*, vol. 55, no. 3, pp. 3–7.
- Pearce, J 1996, 'A user's guide to basalt discrimination diagrams', *Trace Element Geochemistry of Volcanic Rocks: Applications for Massive Sulphide Exploration*, Geological Association of Canada, Short Course Notes, vol. 12, pp. 79–113.
- Pees, S, Duvall, G & Girault, J 2003, 'Eolian calcarenite and heavy minerals from the southwest Pacific', *Carbonates and Evaporites*, vol. 18, no. 2, pp. 108–119.
- Petchey, P, Taylor, R, Walker, K & Elliott, G 2023, *Archaeology of the Antipodes Islands*, New Zealand Department of Conservation Te Papa Atawhai, Wellington, New Zealand.
- Pösch, R 1907, 'Ausgrabungen alter Topfscherben in Wanigela (Collingwood Bay)', *Mitteilungen der Anthropologischen Gesellschaft in Wien*, vol. 37, pp. 137–139.
- Portable Spectral Services 2023, 'The Evolution of Portable XRF Instruments', <https://www.portaspecs.com/the-evolution-of-portable-xrf-instruments/>, viewed 1 September 2023.
- Ramírez-Aliaga, JM 2011, 'The Mapuche Connection', in TL Jones, AA Storey, EA Matisoo-Smith, JM Ramírez-Aliaga (eds.), *Polynesians in America: Pre-Columbian contacts with the New World*, Alta Mira Press, Lanham, MD, USA, pp. 95–110.
- Reepmeyer, C 2021, 'Modelling prehistoric social interaction in the south-western Pacific: a view from the obsidian sources in Northern Vanuatu', *Technical Reports of the Australian Museum Online*, no. 34, pp. 137–148.

- Richards, M 2019, 'Realising the potential of portable XRF for the geochemical classification of volcanic rock types', *Journal of Archaeological Science*, vol. 105, pp. 31-45.
- Richards, M 2021, 'Challenging typology: Re-evaluating historical and prehistoric exchanges of Polynesian adzes and pounders with pXRF' PhD thesis, University of Sydney.
- Richards, M & Gunther, J 2019, 'The past, present and future values of the Polynesian stone adzes and pounders collected on the *Pandora*', *Bulletin of the History of Archaeology*, vol. 29, no. 1, pp. 1-15.
- Rick, TC, Vellanoweth, RL, Erlandson, JM & Kennett, DJ 2002, 'On the antiquity of the single-piece shell fishhook: AMS radiocarbon evidence from the Southern California Coast', *Journal of Archaeological Science*, vol. 29, pp. 933-942.
- Rolett, B & Diamond, J 2004, 'Environmental predictors of pre-European deforestation on Pacific islands', *Nature*, vol. 431, pp. 443-446.
- Rolett, BV, West, EW, Sinton, JM & Iovita, R 2015, 'Ancient East Polynesian voyaging spheres: new evidence from the Vitaria Adze Quarry (Rurutu, Austral Islands)', *Journal of Archaeological Science*, vol. 53, pp. 459-471.
- Routledge, KS 1919, *The Mystery of Easter Island*, Sifton, Praed, London.
- Rowland MJ 2018, '65,000 years of isolation in Aboriginal Australia or continuity and external contacts? An assessment of the evidence with an emphasis on the Queensland coast', *Journal of the Anthropological Society of South Australia*, vol. 42, pp. 211-240.
- Rowland, MJ & Kerkhove, RC 2022, 'Evidence of external contact between the Pacific Basin and the east coast of Australia during the Holocene: A review', *Queensland Archaeological Research*, vol. 25, pp. 47-66.
- Roxburgh, MA 2021, 'Time machines; an exploration of Roman period copper-alloy objects in an Estonian *Tarand* cemetery, using pXRF', *Estonian Journal of Archaeology*, vol. 25, no. 2, pp. 182-213.
- Schmidt, L, Anderson, A & Fullagar, R 2001, 'Shell and bone artefacts from the Emily Bay settlement site, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 67-74.
- Sear, DA, Allen, MS, Hassall, JD, Maloney, AE, Langdon, PG, Morrison, AE, Henderson, ACG, Mackay, H, Croudace, IW, Clarke, C, Sachs, JP, Macdonald, G, Chiverrell, RC, Leng, MJ, Cisneros-Dozal, LM, Fonville, T & Pearson, E 2020, 'Human settlement of East Polynesia earlier, incremental, and coincident with prolonged South Pacific drought', *PNAS*, vol. 117, no. 16, pp. 8813-8819.

- Shackley, M 2011, 'An introduction to X-Ray Fluorescence (XRF) analysis in archaeology', in M Shackley (ed.), *X-Ray Fluorescence Spectrometry (XRF) in Geoarchaeology*, Springer, New York, NY.
- Shawcross, W 1967, 'An investigation of prehistoric diet and economy at a coastal site at Galatea Bay, New Zealand', *Proceedings of the Prehistoric Society*, vol. 33, pp. 107-131.
- Shawcross, W 1972, 'Energy and ecology: Thermodynamic models in archaeology', in DL Clarke (ed.), *Models in Archaeology*, Duckworth, London, pp. 277-305.
- Sheppard, P 2011, 'Lapita colonization across the Near/Remote Oceania Boundary', *Current Anthropology*, vol. 52, no. 6, pp. 799-840.
- Sheppard, P, Irwin, G, Lin, S & McCaffrey, C 2011, 'Characterisation of New Zealand obsidian using PXRF', *Journal of Archaeological Science*, vol. 38, no. 1, pp. 45-56.
- Sheppard, P, Trichereau, B & Milicich, C 2010, 'Pacific obsidian sourcing by portable XRF', *Archaeology in Oceania*, vol. 45, pp. 21-30.
- Sinoto, YH 1983, 'The Huahine excavation: Discovery of an ancient Polynesian canoe', *Archaeology*, vol. 36, no. 2, pp. 10-15.
- Smith 1921 [1910], *Hawaiki: The Original Home of the Maori, with a Aketch of Polynesian History*, 4th ed, Whitcombe and Tombs, Auckland, New Zealand.
- Smith, I, Clark, G & White, P 2001, 'Mammalian and reptilian fauna from Emily and Cemetery Bays, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 75-80.
- Speakman, R & Shackley, M 2013, 'Silo science and portable XRF in archaeology: A response to Frahm', *Journal of Archaeological Science*, vol. 40, pp. 1435-1443.
- Specht, J 1978, 'The early mystery of Norfolk Island', *Australian Natural History*, vol. 19, no. 7, pp. 218-223.
- Specht, J 1984, 'The prehistoric archaeology of Norfolk Island', *Pacific Archaeological Records*, vol. 34, pp. 1-76.
- Specht, J 1993, 'Additional evidence for pre-1788 visits by Pacific Islanders to Norfolk Island, South-West Pacific', *Records of the Australian Museum*, supplement 17, pp. 145-157.
- Spriggs, M 2019, 'Towards a history of Melanesian archaeological practices', in M Leclerc & J Flexner (eds.), *Archaeologies of Island Melanesia: Current approaches to landscapes, exchange and practice*, ANU Press, Acton, ACT.
- Spriggs, M & Anderson, A 1993, 'Late colonisation of east Polynesia', *Antiquity*, vol. 67, pp. 200-217.

- Spriggs, M 2022a, 'European interests and ideas on the diversity of human cultures in the Pacific (1500s-1870s)', in H Howes, T Jones & M Spriggs (eds.). *Uncovering Pacific Pasts: Histories of Archaeology in Oceania*, ANU Press, Canberra, ACT.
- Spriggs, M 2022b, 'The burgeoning field of anthropology and archaeology (1918-45)', in H Howes, T Jones & M Spriggs (eds.). *Uncovering Pacific Pasts: Histories of Archaeology in Oceania*, ANU Press, Canberra, ACT.
- Steiger, R & Jager, R 1977, 'Submission on Geochronology: Convention on the use of decay constants in geo- and cosmochronology', *Earth and Planetary Science Letters*, vol. 36, pp. 359-362.
- Steiner, A, Conrey, R & Wolff, J 2017, 'PXRF calibrations for volcanic rocks and the application of in-field analysis to the geosciences', *Chemical Geology*, vol. 453, pp. 35-54.
- Storey, AA, Clarke, AC, Ladefoged, T, Robins, J & Matisoo-Smith, E 2013, 'DNA and Pacific Commensal Models: Construction, limitations, and future prospects', *Journal of Island and Coastal Archaeology*, vol. 8, no. 1, pp. 37-65.
- Sullivan, LR 1924, 'Race types in Polynesia', *American Anthropologist*, vol. 26, pp. 22-26.
- Terrell, JE, Kelly, KM & Rainbird, P 2001, 'Foregone Conclusions? In search of "Papuan" and "Austronesians"', *Current Anthropology*, vol. 42, no. 1, pp. 97-124.
- The Church of England Messenger and Ecclesiastical Gazette for the Diocese of Melbourne and Ballarat*, 8 February 1881, pp. 11, viewed 5 July 2023, Trove database, <https://trove.nla.gov.au/newspaper/article/197132786/21680533>.
- Thomas, N 1989, 'The force of ethnology: Origins and significance of the Melanesia/Polynesia Division', *Current Anthropology*, vol. 30, no. 1, pp. 27-41.
- Thorpe, WW 1929, 'Evidence of Polynesian culture in Australia and Norfolk Island', *The Journal of the Polynesian Society*, vol. 38, no. 2, pp. 122-126.
- Thrum, T 1916-1920, *Fornander's Collection of Hawaiian Antiquities and Folk-lore*, 3 vols, Bernice P. Bishop Museum Memoirs 4, 5, and 6, Bishop Museum Press, Honolulu.
- Tochilin, C, Dickinson, WR, Felgate, MW, Pecha, M, Sheppard, P, Damon, FH, Bickler, S & Gehrels, GE 2012, 'Sourcing temper sands in ancient ceramics with U-Pb ages of detrital zircons: a southwest Pacific test case', *Journal of Archaeological Science*, vol. 39, pp. 2583-2591.
- Turner, M & Bonica, D 1994, 'Following the flake trail: adze production on the Coromandel East Coast, New Zealand', *New Zealand Journal of Archaeology*, vol. 16, pp. 5-32.

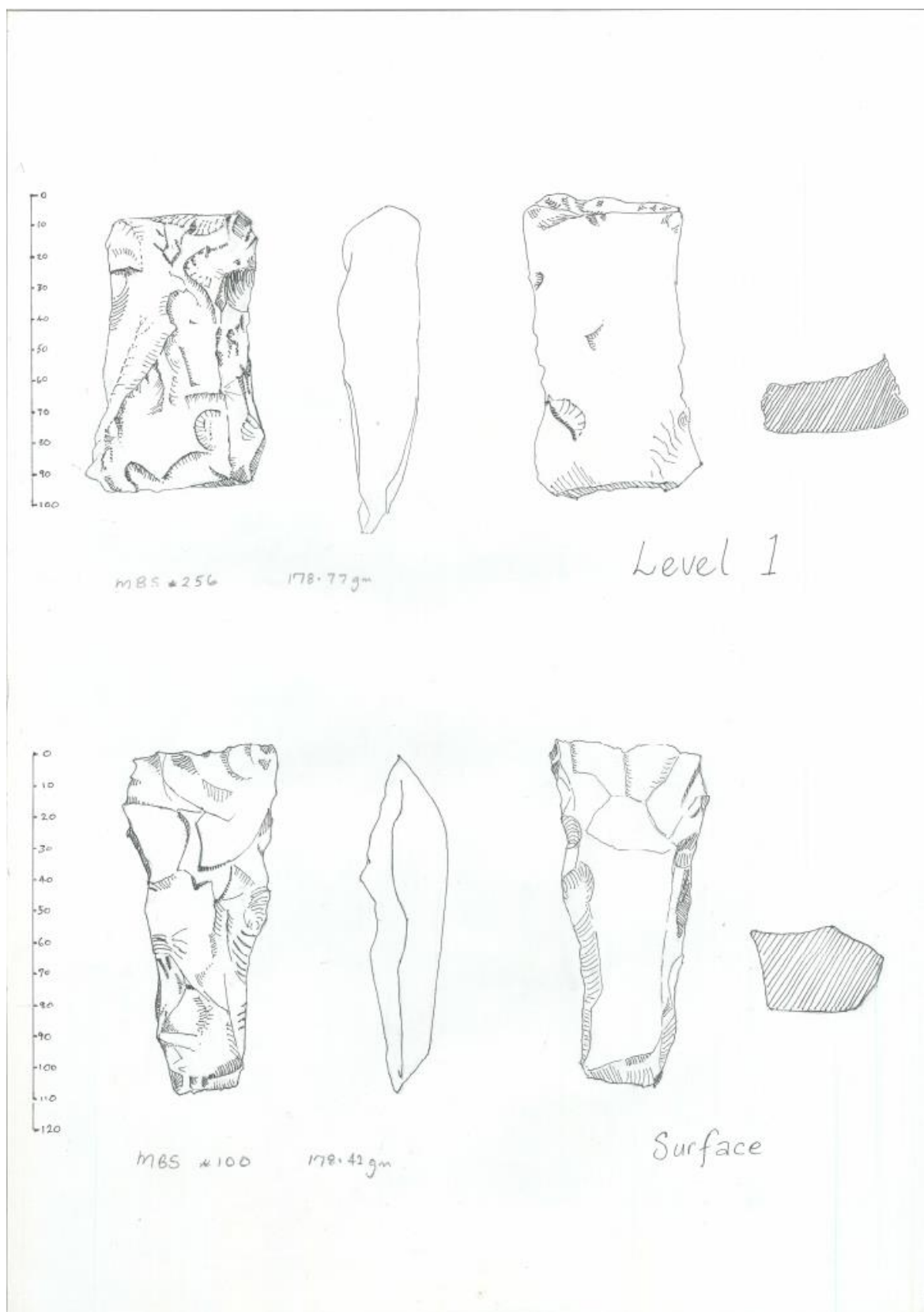
- Turner, M, Anderson, A & Fullagar, R 2001, 'Stone artefacts from the Emily Bay settlement site, Norfolk Island' in A Anderson & P White (eds.), *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 53-66.
- Ulm, S, McNiven, IJ, Summerhayes, GR, Wu, P, Bunbury, MME, Petchey, F, Hua, Q, Skelly, R, Lambrides, ABJ, Rowe, C, Lowe, KM, Reepmeyer, CH, Maclaurin, C, Woo, KGP, Harris, M, Morgan, SB, Turner-Kose, KL, Slater, SA, Connelly, JD, Kneppers, MC, Szabo, K, Fairbairn, A, Haberle, SG, Hopf, F, Bultitude, R, Ash, J, Lewis, SE, Beaman, RJ, Leon, JX, McDowell, MC, Potter, M, Connelly, B, Little, C, Jackson, S, McCarthy, J, Nothdurft, LD, Zhao, J, Bird, MI, Felgate, MW, Cobus, B & Walmbaar Aboriginal Corporation RNTBC 2024, 'Early Aboriginal pottery production and offshore island occupation on Jiigurru (Lizard Island group), Great Barrier Reef, Australia', *Quaternary Science Reviews*, vol. 333, Article 108624, pp. 1-22.
- Varman, R 1990, *Cemetery Bay Water Assurance Scheme. Quarry Site 1. Archaeological Report*, Unpublished report prepared for the Norfolk Island Government.
- Walter, R & Anderson, A 2001, 'Fishbone from the Emily Bay settlement site, Norfolk Island', *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, pp. 101-108.
- Walter, R, Jacomb, C & Bowron-Muth, S 2010, 'Colonisation, mobility and exchange in New Zealand prehistory', *Antiquity*, vol. 84, pp. 497-513.
- Walter, R, Buckley, H, Jacomb, C & Matisoo-Smith, E 2017, 'Mass migration and the Polynesian settlement of New Zealand', *Journal of World Prehistory*, vol. 30, pp. 351-376.
- Walters, I 1988, 'Fishhooks: Evidence for dual social systems in southeastern Australia?', *Australian Archaeology*, vol. 27, pp. 98-114.
- Wehi, PM, Scott, NJ, Beckwith, J, Rodgers, RP, Gillies, T, Van Uitregt, V & Watene, K 2022, 'A short scan of Māori journeys to Antarctica', *Journal of the Royal Society of New Zealand*, vol. 52, no. 5, pp. 587-598.
- Weisler, MI 1995, 'Henderson Island prehistory: colonization and extinction on a remote Polynesian island', *Biological Journal of the Linnean Society*, vol. 56, no. 1, pp. 377-404.
- Weisler, MI 2002, 'Centrality and the collapse of long distance voyaging in East Polynesia', in MD Glascock (ed.), *Geochemical Evidence for Trade and Exchange*, Bergin and Garvey, Westport, pp. 257-273.
- Weisler, MI 2008, 'Tracking ancient routes across Polynesian seascapes with basalt artifact geochemistry', in B David and J Thomas (eds.), *Handbook of Landscape Archaeology*, Left Coast Press, Walnut Creek, CA.

- Weisler, MI & Kirch, PV 1996, 'Interisland and interarchipelago transfer of stone tools in prehistoric Polynesia', *PNAS*, vol. 93, no. 4, pp. 1381-1385.
- Werner, WJ 2013, 'William Ellis, John Williams, and the Role of History in Missionary Nation-Making', *The Journal of the Midwest Modern Language Association*, vol. 46, no. 1, pp. 71-91.
- White, P, Reepmeyer, C & Clark, G 2014, 'A Norfolk Island basalt adze from coastal New South Wales', *Australian Archaeology*, vol. 79, no. 1, pp. 131-136.
- Williams-Thorpe, O 2008, 'The application of portable X-ray fluorescence analysis to archaeological lithic provenancing', in P Potts (ed.), *Portable X-ray Fluorescence Spectrometry: Capabilities for in Situ Analysis*, RSC Publishing, Cambridge, UK.
- Williams-Thorpe, O, Potts, PJ & Webb, PC 1999, 'Field-portable non-destructive analysis of lithic archaeological samples by X-Ray Fluorescence instrumentation using a Mercury Iodide Detector: Comparison with Wavelength-Dispersive XRF and a case study in British stone axe provenancing', *Journal of Archaeological Science*, vol. 26, pp. 215-237.
- Williams, J 1840, *A narrative of missionary enterprises in the South Sea Islands: with remarks upon the natural history of the islands, origin, languages, traditions, and usages of the inhabitants*, John Snow, London.
- Williamson, I & Sabath, MD 1984, 'Small Population Instability and Island Settlement Patterns', *Human Ecology*, vol. 12, no. 1, pp. 21-34.
- Wilmshurst, JM, Anderson, A, Higham, TFG & Worthy, TH 2008, 'Dating the late prehistoric dispersal of Polynesians to New Zealand using the commensal Pacific rat', *PNAS*, vol. 105, no. 22, pp. 7676-7680.
- Wilmshurst, JM, Hunt, TL, Lipo, CP & Anderson, A 2011, 'High-precision radiocarbon dating shows recent and rapid initial human colonization of East Polynesia', *PNAS*, vol. 108, no. 5, pp. 1815-1820.
- Wilson, WH 2012, 'Whence the East Polynesians? Further evidence for a Northern Outlier source', *Oceanic Linguistics*, vol. 51, no. 2, pp. 289-359.
- Wilson, WH 2018, 'The Northern Outliers-East Polynesian hypothesis expanded', *Journal of the Polynesian Society*, vol. 127, no. 4, pp. 389-423.
- Wilson, WH 2021, 'East Polynesian subgrouping and homeland implications within the Northern Outlier-East Polynesian hypothesis', *Oceanic Linguistics*, vol. 60, no. 1, pp. 36-71.

- Winchester, JA & Floyd, PA 1977, 'Geochemical discrimination of different magma series and their differentiation products using immobile elements, *Chemical Geology*, vol. 20, pp. 325–343.
- Yen, DE 1963, 'Sweet potato variation and its relation to human migration in the Pacific', in J Barrau (ed.), *Plants and the migrations of Pacific peoples*, Bishop Museum Press, Honolulu, pp. 93-118.
- Yen, DE 1971, 'Construction of the hypothesis for distribution of the sweet potato', in CL Riley (ed.), *Man across the sea: Problems of pre-Columbian contacts*, University of Texas Press, Austin (TX), pp 328-42.
- Yen, DE 1974, *The Sweet Potato in Oceania: An Essay in Ethnobotany*, Bishop Museum Press, Honolulu.
- Yen, DE, Kirch, PV, Rosendahl, P & Riley, T 1972, 'Prehistoric agriculture in the upper Makaha Valley, Oahu', in DE Yen and E Ladd (eds.), *Makaha Valley Historical Project: Interim Report No. 3*, Pacific Anthropological Records 18, Bernice P. Bishop Museum, Honolulu, pp. 59-94.
- Zinger, W, Valentin, F, Flexner, J, Bedford, S, Detroit, F & Grimaud-Herve, D 2020, 'How to explain Polynesian Outliers' heterogeneity?', in A Hermann, F Valentin, C Sand and E Nolet (eds.), *Networks and Monumentality in the Pacific: Proceedings of the XVIII UISPP World Congress (4-9 June 2018, Paris, France) Volume 7 Session XXXVIII*, Archaeopress Publishing Ltd, Oxford.

Appendix I: Mount Bates Saddle Site – Drawings

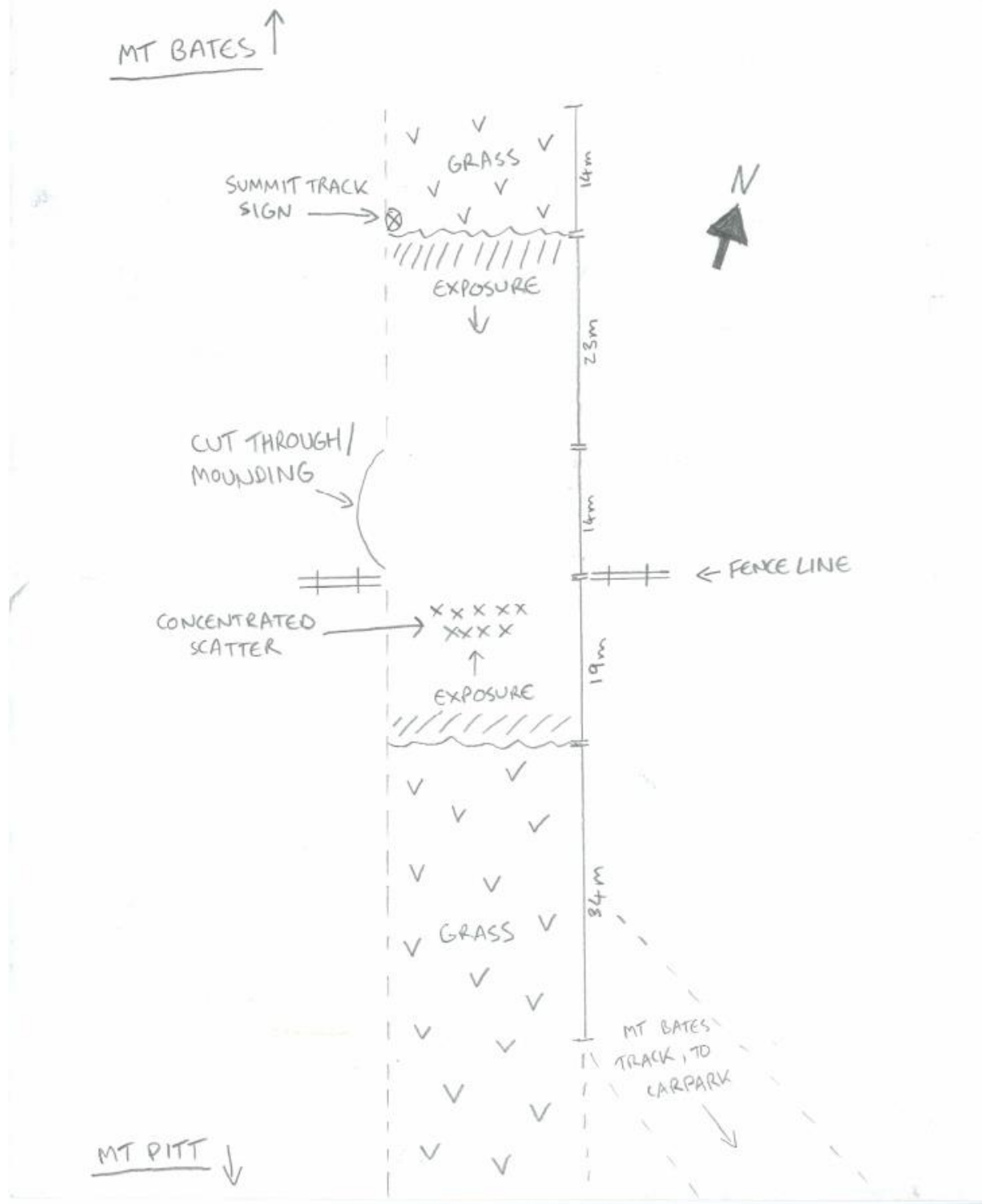
Adze Drawings



Plan Drawings

LOCATION: SADDLE BETWEEN MT PITT + MT BATES

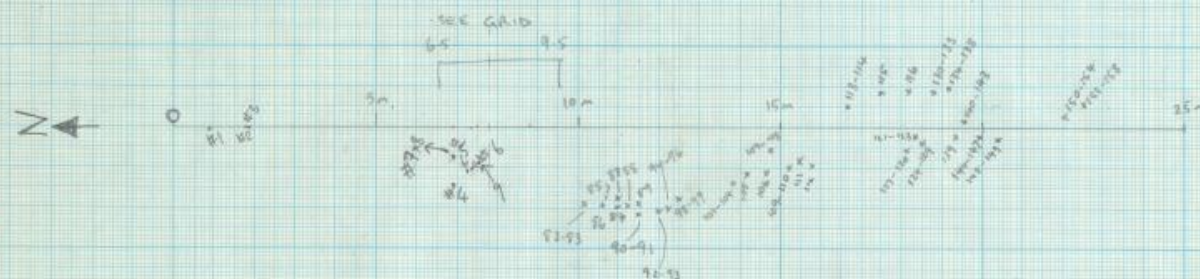
DATE: 18/05/2021



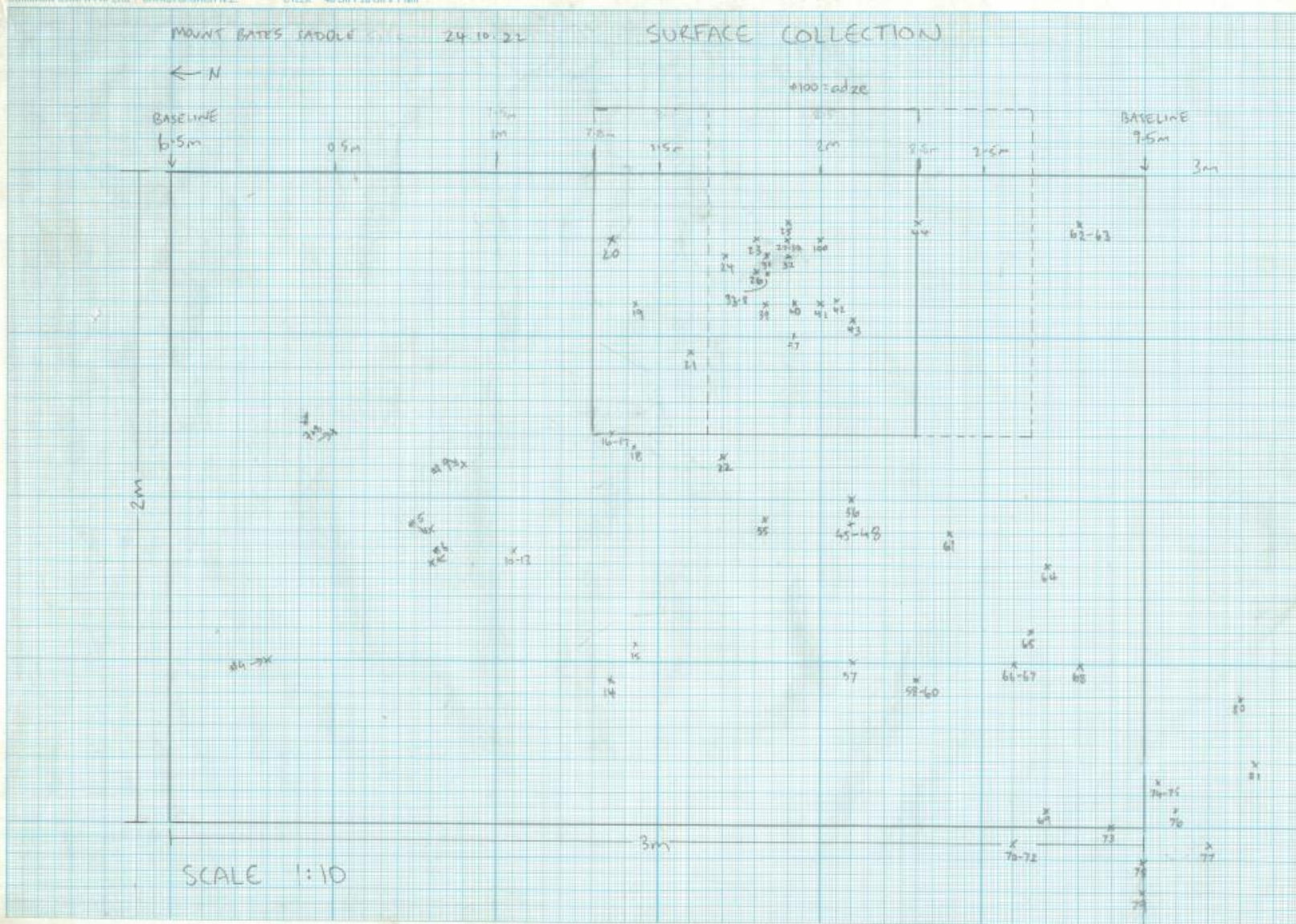
MOUNT BATES SADDLE

24.10.2022

SURFACE COLLECTION



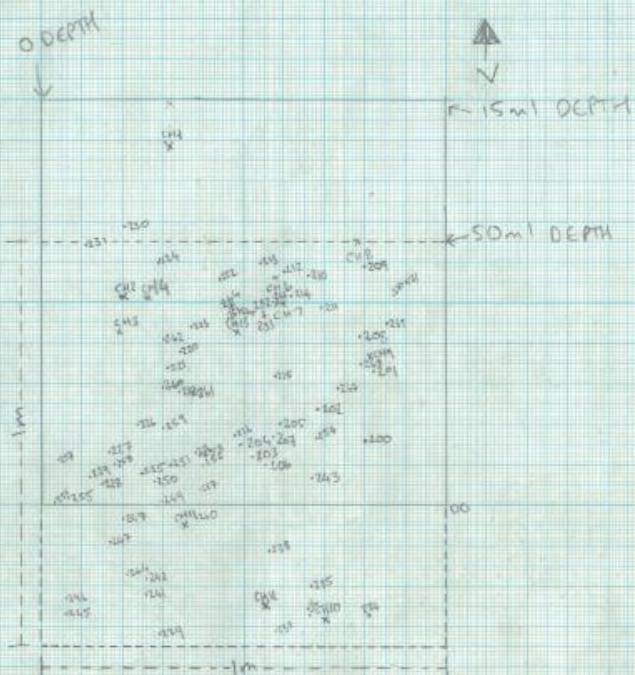
SCALE 1:100



MOUNT BATES SADDLE

25.10.2022 + 26.10.2022

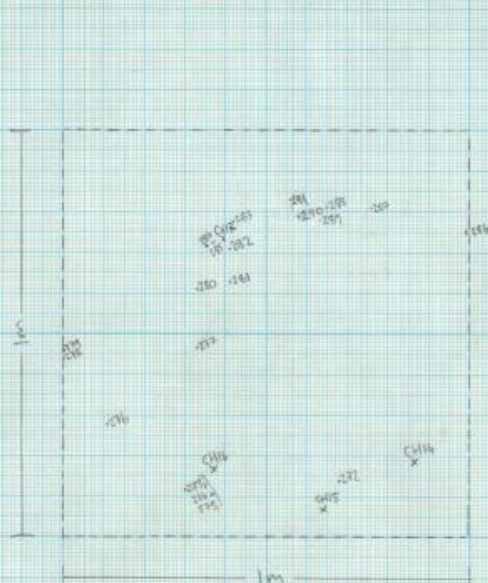
(SPIT/LEVEL 1)



MOUNT BATES SADDLE

26.10.2022

(SPIT/LEVEL 2)

W. 28.15
W. 28.15
W. 28.15

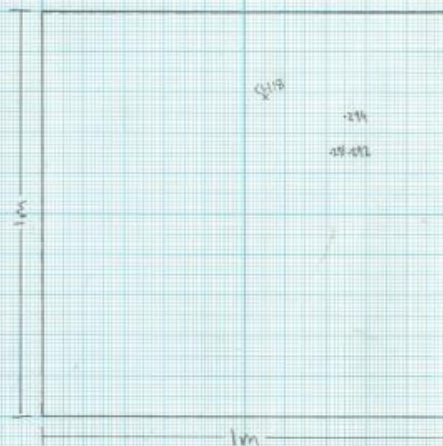
SCALE 1:10

MOUNT BATES SADDLE

26.10.2022

(SPIT/LEVEL 3)

N

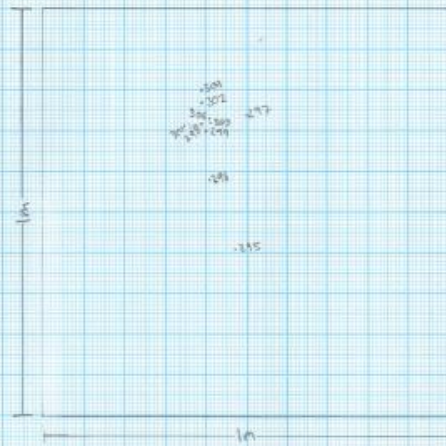


SCALE 1:10

MOUNT BATES SADDLE

26.10.2022

(SPIT / LEVEL 4)

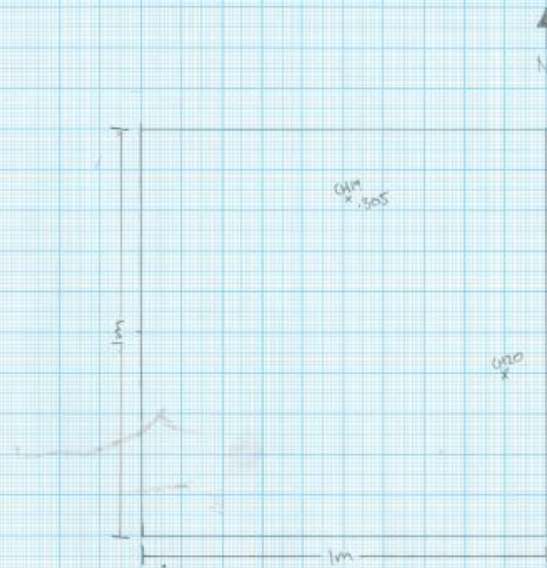


SCALE 1:10

MOUNT BATES SADDLE

27.10.2022

(SPIT/LEVEL 5)

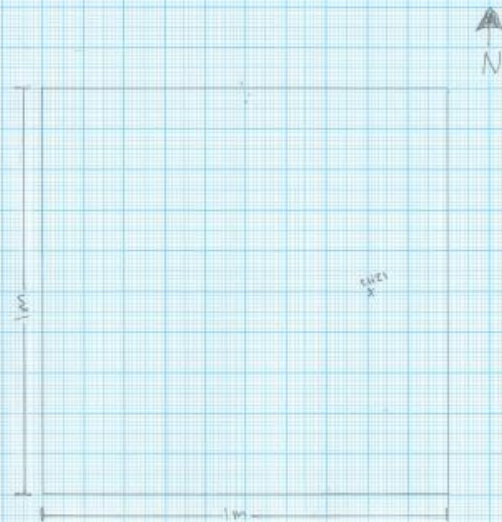


SCALE 1:10

MOUNT BATES SADDLE

27.10.2022

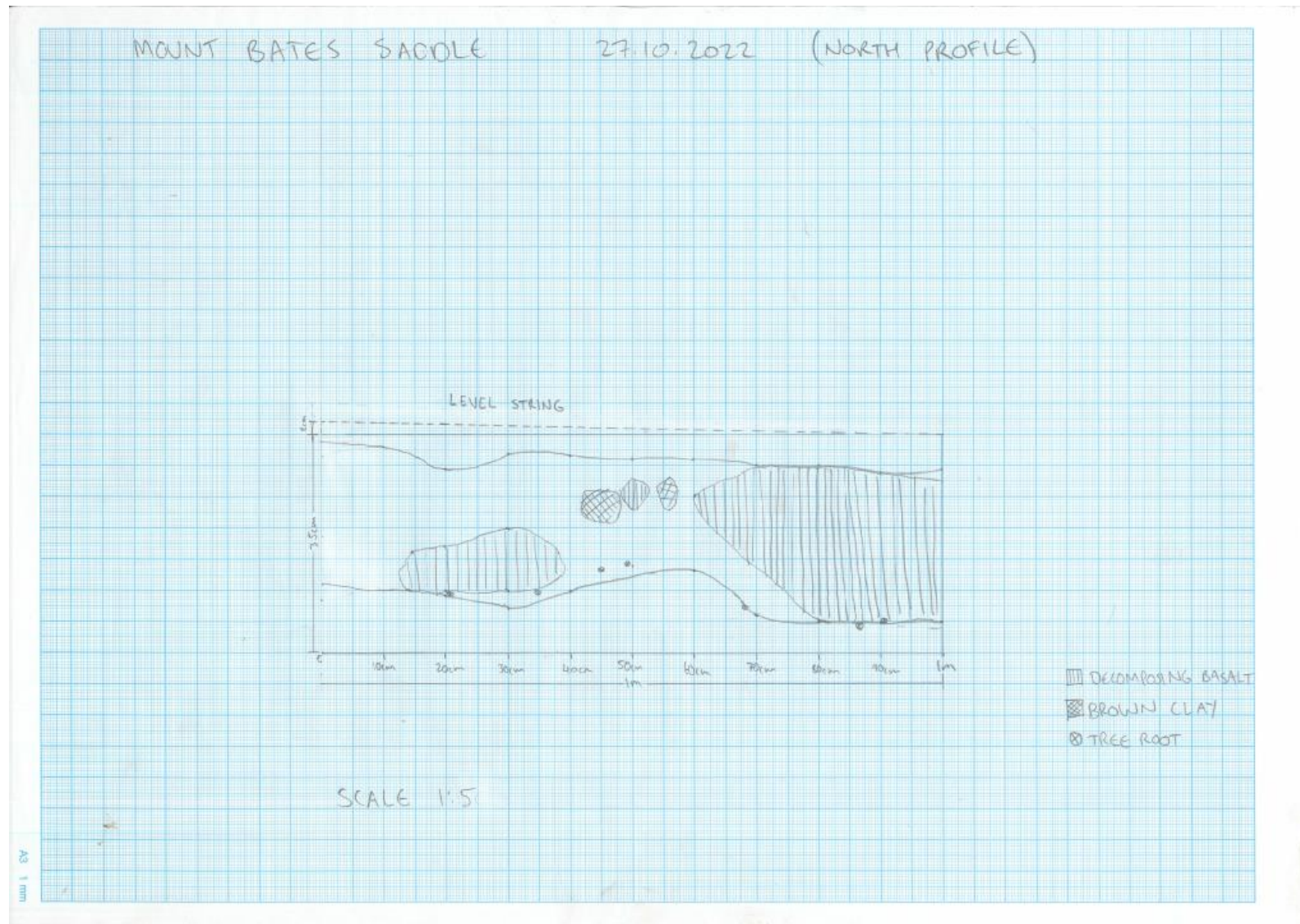
(SPIT/LEVEL 6)



* LEVEL 6 ends @ 30cm (3-4 tiny chips in sieve)
** LEVEL 7 = 30-35cm (sterile)

SCALE 1:10

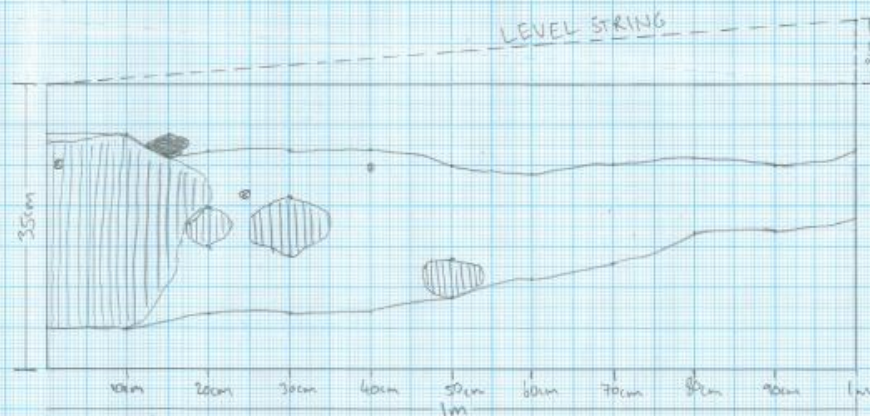
Section Drawings



MOUNT BATES SADDLE

27.10.2022

(EAST PROFILE)



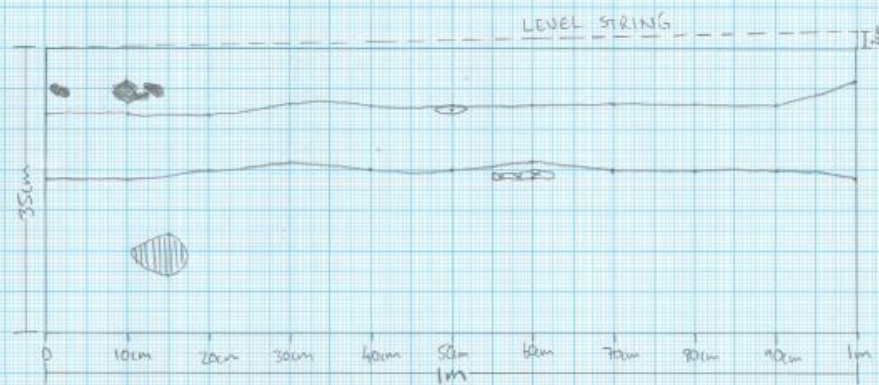
SCALE 1:5

- ROAD BASE (CALCARENITE)
- DECOMPOSING BASALT
- TREE ROOT

MOUNT BATES SADDLE

27.10.2022

(SOUTH PROFILE)



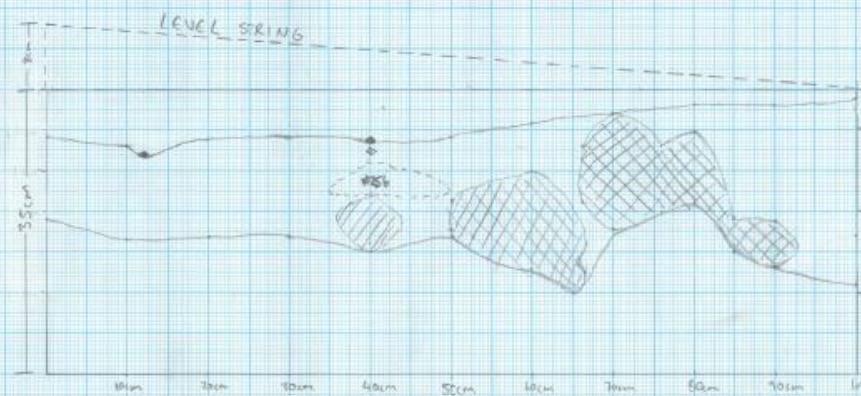
SCALE 1:5

- ▨ DECOMPOSING BASALT
- ARTIFACT
- ROAD BASE (CALCARENITE)
- ⊗ TREE ROOT

MOUNT BATES SADDLE

27.10.2022

(WEST PROFILE)



SCALE 1:5

- ROAD BASE (CALCARENITE)
- ▨ ORANGE CLAY
- ARTIFACT
- ⋯ CAVITY
- ▩ BROWN CLAY

Appendix II: Mount Bates Saddle Site – Artefact Catalogue

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	200	Flake/Preform	Basalt	Complete		210.58	Complex	Feather	80-90	70.51	25.41	76.13	86.94	29.43	0%	Y	N	Some retouch on left lateral margin and smaller amount on distal end (two scars). Retouch on lateral margin appears to be making straight edge, possible very early preform formation. 3D SCAN
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	201	Flake	Basalt	Broken	Proximal	14.63	Flaked		66-80	23.31	9.58							
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	202	Flake	Basalt	Complete		156.63	Plain	Step	80-90	26.43	8.67	72	114.9	14.71	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	203	Flake	Basalt	Broken	Distal	71.99		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	204	Flake	Basalt	Broken	LCS	53.68												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	205	Flake	Basalt	Complete		20.82	Focal	Outrepasse		1.63	0.42	25.68	56.47	14.82	0%	N	N	Outrepasse as termination appears 'stepped' but bottom is actually previous platform, core was rotated. Some crushing evident on platform. Varying weathering
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	206	Flake	Basalt	Broken	Medial	11.83												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	207	Flake	Basalt	Complete		23.18	Flaked	Feather	66-80	32.09	11.72	46.35	34.27	11.99	0%	N	N	Cone almost surrounded by hairline fracture
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	208	Flake	Basalt	Broken	Medial	7.5												Possible change in grain, darker section
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	209	Flake	Basalt	Complete		36.12	Plain	Feather	66-80	23.58	8.21	54.22	45.97	7.04	0%	N	N	Small break on lateral margin
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	210	Flake	Basalt	Complete		156.59	Focal	Outrepasse		1.73	0.84	124.64	49.91	29.4	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	211	Flake	Basalt	Broken	Medial	6.88												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	212	Flake	Basalt	Complete		280.95	Flaked	Feather	80-90	45.78	11.95	91.86	159.58	27.21	0-33%	N	N	Double cone, peripheral faceting around central platform, darker grain section
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	213	Flake	Basalt	Complete		17.53	Focal	Feather		2.83	0.77	41.55	39.58	8.64	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	214	Flake	Basalt	Complete		29.78	Plain	Hinge	33-66	34.61	2.72	32.33	60.91	8.64	0%	N	N	Double cone
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	215	Flake	Basalt	Complete		102.65	Flaked	Feather	66-80	62.13	13.55	69.09	54.32	16.93	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	216	Flake	Basalt	Broken	LCS	71.49												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	217	Flake	Basalt	Complete		61.13	Flaked	Feather	33-66	29.51	8.11	45.28	62.13	13.45	0%	N	N	Minor double cone
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	218	Flake	Basalt	Broken	LCS	62.6												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	219	Flake	Basalt	Broken	LCS	49.32												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	220	Flake	Basalt	Broken	Distal	24.03		Feather										Can't do full percentage of flake cortex as fragment but cortex covers 100% of distal frag dorsal
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	221	Flake	Basalt	Broken	Medial	5.83												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	222	Flake	Basalt	Broken	Proximal	10.71	Flaked		33-66	41.34	13.72							
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	223	Flake	Basalt	Broken	Medial	5.59												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	224	Flake	Basalt	Broken	Distal	12.05		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	225	Flake	Basalt	Complete		23.66	Crushed	Step				30.31	69.09	7.85	66-100%	N	N	Striations on cortex - post depositional? Almost grinding but more likely former
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	226	Flake	Basalt	Broken	LCS	43												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	227	Flake	Basalt	Complete		30.99	Flaked	Feather	66-80	31.43	9.97	64.33	31.31	17.43	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	228	Flake	Basalt	Broken	Proximal	61.54	Plain		66-80	35.46	14.6							
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	229	Flake	Basalt	Broken	Distal	42.04		Hinge										
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	230	Flake	Basalt	Broken	Medial	5.34												
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	231	Flake	Basalt	Broken	Proximal	2.23	Focal			4.22	0.84							
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	232	Flake	Basalt	Complete		7.2	Plain	Feather	33-66	24.51	7.99	26.14	28.65	5.33	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	25/10/2022	233	Flake	Basalt	Complete		54.59	Flaked	Feather	66-80	34.32	16.52	67.04	62.76	10.97	33-66%	N	N	Striations on cortex like #225
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2000	Flake	Basalt	Broken	Distal	13.31		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2001	Flake	Basalt	Broken	Medial	4.06												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2002	Flake	Basalt	Broken	Angular	3.06												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2003	Flake	Basalt	Broken	Proximal	0.54	Flaked		80-90	7.63	1.96							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2004	Flake	Basalt	Broken	Angular	0.33												100% cortex on one side of frag
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2005	Flake	Basalt	Broken	Medial	12.34												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2006	Flake	Basalt	Broken	Angular	8.33												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2007	Flake	Basalt	Complete		1.69	Flaked	Feather	33-66	15.8	4.57	17.47	20.65	2.97	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2008	Flake	Basalt	Broken	Medial	0.77												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2009	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2010	Flake	Basalt	Complete		7.29	Flaked	Feather	33-66	17.3	12.64	41.86	19.99	5.85	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2011	Flake	Basalt	Broken	Distal	2.74		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2012	Flake	Basalt	Broken	Angular	2.06												66-100% cortex on one side of frag
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2013	Flake	Basalt	Broken	Medial	0.44												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2014	Flake	Basalt	Broken	Angular	0.2												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2015	Flake	Basalt	Complete		3.01	Plain	Feather	0-33	4.49	1.29	30.99	17.89	5.31	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2016	Flake	Basalt	Broken	Medial	1.75												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2017	Flake	Basalt	Broken	Medial	1.31												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2018	Flake	Basalt	Broken	Angular	1.6												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2019	Flake	Basalt	Broken	Proximal	0.66	Plain		80-90	7.79	2.08							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2020	Flake	Basalt	Broken	Medial	4.29												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2021	Flake	Basalt	Complete		2.57	Focal	Feather		3.29	0.88	26.27	18.79	3.7	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2022	Flake	Basalt	Broken	Medial	0.54												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2023	Flake	Basalt	Complete		0.35	Plain	Feather	66-80	7.82	2.73	8.34	13.07	2.77	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2024	Flake	Basalt	Complete		0.34	Plain	Feather	33-66	3.73	2.53	11.43	8.65	1.89	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2025	Flake	Basalt	Broken	Angular	6.75												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2026	Flake	Basalt	Complete		2.41	Focal	Step		2.6	0.86	18.71	26.02	4.15	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2027	Flake	Basalt	Broken	Proximal	0.6	Plain		33-66	13.07	2.91							Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2028	Flake	Basalt	Complete		0.45	Plain	Feather	66-80	6.97	2.38	16.36	9.85	2.87	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2029	Flake	Basalt	Broken	Distal	0.27		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2030	Flake	Basalt	Complete		7.92	Plain	Feather	33-66	26.37	11.93	17.92	32.96	6.34	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2031	Flake	Basalt	Complete		1.28	Focal	Step		2.36	0.64	13.71	23	2.98	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2032	Flake	Basalt	Broken	Proximal	1.65	Plain		33-66	22.21	6.79							Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2033	Flake	Basalt	Broken	Medial	0.87												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2034	Flake	Basalt	Broken	Angular	0.4												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2035	Flake	Basalt	Broken	Angular	1.56												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2036	Flake	Basalt	Broken	Distal	0.96		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2037	Flake	Basalt	Broken	Medial	0.92												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2038	Flake	Basalt	Broken	Angular	0.65												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2039	Flake	Basalt	Broken	Angular	0.62												Small amount of cortex
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2040	Flake	Basalt	Broken	Angular	2.77												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2041	Flake	Basalt	Broken	Medial	1.67												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2042	Flake	Basalt	Broken	Medial	1.28												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2043	Flake	Basalt	Broken	LCS	0.96												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2044	Flake	Basalt	Complete		0.69	Crushed	Feather				10.51	17.57	2.76	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2045	Flake	Basalt	Broken	LCS	1.56												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2046	Flake	Basalt	Complete		1.05	Plain	Feather	33-66	13.53	5.2	15.02	14.31	4.44	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2047	Flake	Basalt	Complete		1.04	Plain	Feather	0-33	12.13	1.77	12.34	20.04	3.63	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2048	Flake	Basalt	Broken	Proximal	0.68	Plain		33-66	10.54	2.87							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2049	Flake	Basalt	Complete		0.44	Plain	Feather	33-66	11.51	3.6	8.49	13.25	2.93	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2050	Flake	Basalt	Broken	Medial	1.35												Heavily weathered ventral surface
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2051	Flake	Basalt	Broken	Angular	1.14												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2052	Flake	Basalt	Broken	Distal	0.37		Feather										Transverse breaks on both lateral margins. Small amount of platform visible (possible focal) but more distal so classified as distal frag
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2053	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2054	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2055	Flake	Basalt	Broken	Medial	1.34												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2056	Flake	Basalt	Complete		0.99	Focal	Step		3.19	1.57	21.09	13	1.85	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2057	Flake	Basalt	Broken	Distal	0.88		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2058	Flake	Basalt	Broken	Medial	0.78												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2059	Flake	Basalt	Broken	Angular	0.27												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2060	Flake	Basalt	Complete		0.63	Plain	Step	66-80	6.49	1.04	10.52	13.14	2.48	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2061	Flake	Basalt	Broken	Angular	0.59												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2062	Flake	Basalt	Broken	Angular	0.36												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2063	Flake	Basalt	Broken	Medial	0.22												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2064	Flake	Basalt	Broken	Distal	0.15		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2065	Flake	Basalt	Broken	Distal	0.94		Hinge										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2066	Flake	Basalt	Broken	Angular	0.93												Edge is heavily rounded. Looks like small amount of cortex but seems to extend slightly to ventral surface so more likely weathering
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2067	Flake	Basalt	Complete		0.57	Focal	Feather		2.43	0.75	11.62	17.06	2.78	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2068	Flake	Basalt	Broken	Distal	0.28		Step										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2069	Flake	Basalt	Broken	Angular	0.19												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2070	Flake	Basalt	Broken	Medial	0.53												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2071	Flake	Basalt	Broken	Angular	0.47												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2072	Flake	Basalt	Complete		0.36	Plain	Feather	66-80	10.07	3.51	6.11	13.31	2.77	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2073	Flake	Basalt	Broken	Medial	0.22												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2074	Flake	Basalt	Broken	Angular	0.14												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2075	Flake	Basalt	Broken	Proximal	1.28	Plain		66-80	12.13	1.45							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2076	Flake	Basalt	Broken	Proximal	0.89	Flaked		66-80	12.55	3.96							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2077	Flake	Basalt	Broken	Proximal	0.86	Focal			1.37	0.96							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2078	Flake	Basalt	Broken	Distal	0.72		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2079	Flake	Basalt	Broken	Medial	0.24												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2080	Flake	Basalt	Broken	Angular	0.75												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2081	Flake	Basalt	Broken	Angular	0.53												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2082	Flake	Basalt	Broken	Medial	0.5												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2083	Flake	Basalt	Broken	Medial	0.43												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2084	Flake	Basalt	Broken	Distal	0.18		Feather										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2085	Flake	Basalt	Broken	Angular	1.28												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2086	Flake	Basalt	Broken	Proximal	0.64	Plain		66-80	12.07	3.59							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2087	Flake	Basalt	Broken	Angular	0.44												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2088	Flake	Basalt	Broken	Angular	0.4												Heavily weathered, some cortex on one side - possibly not artefactual, weathering too heavy to identify features
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2089	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2090	Flake	Basalt	Broken	Distal	0.53		Hinge										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2091	Flake	Basalt	Broken	Medial	0.42												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2092	Flake	Basalt	Broken	Medial	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2093	Flake	Basalt	Complete		0.21	Plain	Feather	33-66	10.49	3.06	9.68	10	1.58	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2094	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2095	Flake	Basalt	Broken	Proximal	3.71	Plain		66-80	19.54	9.19							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2096	Flake	Basalt	Broken	Angular	1.55												Heavily weathered, some cortex on one side - possibly not artefactual, weathering too heavy to identify features
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2097	Flake	Basalt	Broken	Angular	1.46												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2098	Flake	Basalt	Broken	Medial	0.83												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2099	Flake	Basalt	Broken	Distal	0.23		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2100	Flake	Basalt	Broken	LCS	2.07												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2101	Flake	Basalt	Complete		1.29	Plain	Feather	66-80	9.1	3.13	20.08	19.48	1.93	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2102	Flake	Basalt	Broken	LCS	1.06												50% of fragment cortical
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2103	Flake	Basalt	Broken	Angular	0.59												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2104	Flake	Basalt	Broken	Distal	0.26		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2105	Flake	Basalt	Broken	Medial	3.41												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2106	Flake	Basalt	Broken	LCS	2.38												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2107	Flake	Basalt	Broken	Medial	1.61												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2108	Flake	Basalt	Broken	Medial	1.15												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2109	Flake	Basalt	Broken	Angular	0.41												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2110	Flake	Basalt	Broken	Distal	3.06		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2111	Flake	Basalt	Complete		2.62	Crushed	Step				27.03	16.13	5.13	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2112	Flake	Basalt	Broken	LCS	0.67												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2113	Flake	Basalt	Broken	Medial	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2114	Flake	Basalt	Broken	Medial	0.13												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2115	Flake	Basalt	Broken	Angular	2.57												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2116	Flake	Basalt	Complete		1.35	Plain	Feather	80-90	12.84	7.85	16.79	19.11	2.4	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2117	Flake	Basalt	Broken	Proximal	1.03	Plain		66-80	13.51	3.62							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2118	Flake	Basalt	Complete		0.72	Focal	Step	80-90	1.71	0.87	13.19	13.09	2.74	0%	N	N	Small lateral margin break - did not affect dimension measurements
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2119	Flake	Basalt	Broken	Distal	0.25		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2120	Flake	Basalt	Broken	Proximal	0.76	Focal			2.62	1.01							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2121	Flake	Basalt	Broken	Proximal	0.44	Plain		80-90	5.89	0.63							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2122	Flake	Basalt	Broken	Medial	0.35												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2123	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2124	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2125	Flake	Basalt	Broken	Medial	1.82												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2126	Flake	Basalt	Broken	Angular	0.69												Fully cortical on one side
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2127	Flake	Basalt	Broken	Medial	0.63												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2128	Flake	Basalt	Broken	Distal	0.34		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2129	Flake	Basalt	Broken	LCS	0.29												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2130	Flake	Basalt	Broken	Medial	0.88												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2131	Flake	Basalt	Broken	LCS	0.6												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2132	Flake	Basalt	Broken	Angular	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2133	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2134	Flake	Basalt	Broken	Angular	0.11												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2135	Flake	Basalt	Complete		3.63	Focal	Step		3.21	0.84	17.28	26.1	6.55	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2136	Flake	Basalt	Broken	LCS	3.08												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2137	Flake	Basalt	Broken	LCS	1.54												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2138	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2139	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2140	Flake	Basalt	Broken	Medial	1.63												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2141	Flake	Basalt	Broken	Angular	0.96												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2142	Flake	Basalt	Broken	Medial	0.63												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2143	Flake	Basalt	Broken	Angular	0.44												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2144	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2145	Flake	Basalt	Broken	Angular	0.64												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2146	Flake	Basalt	Complete		0.61	Focal	Feather		0.89	1.25	15.43	13.46	2.18	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2147	Flake	Basalt	Broken	Angular	0.39												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2148	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2149	Flake	Basalt	Broken	Angular	0.17												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2150	Flake	Basalt	Broken	Angular	1.21												Possible non-artefact, heavy weathering obscuring possible features, one side cortical
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2151	Flake	Basalt	Broken	Angular	0.4												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2152	Flake	Basalt	Broken	Angular	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2153	Flake	Basalt	Broken	Distal	0.3		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2154	Flake	Basalt	Broken	Angular	0.21												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2155	Flake	Basalt	Broken	Proximal	0.62	Focal			1.75	0.9							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2156	Flake	Basalt	Broken	Medial	0.61												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2157	Flake	Basalt	Broken	Proximal	0.39	Plain		80-90	9.18	2.5							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2158	Flake	Basalt	Complete		0.38	Crushed	Feather				11.19	9.92	2.14	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2159	Flake	Basalt	Complete		0.29	Focal	Feather		1.76	0.8	11.65	8.56	3.01	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2160	Flake	Basalt	Broken	Medial	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2161	Flake	Basalt	Broken	Angular	0.27												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2162	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2163	Flake	Basalt	Broken	Angular	0.22												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2164	Flake	Basalt	Broken	Proximal	0.18	Plain		66-80	5.08	2.58							
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2165	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2166	Flake	Basalt	Broken	Angular	0.49												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2167	Flake	Basalt	Broken	Angular	0.42												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2168	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2169	Flake	Basalt	Broken	Angular	0.19												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2170	Flake	Basalt	Broken	Medial	0.84												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2171	Flake	Basalt	Broken	Angular	0.53												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2172	Flake	Basalt	Broken	Angular	0.35												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2173	Flake	Basalt	Broken	Angular	0.24												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2174	Flake	Basalt	Complete		0.17	Focal	Feather		1.83	0.9	9.02	10.32	1.43	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2175	Flake	Basalt	Broken	Angular	0.36												Possible non-artefact, heavy weathering obscuring possible features, one side cortical
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2176	Flake	Basalt	Broken	Angular	0.33												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2177	Flake	Basalt	Broken	Angular	0.27												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2178	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2179	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2180	Flake	Basalt	Broken	Distal	5.64		Step										
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2181	Flake	Basalt	Broken	Medial	2.52												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2182	Flake	Basalt	Broken	Medial	0.76												
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2183	Flake	Basalt	Complete		0.64	Crushed	Step				15.67	18.89	2.03	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	25/10/2022	2184	Flake	Basalt	Broken	Medial	0.57												
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	234	Flake	Basalt	Complete		14.34	Plain	Feather	80-90	14.51	3.86	47.5	46.98	5.58	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	235	Flake	Basalt	Complete		16.14	Flaked	Feather	80-90	16.91	4.52	40.33	54.16	5.37	0%	N	N	Trowel damage on distal margin
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	236	Flake	Basalt	Broken	LCS	11.1												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	237	Flake	Basalt	Complete		142.48	Plain	Feather	80-90	17.39	19.01	91.02	49.61	11.05	0%	N	N	Post depositional edge crushing
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	238	Flake	Basalt	Broken	Medial	0.19												
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	239	Flake	Basalt	Broken	Proximal	34.02	Flaked		66-80	25.96	10.63							Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	240	Flake	Basalt	Complete		82.44	Plain	Step	80-90	35.55	8.7	49.68	86.95	9.43	0%	N	N	Interesting angular ripples
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	241	Flake	Basalt	Complete		2.45	Focal	Feather	66-80	1.91	0.85	27.02	20.93	3.97	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	242	Flake	Basalt	Broken	Distal	11.21		Hinge										Interesting striations on hinge termination. Almost complete, just platform broken
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	243	Flake	Basalt	Broken	Distal	23.44		Feather										Cortex on approx. 50% of dorsal
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	244	Flake	Basalt	Complete		5.01	Plain	Feather	66-80	10.79	6.39	22.46	23.59	9.24	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	245	Flake	Basalt	Broken	Medial	68.43												
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	246	Flake	Basalt	Broken	Proximal	57.21	Flaked		80-90	34.72	14.9							Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	247	Flake	Basalt	Complete		17.18	Focal	Step		5.07	0.9	33.23	28.5	11.26	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	248	Flake	Basalt	Complete		45.11	Flaked	Feather	80-90	41.16	12.7	41.2	47.87	14.61	0%	N	N	Feather termination at line of percussion but stepped in lateral/distal section
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	249	Flake	Basalt	Complete		27.01	Plain	Feather	80-90	27.6	1.54	38.98	68.92	7.77	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	250	Flake	Basalt	Complete		136.81	Plain	Hinge	80-90	73.08	11.76	62.89	78.41	16.75	0%	N	N	Possible double cone
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	251	Flake	Basalt	Complete		45.68	Plain	Hinge	80-90	9.94	9.61	55.18	62.67	11.38	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	252	Flake	Basalt	Complete		105.41	Plain	Feather	80-90	33.46	11.94	43.85	129.35	10.1	0%	N	N	Interesting ventral and negative scarring on dorsal
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	253	Flake	Basalt	Complete		54.77	Flaked	Step	80-90	39.46	11.69	54.26	57.84	9.51	0%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	254	Flake	Basalt	Broken	Proximal	7.96	Flaked		90+	24.49	6.15							Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	255	Flake	Basalt	Broken	Distal	80.3		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	256	Adze	Basalt	Preform		178.77						90.29	56.94	25.18	0%			Adze preform, earlier stage than #100. Dimensions are maximums.
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	257	Flake	Basalt	Complete		96.66	Plain	Hinge	90+	33.44	9.57	61.69	89.64	14.83	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	258	Flake	Basalt	Broken	Distal	13.73		Step										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	259	Flake	Basalt	Broken	Distal	25.41		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	260	Flake	Basalt	Broken	Proximal	10.94	Flaked		66-80	20.25	4.95							Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	261	Flake	Basalt	Broken	Proximal	14.83	Flaked		80-90	22.9	6.57	6						Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	262	Flake	Basalt	Broken	Distal	7.22		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	263	Flake	Basalt	Complete		4.37	Plain	Feather	66-80	19.58	9.45	28.36	19.7	4.62	0%	Y	N	4 negative retouch scars. Blocky piece, granular, difficult to distinguish features on ventral
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	264	Flake	Basalt	Broken	Distal	8.05		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	265	Flake	Basalt	Broken	Distal	4.64		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	266	Flake	Basalt	Complete		24.01	Plain	Step	80-90	59.5	13.58	44.85	60.6	13.01	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	267	Flake	Basalt	Complete		7.05	Focal	Feather		4.94	1	34.03	28.27	6.18	0%	N	N	Trowel damage on platform
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	268	Flake	Basalt	Complete		2.68	Plain	Step	33-66	31.41	6.52	11.92	35.72	4.2	0%	N	N	Double cone
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	269	Flake	Basalt	Complete		133.16	Plain	Step	66-80	48.93	17.9	68.61	55.11	22.34	0-33%	N	N	
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	270	Flake	Basalt	Broken	Distal	5.39		Feather										
Mount Bates Saddle (MBS)	1	1	In situ	26/10/2022	271	Flake	Basalt	Broken	Distal	21.4		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2185	Flake	Basalt	Broken	Angular	3.3												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2186	Flake	Basalt	Complete		1.65	Focal	Feather		1.66	0.18	21.01	16.64	4.02	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2187	Flake	Basalt	Broken	Medial	1.16												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2188	Flake	Basalt	Broken	Medial	1.09												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2189	Flake	Basalt	Broken	Proximal	0.21	Focal			1.47	0.63							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2190	Flake	Basalt	Broken	Distal	3.39		Feather										Small amount of cortex on dorsal distal margin - approx 30% of frag dorsal
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2191	Flake	Basalt	Broken	Angular	2.3												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2192	Flake	Basalt	Broken	Angular	0.72												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2193	Flake	Basalt	Broken	Medial	0.66												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2194	Flake	Basalt	Broken	Distal	0.24		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2195	Flake	Basalt	Broken	Medial	4												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2196	Flake	Basalt	Broken	Medial	0.98												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2197	Flake	Basalt	Broken	Medial	0.87												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2198	Flake	Basalt	Broken	Medial	0.45												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2199	Flake	Basalt	Broken	Angular	0.36												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2200	Flake	Basalt	Broken	Proximal	2.91	Plain		80-90	13.86	2.88							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2201	Flake	Basalt	Broken	Medial	0.92												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2202	Flake	Basalt	Broken	Angular	0.87												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2203	Flake	Basalt	Broken	Medial	0.48												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2204	Flake	Basalt	Broken	Angular	0.27												Dorsal side 100% cortical
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2205	Flake	Basalt	Broken	Distal	1.9		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2206	Flake	Basalt	Complete		1.22	Plain	Feather	33-66	15.34	4.94	4.89	15.36	5	0%	N	N	Tiny double cone.
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2207	Flake	Basalt	Broken	Medial	0.74												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2208	Flake	Basalt	Broken	Medial	0.43												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2209	Flake	Basalt	Broken	Angular	0.15												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2210	Flake	Basalt	Broken	LCS	8												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2211	Flake	Basalt	Complete		1.25	Plain	Feather	33-66	5.2	1.99	22.19	17.05	2.98	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2212	Flake	Basalt	Broken	Medial	1.12												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2213	Flake	Basalt	Broken	Distal	0.33		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2214	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2215	Flake	Basalt	Broken	Angular	4.68												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2216	Flake	Basalt	Broken	Medial	0.96												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2217	Flake	Basalt	Broken	Medial	0.6												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2218	Flake	Basalt	Broken	Proximal	0.56	Focal			1.66	0.45							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2219	Flake	Basalt	Broken	Angular	0.17												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2220	Flake	Basalt	Complete		2.23	Plain	Hinge	66-80	5.91	4.12	21.22	17.04	4.94	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2221	Flake	Basalt	Broken	Proximal	1.12	Plain		80-90	4.36	1.18							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2222	Flake	Basalt	Broken	Medial	0.74												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2223	Flake	Basalt	Broken	LCS	0.56												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2224	Flake	Basalt	Broken	Angular	0.26												Possible non-artefact, heavily weathered and broken
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2225	Flake	Basalt	Complete		2.19	Plain	Step	66-80	14.22	4.46	14.78	25.83	3.96	0%	N	N	Trowel damage at distal edge
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2226	Flake	Basalt	Broken	Medial	0.93												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2227	Flake	Basalt	Broken	Proximal	0.54	Plain		80-90	11.69	0.93							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2228	Flake	Basalt	Broken	Medial	0.41												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2229	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2230	Flake	Basalt	Complete		10.39	Flaked	Feather	0-33	30.19	12.63	21.84	30.16	13.4	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2231	Flake	Basalt	Complete		1.43	Plain	Feather	80-90	15.41	3.25	13.57	20.9	2.85	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2232	Flake	Basalt	Broken	Distal	1.02		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2233	Flake	Basalt	Broken	Angular	0.43												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2234	Flake	Basalt	Broken	Angular	0.22												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2235	Flake	Basalt	Complete		4.45	Plain	Step	66-80	12.26	4.88	32.4	22.13	3.54	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2236	Flake	Basalt	Broken	Medial	1.49												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2237	Flake	Basalt	Broken	Medial	0.9												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2238	Flake	Basalt	Broken	Angular	0.78												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2239	Flake	Basalt	Broken	Angular	0.24												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2240	Flake	Basalt	Broken	Medial	2.66												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2241	Flake	Basalt	Broken	Medial	1												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2242	Flake	Basalt	Broken	Medial	0.62												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2243	Flake	Basalt	Broken	Medial	0.31												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2244	Flake	Basalt	Broken	Angular	0.13												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2245	Flake	Basalt	Complete		2.48	Focal	Step		2.1	0.46	24.2	16.95	6.02	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2246	Flake	Basalt	Complete		0.93	Plain	Feather	33-66	12.9	4.54	14.81	13.02	3.23	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2247	Flake	Basalt	Broken	Medial	0.88												Almost complete flake, breaks at distal and platform will affect measurements/angles so none taken
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2248	Flake	Basalt	Broken	Proximal	0.57	Plain		80-90	6.01	1.46							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2249	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2250	Flake	Basalt	Broken	LCS	2.31												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2251	Flake	Basalt	Broken	Medial	1.01												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2252	Flake	Basalt	Complete		0.64	Focal	Feather		2	1.38	12.69	15.94	2.72	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2253	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2254	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2255	Flake	Basalt	Broken	LCS	1.96												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2256	Flake	Basalt	Broken	Medial	0.77												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2257	Flake	Basalt	Broken	Medial	0.55												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2258	Flake	Basalt	Broken	Medial	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2259	Flake	Basalt	Broken	Proximal	0.18	Plain		66-80	5.92	2.04							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2260	Flake	Basalt	Broken	Medial	1.81												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2261	Flake	Basalt	Broken	Angular	1.06												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2262	Flake	Basalt	Broken	Medial	0.6												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2263	Flake	Basalt	Complete		0.47	Plain	Feather	33-66	13.36	2.7	8.16	14.34	2.71	0%	N	N	Tiny double cone
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2264	Flake	Basalt	Broken	Angular	0.33												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2265	Flake	Basalt	Broken	LCS	1.82												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2266	Flake	Basalt	Broken	Angular	1.51												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2267	Flake	Basalt	Broken	Medial	0.87												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2268	Flake	Basalt	Complete		0.44	Plain	Step	66-80	3.81	1.91	12.87	9.28	2.71	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2269	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2270	Flake	Basalt	Broken	Proximal	7.21	Plain		80-90	6.71	2.69	30.68	26.47	5.15	0%	N	N	Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2271	Flake	Basalt	Broken	Medial	2.09												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2272	Flake	Basalt	Broken	Proximal	1.49	Plain		80-90	5.03	2.41							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2273	Flake	Basalt	Broken	Angular	0.42												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2274	Flake	Basalt	Broken	Angular	0.28												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2275	Flake	Basalt	Complete		2.12	Plain	Feather	80-90	11.55	2.86	14.23	27.69	2.41	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2276	Flake	Basalt	Broken	Medial	0.97												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2277	Flake	Basalt	Broken	LCS	0.68												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2278	Flake	Basalt	Broken	Medial	0.55												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2279	Flake	Basalt	Broken	Angular	0.48												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2280	Flake	Basalt	Complete		7.31	Focal	Step		4.97	1.88	41.32	32.6	5.97	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2281	Flake	Basalt	Broken	Medial	1.37												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2282	Flake	Basalt	Broken	Proximal	0.98	Plain		66-80	10.44	4.14							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2283	Flake	Basalt	Broken	Medial	0.33												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2284	Flake	Basalt	Broken	Angular	0.17												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2285	Flake	Basalt	Complete		12.25	Flaked	Step	80-90	24.4	6.23	23.78	28.58	8.01	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2286	Flake	Basalt	Broken	Proximal	1.21	Focal			2.16	0.79							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2287	Flake	Basalt	Broken	Angular	0.53												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2288	Flake	Basalt	Complete		0.41	Plain	Step	80-90	9.38	1.09	10.66	14.86	2.36	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2289	Flake	Basalt	Complete		0.31	Crushed	Feather				7.79	12.95	2.34	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2290	Flake	Basalt	Complete		2.05	Plain	Feather	33-66	19.05	6.58	16.02	22.4	4.96	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2291	Flake	Basalt	Broken	Medial	1.05												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2292	Flake	Basalt	Broken	Medial	0.69												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2293	Flake	Basalt	Broken	Medial	0.45												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2294	Flake	Basalt	Broken	Angular	0.33												Possible non-artefact
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2295	Flake	Basalt	Broken	Medial	2.46												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2296	Flake	Basalt	Broken	Medial	1.14												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2297	Flake	Basalt	Broken	Angular	1.04												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2298	Flake	Basalt	Broken	Angular	0.76												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2299	Flake	Basalt	Broken	Distal	0.32		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2300	Flake	Basalt	Broken	Medial	2.22												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2301	Flake	Basalt	Broken	Medial	1												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2302	Flake	Basalt	Complete		0.94	Plain	Feather	33-66	16.3	6.49	9.81	16.34	5.73	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2303	Flake	Basalt	Broken	Angular	0.77												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2304	Flake	Basalt	Broken	Distal	0.24		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2305	Flake	Basalt	Broken	Angular	5.29												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2306	Flake	Basalt	Broken	Medial	1.4												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2307	Flake	Basalt	Broken	LCS	0.76												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2308	Flake	Basalt	Broken	Proximal	0.39	Plain		66-80	5.5	3.6							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2309	Flake	Basalt	Broken	Angular	0.06												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2310	Flake	Basalt	Broken	Medial	8.55												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2311	Flake	Basalt	Complete		2.09	Crushed	Feather				14.61	24.17	5.07	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2312	Flake	Basalt	Complete		2	Plain	Feather	66-80	13.58	6.28	19.12	20.97	3.1	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2313	Flake	Basalt	Complete		0.56	Focal	Step		1.57	0.55	15.57	13	2.38	0	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2314	Flake	Basalt	Complete		0.21	Plain	Step	66-80	6.06	2.81	8.03	7.87	1.96	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2315	Flake	Basalt	Broken	LCS	15.13												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2316	Flake	Basalt	Complete		1.31	Crushed	Step				23.23	16.49	2.61	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2317	Flake	Basalt	Broken	Distal	1.21		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2318	Flake	Basalt	Broken	LCS	0.43												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2319	Flake	Basalt	Broken	LCS	0.14												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2320	Flake	Basalt	Broken	LCS	5.93												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2321	Flake	Basalt	Complete		1.76	Plain	Step	80-90	11.3	2.22	15.35	20.59	4.34	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2322	Flake	Basalt	Broken	Distal	0.72		Step										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2323	Flake	Basalt	Broken	Medial	0.64												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2324	Flake	Basalt	Broken	Proximal	0.39	Focal			3.02	0.95							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2325	Flake	Basalt	Broken	Proximal	8.67	Plain		80-90	11.73	1.66							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2326	Flake	Basalt	Broken	LCS	1.66												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2327	Flake	Basalt	Broken	Medial	0.94												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2328	Flake	Basalt	Broken	Distal	0.69		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2329	Flake	Basalt	Broken	Medial	0.46												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2330	Flake	Basalt	Complete		6.54	Focal	Feather		1.82	1.79	22.33	43.94	7.02	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2331	Flake	Basalt	Broken	Angular	2.35												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2332	Flake	Basalt	Broken	Angular	1.98												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2333	Flake	Basalt	Broken	Medial	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2334	Flake	Basalt	Broken	Angular	0.12												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2335	Flake	Basalt	Broken	Distal	3.61		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2336	Flake	Basalt	Broken	Distal	1.12		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2337	Flake	Basalt	Broken	LCS	0.55												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2338	Flake	Basalt	Broken	Medial	0.47												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2339	Flake	Basalt	Broken	Medial	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2340	Flake	Basalt	Broken	Medial	3.01												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2341	Flake	Basalt	Broken	Medial	0.93												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2342	Flake	Basalt	Broken	Distal	0.8		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2343	Flake	Basalt	Complete		0.51	Plain	Feather	66-80	13.98	3.33	8.45	14.24	2.97	0%	N	N	Heavy weathering on dorsal face
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2344	Flake	Basalt	Complete		0.06	Focal	Feather		0.95	0.46	6.47	7.18	0.86	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2345	Flake	Basalt	Complete		10.98	Plain	Step	66-80	28.06	11.22	33.59	24.08	9.74	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2346	Flake	Basalt	Broken	Distal	1.43		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2347	Flake	Basalt	Broken	Distal	1.34		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2348	Flake	Basalt	Broken	Angular	0.61												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2349	Flake	Basalt	Broken	Distal	0.14		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2350	Flake	Basalt	Broken	Angular	0.71												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2351	Flake	Basalt	Broken	Medial	0.65												Heavy weathering on dorsal face
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2352	Flake	Basalt	Broken	Medial	0.64												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2353	Flake	Basalt	Broken	Angular	0.42												Possible non-arteifact
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2354	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2355	Flake	Basalt	Broken	Proximal	0.66	Plain		80-90	8.76	2.17							Tiny double cone
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2356	Flake	Basalt	Broken	Angular	0.62												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2357	Flake	Basalt	Broken	Distal	0.27		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2358	Flake	Basalt	Broken	Proximal	0.24	Focal			2.28	0.86							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2359	Flake	Basalt	Broken	Angular	0.13												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2360	Flake	Basalt	Broken	Medial	0.42												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2361	Flake	Basalt	Broken	Proximal	0.22	Plain		33-66	4.99	1.23							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2362	Flake	Basalt	Complete		0.28	Plain	Feather	33-66	4.79	3.04	12.94	6.08	1.55	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2363	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2364	Flake	Basalt	Complete		0.2	Plain	Feather	66-80	8.67	3.52	8.07	9.13	2.33	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2365	Flake	Basalt	Broken	Medial	0.6												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2366	Flake	Basalt	Broken	LCS	0.31												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2367	Flake	Basalt	Broken	Medial	0.27												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2368	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2369	Flake	Basalt	Broken	Angular	0.21												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2370	Flake	Basalt	Broken	Angular	0.45												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2371	Flake	Basalt	Broken	Proximal	0.26	Plain		80-90	9.55	1.42							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2372	Flake	Basalt	Broken	Medial	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2373	Flake	Basalt	Complete		0.15	Plain	Step	80-90	5.1	0.86	7.79	10.01	1.17	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2374	Flake	Basalt	Broken	Angular	0.14												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2375	Flake	Basalt	Complete		0.57	Plain	Feather	80-90	10.83	2.02	9.92	16.68	3.12	N	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2376	Flake	Basalt	Broken	Angular	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2377	Flake	Basalt	Broken	Angular	0.19												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2378	Flake	Basalt	Broken	Medial	0.19												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2379	Flake	Basalt	Broken	Medial	0.16												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2380	Flake	Basalt	Broken	LCS	0.6												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2381	Flake	Basalt	Broken	Angular	0.47												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2382	Flake	Basalt	Broken	Distal	0.28		Hinge										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2383	Flake	Basalt	Complete		0.24	Plain	Feather	66-80	10.27	2.22	9.38	11.82	1.98	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2384	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2385	Flake	Basalt	Complete		0.48	Crushed	Step				13.32	8.88	1.97	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2386	Flake	Basalt	Broken	Medial	0.4												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2387	Flake	Basalt	Complete		0.38	Plain	Feather	33-66	4.87	1.58	10.84	11.25	1.31	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2388	Flake	Basalt	Broken	Angular	0.34												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2389	Flake	Basalt	Broken	Angular	0.3												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2390	Flake	Basalt	Broken	Distal	0.74		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2391	Flake	Basalt	Broken	Angular	0.61												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2392	Flake	Basalt	Broken	Medial	0.54												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2393	Flake	Basalt	Broken	Medial	0.38												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2394	Flake	Basalt	Broken	LCS	0.24												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2395	Flake	Basalt	Broken	Angular	0.98												Possible non artefact, heavy weathering
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2396	Flake	Basalt	Broken	Medial	0.63												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2397	Flake	Basalt	Broken	Medial	0.44												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2398	Flake	Basalt	Broken	Medial	0.32												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2399	Flake	Basalt	Broken	Medial	0.23												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2400	Flake	Basalt	Broken	Angular	1.01												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2401	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2402	Non-artefact	Basalt															Piece of Norfolk Island Pine seed
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2403	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2404	Flake	Basalt	Broken	Medial	0.22												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2405	Flake	Basalt	Broken	Medial	0.78												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2406	Flake	Basalt	Broken	LCS	0.51												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2407	Flake	Basalt	Broken	Distal	0.33		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2408	Flake	Basalt	Broken	LCS	0.29												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2409	Flake	Basalt	Complete		0.24	Focal	Feather		1.99	0.54	12.12	9.56	1.77	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2410	Flake	Basalt	Broken	Medial	1.68												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2411	Flake	Basalt	Broken	Medial	0.67												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2412	Flake	Basalt	Broken	Angular	0.58												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2413	Flake	Basalt	Broken	Angular	0.48												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2414	Flake	Basalt	Broken	LCS	0.29												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2415	Flake	Basalt	Broken	Angular	0.94												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2416	Flake	Basalt	Broken	Medial	0.7												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2417	Flake	Basalt	Broken	Angular	0.58												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2418	Flake	Basalt	Broken	Medial	0.3												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2419	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2420	Flake	Basalt	Broken	Proximal	0.78	Plain		66-80	11.27	2.31							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2421	Flake	Basalt	Broken	Medial	0.66												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2422	Flake	Basalt	Broken	Angular	0.45												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2423	Flake	Basalt	Broken	Distal	0.33		Distal										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2424	Flake	Basalt	Broken	Angular	0.19												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2425	Flake	Basalt	Broken	Proximal	0.89	Plain		80-90	9.13	3.68							
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2426	Flake	Basalt	Broken	Distal	0.61		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2427	Flake	Basalt	Broken	Medial	0.3												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2428	Flake	Basalt	Broken	Angular	0.27												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2429	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2430	Flake	Basalt	Broken	Distal	1		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2431	Flake	Basalt	Broken	Angular	0.85												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2432	Flake	Basalt	Complete		0.76	Plain	Feather	33-66	13.68	4.44	10.62	13.6	4.26	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2433	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2434	Flake	Basalt	Complete		0.24	Plain	Feather	33-66	7.42	3.34	8.12	7.82	1.96	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2435	Flake	Basalt	Complete		1.14	Plain	Feather	33-66	12.9	5.46	15.84	17.28	3.54	0%	qN	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2436	Flake	Basalt	Complete		0.72	Plain	Step	80-90	6.59	2.67	13.33	12.6	2.96	0%	N	N	
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2437	Flake	Basalt	Broken	Medial	0.67												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2438	Flake	Basalt	Broken	Distal	0.36		Feather										
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2439	Flake	Basalt	Broken	Medial	0.21												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2440	Flake	Basalt	Broken	Medial	0.64												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2441	Flake	Basalt	Broken	Medial	0.48	Plain	Feather										Partial platform and dorsal but not LCS - lateral margin break
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2442	Flake	Basalt	Broken	Angular	0.39												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2443	Flake	Basalt	Broken	Angular	0.37												
Mount Bates Saddle (MBS)	1	1	Sieve	26/10/2022	2444	Flake	Basalt	Broken	Angular	0.17												
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	272	Flake	Basalt	Complete		76.33	Flaked	Feather	33-66	55.01	18	43.16	80.24	21.8	33-66%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	273	Flake	Basalt	Complete		11.56	Plain	Feather	66-80	19.39	8.3	29.19	32.37	9.11	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	274	Flake	Basalt	Broken	Distal	4.31		Feather										
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	275	Flake	Basalt	Complete		18.89	Flaked	Feather	80-90	27.63	6.61	37.84	47.27	10.11	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	276	Flake	Basalt	Broken	LCS	50.24												
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	277	Flake	Basalt	Complete		216.05	Flaked	Feather	80-90	23.4	10.11	66.69	127.21	19.72	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	278	Flake	Basalt	Broken	Distal	30.07		Feather										Almost complete, platform broken off
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	279	Flake	Basalt	Broken	LCS	138.47												
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	280	Flake	Basalt	Complete		30.09	Plain	Step	80-90	20.72	8.71	31.31	59.99	12.75	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	281	Flake	Basalt	Complete		57.04	Plain	Hinge	80-90	26.3	10.87	57.98	49.36	13.11	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	282	Flake	Basalt	Complete		8.31	Plain	Feather	80-90	12.96	2.46	37.91	36.52	4.61	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	283	Flake	Basalt	Complete		49.07	Flaked	Feather	80-90	15.6	8.63	53.56	83.85	8.35	0%	N	N	Artefact was overlying charcoal sample #CH17, remnant charcoal remains on dorsal surface

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	284	Flake	Basalt	Broken	LCS	16.51												
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	285	Flake	Basalt	Complete		30.22	Plain	Feather	33-66	37.21	4.99	49.03	57.32	9.44	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	286	Flake	Basalt	Complete		15.17	Plain	Step	66-80	44.83	7.02	39.52	44.93	6.77	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	287	Flake	Basalt	Broken	Proximal	70.61	Plain		80-90	29.84	9.97							Almost complete flake, breakage at distal end - platform angle measured because almost complete
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	288	Flake	Basalt	Broken	LCS	144.11												
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	289	Flake	Basalt	Complete		5.47	Plain	Feather	66-80	29.44	6.62	23.64	29.35	6.86	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	290	Flake	Basalt	Complete		10.54	Plain	Step	66-80	26.06	4.71	28.47	41.62	5.33	0%	N	N	
Mount Bates Saddle (MBS)	1	2	In situ	26/10/2022	291	Flake	Basalt	Complete		103.08	Plain	Step	80-90	32.71	10.81	52.38	77.96	15.69	0%	N	N	Double cone
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2445	Flake	Basalt	Broken	Proximal	5.36	Plain		80-90	27.45	3.33							
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2446	Flake	Basalt	Broken	Medial	0.88												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2447	Flake	Basalt	Broken	Angular	0.62												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2448	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2449	Flake	Basalt	Broken	Medial	0.17												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2450	Flake	Basalt	Complete		4.01	Plain	Feather	33-66	21.38	5.77	22.35	24.54	5.73	0%	N	N	
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2451	Flake	Basalt	Complete		1	Plain	Feather	33-66	10.68	4.55	8.86	17.16	3.63	0%	N	N	Heavily weathered
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2452	Flake	Basalt	Broken	Angular	0.63												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2453	Flake	Basalt	Broken	Medial	0.51												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2454	Flake	Basalt	Broken	Angular	0.14												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2455	Flake	Basalt	Broken	Proximal	3.82	Plain		80-90	20.94	9.12							
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2456	Flake	Basalt	Broken	Angular	2.95												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2457	Flake	Basalt	Broken	Medial	0.79												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2458	Flake	Basalt	Broken	Medial	0.67												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2459	Flake	Basalt	Broken	Angular	0.32												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2460	Flake	Basalt	Complete		2.05	Plain	Feather	33-66	25.5	6.77	12.05	28.54	5.35	0%	N	N	
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2461	Flake	Basalt	Broken	LCS	1.95												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2462	Flake	Basalt	Broken	Medial	0.88												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2463	Flake	Basalt	Broken	Angular	0.7												100% cortex on one side
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2464	Flake	Basalt	Broken	Angular	0.5												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2465	Flake	Basalt	Broken	Medial	3												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2466	Flake	Basalt	Broken	Distal	2.85		Feather										
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2467	Flake	Basalt	Broken	Medial	0.39												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2468	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2469	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2470	Flake	Basalt	Broken	Distal	2.22		Feather										
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2471	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2472	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2473	Flake	Basalt	Broken	Distal	0.27		Feather										
Mount Bates Saddle (MBS)	1	2	Sieve	26/10/2022	2474	Flake	Basalt	Broken	Distal	0.22		Feather										
Mount Bates Saddle (MBS)	1	3	In situ	26/10/2022	292	Flake	Basalt	Complete		14.17	Flaked	Feather	66-80	22.18	10.08	42.75	29.48	8.18	0%	N	N	
Mount Bates Saddle (MBS)	1	3	In situ	26/10/2022	293	Flake	Basalt	Broken	Medial	8.43	Crushed											Partial platform, breakage on distal and left lateral margin
Mount Bates Saddle (MBS)	1	3	In situ	26/10/2022	294	Flake	Basalt	Complete		221.04	Plain	Feather	80-90	27.99	5.23	76.5	118.03	18.63	0-33%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2475	Flake	Basalt	Broken	Medial	1.03												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2476	Flake	Basalt	Broken	Proximal	0.31	Plain		33-66	7.64	4.79							
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2477	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2478	Flake	Basalt	Broken	LCS	0.26												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2479	Flake	Basalt	Broken	LCS	0.21												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2480	Flake	Basalt	Broken	Proximal	1.17	Plain		33-66	12.93	4.7							
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2481	Flake	Basalt	Broken	Medial	1.04												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2482	Flake	Basalt	Broken	Angular	0.81												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2483	Flake	Basalt	Broken	Medial	0.37												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2484	Flake	Basalt	Broken	Angular	0.27												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2485	Flake	Basalt	Broken	Distal	8.48		Hinge										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2486	Flake	Basalt	Broken	Distal	1.4		Feather										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2487	Flake	Basalt	Complete		1.04	Crushed	Step				17.16	16.19					
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2488	Flake	Basalt	Complete		0.6	Plain	Step	80-90	8.29	3.08	16.42	11.88	1.78	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2489	Flake	Basalt	Broken	Medial	0.19												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2490	Flake	Basalt	Complete		11.13	Plain	Feather	80-90	14.77	7.11	25.19	46	4.53	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2491	Flake	Basalt	Broken	Medial	1.74												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2492	Flake	Basalt	Broken	Angular	1.05												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2493	Flake	Basalt	Broken	Angular	1.04												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2494	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2495	Flake	Basalt	Complete		56.78	Plain	Feather	80-90	11.77	5.36	49.76	57.2	19.12	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2496	Flake	Basalt	Broken	Proximal	2.77	Plain		80-90	17.35	7.16							
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2497	Flake	Basalt	Broken	Angular	1.21												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2498	Flake	Basalt	Broken	Angular	0.74												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2499	Flake	Basalt	Broken	LCS	0.66												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2500	Flake	Basalt	Broken	Medial	2.68												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2501	Flake	Basalt	Broken	Medial	1.77												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2502	Flake	Basalt	Broken	Medial	1.26												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2503	Flake	Basalt	Broken	Medial	1.2												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2504	Flake	Basalt	Complete		0.45	Crushed	Feather				16.24	10.41	2.59	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2505	Flake	Basalt	Broken	Angular	3.67												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2506	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2507	Flake	Basalt	Complete		0.94	Plain	Feather	33-66	15.86	5.78	11.94	16.19	3.51	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2508	Flake	Basalt	Broken	Angular	0.9												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2509	Flake	Basalt	Broken	Angular	0.83												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2510	Flake	Basalt	Broken	Medial	2.07												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2511	Flake	Basalt	Broken	Medial	0.93												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2512	Flake	Basalt	Broken	Angular	0.52												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2513	Flake	Basalt	Broken	Angular	0.4												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2514	Flake	Basalt	Broken	Medial	0.31												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2515	Flake	Basalt	Broken	Distal	3.41		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2516	Flake	Basalt	Broken	Angular	1.04												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2517	Flake	Basalt	Broken	Distal	0.53		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2518	Flake	Basalt	Broken	Distal	0.43		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2519	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2520	Flake	Basalt	Broken	Distal	2.42		Step										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2521	Flake	Basalt	Broken	Angular	1.34												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2522	Flake	Basalt	Broken	Angular	1.21												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2523	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2524	Flake	Basalt	Complete		0.3	Plain	Feather	66-80	6.17	2.37	8.81	9.53	3.18	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2525	Flake	Basalt	Complete		3.79	Flaked	Feather	66-80	11.89	2.95	31.52	21.1	6.07	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2526	Flake	Basalt	Complete		2.02	Plain	Feather	66-80	21.69	3.96	13.81	29.93	5.72	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2527	Flake	Basalt	Broken	Medial	1.5												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2528	Flake	Basalt	Broken	Angular	0.68												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2529	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2530	Flake	Basalt	Broken	Distal	5.11		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2531	Flake	Basalt	Broken	LCS	1.97												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2532	Flake	Basalt	Broken	Angular	0.76												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2533	Flake	Basalt	Complete		0.24	Plain	Feather	80-90	6.92	3.3	9.28	8.28	2.54	0%	N	N	
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2534	Flake	Basalt	Broken	Angular	0.22												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2535	Flake	Basalt	Broken	Medial	7.47												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2536	Flake	Basalt	Broken	Medial	1.55												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2537	Flake	Basalt	Broken	Distal	0.95		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2538	Flake	Basalt	Broken	Angular	0.48												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2539	Flake	Basalt	Broken	Angular	0.28												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2540	Flake	Basalt	Complete		15.7	Flaked	Feather	80-90	27.01	7.72	39.07	48.48	7.3	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2541	Flake	Basalt	Broken	Angular	2.44												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2542	Flake	Basalt	Broken	Angular	0.81												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2543	Flake	Basalt	Broken	Medial	0.48												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2544	Flake	Basalt	Broken	Distal	0.23		Feather										
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2545	Flake	Basalt	Broken	Medial	1.05												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2546	Flake	Basalt	Broken	Medial	0.55												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2547	Flake	Basalt	Broken	Medial	0.31												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2548	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2549	Flake	Basalt	Broken	Angular	0.21												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2550	Flake	Basalt	Broken	Medial	5.91												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2551	Flake	Basalt	Broken	Angular	2.1												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2552	Flake	Basalt	Broken	Angular	1.41												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2553	Flake	Basalt	Broken	Angular	0.37												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2554	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2555	Flake	Basalt	Broken	Angular	1.22												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2556	Flake	Basalt	Broken	Angular	0.45												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2557	Flake	Basalt	Broken	LCS	0.29												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2558	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2559	Flake	Basalt	Broken	Angular	0.21												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2560	Flake	Basalt	Broken	Angular	29.58												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2561	Flake	Basalt	Broken	Proximal	2.8	Plain		66-80	15.25	5.57							Edge crushed at distal end (post-depositional damage)
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2562	Flake	Basalt	Broken	Medial	1.02												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2563	Flake	Basalt	Broken	LCS	0.38												
Mount Bates Saddle (MBS)	1	3	Sieve	26/10/2022	2564	Flake	Basalt	Broken	Medial	0.36												
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	295	Flake	Basalt	Complete		15.96	Plain	Step	33-66	29.14	12	27.01	37.66	7.37	0%	N	N	
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	296	Flake	Basalt	Broken	Medial	16.24												
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	297	Flake	Basalt	Broken	Distal	38.39		Feather										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	298	Flake	Basalt	Complete		39.93	Plain	Feather	80-90	28.96	7.53	57.42	59.42	8.89	0%	N	N	Break on right lateral margin
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	299	Flake	Basalt	Complete		9.7	Plain	Feather	66-80	29.93	10.63	22.69	50.36	3.81	0%	N	N	Indent line down percussion axis
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	300	Flake	Basalt	Broken	Distal	5.14		Feather										Almost complete, platform crushed off (trowel damage?)
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	301	Flake	Basalt	Broken	Medial	8.46												
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	302	Flake	Basalt	Complete		148.92	Plain	Feather	33-66	88.18	20.64	27.81	103.29	12.49	33-66%	N	N	Cortical patches, percussion point does not to be near edge - very wide platform.
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	303	Flake	Basalt	Broken	Distal	22.7		Feather										
Mount Bates Saddle (MBS)	1	4	In situ	26/10/2022	304	Flake	Basalt	Complete		10.52	Plain	Step	80-90	11.35	3.69	36.4	37.15	7.59	0%	N	N	
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2565	Flake	Basalt	Broken	Distal	0.79		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2566	Flake	Basalt	Broken	Angular	0.66												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2567	Flake	Basalt	Broken	Angular	0.58												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2568	Flake	Basalt	Broken	Proximal	0.39	Plain		33-66	6.99	3.9							
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2569	Flake	Basalt	Broken	Distal	0.11		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2570	Flake	Basalt	Complete		0.36	Crushed	Feather				7.79	14.72	3.55	0%	N	N	
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2571	Flake	Basalt	Broken	Angular	0.21												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2572	Flake	Basalt	Broken	Distal	0.19		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2573	Flake	Basalt	Broken	Angular	0.18												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2574	Flake	Basalt	Broken	Distal	0.17		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2575	Flake	Basalt	Broken	LCS	14.88												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2576	Flake	Basalt	Broken	Medial	2.41												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2577	Flake	Basalt	Broken	LCS	2.02												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2578	Flake	Basalt	Broken	Distal	1.72		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2579	Flake	Basalt	Complete		1.1	Plain	Step	80-90	4.69	3.34	18.34	11.39	3.64	0%	N	N	
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2580	Flake	Basalt	Broken	Medial	1.02												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2581	Flake	Basalt	Broken	Medial	0.61												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2582	Flake	Basalt	Complete		0.47	Focal	Feather		3.55	0.73	9.1	15.65	2.64	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2583	Flake	Basalt	Broken	LCS	0.39												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2584	Flake	Basalt	Broken	LCS	0.19												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2585	Flake	Basalt	Broken	LCS	0.62												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2586	Flake	Basalt	Broken	LCS	0.58												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2587	Flake	Basalt	Broken	Medial	0.54												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2588	Flake	Basalt	Broken	Distal	0.36		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2589	Flake	Basalt	Broken	LCS	0.24												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2590	Flake	Basalt	Broken	Distal	3.69		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2591	Flake	Basalt	Complete		1.05	Plain	Feather	66-80	16.44	3.05	15.18	18.06	2.63	0%	N	N	
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2592	Flake	Basalt	Broken	Medial	0.83												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2593	Flake	Basalt	Broken	Distal	0.41		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2594	Flake	Basalt	Broken	Proximal	0.25	Plain		0-33	8.44	4							
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2595	Flake	Basalt	Broken	Distal	1.33		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2596	Flake	Basalt	Broken	Proximal	0.75	Plain		33-66	9.91	3.87							
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2597	Flake	Basalt	Broken	Angular	0.52												
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2598	Flake	Basalt	Broken	Distal	0.35		Feather										
Mount Bates Saddle (MBS)	1	4	Sieve	26/10/2022	2599	Flake	Basalt	Complete		0.22	Plain	Feather	80-90	7.15	2.16	5.5	12.61	2.89	60%	N	N	
Mount Bates Saddle (MBS)	1	5	In situ	27/10/2022	305	Flake	Basalt	Broken	Medial	2.82												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2600	Flake	Basalt	Broken	Medial	5.8												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2601	Flake	Basalt	Broken	Angular	2.71												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2602	Flake	Basalt	Broken	Angular	0.42												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2603	Flake	Basalt	Broken	Medial	0.19												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2604	Flake	Basalt	Broken	Medial	3.65												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2605	Flake	Basalt	Broken	Medial	0.52												
Mount Bates Saddle (MBS)	1	5	Sieve	27/10/2022	2606	Flake	Basalt	Broken	Distal	0.19		Feather										
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2607	Flake	Basalt	Broken	Angular	3.51												
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2608	Flake	Basalt	Broken	Angular	0.4												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2609	Flake	Basalt	Broken	Medial	0.21												
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2610	Flake	Basalt	Broken	Medial	0.89												
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2611	Flake	Basalt	Broken	Angular	0.66												
Mount Bates Saddle (MBS)	1	6	Sieve	27/10/2022	2612	Flake	Basalt	Broken	Angular	0.39												
Mount Bates Saddle (MBS)		Surface		24/10/2022	1	Flake	Basalt	Broken	Medial	2.53												
Mount Bates Saddle (MBS)		Surface		24/10/2022	2	Flake	Basalt	Broken	Distal	2.95		Feather										
Mount Bates Saddle (MBS)		Surface		24/10/2022	3	Flake	Basalt	Broken	Angular	43.77												
Mount Bates Saddle (MBS)		Surface		24/10/2022	4	Flake	Basalt	Broken	Medial	18.46												
Mount Bates Saddle (MBS)		Surface		24/10/2022	5	Flake	Basalt	Broken	Proximal	22.05	Plain		80-90	39.76	9.98							
Mount Bates Saddle (MBS)		Surface		24/10/2022	6	Flake	Basalt	Complete		2.96	Focal	Step		2.13	0.85	29.05	14.16	6.16	0%	N	N	
Mount Bates Saddle (MBS)		Surface		24/10/2022	7	Flake	Basalt	Broken	LCS	2.53												Proximal fragment
Mount Bates Saddle (MBS)		Surface		24/10/2022	8	Flake	Basalt	Broken	Proximal	0.87	Plain		80-90	13.3	5.09							
Mount Bates Saddle (MBS)		Surface		24/10/2022	9	Flake	Basalt	Broken	LCS	1.02												
Mount Bates Saddle (MBS)		Surface		24/10/2022	10	Flake	Basalt	Broken	Proximal	0.56	Crushed											Minor fresh edge break - possible trowel damage
Mount Bates Saddle (MBS)		Surface		24/10/2022	11	Flake	Basalt	Broken	Medial	0.23												
Mount Bates Saddle (MBS)		Surface		24/10/2022	12	Flake	Basalt	Broken	Distal	0.15		Step										
Mount Bates Saddle (MBS)		Surface		24/10/2022	13	Flake	Basalt	Broken	Medial	0.11												
Mount Bates Saddle (MBS)		Surface		24/10/2022	14	Flake	Basalt	Complete		214.37	Plain	Feather	90+	31.22	6.51	69.65	88.38	39.71	0%	N	Y	Some fresher crushing/edge damage - post deposition
Mount Bates Saddle (MBS)		Surface		24/10/2022	15	Flake	Basalt	Broken	Proximal	2.14	Plain		80-90	5.21	1.84							
Mount Bates Saddle (MBS)		Surface		24/10/2022	16	Flake	Basalt	Broken	Medial	0.22												
Mount Bates Saddle (MBS)		Surface		24/10/2022	17	Flake	Basalt	Broken	Medial	0.05												
Mount Bates Saddle (MBS)		Surface		24/10/2022	18	Flake	Basalt	Broken	LCS	0.23												
Mount Bates Saddle (MBS)		Surface		24/10/2022	19	Flake	Basalt	Broken	LCS	40.5												Some crushing, irregular break from fault in raw material
Mount Bates Saddle (MBS)		Surface		24/10/2022	20	Flake	Basalt	Broken	Medial	0.46												
Mount Bates Saddle (MBS)		Surface		24/10/2022	21	Flake	Basalt	Broken	Medial	0.25												
Mount Bates Saddle (MBS)		Surface		24/10/2022	22	Flake	Basalt	Broken	Medial	0.2												
Mount Bates Saddle (MBS)		Surface		24/10/2022	23	Flake	Basalt	Broken	LCS	161.26												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)		Surface		24/10/2022	24	Flake	Basalt	Broken	Distal	5.98		Hinge										
Mount Bates Saddle (MBS)		Surface		24/10/2022	25	Flake	Basalt	Complete		40.37	Plain	Feather	33-66	38.51	10.59	50.1	49.32	12.99	0%	N	N	Nodules on ventral surface, one nodule appears to be grain inclusion, double cone
Mount Bates Saddle (MBS)		Surface		24/10/2022	26	Flake	Basalt	Broken	Medial	3.84												
Mount Bates Saddle (MBS)		Surface		24/10/2022	27	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	28	Flake	Basalt	Broken	Medial	1.65												
Mount Bates Saddle (MBS)		Surface		24/10/2022	29	Flake	Basalt	Broken	Medial	1.39												
Mount Bates Saddle (MBS)		Surface		24/10/2022	30	Flake	Basalt	Broken	Medial	0.27												
Mount Bates Saddle (MBS)		Surface		24/10/2022	31	Flake	Basalt	Complete		11.39	Plain	Feather	33-66	25.6	9.92	34.04	32.39	7.6	0%	N	N	
Mount Bates Saddle (MBS)		Surface		24/10/2022	32	Flake	Basalt	Broken	Medial	23.1												
Mount Bates Saddle (MBS)		Surface		24/10/2022	33	Flake	Basalt	Complete		1.63	Plain	Feather	33-66	14.67	5.44	14.16	19.95	3.77	0%	N	N	
Mount Bates Saddle (MBS)		Surface		24/10/2022	34	Flake	Basalt	Broken	Medial	1.43												
Mount Bates Saddle (MBS)		Surface		24/10/2022	35	Flake	Basalt	Broken	Angular	0.56												
Mount Bates Saddle (MBS)		Surface		24/10/2022	36	Flake	Basalt	Broken	Angular	0.37												
Mount Bates Saddle (MBS)		Surface		24/10/2022	37	Flake	Basalt	Broken	Angular	0.24												
Mount Bates Saddle (MBS)		Surface		24/10/2022	38	Flake	Basalt	Broken	Angular	0.08												
Mount Bates Saddle (MBS)		Surface		24/10/2022	39	Flake	Basalt	Complete		5.69	Plain	Hinge	33-66	23.49	4.08	21.11	32.08	8.52	0%	N	N	Irregular ventral and hinge indicates fault in raw material
Mount Bates Saddle (MBS)		Surface		24/10/2022	40	Flake	Basalt	Broken	Distal	7.06		Feather										Almost complete flake and blade-like, platform gone
Mount Bates Saddle (MBS)		Surface		24/10/2022	41	Flake	Basalt	Complete		13.13	Crushed	Feather				29.48	32.88	12.59	0%	N	N	Heavy crushing on platform, very irregular ventral surface
Mount Bates Saddle (MBS)		Surface		24/10/2022	42	Flake	Basalt	Complete		0.8	Plain	Hinge	33-66	10.73	2.26	12.26	13.84	3.18	0%	N	N	
Mount Bates Saddle (MBS)		Surface		24/10/2022	43	Flake	Basalt	Broken	LCS	1.59												
Mount Bates Saddle (MBS)		Surface		24/10/2022	44	Flake	Basalt	Broken	Medial	1.99												
Mount Bates Saddle (MBS)		Surface		24/10/2022	55	Flake	Basalt	Broken	Medial	0.54												
Mount Bates Saddle (MBS)		Surface		24/10/2022	56	Flake	Basalt	Broken	Angular	0.59												
Mount Bates Saddle (MBS)		Surface		24/10/2022	45	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)		Surface		24/10/2022	46	Flake	Basalt	Broken	Angular	0.26												
Mount Bates Saddle (MBS)		Surface		24/10/2022	47	Flake	Basalt	Broken	Angular	0.21												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)		Surface		24/10/2022	48	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)		Surface		24/10/2022	57	Flake	Basalt	Broken	Medial	2.84												
Mount Bates Saddle (MBS)		Surface		24/10/2022	58	Flake	Basalt	Broken	LCS	3.43												
Mount Bates Saddle (MBS)		Surface		24/10/2022	59	Flake	Basalt	Broken	Angular	1.24												
Mount Bates Saddle (MBS)		Surface		24/10/2022	60	Flake	Basalt	Broken	Angular	0.59												
Mount Bates Saddle (MBS)		Surface		24/10/2022	61	Flake	Basalt	Broken	Angular	0.73												
Mount Bates Saddle (MBS)		Surface		24/10/2022	49	Flake	Basalt	Broken	Angular	0.88												
Mount Bates Saddle (MBS)		Surface		24/10/2022	62	Flake	Basalt	Broken	Angular	0.71												
Mount Bates Saddle (MBS)		Surface		24/10/2022	63	Flake	Basalt	Broken	Angular	0.37												
Mount Bates Saddle (MBS)		Surface		24/10/2022	64	Flake	Basalt	Broken	Angular	0.55												
Mount Bates Saddle (MBS)		Surface		24/10/2022	65	Flake	Basalt	Broken	Angular	1.14												
Mount Bates Saddle (MBS)		Surface		24/10/2022	66	Flake	Basalt	Broken	Proximal	1.9	Plain		66-80									
Mount Bates Saddle (MBS)		Surface		24/10/2022	67	Flake	Basalt	Broken	Angular	2.12												
Mount Bates Saddle (MBS)		Surface		24/10/2022	68	Flake	Basalt	Broken	Angular	44.78												Fresh breaks show artefactual weathered surface and internal rock
Mount Bates Saddle (MBS)		Surface		24/10/2022	69	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	70	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	71	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	72	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	73	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	74	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	75	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	76	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	77	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	78	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	79	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	80	Flake	Basalt	Broken	Distal	2.8		Hinge										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)		Surface		24/10/2022	81	Flake	Basalt	Complete		2.35		Feather	33-66	12.29	3.28	17.97	16.49	4.49		N	N	Post depositional edge crushing
Mount Bates Saddle (MBS)		Surface		24/10/2022	82	Flake	Basalt	Broken	Angular	2.3												
Mount Bates Saddle (MBS)		Surface		24/10/2022	83	Flake	Basalt	Broken	Angular	0.99												
Mount Bates Saddle (MBS)		Surface		24/10/2022	84	Flake	Basalt	Broken	Angular	2.3												
Mount Bates Saddle (MBS)		Surface		24/10/2022	85	Flake	Basalt	Broken	Proximal	6.75	Flaked		66-80	23.03	7.87							
Mount Bates Saddle (MBS)		Surface		24/10/2022	86	Flake	Basalt	Broken	Angular	1.23												
Mount Bates Saddle (MBS)		Surface		24/10/2022	87	Flake	Basalt	Broken	Angular	0.35												
Mount Bates Saddle (MBS)		Surface		24/10/2022	88	Flake	Basalt	Broken	Angular	3.08												
Mount Bates Saddle (MBS)		Surface		24/10/2022	89	Flake	Basalt	Broken	LCS	2.15												Half of platform broken off so cannot measure
Mount Bates Saddle (MBS)		Surface		24/10/2022	90	Flake	Basalt	Broken	Angular	2.05												
Mount Bates Saddle (MBS)		Surface		24/10/2022	91	Flake	Basalt	Broken	Angular	0.27												
Mount Bates Saddle (MBS)		Surface		24/10/2022	92	Non-arteifact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	93	Flake	Basalt	Broken	Angular	0.67												
Mount Bates Saddle (MBS)		Surface		24/10/2022	94	Flake	Basalt	Broken	Medial	2.41												
Mount Bates Saddle (MBS)		Surface		24/10/2022	95	Flake	Basalt	Broken	Angular	1.05												
Mount Bates Saddle (MBS)		Surface		24/10/2022	96	Flake	Basalt	Broken	Angular	0.52												
Mount Bates Saddle (MBS)		Surface		24/10/2022	97	Flake	Basalt	Broken	Angular	0.94												
Mount Bates Saddle (MBS)		Surface		24/10/2022	98	Flake	Basalt	Broken	LCS	3.52												
Mount Bates Saddle (MBS)		Surface		24/10/2022	99	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)		Surface		24/10/2022	100	Adze	Basalt	Preform		178.42						110.36	48.93	27.37	0%			Adze preform, smooth top appears polished but was exposed on track surface so shininess may be result of repeat vehicle and pedestrians. Dimensions here are maximums.
Mount Bates Saddle (MBS)		Surface		24/10/2022	101	Non-arteifact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	102	Non-arteifact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	103	Flake	Basalt	Broken	Angular	0.74												
Mount Bates Saddle (MBS)		Surface		24/10/2022	104	Flake	Basalt	Broken	Angular	0.24												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)		Surface		24/10/2022	105	Flake	Basalt	Broken	Medial	0.47												
Mount Bates Saddle (MBS)		Surface		24/10/2022	106	Flake	Basalt	Broken	Angular	1.46												
Mount Bates Saddle (MBS)		Surface		24/10/2022	107	Flake	Basalt	Complete		1.16	Plain	Feather	33-36	13.12	8.94	7.24	12.91	7.14	0%	N	N	Bending initiation
Mount Bates Saddle (MBS)		Surface		24/10/2022	108	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle (MBS)		Surface		24/10/2022	109	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	110	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	111	Flake	Basalt	Broken	Angular	0.85												
Mount Bates Saddle (MBS)		Surface		24/10/2022	112	Flake	Basalt	Broken	Angular	0.54												
Mount Bates Saddle (MBS)		Surface		24/10/2022	113	Flake	Basalt	Broken	Angular	3.29												
Mount Bates Saddle (MBS)		Surface		24/10/2022	114	Flake	Basalt	Broken	Angular	2.7												
Mount Bates Saddle (MBS)		Surface		24/10/2022	115	Flake	Basalt	Broken	Angular	3.66												
Mount Bates Saddle (MBS)		Surface		24/10/2022	116	Flake	Basalt	Broken	Angular	2.14												
Mount Bates Saddle (MBS)		Surface		24/10/2022	117	Flake	Basalt	Broken	Proximal	2.3	Plain		80-90									Half of platform broken off so cannot measure
Mount Bates Saddle (MBS)		Surface		24/10/2022	118	Flake	Basalt	Broken	Angular	1.7												
Mount Bates Saddle (MBS)		Surface		24/10/2022	119	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)		Surface		24/10/2022	120	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	121	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	122	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	123	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	124	Flake	Basalt	Broken	Medial	1.38												
Mount Bates Saddle (MBS)		Surface		24/10/2022	125	Flake	Basalt	Broken	Angular	0.68												
Mount Bates Saddle (MBS)		Surface		24/10/2022	126	Flake	Basalt	Broken	Angular	1.06												
Mount Bates Saddle (MBS)		Surface		24/10/2022	127	Flake	Basalt	Broken	Angular	0.68												
Mount Bates Saddle (MBS)		Surface		24/10/2022	128	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)		Surface		24/10/2022	129	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	130	Flake	Basalt	Broken	LCS	1.93												
Mount Bates Saddle (MBS)		Surface		24/10/2022	131	Flake	Basalt	Broken	Angular	0.2												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle (MBS)		Surface		24/10/2022	132	Flake	Basalt	Broken	Angular	0.28												
Mount Bates Saddle (MBS)		Surface		24/10/2022	133	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	134	Flake	Basalt	Broken	Angular	0.6												
Mount Bates Saddle (MBS)		Surface		24/10/2022	135	Flake	Basalt	Broken	Angular	0.24												
Mount Bates Saddle (MBS)		Surface		24/10/2022	136	Flake	Basalt	Broken	Angular	0.19												
Mount Bates Saddle (MBS)		Surface		24/10/2022	137	Flake	Basalt	Broken	Angular	0.15												
Mount Bates Saddle (MBS)		Surface		24/10/2022	138	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	139	Flake	Basalt	Broken	Angular	0.49												
Mount Bates Saddle (MBS)		Surface		24/10/2022	140	Flake	Basalt	Broken	Angular	1.48												
Mount Bates Saddle (MBS)		Surface		24/10/2022	141	Flake	Basalt	Broken	Angular	0.23												
Mount Bates Saddle (MBS)		Surface		24/10/2022	142	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	143	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	144	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)		Surface		24/10/2022	145	Flake	Basalt	Broken	Angular	0.3												
Mount Bates Saddle (MBS)		Surface		24/10/2022	146	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)		Surface		24/10/2022	147	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	148	Flake	Basalt	Broken	Angular	0.39												
Mount Bates Saddle (MBS)		Surface		24/10/2022	149	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	150	Flake	Basalt	Broken	Angular	0.54												
Mount Bates Saddle (MBS)		Surface		24/10/2022	151	Flake	Basalt	Broken	Angular	0.43												
Mount Bates Saddle (MBS)		Surface		24/10/2022	152	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle (MBS)		Surface		24/10/2022	153	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	154	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle (MBS)		Surface		24/10/2022	155	Flake	Basalt	Broken	Angular	0.29												
Mount Bates Saddle (MBS)		Surface		24/10/2022	156	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)		Surface		24/10/2022	157	Flake	Basalt	Broken	Angular	0.16												
Mount Bates Saddle (MBS)		Surface		24/10/2022	158	Non-artefact	Basalt															Gravel - EXCLUDE

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5000	Flake	Basalt	Broken	Distal	25.44		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5001	Flake	Basalt	Complete		129.35	Plain	Feather	66-80	76.24	15.53	74.53	112.24	12.31	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5002	Flake	Basalt	Complete		204.43	Flaked	Feather	80-90	64.93	12.61	60.4	114.57	27.23	33-66%	N	N	Striations on cortex
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5003	Flake	Basalt	Broken	Angular	110.56												Large piece but cannot identify percussion point. 100% cortex on one side
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5004	Flake	Basalt	Complete		123.4	Plain	Feather	80-90	56.68	12.73	63.54	75.17	17.77	0%	N	N	Break on right lateral margin - not enough to affect width measurement
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5005	Flake	Basalt	Complete		298.95	Plain	Feather	80-90	47.03	14.37	78.03	117.96	23.26	33-66%	N	N	Post deposition edge damage - distal margin
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5006	Flake	Basalt	Broken	Proximal	41.12	Plain		80-90	31.66	3.12							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5007	Flake	Basalt	Broken	Proximal	22.61	Flaked		80-90	13.31	4.48							Large break on right lateral margin affecting measurements, distal may be stepped but not enough to determine if broken
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5008	Flake	Basalt	Broken	Proximal	34.73	Crushed											Blade-like
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5009	Flake	Basalt	Broken	Proximal	57.41	Plain		33-66	54.43	29.32							Bending initiation
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5010	Flake	Basalt	Broken	Proximal	55.93	Plain		80-90	23.02	5.16							Almost complete, series of post-depositional breaks along distal and lateral margins affects measurements. Platform broken at percussion point - manufacture break (not LCS)
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5011	Flake	Basalt	Broken	Medial	94.34												Different stone? Very granular. Too big for crushed road gravel
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5012	Flake	Basalt	Broken	Medial	44.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5013	Flake	Basalt	Broken	Distal	39.77	Plain	Step										Platform broken post- deposition, appears crushing before broken
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5014	Flake	Basalt	Complete		28.23	Plain	Hinge	80-90	18.25	4.5	54.86	43.12	7.83	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5015	Flake	Basalt	Complete		36.94	Crushed	Step				70.85	49.09	7.18	0%	N	N	Different stone? Or maybe just less weathered.
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5016	Flake	Basalt	Broken	Proximal	28.56	Flaked		80-90	29.09	8.62							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5017	Flake	Basalt	Broken	Proximal	57.93	Plain		80-90	21.79	6.13							Huge euraillure scar
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5018	Flake	Basalt	Broken	Proximal	56.68	Plain		80-90	33.39	12.64							Assume feather termination but break extends left lateral margin across most of distal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5019	Flake	Basalt	Complete		155.91	Plain		80-90	32.61	24.97	34.69	76.53	35.16	0%	N	N	Appears part of platform missing but unsure if pre or post deposition
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5020	Flake	Basalt	Complete		40.02	Plain	Feather	66-80	20.58	6.55	48.61	54.73	13.53	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5021	Flake	Basalt	Broken	LCS	57.46												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5022	Flake	Basalt	Broken	Proximal	14.92	Plain		80-90	24.39								
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5023	Flake	Basalt	Complete		27.1	Plain	Step	80-90	16.31	1.96	37.87	66.08	8.99	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5024	Flake	Basalt	Broken	Proximal	22.11	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5025	Flake	Basalt	Broken	Proximal	22.94	Flaked		80-90	23.44	10.34							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5026	Flake	Basalt	Complete		35.37	Flaked	Feather	80-90	23.82	7.77	53.71	63	7.36	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5027	Flake	Basalt	Broken	Proximal	28.18	Plain	Feather	80-90	27.17	4.12	50.73			0%	N	N	Almost complete so more measurements taken. Break on left lateral/distal margin
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5028	Flake	Basalt	Complete		44.87	Plain	Feather	80-90	19.09	2.13	40.48	81.19	10.72	0-33%	N	N	Tiny double cone
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5029	Flake	Basalt	Complete		67.94	Plain	Feather	80-90	25.38	5.38	78.09	56.04	13.24	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5030	Flake	Basalt	Broken	LCS	17.09												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5031	Flake	Basalt	Broken	Medial	39.1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5032	Flake	Basalt	Broken	Proximal	30.65	Plain		66-80	34.66	6.6							Almost complete, break at distal end

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5033	Flake	Basalt	Broken	Proximal	18.19	Plain		90+	21.68	5.67							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5034	Flake	Basalt	Broken	Proximal	28.73	Plain		80-90	31.11	7.41							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5035	Flake	Basalt	Broken	Proximal	20.14	Plain		80-90	20.03	3.37							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5036	Flake	Basalt	Broken	Proximal	24.82	Crushed											Almost complete flake. Double cone plus crushed initiation
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5037	Flake	Basalt	Broken	Medial	26.7												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5038	Flake	Basalt	Broken	LCS	18.3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5039	Flake	Basalt	Broken	Medial	27.21												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5040	Flake	Basalt	Broken	LCS	35.05												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5041	Flake	Basalt	Broken	Medial	37.17												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5042	Flake	Basalt	Complete		30.75	Plain	Feather	80-90	6.68	1.59	68.27	65.54	5.11	0%			
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5043	Flake	Basalt	Broken	Proximal	19.7	Plain		80-90	15.36	5.83							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5044	Flake	Basalt	Complete		25.14	Flaked	Step	80-90	2.15	3.2	47.65	66.66	6.29	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5045	Flake	Basalt	Broken	Proximal	28.99	Plain		33-66	40.82	14.88							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5046	Flake	Basalt	Broken	LCS	35.86												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5047	Flake	Basalt	Broken	Proximal	26.61	Plain	Feather	33-66	45.88	12.32	27.92		7.55	0%	N	N	Almost complete flake, width not measured due to right lateral margin break (does not reach platform)
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5048	Flake	Basalt	Broken	LCS	50.57												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5049	Flake	Basalt	Broken	Medial	36.69												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5050	Flake	Basalt	Broken	Distal	78.94		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5051	Flake	Basalt	Broken	Proximal	73.69	Flaked		80-90	17.68	6.96							

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5052	Flake	Basalt	Complete		55.91	Flaked	Feather	80-90	30.16	9.56	44.73	82.21	7.74	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5053	Flake	Basalt	Complete		98.34	Crushed	Feather				80.28	65.68	11.47	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5054	Flake	Basalt	Broken	Medial	26.97												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5055	Flake	Basalt	Broken	LCS	16.56												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5056	Flake	Basalt	Broken	Proximal	23.13	Plain		80-90	48.54	14.2							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5057	Flake	Basalt	Broken	Angular	30.88												Different stone? Very granular. Too big for crushed road gravel
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5058	Flake	Basalt	Broken	Medial	20.22												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5059	Flake	Basalt	Broken	LCS	28.98												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5060	Flake	Basalt	Broken	Proximal	14.55	Plain		80-90	21.17	5.2							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5061	Flake	Basalt	Complete		11.59	Plain	Feather		17.97	5.83	30.8	42.94	6.3	0p%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5062	Flake	Basalt	Broken	Proximal	8.94	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5063	Flake	Basalt	Complete		2.63	Crushed	Feather				20.17	23.7	5.63	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5064	Flake	Basalt	Broken	Angular	0.52												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5065	Flake	Basalt	Complete		21.64	Plain	Feather	80-90	20.5	6.31	45.8	42.8	9.28	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5066	Flake	Basalt	Broken	Medial	3.86												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5067	Flake	Basalt	Complete		3.62	Plain	Feather	66-80	21.29	6.88	15.74	21.3	6.57	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5068	Flake	Basalt	Broken	Angular	2.45												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5069	Flake	Basalt	Broken	Proximal	2.29	Plain		80-90	16.51	2.63							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5070	Flake	Basalt	Broken	Medial	16.5												
Mount Bates Saddle -		Surface		2018-2022	5071	Flake	Basalt	Complete		12.32	Plain	Feather	66-80	20.35	7.58	26.4	30.56	8.41	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5072	Flake	Basalt	Broken	Distal	7.42		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5073	Flake	Basalt	Broken	Angular	4.83												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5074	Flake	Basalt	Broken	Angular	3.24												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5075	Flake	Basalt	Complete		24.63	Plain	Feather	80-90	11.24	6.43	35.12	50.7	10.14	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5076	Flake	Basalt	Broken	Medial	8.93												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5077	Flake	Basalt	Broken	Medial	4.95												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5078	Flake	Basalt	Broken	Medial	4.37												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5079	Flake	Basalt	Broken	Proximal	3	Plain		80-90	18.89	6.68							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5080	Flake	Basalt	Broken	Distal	17.13		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5081	Flake	Basalt	Complete		13.66	Crushed	Feather				35.85	38.55	6.9	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5082	Flake	Basalt	Broken	Distal	11.71		Hinge										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5083	Flake	Basalt	Broken	Distal	6.43		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5084	Flake	Basalt	Broken	Angular	0.6												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5085	Flake	Basalt	Broken	LCS	16.71												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5086	Flake	Basalt	Broken	Medial	13.9												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5087	Flake	Basalt	Complete		13.68	Plain	Step	66-80	33.77	11.22	26.64	35.38	10.72	0-33%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5088	Flake	Basalt	Broken	Proximal	12.47	Plain		33-66	21.57	3.49							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5089	Flake	Basalt	Broken	Medial	3.36												Almost distal fragment, post-dep small breaks at distal obscures if feather or step
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5090	Flake	Basalt	Broken	Distal	19.58		Feather										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5091	Flake	Basalt	Broken	Medial	11.96												Partial platform, appears plain
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5092	Flake	Basalt	Broken	Proximal	8.69	Plain		33-66	21.57	3.8							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5093	Flake	Basalt	Broken	Distal	5.62		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5094	Flake	Basalt	Broken	Angular	2.89												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5095	Flake	Basalt	Broken	Proximal	13.56	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5096	Flake	Basalt	Broken	Proximal	11.4	Plain		66-80	21.37	4.7							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5097	Flake	Basalt	Broken	LCS	8.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5098	Flake	Basalt	Broken	Medial	4.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5099	Flake	Basalt	Broken	Medial	1.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5100	Flake	Basalt	Broken	Distal	18.96		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5101	Flake	Basalt	Broken	Distal	7.28		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5102	Flake	Basalt	Broken	Medial	5.31												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5103	Flake	Basalt	Broken	Proximal	2.17	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5104	Flake	Basalt	Broken	Angular	1.29												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5105	Flake	Basalt	Complete		13.9	Plain	Step	80-90	15.43	6.95	46.34	28.49	7.77	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5106	Flake	Basalt	Complete		13.45	Crushed	Feather				34.56	42.09	6.19	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5107	Flake	Basalt	Broken	Distal	5.88		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5108	Flake	Basalt	Broken	Angular	4.8												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5109	Flake	Basalt	Broken	LCS	3.69												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5110	Flake	Basalt	Broken	Medial	18.91												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5111	Flake	Basalt	Broken	Proximal	9.42	Plain		66-80	5.19	2.08							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5112	Flake	Basalt	Broken	LCS	6.66												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5113	Flake	Basalt	Broken	Angular	5.96												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5114	Flake	Basalt	Broken	Angular	1.9												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5115	Flake	Basalt	Broken	Medial	11.66												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5116	Flake	Basalt	Broken	Distal	11.1		Feather										Some cortex along distal margin
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5117	Flake	Basalt	Broken	Distal	4.47		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5118	Flake	Basalt	Broken	Angular	3.93												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5119	Flake	Basalt	Broken	Angular	2.04												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5120	Flake	Basalt	Complete		18.21	Plain	Feather	66-80	46.06	7.37	29.31	52.96	9.57	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5121	Flake	Basalt	Broken	Distal	12.67		Feather										50% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5122	Flake	Basalt	Broken	Medial	4.57												c. 30% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5123	Flake	Basalt	Broken	Medial	3.93												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5124	Flake	Basalt	Broken	Medial	1.66												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5125	Non-arteifact	Basalt															Gravel? - EXCLUDE
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5126	Flake	Basalt	Complete		18.19	Flaked	Feather	80-90	35.33	7.33	46.13	36.53	7.25	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5127	Flake	Basalt	Broken	Medial	4.96												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5128	Flake	Basalt	Broken	Medial	3.33												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5129	Flake	Basalt	Broken	Angular	0.81												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5130	Flake	Basalt	Broken	Proximal	14.88	Focal			8.55	1.28							

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5131	Flake	Basalt	Broken	Distal	12.17		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5132	Flake	Basalt	Complete		4.57	Flaked	Feather	66-80	19.48	7.09	17.07	29.46	6.17	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5133	Flake	Basalt	Broken	Medial	1.64												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5134	Flake	Basalt	Broken	Angular	0.52												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5135	Flake	Basalt	Complete		11.45	Plain	Hinge	80-90	14.87	3.5	34.23	46.98	5.22	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5136	Flake	Basalt	Broken	Medial	9.14												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5137	Flake	Basalt	Broken	Angular	7.95												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5138	Flake	Basalt	Broken	Distal	2.98		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5139	Flake	Basalt	Broken	Distal	0.5		Feather										50% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5140	Flake	Basalt	Broken	Medial	2.48												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5141	Flake	Basalt	Complete		1.69	Plain	Feather	80-90	8.31	2.56	14.19	22.38	4.07	50%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5142	Flake	Basalt	Broken	Proximal	1.35	Plain		80-90	12.65	3.08							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5143	Flake	Basalt	Broken	Distal	1.05		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5144	Flake	Basalt	Broken	Medial	0.69												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5145	Flake	Basalt	Broken	LCS	1.91												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5146	Flake	Basalt	Broken	Medial	1.79												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5147	Flake	Basalt	Broken	Medial	1.77												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5148	Flake	Basalt	Broken	Distal	1.43		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5149	Flake	Basalt	Complete		0.44	Plain	Hinge	80-90	6.26	1.93	12.26	21.55	3.46	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5150	Flake	Basalt	Broken	Medial	4.02												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5151	Flake	Basalt	Broken	Angular	2.03												50% cortex on one side
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5152	Flake	Basalt	Broken	Distal	1.75		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5153	Flake	Basalt	Broken	LCS	1.66												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5154	Flake	Basalt	Broken	Angular	0.59												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5155	Flake	Basalt	Broken	Medial	5.87												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5156	Flake	Basalt	Complete		3	Plain	Step	66-80	16.39	1.1	22.33	26.05	3.02	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5157	Flake	Basalt	Broken	Proximal	2.82	Complex		66-80	17.45	6.83							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5158	Flake	Basalt	Broken	Proximal	2	Plain		66-80	10.14	4.69							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5159	Flake	Basalt	Broken	Medial	0.59												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5160	Flake	Basalt	Broken	Angular	2.53												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5161	Flake	Basalt	Broken	Angular	2.08												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5162	Flake	Basalt	Broken	Distal	1.18		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5163	Flake	Basalt	Broken	Medial	0.51												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5164	Flake	Basalt	Broken	Medial	0.34												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5165	Flake	Basalt	Broken	LCS	3.3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5166	Flake	Basalt	Broken	Distal	1.46		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5167	Flake	Basalt	Broken	Medial	1.23												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5168	Flake	Basalt	Broken	Medial	1.14												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5169	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5170	Flake	Basalt	Broken	Medial	4.83												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5171	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5172	Flake	Basalt	Broken	Medial	3.91												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5173	Flake	Basalt	Broken	Medial	3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5174	Flake	Basalt	Broken	Medial	2.26												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5175	Flake	Basalt	Broken	Medial	2.83												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5176	Flake	Basalt	Broken	Proximal	1.83	Plain		80-90	13.76	2.05							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5177	Flake	Basalt	Broken	Medial	1.63												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5178	Flake	Basalt	Broken	Medial	1.26												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5179	Flake	Basalt	Broken	Angular	0.8												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5180	Flake	Basalt	Broken	LCS	6.54												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5181	Flake	Basalt	Broken	Medial	3.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5182	Flake	Basalt	Broken	Angular	2.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5183	Flake	Basalt	Broken	Distal	1.24		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5184	Flake	Basalt	Broken	Distal	0.45		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5185	Flake	Basalt	Broken	Medial	2.51												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5186	Flake	Basalt	Broken	Medial	2.17												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5187	Flake	Basalt	Broken	Medial	1.87												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5188	Flake	Basalt	Broken	Distal	1.09		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5189	Flake	Basalt	Broken	Medial	0.41												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5190	Flake	Basalt	Broken	Proximal	4.35	Plain		80-90	14.3	3.49							Tiny double cone

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5191	Flake	Basalt	Complete		2.37	Flaked	Step	80-90	12.98	4.55	13.74	27.58	4.62	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5192	Flake	Basalt	Broken	Angular	1.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5193	Flake	Basalt	Broken	Medial	0.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5194	Flake	Basalt	Broken	Medial	0.5												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5195	Flake	Basalt	Broken	Medial	3.99												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5196	Flake	Basalt	Broken	Medial	2.3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5197	Flake	Basalt	Broken	Medial	1.47												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5198	Flake	Basalt	Broken	Proximal	0.89	Focal			3.23	1.05							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5199	Flake	Basalt	Broken	Medial	0.73												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5200	Flake	Basalt	Complete		9.22	Plain	Feather	66-80	22.82	8.08	31.2	33.07	5.17	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5201	Flake	Basalt	Broken	Distal	8.9		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5202	Flake	Basalt	Broken	Medial	7.53												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5203	Flake	Basalt	Complete		4.25	Flaked	Step	80-90	10.44	8.29	31.14	14.62	5.59	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5204	Flake	Basalt	Broken	Distal	1.97		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5205	Flake	Basalt	Broken	Proximal	15.2	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5206	Flake	Basalt	Complete		6.02	Focal	Feather		4.23	1	17.7	47.87	6.02	66-100%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5207	Flake	Basalt	Broken	Medial	3.35												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5208	Flake	Basalt	Broken	Angular	3.08												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5209	Flake	Basalt	Broken	LCS	2.25												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5210	Flake	Basalt	Broken	Distal	13.65		Feather										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5211	Flake	Basalt	Broken	Medial	7.17												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5212	Flake	Basalt	Broken	Medial	7.1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5213	Flake	Basalt	Broken	Proximal	4.03	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5214	Flake	Basalt	Broken	Distal	1.12		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5215	Flake	Basalt	Broken	Medial	13.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5216	Flake	Basalt	Complete		9.4	Focal	Feather		2.8	1.43	42.39	19.36	8.82	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5217	Flake	Basalt	Broken	Proximal	7	Plain		80-90	14.95	3.85							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5218	Flake	Basalt	Broken	Distal	6.48		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5219	Flake	Basalt	Broken	Medial	1.54												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5220	Flake	Basalt	Broken	Distal	22.52		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5221	Flake	Basalt	Broken	Medial	6.9												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5222	Flake	Basalt	Broken	Proximal	6.23	Plain		66-80	24.54	10.02							Almost complete flake, edge damage (post dep) at distal end makes unclear if feather or step termination, 100% cortex on dorsal face
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5223	Flake	Basalt	Broken	Proximal	5.98	Plain		80-90	13.52	3.23							66-100% cortex on dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5224	Flake	Basalt	Broken	Angular	2.1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5225	Flake	Basalt	Complete		8.97	Plain	Step	66-80	16.05	2.49	32.14	29.12	6.38	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5226	Flake	Basalt	Broken	Medial	5.02												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5227	Flake	Basalt	Broken	Distal	3.27		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5228	Flake	Basalt	Complete		2.31	Plain	Step	66-80	10.78	3.49	20.39	20.14	3.59	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5229	Flake	Basalt	Complete		2.18	Focal	Feather		3.19	1.15	27.26	16.66	3.66	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5230	Flake	Basalt	Broken	Proximal	10.38	Plain		66-80	21.49	6.74							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5231	Flake	Basalt	Broken	Distal	8.01		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5232	Flake	Basalt	Broken	Distal	5.89		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5233	Flake	Basalt	Complete		2.96	Flaked	Feather	80-90	10.08	4.66	21.04	30.23	3.04	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5234	Flake	Basalt	Broken	Distal	1.05		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5235	Flake	Basalt	Complete		8.05	Plain	Feather	80-90	15.95	4.31	26.9	36.31	5.1	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5236	Flake	Basalt	Broken	LCS	7.81												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5237	Flake	Basalt	Broken	LCS	5.55												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5238	Flake	Basalt	Broken	Medial	2.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5239	Flake	Basalt	Broken	Medial	1.18												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5240	Flake	Basalt	Broken	Distal	9.53		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5241	Flake	Basalt	Broken	LCS	7.31												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5242	Flake	Basalt	Broken	LCS	6.13												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5243	Flake	Basalt	Broken	Medial	4.7												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5244	Flake	Basalt	Broken	Angular	0.38												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5245	Flake	Basalt	Broken	Medial	13.7												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5246	Non-artefact	Basalt															Gravel - EXCLUDE
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5247	Flake	Basalt	Broken	Medial	11.19												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5248	Flake	Basalt	Broken	LCS	6.23												Broken, clean break showing dark fine grained material and weathering depth
Mount Bates Saddle -		Surface		2018-2022	5249	Flake	Basalt	Broken	Medial	0.49												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5250	Flake	Basalt	Broken	Angular	7.36												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5251	Flake	Basalt	Complete		3.56	Plain	Feather	80-90	13.42	2.68	18.95	30.12	3.05	0%	N	N	Different material?
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5252	Flake	Basalt	Broken	Medial	2.07												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5253	Flake	Basalt	Broken	Distal	1.5		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5254	Flake	Basalt	Broken	Proximal	0.69	Plain		66-80	6.64	3.56							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5255	Flake	Basalt	Broken	Medial	2.72												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5256	Flake	Basalt	Broken	Angular	2.11												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5257	Flake	Basalt	Broken	Medial	1.72												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5258	Flake	Basalt	Broken	Medial	1.48												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5259	Flake	Basalt	Broken	Medial	0.87												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5260	Flake	Basalt	Complete		5.22	Crushed	Step				33.23	21.41	4.2	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5261	Flake	Basalt	Broken	Medial	3.12												50% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5262	Flake	Basalt	Broken	LCS	2.49												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5263	Flake	Basalt	Broken	Medial	1.76												100% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5264	Flake	Basalt	Broken	Medial	0.71												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5265	Flake	Basalt	Complete		3.39	Plain	Feather	66-80	9.26	4.27	42.48	17.86	2.68	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5266	Flake	Basalt	Broken	Angular	3.02												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5267	Flake	Basalt	Broken	Medial	2												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5268	Flake	Basalt	Complete		1.7	Plain	Feather	33-66	20.89	4.8	12.71	22.71	3.26	0%	N	N	Bending initiation

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5269	Flake	Basalt	Broken	LCS	0.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5270	Flake	Basalt	Broken	Proximal	5.24	Crushed											Almost complete, lateral breaks on both margins and distal crushing
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5271	Flake	Basalt	Broken	Medial	2.67												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5272	Flake	Basalt	Broken	Distal	2.47		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5273	Flake	Basalt	Complete		1.56	Focal	Feather		2.2	1.33	14.11	30.08	2.96	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5274	Flake	Basalt	Broken	Medial	1.29												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5275	Flake	Basalt	Broken	Medial	2.74												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5276	Flake	Basalt	Broken	Medial	1.77												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5277	Flake	Basalt	Broken	Medial	1.56												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5278	Flake	Basalt	Broken	Medial	0.57												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5279	Flake	Basalt	Broken	Proximal	0.44	Focal			2.44	1.23							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5280	Flake	Basalt	Broken	Medial	6.76												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5281	Flake	Basalt	Broken	Proximal	3.06	Flaked		66-80	12.39	4.05							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5282	Flake	Basalt	Broken	Medial	1.98												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5283	Flake	Basalt	Broken	Medial	1.69												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5284	Flake	Basalt	Broken	Medial	0.63												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5285	Flake	Basalt	Broken	Distal	5.27		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5286	Flake	Basalt	Broken	Distal	4.08		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5287	Flake	Basalt	Broken	Proximal	2.95	Plain		80-90	18.78	4.38							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5288	Flake	Basalt	Broken	Medial	1.9												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5289	Flake	Basalt	Broken	Medial	0.9												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5290	Flake	Basalt	Broken	Distal	2.54		Feather										66-100% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5291	Flake	Basalt	Broken	LCS	1.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5292	Flake	Basalt	Broken	Proximal	1.76	Plain		33-66	15.79	7.64							Bending initiation
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5293	Flake	Basalt	Broken	Distal	0.66		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5294	Flake	Basalt	Broken	Angular	0.53												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5295	Flake	Basalt	Broken	Medial	2.65												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5296	Flake	Basalt	Broken	Medial	1.94												100% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5297	Flake	Basalt	Broken	Proximal	1.57	Plain		66-80	11.01	2.52							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5298	Flake	Basalt	Broken	Medial	0.63												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5299	Flake	Basalt	Broken	Angular	0.78												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5300	Flake	Basalt	Broken	Proximal	2.45	Plain		80-90	10.91	5.2							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5301	Flake	Basalt	Broken	LCS	2.23												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5302	Flake	Basalt	Broken	Angular	1.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5303	Flake	Basalt	Broken	Distal	1.04		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5304	Flake	Basalt	Broken	Medial	0.46												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5305	Flake	Basalt	Broken	Angular	2.03												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5306	Flake	Basalt	Broken	Proximal	2	Plain		80-90	8.99	3.27							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5307	Flake	Basalt	Complete		1.46	Plain	Feather	66-80	11.99	2.39	16.99	18.72	3.28	0%	N	N	

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5308	Flake	Basalt	Broken	Distal	1.16		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5309	Flake	Basalt	Broken	Angular	0.25												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5310	Flake	Basalt	Broken	Medial	7.21												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5311	Flake	Basalt	Broken	Medial	3.6												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5312	Flake	Basalt	Broken	Medial	3.51												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5313	Flake	Basalt	Broken	Proximal	3.29	Plain		66-80	22.28	7.85							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5314	Flake	Basalt	Broken	Medial	0.77												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5315	Flake	Basalt	Broken	Medial	3.44												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5316	Flake	Basalt	Broken	Proximal	2.6	Plain		80-90	7.33	1.88							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5317	Flake	Basalt	Broken	LCS	1.15												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5318	Flake	Basalt	Broken	Proximal	1.14	Plain		80-90	12.31	1.86							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5319	Flake	Basalt	Broken	Angular	1.14												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5320	Flake	Basalt	Broken	Medial	2.48												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5321	Flake	Basalt	Broken	Medial	2.11												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5322	Flake	Basalt	Broken	Medial	1.87												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5323	Flake	Basalt	Broken	Proximal	1.21	Plain		66-80	12.96	3.48							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5324	Flake	Basalt	Broken	LCS	0.99												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5325	Flake	Basalt	Broken	Proximal	4.33	Plain		66-80	8.05	2.78							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5326	Flake	Basalt	Broken	Proximal	4.15	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5327	Flake	Basalt	Broken	Medial	3.75												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5328	Flake	Basalt	Broken	Angular	1.1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5329	Flake	Basalt	Complete		0.73	Plain	Step	80-90	11.7	1.12	10.78	16.4	2.83	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5330	Flake	Basalt	Broken	Distal	6.53		Step										Almost complete flake, platform fractured and weathered
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5331	Flake	Basalt	Broken	Angular	2.93												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5332	Flake	Basalt	Broken	Distal	1.92		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5333	Flake	Basalt	Broken	Proximal	1.77	Plain		66-80	12.12	2.72							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5334	Flake	Basalt	Broken	Distal	1.7		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5335	Flake	Basalt	Broken	Proximal	4.62	Plain		80-90	19.85	4.82							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5336	Flake	Basalt	Complete		3.83	Plain	Feather	66-80	12.1	6.26	19.59	26.11	5.16	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5337	Flake	Basalt	Broken	Medial	1.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5338	Flake	Basalt	Broken	Proximal	0.92	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5339	Flake	Basalt	Broken	Angular	0.46												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5340	Flake	Basalt	Broken	Distal	2.29		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5341	Flake	Basalt	Broken	Distal	1.89		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5342	Flake	Basalt	Broken	Medial	1.63												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5343	Flake	Basalt	Broken	Medial	1.28												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5344	Flake	Basalt	Broken	Medial	0.37												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5345	Flake	Basalt	Broken	Distal	1.74	Plain	Feather	66-80									Almost complete flake, lateral breaks on both margins affecting platform and width measurements
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5346	Flake	Basalt	Broken	LCS	1.64												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5347	Flake	Basalt	Broken	Distal	1.18		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5348	Flake	Basalt	Broken	Medial	0.74												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5349	Flake	Basalt	Broken	Medial	0.3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5350	Flake	Basalt	Broken	Medial	2.09												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5351	Flake	Basalt	Broken	Medial	1.88												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5352	Flake	Basalt	Broken	Medial	1.5												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5353	Flake	Basalt	Broken	Proximal	1.13	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5354	Flake	Basalt	Broken	Angular	0.5												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5355	Flake	Basalt	Broken	Distal	5.65		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5356	Flake	Basalt	Broken	Medial	3.01												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5357	Flake	Basalt	Broken	Medial	1.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5358	Flake	Basalt	Broken	Medial	1.2												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5359	Flake	Basalt	Broken	Angular	0.48												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5360	Flake	Basalt	Broken	Medial	8.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5361	Flake	Basalt	Broken	LCS	4.08												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5362	Flake	Basalt	Broken	Distal	2.43		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5363	Flake	Basalt	Broken	Medial	1.18												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5364	Flake	Basalt	Broken	Proximal	0.82	Focal			2.12	1.19							Almost complete flake, post dep edge crushing at distal, heavily weathered
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5365	Flake	Basalt	Broken	Proximal	7.57	Plain		80-90	13.72	4.22							
Mount Bates Saddle -		Surface		2018-2022	5366	Flake	Basalt	Broken	Distal	5.65		Step										

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5367	Flake	Basalt	Complete		4.29	Focal	Step		2.86	2.49	26.96	29.42	3.13	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5368	Flake	Basalt	Broken	LCS	2.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5369	Flake	Basalt	Broken	Angular	0.56												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5370	Flake	Basalt	Broken	Proximal	9.29	Plain		66-80	20.91	9.35							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5371	Flake	Basalt	Broken	Proximal	6.21	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5372	Flake	Basalt	Broken	Angular	2.33												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5373	Flake	Basalt	Broken	Medial	1.52												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5374	Flake	Basalt	Broken	Angular	1.03												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5375	Flake	Basalt	Broken	Angular	15.94												Heavily broken, large piece showing difference between weathered artefactual surface and fresh internal dark stone
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5376	Flake	Basalt	Broken	Medial	6.67												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5377	Flake	Basalt	Broken	Medial	5.1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5378	Flake	Basalt	Broken	Distal	1.09		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5379	Flake	Basalt	Broken	Distal	0.41		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5380	Flake	Basalt	Broken	Angular	11.64												Heavily weathered, possible non-artefact
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5381	Flake	Basalt	Broken	Medial	8.23												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5382	Flake	Basalt	Complete		5.15	Plain	Feather	80-90	23.22	4.61	29.39	27.65	4.53	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5383	Flake	Basalt	Broken	Proximal	4.66	Plain		80-90	6.49	2							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5384	Flake	Basalt	Broken	LCS	0.43												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5385	Flake	Basalt	Broken	Medial	15.29												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5386	Flake	Basalt	Broken	Proximal	8.87	Plain		80-90	17.78	5.27							Almost complete flake, post dep edge crushing at distal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5387	Flake	Basalt	Broken	LCS	4.14												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5388	Flake	Basalt	Broken	Medial	1.66												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5389	Flake	Basalt	Broken	Medial	0.83												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5390	Flake	Basalt	Complete		13.59	Plain	Step	80-90	18.1	4.88	23.73	46.6	10.53	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5391	Flake	Basalt	Broken	Medial	4.47												Almost complete, post dep fracture on ventral face may have taken part of platform. Also breakage at distal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5392	Flake	Basalt	Broken	Proximal	3.72	Plain		66-80	24.82	2.23							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5393	Flake	Basalt	Broken	Proximal	2.74	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5394	Flake	Basalt	Broken	Medial	0.98												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5395	Flake	Basalt	Broken	Angular	1.12												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5396	Flake	Basalt	Broken	Angular	0.84												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5397	Flake	Basalt	Broken	Medial	0.56												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5398	Flake	Basalt	Broken	Medial	0.52												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5399	Flake	Basalt	Broken	Proximal	0.44	Plain		33-66	12.3	1.98							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5400	Flake	Basalt	Broken	Medial	1.45												60% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5401	Flake	Basalt	Broken	Angular	1.42												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5402	Flake	Basalt	Broken	Distal	0.78		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5403	Flake	Basalt	Broken	Medial	0.68												
Mount Bates Saddle -		Surface		2018-2022	5404	Flake	Basalt	Broken	Angular	0.64												100% cortex on frag dorsal

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5405	Flake	Basalt	Broken	Medial	2.41												40% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5406	Flake	Basalt	Broken	Proximal	1.01	Flaked		66-80	12.75	3.97							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5407	Flake	Basalt	Broken	Angular	1												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5408	Flake	Basalt	Broken	Medial	0.88												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5409	Flake	Basalt	Broken	Medial	0.83												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5410	Flake	Basalt	Complete		1.14	Plain	Feather	33-66	8.69	2.92	14	16.2	2.61	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5411	Flake	Basalt	Broken	Angular	0.99												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5412	Flake	Basalt	Broken	Angular	0.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5413	Flake	Basalt	Broken	Medial	0.72												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5414	Flake	Basalt	Broken	Medial	0.29												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5415	Flake	Basalt	Complete		0.96	Plain	Feather	33-66	20.25	2.28	11.5	20.77	2.8	0%	N	N	
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5416	Flake	Basalt	Broken	Angular	0.86												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5417	Flake	Basalt	Broken	Medial	0.49												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5418	Flake	Basalt	Broken	Medial	0.41												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5419	Flake	Basalt	Broken	Medial	0.17												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5420	Flake	Basalt	Broken	Medial	1.48												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5421	Flake	Basalt	Broken	Proximal	1.33	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5422	Flake	Basalt	Broken	Medial	0.85												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5423	Flake	Basalt	Broken	LCS	0.75												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5424	Flake	Basalt	Broken	Angular	0.63												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5425	Flake	Basalt	Broken	Angular	1.47												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5426	Flake	Basalt	Broken	Medial	0.92												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5427	Flake	Basalt	Broken	Medial	0.75												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5428	Flake	Basalt	Broken	Medial	0.91												100% cortex on frag dorsal
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5429	Flake	Basalt	Broken	Medial	0.57												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5430	Flake	Basalt	Broken	Angular	2.03												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5431	Flake	Basalt	Broken	Medial	1.35												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5432	Flake	Basalt	Broken	Medial	1.42												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5433	Flake	Basalt	Broken	Medial	1.28												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5434	Flake	Basalt	Broken	Medial	0.55												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5435	Flake	Basalt	Broken	Proximal	1.23	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5436	Flake	Basalt	Broken	Medial	1.15												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5437	Flake	Basalt	Broken	Proximal	1.13	Crushed	Feather				16.29		3.8				Lateral margin breaks affecting width measurement - not taken
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5438	Flake	Basalt	Broken	Medial	0.96												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5439	Flake	Basalt	Broken	Distal	0.53		Step										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5440	Flake	Basalt	Broken	Angular	1.71												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5441	Flake	Basalt	Broken	Angular	1.3												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5442	Flake	Basalt	Broken	Angular	1.23												
Mount Bates Saddle -		Surface		2018-2022	5443	Flake	Basalt	Broken	Medial	0.81												

Site	Pit	Level	In situ/ sieve	Date	Artefact #	Artefact type	Raw material	Complete / broken	Breakage type	Weight (g)	Platform type	Termination type	Exterior platform angle (80- 90, 66-80, 33-66, 0- 33)	Platform width (mm)	Platform thickness (mm)	Artefact length (mm)	Artefact width (mm)	Artefact thickness (mm)	Cortex %	Retouch Y/N	Usewear Y/N	Comment
Snowy (MBS- S)																						
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5444	Flake	Basalt	Broken	Proximal	0.57	Plain		80-90	9.97	2.18							
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5445	Flake	Basalt	Broken	Angular	2.08												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5446	Flake	Basalt	Broken	Distal	1.23		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5447	Flake	Basalt	Broken	Medial	1.14												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5448	Flake	Basalt	Broken	Distal	0.94		Feather										
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5449	Flake	Basalt	Broken	Medial	0.87												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5450	Flake	Basalt	Broken	LCS	10.28												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5451	Flake	Basalt	Broken	Medial	7.34												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5452	Flake	Basalt	Broken	Medial	4.27												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5453	Flake	Basalt	Broken	Angular	3.23												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5454	Flake	Basalt	Broken	Angular	1.06												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5455	Flake	Basalt	Broken	Proximal	0.85	Crushed											
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5456	Flake	Basalt	Broken	Medial	0.59												
Mount Bates Saddle - Snowy (MBS- S)		Surface		2018-2022	5457	Flake	Basalt	Broken	Angular	0.24												

Appendix III: University of Waikato Radiocarbon Dating Laboratory Report



Private Bag 3105
Hamilton,
New Zealand.
Ph +64 7 838 4278
email c14@waikato.ac.nz
Tuesday, 10 January 2023

Radiocarbon Dating Laboratory

Report on Radiocarbon Age Determination for Wk- 55374

Submitter	A Way
Submitter's Code	CH8
Site & Location	Mount Bates Saddle, Norfolk Island
Sample Material	Charcoal
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$ -71.9 ± 2.7 ‰

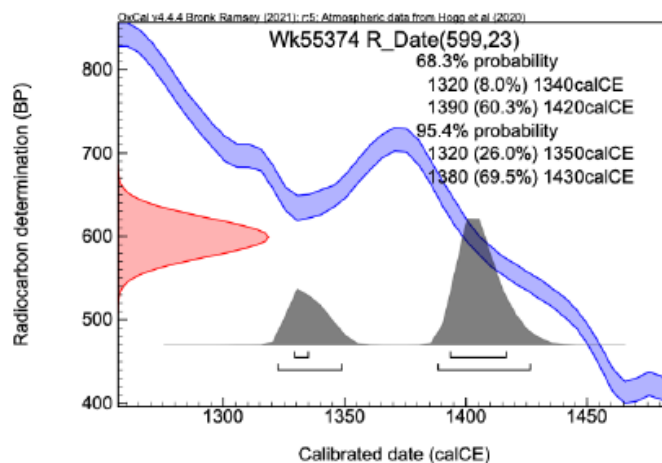
$F^{14}C\%$ 92.8 ± 0.3 %

Result **599 $\pm$ 23 BP**

(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (<http://c14.arch.ox.ac.uk/embed.php?File=explanation.php>)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2 .
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

M. P. Hogg



Radiocarbon Dating Laboratory

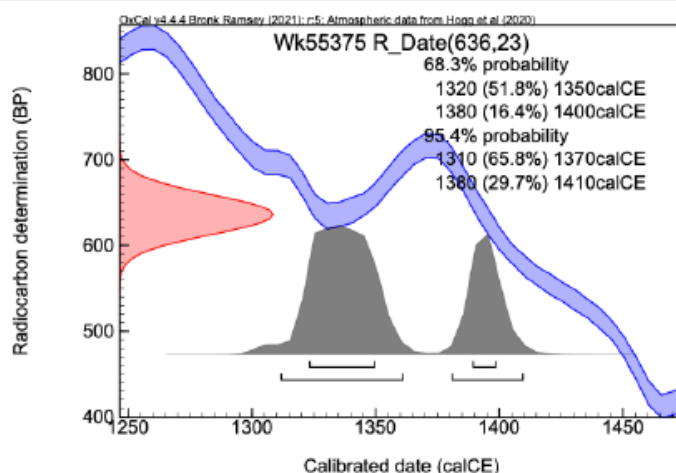
Report on Radiocarbon Age Determination for Wk- 55375

Submitter	A Way
Submitter's Code	CH14
Site & Location	Mount Bates Saddle, Norfolk Island
Sample Material	Charcoal
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

$D^{14}C$ -76.1 ± 2.7 ‰
 $F^{14}C\%$ 92.4 ± 0.3 ‰
Result **636 ± 23 BP**
(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}C$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}C$ value can differ from the $\delta^{13}C$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (<http://c14.arch.ox.ac.uk/embed.php?File=explanation.php>)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB and is measured on sample CO_2 .
- $F^{14}C\%$ is also known as *Percent Modern Carbon (pMC)*.

M. P. Hogg



Radiocarbon Dating Laboratory

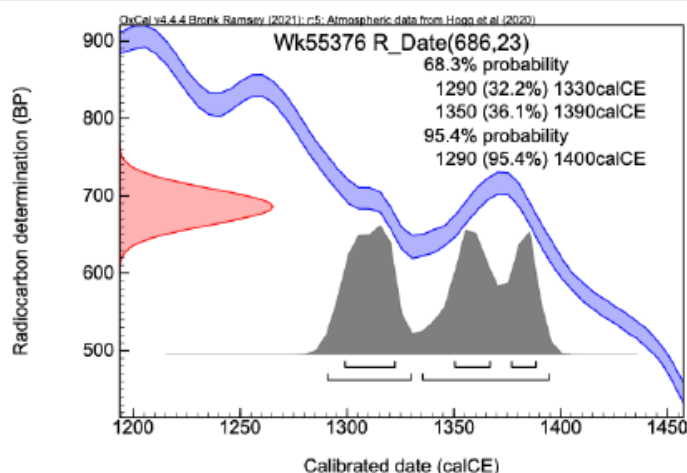
Report on Radiocarbon Age Determination for Wk- 55376

Submitter	A Way
Submitter's Code	CH17
Site & Location	Mount Bates Saddle, Norfolk Island
Sample Material	Charcoal
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

D¹⁴C -81.8 ± 2.6 ‰
F¹⁴C‰ 91.8 ± 0.3 ‰
Result **686 ± 23 BP**
(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}\text{C}$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}\text{C}$ value can differ from the $\delta^{13}\text{C}$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (<http://c14.arch.ox.ac.uk/embed.php?File=explanation.php>)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}\text{C}$, is expressed as ‰ wrt PDB and is measured on sample CO_2 .
- F¹⁴C‰ is also known as *Percent Modern Carbon (pMC)*.

M. P. H. H.



Radiocarbon Dating Laboratory

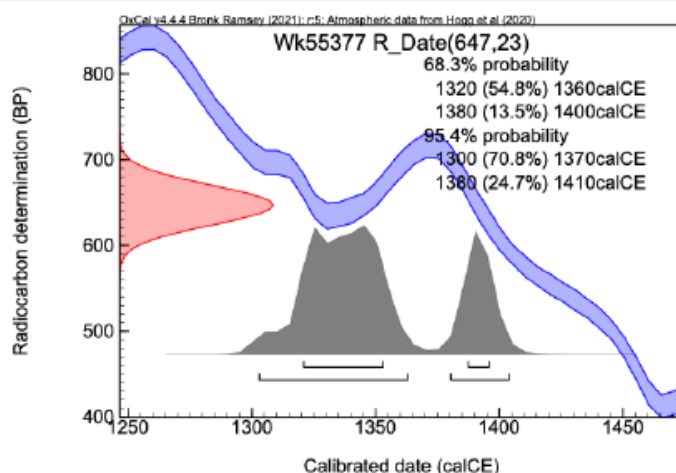
Report on Radiocarbon Age Determination for Wk- 55377

Submitter	A Way
Submitter's Code	CH18
Site & Location	Mount Bates Saddle, Norfolk Island
Sample Material	Charcoal
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

D¹⁴C -77.4 ± 2.7 ‰
F¹⁴C‰ 92.3 ± 0.3 ‰
Result **647 ± 23 BP**
(AMS measurement)

Comments

Please note: The Carbon-13 stable isotope value ($\delta^{13}\text{C}$) was measured on prepared graphite using the AMS spectrometer. The radiocarbon date has therefore been corrected for isotopic fractionation. However the AMS-measured $\delta^{13}\text{C}$ value can differ from the $\delta^{13}\text{C}$ of the original material and it is therefore not shown.



- Explanation of the calibrated Oxcal plots can be found at the Oxford Radiocarbon Accelerator Unit's calibration web pages (<http://c14.arch.ox.ac.uk/embed.php?File=explanation.php>)
- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}\text{C}$, is expressed as ‰ wrt PDB and is measured on sample CO_2 .
- F¹⁴C‰ is also known as *Percent Modern Carbon (pMC)*.

M. P. Hogg

Appendix IV: Geochemical Datasets

Stone Artefacts

File #	Date	Time	Operator	Name	ID	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
2017	6/11/2022	11:51:27	Supervisor	MBS-5	5005	43031.75	166713.3	433027.5	6295.25	10493.75	85651	22575.25	1429	112652.8	137.75	124.25	22.75	96	12.25	631	21	175	24.5	216.75
2021	6/11/2022	12:18:21	Supervisor	MBS	279	53785.33	163309	366159.3	22595.33	12084.67	83782.67	34240.67	1583.333	151941.7	217.6667	152	30.33333	147.3333	15.33333	591	23.66667	218.6667	28.66667	247.3333
2040	6/11/2022	14:54:41	Supervisor	MBS	291	42894.67	166200	449839.3	8885	11519	88992.33	25009.67	1423	112107	172.3333	116	21	94	12.66667	628	25.66667	185.6667	27	213.6667
2043	6/11/2022	15:06:17	Supervisor	MBS-5	5009	38882	174097	483976.7	6226	11489.33	94584.33	23725.67	1322.667	99494	190.6667	85.66667	18	81.33333	13.33333	677.6667	21.66667	178.3333	24.66667	236.6667
2047	6/11/2022	15:23:12	Supervisor	MBS	288	45116.25	158269	437886.3	12784.25	10571	89859.75	23582	1495.5	114476	157	125	21	86	11	605	23.75	178.75	23.25	231.5
2053	6/11/2022	15:52:20	Supervisor	MBS	245	44322.33	168931	460421.3	7615.667	9136.333	92053	22664.67	1433.667	109696.3	149.3333	121.6667	20.66667	87.33333	12	654.6667	20.33333	160.6667	22.33333	205.6667
2217	9/11/2022	9:37:11	Supervisor	MBS	212	37029.33	167741.3	455322	7349.333	11396.33	91390	25669.67	1276	106082	180.3333	93	32	94	12	649.3333	23.66667	191	26.33333	280.3333
2222	9/11/2022	9:57:17	Supervisor	MBS	294	51134.5	156678	417137.5	15382.5	11884.5	81616.25	23661.5	1696.25	127198.8	144	129.5	22	101.5	13.5	580.25	26.25	209	30.75	261
2228	9/11/2022	10:20:09	Supervisor	MBS	215	42970	165356.7	441937.3	10264.33	11135.33	90288	24438	1423.333	113073	179.6667	97.33333	21	94.33333	11.66667	651.3333	24	190	27	216
2231	9/11/2022	10:32:38	Supervisor	MBS	237	42440.33	163349	458627.3	6568	11674	91769	24773	1278.333	105282.3	195.6667	108	21.33333	85.66667	12	628.3333	22.66667	186	26.66667	213.3333
2238	9/11/2022	10:58:03	Supervisor	MBS	217	41266	172463	461192.3	4804.333	11005	85287.67	23828.67	1355.333	106633.3	171.6667	123	22.66667	89.66667	11	646	21	181	24.66667	239.6667
2241	9/11/2022	11:08:21	Supervisor	MBS	210	41569.33	171140.7	461932.7	7825.333	11129	90593.67	24527	1497	111632	180	127	17.66667	90	12	630	21.33333	182.3333	25.33333	223
2245	9/11/2022	11:23:06	Supervisor	MBS	200	35271.25	170940.3	457562	3599.25	14486.5	86080	22268.75	1126	98760.5	171.5	112.25	20.5	85.25	12	656	21.75	179	25.5	233.75
2249	9/11/2022	11:36:42	Supervisor	MBS-5	5003	39299	168314	428422.5	8226.25	10969.25	84552.5	24454.5	1488.25	116443.5	174.5	110	22.25	88.5	13	608.25	24.25	190.75	25	220.75
2253	9/11/2022	11:49:30	Supervisor	MBS-5	5039	38317.67	176018	478719	7730.667	10835.67	93886.67	23967	1552	105104.3	183.6667	87	22	86.33333	12.33333	670.3333	21.33333	185.6667	25.33333	231
2260	9/11/2022	12:54:57	Supervisor	MBS	100	39247.33	169471.3	476420.3	4758.333	13278.67	91985.33	23330	1292.667	101153.3	189.3333	107	22.33333	103	12	634.6667	20.33333	178.3333	25	204
2264	9/11/2022	13:11:46	Supervisor	MBS	256	41822	162667.5	434163.8	7088.5	16192.25	86519	25110	1469.5	118104.8	185.25	118.5	30.25	133	13	624.5	25.75	191	28	250.25
2273	9/11/2022	14:21:12	Supervisor	MBS-5	5015	52028.67	154910.7	430622.7	10695.33	10887.67	87761.33	20784	1522	122926.3	162	119.6667	53	1360.333	12.66667	612.6667	24.66667	173.3333	26.66667	211.3333
2276	9/11/2022	14:34:08	Supervisor	MBS	23	41044.33	168397.7	456102	6362.667	10809.33	91382.67	23859.33	1412	108169.3	171.6667	104.6667	26	94.33333	11	642.6667	23.33333	185.3333	26.66667	206
2280	9/11/2022	14:49:56	Supervisor	MBS	68	45408.67	172544	426925.3	8386.333	9839	83444.33	22058.67	1639.667	122318	133.3333	159.3333	29	96.33333	12.33333	600	21.66667	168.6667	22	208
2292	9/11/2022	15:34:29	Supervisor	MBS	14	43385	170036	439807.3	7446.667	11466.67	84263	25353.67	1482.667	116185.7	167.3333	121.3333	19.66667	93.33333	13	581.6667	26	196.3333	26.33333	199.3333
2296	9/11/2022	15:47:14	Supervisor	MBS	204	36469.5	173111	439996.5	6795.25	10389.75	86918.5	22363.5	1392.5	106896.3	155	101	27.75	77	13.25	656.5	21.5	179	24.5	227
2299	9/11/2022	15:57:27	Supervisor	MBS	202	31808	175571	447325.3	5057.333	10592.33	87751.33	23800	1180.333	101322.7	169.3333	74.66667	21.66667	94.66667	13.66667	669.6667	22.66667	186.3333	25.33333	226.3333
2304	9/11/2022	16:14:04	Supervisor	MBS	226	40221	174050.7	473436.7	4721	10724	90127	23717.33	1259.667	99502	153.3333	99	20.33333	76.66667	11.66667	648.3333	21.66667	178.3333	25.66667	223.3333

File #	Date	Time	Operator	Name	ID	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
2307	9/11/2022	16:24:08	Supervisor	MBS	233	42774.67	167578.7	448513.7	14184	11028	93388	25405.67	1518.333	116416.3	153	114.3333	21	90	11.33333	649.3333	24.66667	189.6667	28.33333	238.3333
2024	6/11/2022	12:33:11	Supervisor	A. EVANS	AE-01	60067.33	158434	430616	4973.667	11845.33	93694.33	23318.67	1700	122928.3	140.6667	137.6667	128.3333	342	12.33333	651.6667	22.66667	176.3333	25	213.6667
2067	7/11/2022	12:50:18	Supervisor	T. IRVINE	SB 5.186	70023.67	153897.3	482321.7	4757	11849	98147.33	22259.33	1636	109323.3	143	117.6667	52.66667	92.33333	12.66667	643	21.33333	177.6667	27.33333	228
2076	7/11/2022	13:23:46	Supervisor	T. IRVINE	UN ID 1	49971.33	155194.7	449910.7	7416.333	11310.67	96171.67	22230.33	1537	112303	137.6667	104.6667	78.66667	172	13.33333	626.6667	24.66667	180.3333	29	234.6667
2079	7/11/2022	13:33:48	Supervisor	T. IRVINE	UN ID 2	64428.67	157997.7	494221.3	8004.333	11818.33	102369.7	22469.67	1529.333	103249	185.6667	76.66667	175	175.6667	12	663	22.66667	182.6667	27	228.3333
2084	7/11/2022	15:37:04	Supervisor	T. IRVINE	SB 5.111	54344.33	150159.3	445777.7	5289	11083.67	93564	20366.67	1537.667	116504.3	160.6667	130.6667	35.33333	91.33333	11.33333	620	21	160.6667	22.66667	218.6667
2090	7/11/2022	16:02:41	Supervisor	T. IRVINE	SB 2.38	51830	146369.7	421513.3	9745.667	10303	94556.67	21261.33	1486.333	126924.3	143	113	39	96	10.66667	628	20.66667	165.6667	22.66667	204
2096	7/11/2022	16:28:44	Supervisor	T. IRVINE	TC 6	45822.67	143812.3	406567.7	6000.333	10132.33	92967.33	20766	1515	129264.7	152	123.3333	40	103.3333	11.66667	615	22.66667	166	24	206
2100	7/11/2022	16:44:30	Supervisor	T. IRVINE	TC 21	55399.75	150750	455894.3	5422	10726.75	92922.25	20184	1564.25	109240.5	139.75	113	52.5	101.5	12	628	20.5	168.75	24.25	221
2109	8/11/2022	11:43:36	Supervisor	T. IRVINE	SB 0.09	23760.75	135062.8	585343.5	2709.25	17906.5	33926.25	10751.25	1361	71607.75	104.25	14.5	57.25	115.25	43	374	22.5	165.5	4.5	436
2117	8/11/2022	12:19:24	Supervisor	T. IRVINE	SB 2.137	53489.33	144594.3	418170	9928.333	9884.667	91154	20856.33	1554.333	128051.7	144.3333	131	40	97	10.66667	607.6667	23	165	25	239.6667
2121	8/11/2022	12:45:06	Supervisor	T. IRVINE	SB 2.45	66500	148062.8	459758.5	4796.5	9972.25	95071.75	20628.75	1539.75	110915	155	160.5	25.5	88.5	10.75	645	19.75	157	22.25	206.75
2125	8/11/2022	13:09:20	Supervisor	T. IRVINE	SB 2.83	52486.25	153619.3	456306	6705.75	11147.75	95196.75	21270	1537	116377.5	181.5	92.25	37.25	110.75	11.75	638.75	21.25	168	24	242.5
2128	8/11/2022	13:19:58	Supervisor	T. IRVINE	SB 2.107	47418	157981.3	458279	7046.667	11310.67	97690	22456.67	1267.333	114379.3	205.3333	87.33333	37.33333	90.33333	12	667.6667	21.33333	168.3333	23.66667	396.6667
2136	8/11/2022	14:17:43	Supervisor	T. IRVINE	SB 2.138	42067.25	156305.5	476989.3	7404.75	11250	102506.5	21759	1271	96033	168.75	93	30	82.75	12.75	672.25	20.75	174.25	24.75	216.25
2139	8/11/2022	14:28:29	Supervisor	T. IRVINE	TC 7	52594.67	149654.7	432728.3	9053.333	10759	94916.67	20798.67	1579.333	129325.7	198	122.3333	92.66667	155	13.33333	630.6667	23.66667	171	26.33333	208.3333
2146	8/11/2022	14:52:04	Supervisor	T. IRVINE	SB 2.200	66915.75	154823.8	492080.5	5546.5	11281.25	100538	22086.75	1642.25	107388.3	182.75	128.25	39.25	99.75	12.75	678.5	21	171	25.75	241.75
2150	8/11/2022	15:05:17	Supervisor	T. IRVINE	SB 2.142	47575.25	154156	463434.3	5526.25	12412.75	98066.5	20700.75	1350	100909.5	149.75	96	27.25	88.75	13	635.5	20.25	171.5	22.75	234.5
2154	8/11/2022	15:26:33	Supervisor	T. IRVINE	SB 1.79	57503.33	149288	445951	9409.333	12605.33	93719.67	20863.67	1555.333	116309.7	153.6667	124.6667	50	129.6667	13	633.3333	23	173.3333	25.66667	226.3333
2157	8/11/2022	15:38:27	Supervisor	T. IRVINE	SB 2.178	46874.67	152003.7	462119.3	12157.33	17209.67	106885	22157	1285	107025.7	174	84.66667	35	94	12.33333	657	21.66667	178.6667	26.66667	231.6667
2164	8/11/2022	16:08:02	Supervisor	T. IRVINE	SB 2.40	41832.5	157584.5	469556.3	5004.75	11595.25	101566	22635.25	1208.5	98247.75	186.5	59.5	43.25	104	13	663.5	21	174.75	24.5	238
2168	8/11/2022	16:22:37	Supervisor	T. IRVINE	SB 2.50	52941.67	154869.7	469977.7	10007.67	11020	100203.3	21761.33	1502	109965.3	175.3333	100.3333	37.33333	99.33333	12.33333	646.3333	21	168.6667	24.66667	264.6667
2181	8/11/2022	17:22:33	Supervisor	T. IRVINE	SB 2.51	50233	151023.3	424041	7206.667	9669	87042.33	19448	1480.333	124177.3	139.3333	131	30.66667	86	10.33333	596.3333	21.66667	157	22.33333	191
2185	8/11/2022	17:38:33	Supervisor	T. IRVINE	SB 5.37	61371.75	151657.3	452379.3	5997.25	11620	98348.5	22312.25	1500.5	115404.3	150.5	124.75	73.5	151.25	12	615.75	22.25	162.75	26	207.5
2189	8/11/2022	17:52:33	Supervisor	T. IRVINE	SB 5.95	50940.75	156748.3	467851.8	4428	10987.25	99475.25	21946	1357	105533	158	106.75	30	109.5	12	638.75	21.5	171.25	25	247.5
2192	8/11/2022	18:04:04	Supervisor	T. IRVINE	EB 1.06	48902.67	139525.7	471798.3	5565	10090	87314.33	19048.67	1510.333	108720.3	129.6667	127	34	93	12.33333	620.6667	19	162.6667	23	228.6667
2199	8/11/2022	18:28:38	Supervisor	T. IRVINE	UN ID 3	58579	136812.3	435760.3	2444.5	4654.75	93997.5	21315.25	2695.25	146438.3	238.75	83.25	31	220.25	8	128.5	35.75	93.5	13.25	59
2204	8/11/2022	18:48:12	Supervisor	T. IRVINE	SB 2.191	56740.75	121836	553177.3	1776.5	1380.5	95706.75	7208.5	1733.25	90270.5	176.25	35.25	33.75	65.5	1.25	123.25	15.5	35.5	6	57
2316	10/11/2022	12:45:29	Supervisor	S. TAVENER	ST-01	27154.4	148757.4	514368	2128.2	3361.6	65908	10935.2	1920.4	94111.8	120.4	53	21.2	173.4	3.2	206.2	23.2	119.6	5.8	89

File #	Date	Time	Operator	Name	ID	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
2333	12/11/2022	11:32:59	Supervisor	J. EVANS	JE-01	45904.33	142877	416606.7	9658.667	10801.67	97310	22199.67	1493	115814	113.3333	98.66667	124.3333	243.6667	11.33333	641.3333	24	175.6667	27.66667	216.6667
2469	15/11/2022	7:21:53	Supervisor	D. SNELL	S8 21 M	45960.33	150528	448419	5410	12296.67	98455	20941.33	1320.333	110362	168	86.33333	22.66667	96.66667	13	649.3333	21.33333	173.6667	25.66667	253.3333
2472	15/11/2022	7:32:34	Supervisor	D. SNELL	S8 15	36416.33	171204	496529	776	5062.333	93450.67	11931.33	1891	111565	202.6667	17	28	101	8.666667	257	22	82.33333	7.666667	177.3333

Norfolk Island (unpublished Oliver Nebel data removed)

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
NF-20				Steels Point Basalt	Flow 3 above tuff marker	Green 1973	85700	154900	475500	4600	11700	89700	19700	1700	19200					21	577	23	184		
NF-38				Steels Point Basalt	Flow 5 above tuff	Green 1973	62000	165600	490800	4300	9100	85700	20500	1200	56700					10	596	25	173		
NF-69				Steels Point Basalt	Flow 6 above tuff	Green 1973	64100	161200	497800	3100	6100	81100	19800	1400	46700					7	406	105	149		
NF-75				Steels Point Basalt	Flow 9 above tuff	Green 1973	63200	156000	509300	2900	4800	83400	20200	1200	42400					4	374	98	148		
NF-91				Duncombe Bay Basalt	400m SE of Capt. Cook memorial	Green 1973	55100	170300	468200	5100	11000	83700	19700	1400	84800					14	746	25	224		
NF-11				Cascade Basalt	Cascade Flow 1	Green 1973	71000	165500	476300	3800	7900	82400	19900	1400	58400					6	566	24	169		
NF-56				Cascade Basalt	Jacobs Rock Flow 6	Green 1973	70400	160600	495900	3100	4300	90200	18300	1600	33900					4	428	23	146		
NF-58				Cascade Basalt	Jacobs Rock Flow 7	Green 1973	48800	168800	505100	3800	8000	82400	19400	1300	55400					10	560	22	187		
NF-95				Cascade Basalt	250m SE of Capt. Cook memorial	Green 1973	77100	164100	482500	4700	9100	88700	18500	1500	46600					12	675	27	200		
NF-98				Cascade Basalt	Anson Bay	Green 1973	73800	155600	498100	3000	5700	89300	17800	1500	21500					6	417	22	143		
70-721				Cascade Basalt	Cascade, massive flow	Green 1973	79800	162500	489100	4000	8000	90700	17700	1600	29900					10	522	21	156		
NF-16				Cascade Basalt	Cascade, at sea level	Green 1973	74500	151100	488600	2600	5800	90400	18800	1500	46300					5	385	21	142		
NF-26				Bali Bay Basalt	Pt. Blackbourne	Green 1973	73100	158600	488100	5100	12400	84600	20800	1400	27300					15	747	26	234		
NF-43				Bali Bay Basalt	Collins Head	Green 1973	73900	161000	490300	5100	11900	85300	20300	1500	38500					15	672	21	225		
NF-724				Bali Bay Basalt	Bali Bay (boulder)	Green 1973	66800	161400	509500	2900	5100	90800	19100	1600	32000					8	408	33	141		
NF-723				T. Buffet's property	Bore near air strip	Green 1973	61900	163400	499500	3700	7000	87400	20900	1500	43100					8	478	23	161		
PH-4				Phillip Island	Phillip Island	Green 1973	39800	173600	502000	4400	9100	76900	22300	1200	67000					11	531	84	194		
PH14				Phillip Island	Phillip Island	Green 1973	67800	159500	506200	3700	7300	88700	19400	1500	42400					10	492	22	157		
2350	12/11/2022	16:41:45	Supervisor	SOURCE MATERIAL	PALM GLEN	PXRF	40231.67	172585.7	482375	6179.333	12140.33	76594.67	18503.67	1419.333	101188	175	86.66667	50	73	13.66667	549	27.33333	173.6667	26.66667	229
2354	12/11/2022	17:01:09	Supervisor	SOURCE MATERIAL	COCKPIT BETWEEN WATERFALLS	PXRF	37856	162562.7	438831	4219.667	10883	75344.33	20170.67	1371.333	118077.3	129	118.3333	61.66667	88.33333	9	636	35	171.6667	30	259.3333
2370	12/11/2022	18:25:35	Supervisor	SOURCE MATERIAL	ANSON BAY BEACH - SOUTH END 2	PXRF	43902	152786.3	459538.3	2489	6075.75	79359.5	17509.5	1326.75	106523	123.25	92.25	60.75	78	6.75	386	26.75	121.25	17.5	101.5
2376	12/11/2022	18:53:01	Supervisor	SOURCE MATERIAL	ANSON BAY - CLIFF BASE	PXRF	45741.25	152930.5	463746	2071.75	6533.25	78829	18219	1368	107398.5	104.5	98.25	47.25	74.5	7	370	25	120.5	17	103
2382	12/11/2022	19:16:46	Supervisor	SOURCE MATERIAL	PHILLIP ISLAND 1	PXRF	40650.5	149970.3	473348.8	5915.25	8844.25	81404.75	21220.75	1531.5	109481.5	180.75	53	59.5	99.25	3.5	516.75	113.25	157.25	55.5	342

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
2388	12/11/2022	19:39:10	Supervisor	SOURCE MATERIAL	PHILLIP ISLAND 2	PXRF	35551.33	163502.7	453669.3	4050.667	8834.667	71254.33	17058.67	1129.333	113519	161	130.3333	49.66667	201.3333	9.666667	447	350.3333	143.3333	147.6667	185
2399	13/11/2022	8:46:56	Supervisor	SOURCE MATERIAL	MOUNT BATES 2	PXRF	66134	150575	461123.3	4266.333	10907	85828.67	20006.67	1641.333	111074.7	150	134.6667	58	100	13	613.3333	22.33333	166.3333	24.33333	257
2421	13/11/2022	12:48:43	Supervisor	SOURCE MATERIAL	BALL BAY NORTH 1	PXRF	74874.67	150166	448494.7	5192.667	9985	77655	17992.33	1679.333	112386	111.3333	126	59.66667	80	9.333333	590	22.66667	164	24.66667	221
2425	13/11/2022	13:05:01	Supervisor	SOURCE MATERIAL	BALL BAY BEACH 1	PXRF	32694.33	170739.3	493343.3	5946.667	13573.33	78957	16722	1112.333	86212.67	111	83	56.33333	90.33333	12.33333	614.3333	84	199	52	199.3333
2430	13/11/2022	13:59:56	Supervisor	SOURCE MATERIAL	BALL BAY BEACH 2	PXRF	37434.25	153782.8	437575	4311.25	10766.5	76072.75	17331.75	1374.75	130190	88	154	50	63.25	11.5	523	23	155	26.5	184.25
2433	13/11/2022	14:12:47	Supervisor	SOURCE MATERIAL	BALL BAY GAS HILL	PXRF	23924.33	188298	460638.3	5458.667	12553.33	61943.33	13348.33	1272	105119.7	119.6667	97	58.33333	85.66667	13	563	23	206	29.33333	237.6667
2439	13/11/2022	14:40:26	Supervisor	SOURCE MATERIAL	SLAUGHTER BAY 1	PXRF	30088	168136.3	456386.7	4552	8302.333	68537.33	13699	7938	107637.7	131.3333	151.3333	46.33333	131.3333	10	399.6667	1229.333	116.6667	489.6667	448.3333
1173				BUMBORAS SOURCE ROCK 2	BUMBORAS 2	PXRF	57014.67	147383.3	482823.7	1972.667	6335	83827.67	19735	1353.667	109721.7	161.3333	102.6667	53.33333	81.66667	7.333333	356.6667	23.33333	116.6667	19.33333	108
1176				CASCADE BEACH SOURCE ROCK	CASCADE 1	PXRF	92191.33	149065.3	490746.7	3389	8089.333	86595	15785.67	1630.333	110477	140.3333	146.3333	54.66667	76.66667	8	433.6667	20.33333	120.6667	20.66667	153.6667
1179				CASCADE BEACH SOURCE ROCK 2	CASCADE 2	PXRF	61969	158386	502869.3	3709.667	9100.667	92811.67	15855.33	1697.333	98936.33	147.3333	107.3333	48	67.66667	10.66667	496	20	134.6667	19.66667	181
1182				MT BATES QUARRY SOURCE ROCK	MT BATES QUARRY	PXRF	71138	161275.3	516413.7	5189.667	11733	93566	19052.33	1517.667	94653.67	177	105.6667	54	63.66667	13	676	20	170	23	231.6667
1185				ANSON BAY SOURCE ROCK	ANSON	PXRF	78077.67	150521.7	524679.3	2807.667	5958.333	90559.67	18904.67	1526.667	102295	154	132.3333	55	85.66667	6	370.3333	19	119.3333	16.33333	124
1188				CEMETERY BAY SOURCE ROCK	CEMETERY	PXRF	49572	155918.7	485105.7	2998.667	9178.333	82708.33	18334.33	1960.333	111706	172.6667	120.6667	48.66667	81	13.66667	417.3333	39.33333	130.6667	31.33333	175.3333
1191				COCKPIT SOURCE ROCK	COCKPIT	PXRF	63739.33	157544	488047.7	3689.667	9820.667	87867	20039.67	1534.333	113746.3	180.6667	168.6667	44	71.33333	8.666667	531.6667	20	141	21	208
1194				MUSIC VALLEY SOURCE ROCK	MUSIC VALLEY 1	PXRF	41957	165708.3	459377	3542	10683.33	63867	18625	1480	128451.3	137.6667	141	39.33333	148.6667	17.33333	439	38.66667	151	32.33333	169.6667
1197				MUSIC VALLEY SOURCE ROCK 2	MUSIC VALLEY 2	PXRF	70425	152649.7	499736	4320	11365.67	81256	19507	1410	99831.67	144.3333	95.66667	46.66667	78	9.666667	534.3333	19.33333	177	26.33333	169.3333
3001				Norfolk Island Basalt Mount Bates Sample 001	X22230-1	QUT	80300	164200	489400	5100	10500	91200	19700	1400	101200	122.8	104.9	50.8	89.4	14.1	704.3	14.8	169.6		
3002				Norfolk Island Basalt Slaughter Bay Sample 002	X22230-2	QUT	81300	153700	490600	3600	11400	81900	18900	1300	104400	133	136.2	50	100.7	18.4	666.4	19	149.2		
881				Ball Bay	Beach boulder 1	Anderson et al. 1997							19200	1500	88888.8		102	52	85	13	742	26	184	35.6	

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
B82				Ball Bay	Beach boulder 2	Anderson et al. 1997							18600	3200	87555.47		99	46	73	13	685	23	182	33.5	
B83				Ball Bay	Beach boulder 3	Anderson et al. 1997							18700	1500	87777.69		86	53	78	13	683	23	185	38.2	
NIPP 48				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							18700	1700	99111.01		164	33	90	17	781	24	161	31.1	
NIPP 68A				Emily Bay Excavation - Anderson et al. 1997	Hammerstone flake	Anderson et al. 1997							18100	1600	90999.91		96	35	100	12	750	24	173	33.1	
NIPP 68B				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							19300	1600	94999.91		113	26	83	13	963	27	160	33.3	
NIPP 68C				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							18600	1600	91999.91		99	18	93	14	800	29	164	38.4	
NIPP 68D				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							17200	1400	87333.25		128	20	81	11	850	24	162	27.7	
NIPP 70				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							18300	1500	95888.79		105	36	94	16	866	28	171	32.6	
NIPP 69				Emily Bay Excavation - Anderson et al. 1997	Secondary flake	Anderson et al. 1997							16400	1300	81555.47		55	27	84	15	798	23	166	30.3	

New Zealand

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ1				samp. 14858		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	67000	170800	538300	1000	6800	89100	6900	1200	28400	258	51	49	83	18	219	20	58	2	237
GEOROC NZ2				samp. 29250	58125	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - NGAURUHOE	ANDESITE, BASALTIC	52400	166300	562200	1700	11400	83100	7600	1500	23700	220	29	41	89	38	247	24	95	2	214
GEOROC NZ3				samp. 14844		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46500	171200	574000	1000	12000	74900	6900	1000	18100	195	35	56	74	37	250	20	93	2	310
GEOROC NZ4				samp. 14867		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHANOA FORMATION	ANDESITE	25400	175900	604000	1300	15800	59300	7200	800	19000	173	17	38	72	56	248	24	119	5	389
GEOROC NZ5				samp. 14883		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	69500	154300	572700	1100	13900	75000	6800	1100	16300	189	110	34	68	54	250	19	114	4	331

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ6				samp. 14811		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	61200	154900	579100	1000	12100	82200	6600	1700	22300	207	73	60	73	40	334	20	90	3	294
GEOROC NZ7				samp. 14798		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / OHAKUNE ANDESITE	ANDESITE, BASALTIC	70700	145000	567900	700	6600	90500	5300	1900	21100	226	39	102	74	16	390	17	65	3	144
GEOROC NZ8				samp. 14848	58124	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - PUKEONAKE	ANDESITE, BASALTIC	86400	142900	570100	1100	14500	72600	6900	1500	16800	181	237	96	71	49	277	18	115	5	355
GEOROC NZ9				samp. VUW22996		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / K-TRIG	BASALT	69700	172000	489200	1100	3300	120700	9700	1500	12400	244	39	33	76	8	344	20	56	2	94
GEOROC NZ10				samp. VUW22993		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / ORAKEIKORAKO	BASALT	62400	168800	501100	2100	4000	105700	13100	1800	12700	286	33	42	90	8	347	30	147	4	145
GEOROC NZ11				samp. VUW21717		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA	BASALT	61700	171700	506300	1000	5500	113400	8300	1700	12400	256	14	25	94	15	318	19	82	2	201
GEOROC NZ12				samp. VUW33431		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAROA	BASALT	58000	168100	505100	2100	6400	106000	12600	1800	12600	297	21	28	96	15	368	26	103	4	185
GEOROC NZ13				samp. VUW33432		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / BEN LOMOND	BASALT	60600	175000	506600	1800	3900	104800	11100	1800	12500	292	33	27	90	9	347	25	84	4	158

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ14				samp. VUW33433		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TRIG 9474	BASALT	69400	172200	495000	1200	3000	120000	9800	1900	12400	283	35	44	84	7	347	21	58	2	88
GEOROC NZ15				samp. VUW33434		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAROA	BASALT	63100	177500	510600	1000	5500	118600	8000	1900	11400	277	27	38	83	13	372	19	52	1	212
GEOROC NZ16				samp. VUW33435		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAROA	BASALT	52400	168600	532400	1300	7800	99300	9300	1700	12000	296	15	28	95	20	382	22	76	3	286
GEOROC NZ17				samp. VUW11965		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RED CRATER	BASALT	76700	152900	524500	800	6700	102900	7300	1700	11800	271	63	73	84	20	278	21	68	3	137
GEOROC NZ18				samp. VUW17439	58122	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - WAIMARINO	BASALT	131700	127000	522600	500	4300	96100	4700	1600	16000	226	341	85	76	15	342	13	48	2	122
GEOROC NZ19				samp. VUW33436		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TATUA	BASALT	61400	171300	501900	2400	3700	104900	13300	1700	12400	264	30	44	92	6	348	31	148	5	167
GEOROC NZ20				samp. VUW33437		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TATUA	BASALT	74600	177800	494300	2000	3100	116800	11500	1500	11200	245	58	35	75	4	357	24	99	4	104
GEOROC NZ21				samp. VUW33438		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / ONGAROTO	BASALT	92000	154900	510200	2700	5600	101800	10700	1300	11800	240	138	55	82	10	330	25	108	5	187
GEOROC NZ22				samp. TV2-15	45866	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / KAKUKI	BASALT	91200	180900	485200	1400	2700	111600	8900	1300	10500	191	113	56	70	4	350	19	79	3	70

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ23				samp. VUW14855		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	BASALT	91500	153400	522700	800	5800	96100	6400	1600	11200	245	139	78	88	12	199	17	48	1	182
GEOROC NZ24				samp. VUW33440		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / HARRY JOHNSON	BASALT	60000	172100	517400	1600	7100	100800	11600	1800	11900	244	26	33	84	22	357	24	108	4	262
GEOROC NZ25				samp. AU14761		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / HERALD	BASALT	41800	177500	529300	800	2400	98800	9200	1700	12500	366	20	139	88	3	189	23	42	1	97
GEOROC NZ26				samp. AU14782		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / HERALD	BASALT	73300	177500	487600	800	1200	114400	7900	1900	13900	355	41	150	92	2	161	19	30	2	33
GEOROC NZ27				samp. RC7C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE	45200	161100	575900	1100	12000	86600	6800	1500	0	227	8		69	43	259	21	91	6	427
GEOROC NZ28				samp. HPDC1A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE	40100	149600	627700	900	19200	69200	5100	1200	0	161	13		59	67	201	22	79	6	547
GEOROC NZ29				samp. FC4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	BASALT	67200	168500	517900	1200	5900	115500	7700	1700	0	238	22		73	11	303	19	60	5	242
GEOROC NZ30				samp. PW5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	BASALT	71500	164700	513900	1200	6600	117000	7400	1700	0	238	26		72	12	297	18	56	5	249

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ31				samp. RC5A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	55900	170400	530500	1200	7400	105900	7900	1700	0	287	9		74	21	294	20	72	5	316
GEOROC NZ32				samp. A03B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	45400	163700	567400	1500	11400	86500	7300	1600	0	208	11		72	36	283	22	94	5	394
GEOROC NZ33				samp. RU057B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	52700	159700	582900	1000	13700	75800	6400	1100	0	170	46	64	63	48	267	19	101	5	339
GEOROC NZ34				samp. RU059		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54200	160700	582500	1000	13600	76000	6500	1100	0	178	51	64	65	48	264	19	100	3	332
GEOROC NZ35				samp. RU069		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53200	162400	581600	1100	13800	75500	6400	1200	0	184	53	69	67	51	267	20	103	5	345
GEOROC NZ36				samp. RU074		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	45000	168500	578100	1100	14100	73800	6600	1100	0	188	39	36	65	49	281	18	106	3	355
GEOROC NZ37				samp. RU-N101		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53400	162100	578000	1000	13600	77900	6500	1200	0	179	51	71	67	49	270	19	100	3	320

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ38				samp. RU-N102		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53100	158700	562500	1000	13100	74900	6200	1100	0	181	46	71	64	49	273	19	101	4	344
GEOROC NZ39				samp. MKP120		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAMAKU IGNIMBRITE	ANDESITE	26300	176300	583500	400	19700	33400	9700	1800	0	168	14		196	81	164	19	209	10	742
GEOROC NZ40				samp. MKP152		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAMAKU IGNIMBRITE	ANDESITE	28300	150400	604600	1300	22600	37800	9600	2700	0	120	6		237	130	172	28	189	9	615
GEOROC NZ41				samp. R95/9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40600	161400	596500	1400	18400	65200	7500	1200	68700	177	17	30	67	68	287	21	162	5	473
GEOROC NZ42				samp. R95/15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33700	170300	589500	1300	17100	64600	7300	1200	70300	183	9	24	74	64	239	23	146	7	431
GEOROC NZ43				samp. R97/111		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	52700	150100	605000	1700	21500	58800	7300	1200	7000	146	96	62	54	89	217	21	157	6	445
GEOROC NZ44				samp. R97/44		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	47500	156900	598000	1500	16800	68900	7000	1400	9900	165	35	41	63	66	277	20	133	5	390

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ45				samp. R97/4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	41100	168600	576400	1500	14700	74600	7700	1500	19600	199	14	37	71	57	248	21	117	5	332
GEOROC NZ46				samp. R97/19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46800	159900	590800	1500	16100	71200	7000	1400	23300	126	22	27	56	81	268	20	148	6	433
GEOROC NZ47				samp. R97/23		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	25800	168500	617100	2000	20700	58000	8300	1100	8600	167	6	34	62	71	298	20	144	6	420
GEOROC NZ48				samp. R97/34		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	33700	164200	615400	1500	19600	60000	6900	1200	200	167	42	44	61	64	227	20	121	5	345
GEOROC NZ49				samp. R97/35A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	22900	175400	606800	1700	18500	61900	7900	1100	11200	162	5	40	60	70	297	21	145	5	420
GEOROC NZ50				samp. R97/36		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	41700	169600	576600	1500	14500	74200	7500	1500	16000	199	21	48	69	56	234	21	115	5	321

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ51				samp. R97/46		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	61800	150700	592100	1500	17200	67500	7000	1300	9900	157	122	52	54	69	227	20	133	5	388
GEOROC NZ52				samp. R97/108		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	52100	154100	594300	1300	15000	72600	6900	1400	11500	173	38	42	62	58	255	19	124	5	366
GEOROC NZ53				samp. R97/112		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	55300	147800	599400	1400	16400	69400	6600	1300	8200	151	64	65	58	63	339	19	137	5	377
GEOROC NZ54				samp. R97/58		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	59800	152800	588200	1600	15800	71500	7200	1400	15100	172	86	49	60	61	230	20	124	5	374
GEOROC NZ55				samp. R97/65D		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	34800	170500	591700	1500	16800	68400	7200	1400	14200	161	13	26	66	68	240	21	129	5	366
GEOROC NZ56				samp. R97/6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35300	172500	587500	1400	15500	69400	7200	1400	15600	169	14	25	69	63	229	21	122	5	346

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ57				samp. R97/65		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35700	171900	587000	1400	15500	69300	7200	1400	16000	172	15	30	70	62	229	22	121	5	352
GEOROC NZ58				samp. R97/65C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45300	164000	588900	1400	15900	69000	6900	1400	13100	168	49	31	65	63	236	20	123	5	353
GEOROC NZ59				samp. R97/27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	23200	176500	607700	1800	18600	61700	7800	1200	11800	153	14	27	55	82	281	21	150	6	460
GEOROC NZ60				samp. R97/56		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	32900	161000	623500	1800	20300	57100	6700	1200	7700	115	27	16	58	83	254	21	149	6	440
GEOROC NZ61				samp. R97/49		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44800	176000	559200	1200	10000	75500	7600	1600	24500	219	15	39	72	33	240	19	88	3	265
GEOROC NZ62				samp. R97/50		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	47600	171400	565000	1100	8800	78800	7000	1600	19200	215	23	51	68	29	235	17	80	3	235

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ63				samp. R97/65A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	51700	151300	600700	1700	18800	63900	7900	1300	12400	164	80	19	59	73	231	22	148	5	434
GEOROC NZ64				samp. ICR9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MANGAKINO VOLCANIC CENTER / IGNIMBRITE C	ANDESITE, BASALTIC	32800	173800	554500	2000	12600	82700	13500	1500	19600	373	7		78	39	334	23	131	3	321
GEOROC NZ65				samp. OU45629		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	31400	170300	597900	2400	15100	74000	9700	1300	27400	158	14	32	82	23	491	29	192	5	351
GEOROC NZ66				samp. OU49443		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	30400	167900	593500	2400	26300	60300	9600	1200	35000	158	16	35	74	100	385	31	197	5	344
GEOROC NZ67				samp. OU49444		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	30700	168500	595100	2300	25800	59000	9700	1200	32300	157	16	29	78	97	371	32	195	5	395
GEOROC NZ68				samp. OU49445		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	30600	169200	596000	2300	26100	59500	9700	1100	33200	157	16	32	71	99	383	32	198	7	406
GEOROC NZ69				samp. OU49452		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	31600	167800	597200	2500	18100	65000	10000	1300	20300	168	17	32	88	42	433	30	201	6	340
GEOROC NZ70				samp. OU49453		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	25000	169300	609200	2400	26700	54600	9800	900	26000	165	16	38	79	95	366	30	201	6	399

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ71				samp. OU54985		NEW ZEALAND / SOUTH ISLAND / SOUTHLAND / PARK VOLCANICS - GOWAN ANDESITE	ANDESITE	26300	168500	589400	2400	26100	59700	10000	1500	54800	172	16	24	79	101	380	27	205	6	411
GEOROC NZ72				samp. OU45650		NEW ZEALAND / SOUTH ISLAND / DUN MOUNTAIN- MAITAI TERRANE / PARK VOLCANICS - BARNICOAT ANDESITE	ANDESITE	27400	173200	575500	3300	10700	80600	12900	1300	33600	205	19	97	87	54	633	24	183	6	457
GEOROC NZ73				samp. OU49428		NEW ZEALAND / SOUTH ISLAND / DUN MOUNTAIN- MAITAI TERRANE / PARK VOLCANICS - BARNICOAT ANDESITE	ANDESITE	30600	180700	555900	3800	11000	86500	14100	1500	43000	213	15	104	91	28	885	25	205	9	452
GEOROC NZ74				samp. OU49429		NEW ZEALAND / SOUTH ISLAND / DUN MOUNTAIN- MAITAI TERRANE / PARK VOLCANICS - BARNICOAT ANDESITE	ANDESITE	26900	171600	583300	3800	11300	76900	13800	1400	38100	205	14	99	89	44	677	24	206	8	476
GEOROC NZ75				samp. OU49430		NEW ZEALAND / SOUTH ISLAND / DUN MOUNTAIN- MAITAI TERRANE / PARK VOLCANICS - BARNICOAT ANDESITE	ANDESITE	26500	171900	579800	3500	13500	75800	13500	1200	32600	209	16	102	91	53	753	25	193	8	456
GEOROC NZ76				samp. 42563S20-151	10057 0	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE, BASALTIC, OLIVINE	84600	159600	531100	1700	7500	94800	10600	1200	13600	201	96	78	81	15	296	78	105	5	245
GEOROC NZ77				samp. 27289		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MAUNGATAPU	ANDESITE, BASALTIC, OLIVINE	63500	164600	551300	1000	8000	93300	7200	1500	18100	236	28	72	74	18	373	113	70	3	232

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ78				samp. 27250		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - RURU	ANDESITE, BASALTIC, OLIVINE	68700	155800	537200	800	8800	100800	7600	1400	20600	238	72	58	98	17	343	136	72	2	221
GEOROC NZ79				samp. 27284		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - TE TAPUI	ANDESITE, BASALTIC, OLIVINE	87600	134700	560100	800	9400	94800	5600	1500	18100	234	71	275	85	19	359	424	63	3	301
GEOROC NZ80				samp. 46078		NEW ZEALAND / NORTHLAND- AUCKLAND PENINSULA / LITTLE BARRIER ISLAND / LITTLE BARRIER ISLAND / HAOWHENUA DACITE MEMBER	ANDESITE, BASALTIC	26800	205900	535100	2900	4500	82300	9700	1200	0	144	95	86	8	551	25	137	8	131	
GEOROC NZ81				samp. 44071		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT, ALKALINE	112100	129200	454000	4400	10500	98900	22400	1800	0	212	234	55	106	16.7	492	22.4	172	40.1	211
GEOROC NZ82				samp. 44079		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / MOUNT EDEN (MAUNGAWHAU)	BASALT, ALKALINE	103500	134300	460000	4300	9600	96800	22500	1800	0	211	226	74	106	15.9	491	23.5	166	34.2	187
GEOROC NZ83				samp. OR6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER / ORUANUI ERUPTION	ANDESITE	61800	141600	575400	900	9000	89100	5400	1400	0	205	26	65	27	310	14	77	2	224	
GEOROC NZ84				samp. OR2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER / ORUANUI ERUPTION	ANDESITE	53000	148600	600000	1000	11400	79900	5800	1300	0	169	25	70	37	413	14	89	2	280	

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC N285				samp. OR13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER / ORUANUI ERUPTION	ANDESITE	32300	168000	607600	1200	11100	57600	5000	900	0	162	26		80	35	230	12	70	2	385
GEOROC N286				samp. 31158		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER / TAUPO IGNIMBRITE	ANDESITE	51300	145700	591300	900	11200	76800	5100	1300	0	165	25		68	38	401	19	90	3	306
GEOROC N287				samp. TA6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER / TAUPO IGNIMBRITE	ANDESITE	21400	158500	628200	1800	17100	54100	8100	1300	0	130	6		62	60	264	22	190	4	400
GEOROC N288				samp. 44		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TUNAITI CALDERA	ANDESITE	33500	205200	550900	1300	8900	78600	8500	1100	14900	194	12	13	92	19	390	120	85	3	265
GEOROC N289				samp. 15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TUNAITI CALDERA	ANDESITE	36500	196200	553700	1100	10300	81800	7900	1100	14900	199	6	17	66	22	424	18	88	3	281
GEOROC N290				samp. AU37632		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KERIKERI	BASALT, ALKALINE	78000	173700	488300	3100	3300	103700	15400	1500	0	152	100	63	62	6	401	29	139	7	
GEOROC N291				samp. AU37675		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KERIKERI	BASALT, ALKALINE	63000	171400	491900	3100	7100	108500	17300	1500	0	183	49	44	80	16	488	21	128	23	
GEOROC N292				samp. WI-3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	41900	157800	596500	1000	15300	72100	7700	1200	13200	258	24	58	75	52	206	24	110	4	592

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ93				samp. 10449		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	38900	155500	600800	800	15500	73400	8700	1500	12900	266	19	60	73	51	206	25	113	5	580
GEOROC NZ94				samp. WI-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	38500	153600	602900	1000	15600	72600	7700	1100	13000	272	26	60	67	52	204	25	111	3	596
GEOROC NZ95				samp. WI-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	39700	153000	603000	1000	15900	72600	8100	1300	12900	271	24	56	74	53	204	25	114	4	603
GEOROC NZ96				samp. WI-4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	39700	135400	608500	800	19000	81800	6500	500	12400	194	70	95	29	67	185	21	108	4	525
GEOROC NZ97				samp. WI-5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	37400	162800	621000	600	14700	65900	5100	1100	10800	155	23	41	62	49	175	17	93	3	587
GEOROC NZ98				samp. WI-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	39400	153100	629500	900	18400	62600	6400	1000	10400	176	31	48	56	67	172	24	131	5	740
GEOROC NZ99				samp. 12242	10266 0	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	38400	144300	634500	1200	21700	59100	7500	900	10000	184	54	79	62	73	183	26	155	3	762
GEOROC NZ100				samp. WI-7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	37000	148700	637500	1100	22200	57100	6500	900	9700	167	39	50	53	75	176	25	146	4	784
GEOROC NZ101				samp. 10450		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	33700	149800	643100	800	23500	55100	7500	1000	9300	164	38	103	71	77	173	51	149	6	785

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ102				samp. 11246	10266 3	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	42000	169700	592300	300	11600	82300	6100	1300	11700	188	15	31	68	41	217	20	81	2	470
GEOROC NZ103				samp. WI-10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	38900	170700	597000	600	11800	79100	5900	1100	12000	209	16	33	69	41	208	22	82	2	468
GEOROC NZ104				samp. WI-11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	40100	157800	616200	700	14400	68200	5700	1200	11500	164	19	58	56	50	186	20	93	3	578
GEOROC NZ105				samp. WI-9A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	50900	162000	567400	400	10000	89100	5300	1500	14200	223	26	127	85	28	245	20	58	2	405
GEOROC NZ106				samp. WI-9B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE	38100	169300	585600	500	12800	79000	5700	1200	13100	148	11	165	54	42	247	14	74	2	540
GEOROC NZ107				samp. K11		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / KARIOI	BASALT, ALKALINE, OLIVINE	107300	135300	473400	3600	11500	105400	17400	1800	19700	254	239	84	89	25	470	21	122	21	375
GEOROC NZ108				samp. K96		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / OKETE	BASALT, ALKALINE, OLIVINE	103300	132800	448900	4500	5800	108800	20700	2000	48900	285	263	88	90	7	542	24	150	33	323
GEOROC NZ109				samp. 30450	11087 3	NEW ZEALAND / SOUTH ISLAND / OTAGO / DUNEDIN	BASALT, ALKALINE, OLIVINE	79600	144100	453800	6000	14700	100900	24400	1900	35100	199	136	66	105	31	679	22	221	54	423
GEOROC NZ110				samp. VUW30135		NEW ZEALAND / SOUTH ISLAND / AUCKLAND ISLANDS	BASALT	93000	123700	482500	4900	8300	101700	28600	1600	33100	222	201	64	121	13	508	29	183	42	206
GEOROC NZ111				samp. VUW30163		NEW ZEALAND / SOUTH ISLAND / AUCKLAND ISLANDS	BASALT	80800	148300	466100	6000	10600	97600	31700	1900	21500	268	149	65	114	21	698	33	229	61	322
GEOROC NZ112				samp. P21A		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / PIRONGIA	BASALT	42000	173300	514500	2500	14900	92800	8100	1800	52900	235	19	83	76	54	571	29	120	5	710
GEOROC NZ113				samp. P7		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / PIRONGIA	BASALT	38000	186800	517300	3200	12600	84600	9000	1800	42900	163	16	38	87	20	811	24	185	18	1005

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ114				samp. P31		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / PIRONGIA	ANDESITE	33000	176200	549500	3200	18500	74900	9100	1600	40200	190	18	46	73	63	644	29	143	10	767
GEOROC NZ115				samp. P11		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / PIRONGIA	ANDESITE	35100	169000	549600	2500	17700	73800	8300	1500	40800	175	21	62	60	48	696	29	165	15	857
GEOROC NZ116				samp. P77		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / PIRONGIA	ANDESITE	28600	171700	578300	2200	20500	67200	7200	1400	38700	140	11	50	82	66	676	24	192	19	914
GEOROC NZ117				samp. U13		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / KAKEPUKU	BASALT	54300	179700	486400	2200	9800	99300	11900	2300	45300	314	22	102	65	30	459	34	70	2	406
GEOROC NZ118				samp. U16		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / KAKEPUKU	BASALT	44000	187100	482000	2400	11900	97000	12600	2000	49100	340	15	26	88	24	550	54	87	4	476
GEOROC NZ119				samp. T3		NEW ZEALAND / NORTH ISLAND / ALEXANDRA FIELD / TE KAWA	BASALT	61600	180300	471800	2300	10100	111900	12600	2100	30400	404	35	151	70	28	467	42	62	2	475
GEOROC NZ120				samp. C38		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	45600	164500	570100	1500	11500	86900	7300	1600	0	208	11		72	36	283	22	94	5	394
GEOROC NZ121				samp. D5C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	54000	158600	568100	1200	11300	92600	6500	1500	0	221	18		67	38	253	21	76	5	385
GEOROC NZ122				samp. D4E		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	BASALT	66900	167600	515200	1200	5900	114900	7700	1700	0	238	22		73	11	303	19	60	5	242
GEOROC NZ123				samp. H5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	BASALT	71400	164600	513400	1200	6600	116900	7400	1700	0	238	26		72	12	297	18	56	5	249

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ124				samp. H13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	59500	161000	548100	1100	10200	101100	6900	1600	0	206	20		68	26	270	21	66	5	339
GEOROC NZ125				samp. H20		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	55900	158500	562300	1000	11300	95700	6600	1500	0	188	20		65	28	259	21	69	5	399
GEOROC NZ126				samp. D1A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE	39900	148900	624600	900	19100	68900	5100	1200	0	161	13		59	67	201	22	79	6	547
GEOROC NZ127				samp. A1A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE, BASALTIC	48700	164800	559100	1200	10200	93500	7300	1500	0	187	9		61	29	287	22	85	5	374
GEOROC NZ128				samp. ASA		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	BASALT	55900	170400	530500	1200	7400	105900	7900	1700	0	287	9		74	21	294	20	72	5	316
GEOROC NZ129				samp. A7C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / KAHAROA FORMATION	ANDESITE	45300	161400	577000	1100	12000	86800	6800	1500	0	227	8		69	43	259	21	91	6	427
GEOROC NZ130				samp. 46252A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA / MATAHI BASALT	ANDESITE, BASALTIC	48500	173300	547000	2300	8500	90100	9800	1500	93400	254	3	89		23	294	25	129	6	321

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ131				samp. 462528		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA / MATAHI BASALT	ANDESITE, BASALTIC	48300	175000	550900	2300	8600	88300	9800	1700	91100	236	2	88		27	294	25	128	6	344
GEOROC NZ132				samp. 26592	10266 8	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE, BASALTIC	93400	136000	564300	700	12000	87000	6100	1100	0	209	158	91	67	40	165	21	88	2	481
GEOROC NZ133				samp. P41600	12746 6	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE, BASALTIC	101400	132600	559400	700	11500	89600	6300	1400	0	209	158		67	34	169	21	88	2	481
GEOROC NZ134				samp. 26589	10266 9	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / WHITE ISLAND	ANDESITE, BASALTIC	79000	139000	580000	1000	14000	82000	6000	2000	0	215	102	90	69	47	166	21	102	2	551
GEOROC NZ135				samp. S2807.1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER	ANDESITE	26300	156700	595600	7300	14600	59300	15000	1600	0	121	7	9	104	52.2	304	29.6	130	7	365
GEOROC NZ136				samp. 41618		NEW ZEALAND / NORTH ISLAND / SOUTH AUCKLAND VOLCANIC ZONE / FRANKLIN BASALT	BASALT, ALKALINE	100500	137300	462400	3500	7300	94700	22500	1800	22400	227	181	65	100	12	387	21	130	18	120
GEOROC NZ137				samp. 22043		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE	BASALT	72600	175700	493600	1300	2600	119100	9700	1800	0	290	41		88	5	342	21	58	3	115
GEOROC NZ138				samp. 22101		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE	BASALT	73200	173000	494100	1400	3300	120700	9500	2100	0	303	38		84	7	340	19	59	3	113
GEOROC NZ139				samp. 22099		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE	BASALT	72200	173100	493300	1300	3300	119900	9600	2100	0	292	39		83	8	339	20	44	3	101
GEOROC NZ140				samp. 22048		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE	BASALT	62800	174800	498800	2000	3400	111000	11300	2000	0	356	28		103	7	401	21	76	4	119
GEOROC NZ141				samp. 22046		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE	BASALT	67300	174800	497500	2300	4400	118000	9900	1600	0	300	42		87	12	366	34	60	2	263

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ142				samp. OU30435		NEW ZEALAND / SOUTH ISLAND / OTAGO / DUNEDIN	BASALT	103900	127800	426500	5900	9200	104000	29000	1800	49700	235	234	64	101	22	617	22	180	46	295
GEOROC NZ143				samp. OU30436		NEW ZEALAND / SOUTH ISLAND / OTAGO / DUNEDIN	BASALT	87900	143700	443600	5500	10500	89900	25200	1800	39900	180	163	51	99	23	738	22	209	54	422
GEOROC NZ144				samp. PF-001		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	35100	170100	597100	1400	18800	59000	6700	1100	0	154	14	28	70	79	230	24	139	4.5	383
GEOROC NZ145				samp. PF-002		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	34100	170700	600100	1400	18700	61200	6800	1100	0	145	14	31	68	80	240	25	140	5.8	394
GEOROC NZ146				samp. PF- 1/1994		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	37000	158900	594900	1400	20700	59100	7200	1000	0	123	16	23	55	90	228	25	157	6	478
GEOROC NZ147				samp. SCH-001		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	35400	161800	597000	1300	19500	59000	7000	1000	0	125	23	23	58	87	232	25	154	5.5	470
GEOROC NZ148				samp. PF- 2/1/1994		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	35200	165200	593100	1400	20100	57400	7200	1000	0	123	18	25	54	90	230	27	162	6	489
GEOROC NZ149				samp. PF- 2/2/1994		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	37600	165000	586300	1300	19200	59500	7400	1000	0	115	13	18	51	82	227	25	151	5	432

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ150				samp. 94011A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	46000	166900	575700	1200	15600	70100	7300	1200	0	185	27	42	69	64	232	24	122	4	336
GEOROC NZ151				samp. 94011B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	47100	165900	575000	1200	15300	71800	7100	1200	0	181	26	52	69	62	234	25	119	5	345
GEOROC NZ152				samp. 94010A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	37700	169900	577300	1400	17400	62200	7300	1100	0	154	21	39	69	73	239	25	149	4	433
GEOROC NZ153				samp. 94010B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / PORUHAU FORMATION	ANDESITE	33000	169200	589700	1500	18700	58500	6800	1000	0	140	17	27	65	79	246	24	147	4	428
GEOROC NZ154				samp. TNG 54- 1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	40000	187600	551000	1300	11400	82100	7900	1400	0	214	11		89	39	275	18	104	4	241
GEOROC NZ155				samp. TNG 54- 3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	31000	179100	575800	1500	15500	70900	8200	1300	0	214	8		88	53	268	20	125	4	306
GEOROC NZ156				samp. TNG 40		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	60200	171400	531100	1100	8600	88400	7800	1400	0	215	28		92	28	311	15	92	2	285
GEOROC NZ157				samp. TNG 33- 4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	35000	189800	546600	1500	11200	72900	8500	1400	0	213	8		88	36	300	20	120	4	211

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba	
GEOROC NZ158				samp. TNG 33-5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	44100	171500	568700	1200	13600	77600	7900	1400	0	219	17			88	47	290	18	104	3	255
GEOROC NZ159				samp. TNG 76-3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	31900	179400	570200	1400	14800	73800	8500	1300	0	217	9			86	52	272	20	116	3	289
GEOROC NZ160				samp. TNG 80-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	51700	171800	549600	1100	10600	87500	7500	1500	0	250	13			92	34	299	17	84	4	192
GEOROC NZ161				samp. TNG 82-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	37800	177800	561200	1300	13300	76300	8200	1300	0	219	10			90	46	306	19	103	3	238
GEOROC NZ162				samp. TNG 84-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	34400	175300	570100	1300	14500	72200	7700	1300	0	197	10			87	51	297	19	113	3	277
GEOROC NZ163				samp. TNG 86-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	29000	179300	581300	1500	15700	66600	7600	1300	0	165	7			88	54	296	21	128	3	318
GEOROC NZ164				samp. TNG 87-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	35100	184300	563400	1500	13000	75300	7900	1400	0	213	9			93	43	314	20	116	3	270
GEOROC NZ165				samp. TNG 98		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	32700	179700	573200	1500	15100	73700	8100	1300	0	218	8			86	51	269	21	119	3	292
GEOROC NZ166				samp. TNG 104-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	35500	185500	556900	1400	13100	74200	9200	1300	0	226	11			90	44	273	19	117	4	271

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ167				samp. TNG 109-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	33500	184000	564400	1600	14300	73200	8700	1400	0	220	10		88	51	269	20	119	4	286
GEOROC NZ168				samp. TNG 110-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	56700	166000	549200	1200	10200	87100	7500	1400	0	223	24		81	32	293	15	92	2	186
GEOROC NZ169				samp. TNG 111-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	81100	150800	542900	1100	8900	94700	7200	1500	0	220	66		81	28	268	14	78	3	158
GEOROC NZ170				samp. TNG 112-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	60800	165200	519000	1100	9400	87800	7400	1400	0	215	27		83	31	291	15	88	2	185
GEOROC NZ171				samp. TNG 114-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	69900	159200	544400	1100	8100	95900	7200	1500	0	230	38		84	25	290	14	81	2	183
GEOROC NZ172				samp. TN 169		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE, BASALTIC	66700	157700	547700	1100	9000	93000	7300	1400	0	226	36		83	28	286	14	81	3	172
GEOROC NZ173				samp. CHT-1		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	112300	122600	448500	11000	15500	91500	33600	2000	0	230	334	45	135	31	1083	38	421	82	455
GEOROC NZ174				samp. CHT-3		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	112600	122600	450300	10800	15300	90600	33300	1900	0	225	345	48	134	31	1046	38	412	79	447
GEOROC NZ175				samp. CHT-18		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	83800	146100	438600	6200	11700	118400	37100	1800	0	335	99	74	126	32	998	30	273	77	506
GEOROC NZ176				samp. T90/39		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	29600	182400	566700	2900	21500	77800	8500	1700	30500	170	6	100	75	51	595	23	111	6.8	805

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ177				samp. BR1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	25700	184100	565000	3200	21200	79500	7100	1700	31700	144	5	94	75	54	710	21	112	6.8	820
GEOROC NZ178				samp. T90/28		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	27500	179100	576000	3200	30100	70300	7600	1400	32600	148	6	132	61	81	661	22	142	7.1	1137
GEOROC NZ179				samp. T89/11	11541 7	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	BASALT	64000	163900	495400	2600	15300	110900	11700	1700	48200	308	25	197	78	34	552	19	73	3	665
GEOROC NZ180				samp. T89/14	11541 8	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	BASALT	50700	176800	499300	2800	15600	107100	11400	1900	61800	277	10	144	82	32	619	23	65	2	724
GEOROC NZ181				samp. T89/13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	31200	191500	530400	3500	19900	91900	9300	1800	43300	193	2	63	90	45	713	23	90	2	884
GEOROC NZ182				samp. T89/15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	35500	177800	545700	3900	25000	81900	9800	1700	41300	210	4	118	80	60	719	24	114	3	981
GEOROC NZ183				samp. T90/16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	37600	176600	550000	3100	22500	83900	9300	1700	34800	231	8	135	79	55	625	22	108	6.5	827
GEOROC NZ184				samp. T89/12A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	29300	179500	560200	3100	23600	79900	8700	1600	35600	169	7	75	72	67	633	23	127	3	836
GEOROC NZ185				samp. T90/13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	38700	174600	545900	3800	25100	83900	9400	1600	46800	209	8	109	68	67	724	23	129	7.2	914

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ186				samp. T89/16	11541 1	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	30700	177800	568900	2900	28300	73000	7800	1500	35800	145	7	81	71	79	627	21	132	4	1026
GEOROC NZ187				samp. T90/3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE	28500	178900	575300	3100	27900	71900	7700	1400	34200	164	7	122	66	77	621	22	141	7.2	1039
GEOROC NZ188				samp. 37944		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	31900	185300	524300	2300	9700	91500	7900	1900	0	170	6	48	82	20	496	18	81	3	400
GEOROC NZ189				samp. 37953		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI) / MAERO DEBRIS FLOW	ANDESITE, BASALTIC	26400	186800	560100	3200	22000	77700	8200	1700	0	173	4	74	74	60	641	23	122	3	769
GEOROC NZ190				samp. 1		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	34900	171500	535300	2400	13400	71600	11700	700	80600	270	16	136	74	31	307	27	133	3.7	332
GEOROC NZ191				samp. 2		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	33500	173200	542900	2400	13500	70900	11600	700	77500	276	26	143	79	30	308	27	136	4	337
GEOROC NZ192				samp. 3		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	34700	150600	533500	4300	11500	71700	13000	1300	96800	291	8	152	101	32	263	33	150	4.3	319
GEOROC NZ193				samp. 4		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	35100	149500	537900	3900	10800	69600	12900	1300	98600	308	7	151	107	33	262	31	149	4.3	320

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ194				samp. 5		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	35800	147600	531600	4000	10800	70400	12900	1300	100100	301	8	147	109	32	261	32	149	4.3	312
GEOROC NZ195				samp. 6		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	36500	152500	524600	4800	10500	75600	12800	1400	98100	296	4	140	97	29	273	32	148	4.3	334
GEOROC NZ196				samp. 7		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU / MANUKAU SUBGROUP - WAIATARUA FORMATION	ANDESITE, BASALTIC	35700	150800	533200	4100	11100	74500	12900	1400	97200	289	9	142	98	31	271	32	150	4.4	334
GEOROC NZ197				samp. 14340		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE, OLIVINE	122600	110400	451000	8800	14300	107400	37100	1800	21000	238	315			23	767	22	238	62	517
GEOROC NZ198				samp. 14350		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE, OLIVINE	102800	125800	461700	6800	11200	106800	35400	1500	20700	268	278			14	677	27	277	53	342
GEOROC NZ199				samp. 14432		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	102300	102900	396300	11900	11600	118700	45600	1900	28400	280	190			15	1011	33	413	49	779
GEOROC NZ200				samp. 14440		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	117800	106600	422600	9500	5700	118900	37800	2200	26500	275	227			17	920	27	276	46	638
GEOROC NZ201				samp. 14441		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	119200	104200	425200	9500	9500	131300	37600	1800	26100	235	268			38	966	28	259	45	694
GEOROC NZ202				samp. 14434		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	112700	110600	409200	11400	16100	127700	45600	1700	29100	229	235			35	815	34	366	43	654
GEOROC NZ203				samp. 14435		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	121800	104600	407700	10200	12200	139800	38000	2000	26500	253	239			24	734	29	289	47	447
GEOROC NZ204				samp. 14438		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	117600	104600	415000	10900	18600	117700	45200	2100	28300	226	242			60	900	23	364	52	735

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ205				samp. 14443		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	115800	103400	427500	11600	14900	127400	42800	2100	25700	224	279			29	864	38	402	109	585
GEOROC NZ206				samp. 14447		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	82100	149000	441700	7600	20300	109300	31000	2000	25100	217	92			49	1027	34	306	91	636
GEOROC NZ207				samp. 14451		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	64700	149100	453700	7800	21300	101900	30600	2000	25200	208	85			55	1135	37	306	93	692
GEOROC NZ208				samp. 14445		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	57500	157600	442700	10900	17500	109900	34400	2300	27700	253	36			38	1274	37	369	32	676
GEOROC NZ209				samp. 14444		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	81000	147000	428900	12600	14900	120800	34700	1600	24400	280	120			25	1028	32	250	84	480
GEOROC NZ210				samp. 14449		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	91300	121800	456800	11300	14900	103500	36000	2600	25700	226	228			16	1156	29	326	70	494
GEOROC NZ211				samp. 14450		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	BASALT, ALKALINE	92400	135300	501400	4700	18100	104200	21700	1500	20400	204	169			43	3171	26	117	36	676
GEOROC NZ212				samp. 14454		NEW ZEALAND / SOUTH ISLAND / CHATHAM PROVINCE	ANDESITE, BASALTIC	6100	187400	556400	9200	64200	26100	21900	500	17400	163	45			68	581	24	449	72	872
GEOROC NZ213				samp. 10211	25148 7	NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE, BASALTIC	50900	163200	533300	2200	15900	78600	12500	1500	0	129	42			62	235	36	228	15	388
GEOROC NZ214				samp. 10175	25149 0	NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE	44300	160000	582800	2200	16700	65500	11600	1400	0	104	41			126.6	249.5	39	225	19.1	472
GEOROC NZ215				samp. 10178		NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE	36500	158000	592300	2300	19200	60600	11000	1100	0	89	35			112.4	329.8	38	239	14.9	517
GEOROC NZ216				samp. 10157		NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE	26400	156400	601900	2700	20300	52300	13000	1300	0	83	15			141.3	268.1	45	263	17.1	677
GEOROC NZ217				samp. 10174	25149 3	NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE	23800	153900	613900	2800	17400	48700	12500	1100	0	75	12			175.1	250.5	47	289	19.3	623
GEOROC NZ218				samp. 10176	25149 4	NEW ZEALAND / SOUTH ISLAND / SOUTHERN ALPS / MOUNT SOMERS	ANDESITE	21200	152500	620200	2700	20000	46800	12300	1100	0	75	14			171	258.7	45	296	17.7	630

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ219				samp. 39796		NEW ZEALAND / SOUTH ISLAND / CAMPBELL ISLAND	BASALT, ALKALINE	109500	128500	468600	4800	8900	97200	30000	1900	21500	238	265			23	542	28	192	50	251
GEOROC NZ220				samp. 45-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	40400	175700	564900	1500	14000	66900	7900	1300	0	172	14	59	93	54	269	27	155	7	575
GEOROC NZ221				samp. 46-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	38100	173100	582000	1600	15700	67400	7900	1200	0	174	14	63	73	58	273	26	151	6	386
GEOROC NZ222				samp. 48-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	34700	164700	576300	1500	16300	63400	7500	1200	0	165	11	43	78	62	280	24	148	6	399
GEOROC NZ223				samp. 57-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	37400	163800	587800	1500	16400	60400	7400	1300	0	155	18	32	69	61	242	24	148	6	370
GEOROC NZ224				samp. 58-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	34800	167800	596000	1600	16900	60900	7500	1200	0	155	15	35	69	61	247	23	149	6	365
GEOROC NZ225				samp. 59-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	37700	162800	588100	1500	15700	63800	7300	1200	0	163	19	34	70	59	260	24	142	6	347
GEOROC NZ226				samp. P57472A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	51900	155500	557800	1000	13400	73600	6300	1100	0	179	46	64	65	49	265	20	103	5	339
GEOROC NZ227				samp. P57472B	20036 3	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	52700	159700	582900	1000	13700	75800	6400	1100	0	170	46	64	63	48	267	19	101	5	339

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ228				samp. RU-059		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54200	160700	582500	1000	13600	76000	6500	1100	0	178	51	64	65	48	264	19	100	3	332
GEOROC NZ229				samp. JG-001		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	51500	158500	571400	1000	13600	73600	6300	1200	0	179	46	67	65	51	271	20	104	5	369
GEOROC NZ230				samp. JG- 002(1)		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53000	162900	580300	1100	13900	75700	6400	1200	0	183	48	69	64	50	269	20	103	4	357
GEOROC NZ231				samp. JG-002- (R)		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	52300	162400	578000	1100	13800	75000	6300	1200	0	179	52	57	65	49	265	20	101	4	336
GEOROC NZ232				samp. JG-003		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	50900	153100	552900	1000	13100	71500	6100	1100	0	179	45	66	64	52	271	20	103	5	368
GEOROC NZ233				samp. P57476		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53400	162200	584600	1100	14000	76300	6500	1200	0	183	49	70	66	51	270	20	103	5	359
GEOROC NZ234				samp. RU-069		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53200	162400	581600	1100	13800	75500	6400	1200	0	184	53	69	67	51	267	20	103	5	345

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ235				samp. P57482		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	45000	168500	578100	1100	14100	73800	6600	1100	0	188	39	36	65	49	281	18	106	3	355
GEOROC NZ236				samp. P57487		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54600	162000	582300	1100	14200	76400	6500	1200	0	186	54	70	69	52	267	19	104	4	344
GEOROC NZ237				samp. P57484		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53400	162100	578000	1000	13600	77900	6500	1200	0	179	51	71	67	49	270	19	100	3	320
GEOROC NZ238				samp. RU-N102		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53100	158700	562500	1000	13100	74900	6200	1100	0	181	46	71	64	49	273	19	101	4	344
GEOROC NZ239				samp. P57486	20035 7	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54300	163500	579600	1000	13700	77600	6500	1200	0	186	50	69	67	49	268	20	101	3	340
GEOROC NZ240				samp. P57488		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53500	162300	577700	1000	13500	77600	6500	1200	0	187	53	74	68	48	271	20	101	3	333
GEOROC NZ241				samp. P57489		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54700	161400	576000	1000	13300	78600	6400	1100	0	188	56	73	69	48	268	20	98	4	322

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ242				samp. P57531A	20035 9	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54400	163800	579100	1000	13600	78100	6400	1200	0	181	54	71	67	48	270	20	100	3	331
GEOROC NZ243				samp. P57531B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54700	162300	579000	1000	13700	77100	6500	1200	0	190	54	70	67	48	267	20	101	4	334
GEOROC NZ244				samp. P57535	18635 0	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	54100	165100	579800	1000	13300	79200	6400	1200	0	196	59	72	68	46	263	19	104	3	352
GEOROC NZ245				samp. RU- 1996-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	55700	164500	580800	1000	13200	78300	6400	1200	0	200	59	69	70	45	262	19	104	3	343
GEOROC NZ246				samp. P57536	20035 3	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	56000	166000	581600	1000	13300	78500	6300	1200	0	200	58	71	67	45	262	18	107	4	357
GEOROC NZ247				samp. AK110		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	93700	134700	448700	6400	14700	95500	27900	1900	22000	210	181	74	120	22	645	25	219	51	248.62
GEOROC NZ248				samp. AU39360		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91200	134600	450400	6700	14700	93400	27600	1900	22100	199	179	75	119	23	663	24	223	53	258.45
GEOROC NZ249				samp. AU39359		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	87300	134100	464700	6400	14500	90600	27000	1800	21300	199	167	73	118	22	644	24	236	51	258.45

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ250				samp. AU39362		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91400	135500	449900	6500	14800	94600	28000	1900	22000	206	203	70	118	22	660	24	220	53	260.95
GEOROC NZ251				samp. AU39363		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91700	135200	449900	6400	14600	95400	28200	1900	22000	206	172	75	116	24	665	24	221	53	264.12
GEOROC NZ252				samp. AU39361		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	86500	133300	469300	6300	14300	90100	26700	1800	21100	199	165	69	115	23	638	23	240	51	267.23
GEOROC NZ253				samp. AK148		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91000	135700	450800	6300	14300	95400	27200	1900	21500	206	172	70	117	22	651	25	216	52	266.03
GEOROC NZ254				samp. AK150		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	92600	135400	452200	6300	13900	95000	27400	1900	21700	211	181	72	119	23	669	25	218	52	258.44
GEOROC NZ255				samp. AK149		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	93500	135900	454200	6200	13800	94400	27300	1900	21700	210	182	71	117	22	645	24	217	51	262.1
GEOROC NZ256				samp. AK151		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91500	136600	454400	6300	14100	94200	27500	1900	21700	211	175	74	118	22	641	24	219	52	260.25
GEOROC NZ257				samp. AK147		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	92000	136200	455700	6200	14400	93500	27100	1900	21600	204	176	72	119	23	635	24	216	51	262
GEOROC NZ258				samp. AK152		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	90600	135600	460000	6000	14000	92900	26900	1800	21500	209	174	73	117	23	633	24	216	51	267.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ259				samp. AK127		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	95600	135800	453200	5600	12800	97000	26400	1900	21400	213	189	75	115	18	600	24	201	47	228.16
GEOROC NZ260				samp. AK126		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	94400	135500	453300	5800	13100	96400	26700	1900	21600	211	184	73	116	20	622	23	211	49	253.42
GEOROC NZ261				samp. AK128		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	96800	135000	452600	5700	12900	96000	26500	1900	21400	213	195	80	117	20	602	23	203	48	236.56
GEOROC NZ262				samp. AK118		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	92600	136200	453800	6300	14400	93400	27400	1900	21800	203	179	73	119	24	634	24	218	52	232.24
GEOROC NZ263				samp. AK125		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	95300	136600	454800	5700	12900	97000	26400	1900	21200	214	186	70	115	20	603	24	203	47	231.31
GEOROC NZ264				samp. AK119		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91700	136500	454600	6100	13100	95600	27200	1900	21600	209	174	72	117	23	771	24	217	52	264.27
GEOROC NZ265				samp. AK117		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91800	136100	456700	6200	14400	93000	27000	1900	21600	207	177	71	118	24	633	25	214	50	259.22
GEOROC NZ266				samp. AK120		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91400	138400	458800	6100	12600	96100	27600	1900	21800	217	175	68	117	21	660	25	218	52	260.93
GEOROC NZ267				samp. AK115		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	90600	135700	457500	6300	14400	93100	27100	1900	21600	203	173	70	119	23	630	24	215	51	245.97

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ268				samp. AK122		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	92700	135400	456500	5800	11300	94200	26900	1900	21600	211	185	70	120	20	627	24	213	48	253.03
GEOROC NZ269				samp. AK124		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	95800	135400	459700	5600	10200	95100	27100	1900	21800	210	191	70	118	18	638	24	216	48	248.41
GEOROC NZ270				samp. AK123		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91900	137200	459200	5800	12000	91500	27400	1900	21900	195	182	77	124	20	596	23	218	51	263.97
GEOROC NZ271				samp. AK116		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	90000	136000	462500	6200	14400	92400	26800	1900	21400	202	171	73	120	24	627	24	216	51	241.48
GEOROC NZ272				samp. AK121		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	92000	137100	464000	5800	11300	93800	27000	1900	21600	213	181	75	123	21	622	24	215	48	226.73
GEOROC NZ273				samp. AU39364		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	91700	135500	449500	6300	14200	101400	27400	1900	21700	207	173	73	117	21	677	25	218	52	255.64
GEOROC NZ274				samp. AU39367		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	104100	133100	456800	4600	11200	99300	24900	1800	20900	227	217	72	111	16	522	22	178	41	201.08
GEOROC NZ275				samp. AU39366		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	101000	135600	458400	4900	11200	98700	25100	1800	20800	220	203	78	110	15	538	23	184	42	206.49
GEOROC NZ276				samp. AU39365		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	102300	134000	458100	4500	11000	99100	24900	1800	20800	220	207	76	108	18	527	21	179	40	205.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ277				samp. AU39368		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	108100	132400	461100	4200	10300	100900	23300	1800	20100	226	225	75	103	16	485	21	161	36	186.54
GEOROC NZ278				samp. AK130		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	97500	136200	456800	5400	12400	98000	26000	1900	21100	216	194	76	113	21	590	23	198	46	220.12
GEOROC NZ279				samp. AK131		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	103000	135900	458400	4800	9600	99900	25100	1800	20900	226	208	72	109	16	563	22	181	41	197.64
GEOROC NZ280				samp. AK133		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	100200	136900	458100	5000	7400	99200	25400	1800	20900	228	206	71	111	17	580	22	187	43	200.07
GEOROC NZ281				samp. AK139		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	105400	135600	460100	4700	10700	101500	24500	1800	20600	226	215	78	109	18	540	22	174	40	200.05
GEOROC NZ282				samp. AK132		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	99200	138900	460700	4900	7400	101800	25600	1800	20800	231	197	72	109	20	578	22	184	42	202.29
GEOROC NZ283				samp. AK129		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	103100	134300	461800	4800	11000	99500	24800	1800	20600	223	211	75	110	20	530	22	178	41	199.63
GEOROC NZ284				samp. AK136		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	97800	138200	462900	5100	10800	97400	25400	1800	20800	220	200	74	112	18	588	24	197	41	219.96
GEOROC NZ285				samp. AK138		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	96300	135300	460900	5200	11600	98100	25200	1800	20700	218	193	73	112	18	590	23	195	44	211.93

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ286				samp. AK137		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	97800	138500	463600	5100	11500	98900	25300	1800	20800	220	200	73	112	20	587	23	200	43	214.04
GEOROC NZ287				samp. AK134		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	97500	138600	464300	5100	10400	96700	25400	1800	20800	220	197	69	111	19	582	23	196	43	217.38
GEOROC NZ288				samp. AK135		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	96400	138400	465500	5100	10100	96900	25500	1800	20700	218	193	66	113	17	591	23	201	44	216.47
GEOROC NZ289				samp. AK140		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	109700	137800	455400	4400	9500	102600	24600	1900	20900	234	234	93	108	13	549	22	172	39	206.61
GEOROC NZ290				samp. AK141		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	108800	136400	458100	4600	10100	102600	24500	1900	20800	230	227	85	109	16	530	21	170	38	197.22
GEOROC NZ291				samp. AK143		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	106700	134700	459900	4400	10500	101100	24200	1800	20500	228	217	67	107	15	508	22	168	39	188.65
GEOROC NZ292				samp. AK145		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	111000	133500	461100	4300	10100	102200	23600	1800	20400	224	234	76	104	15	511	22	165	39	191.13
GEOROC NZ293				samp. AK146		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	110000	132800	458800	4200	9900	101700	23400	1800	20200	223	231	76	105	17	494	22	163	38	188.2
GEOROC NZ294				samp. AK142		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	105600	134300	461400	4500	10500	101400	24200	1800	20400	225	217	80	108	15	513	22	169	39	185.65

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ295				samp. AK144		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	109800	132500	462000	4200	10100	101600	23400	1800	20200	223	227	73	106	15	489	22	162	39	192.93
GEOROC NZ296				samp. AU44068		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	104300	132800	454100	4400	10900	101600	26500	1800	20900	232	216	81	111	14	512	23	165	41	194.46
GEOROC NZ297				samp. AU39370		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	114700	129900	458400	4100	10000	100600	23000	1800	20300	218	230	76	104	15	480	20	153	37	185.64
GEOROC NZ298				samp. AU39371		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	111600	130000	457800	4300	10300	101100	23300	1800	20200	221	221	74	105	15	489	21	157	38	191.99
GEOROC NZ299				samp. AU39372		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	107900	132500	460100	4000	9800	100900	23500	1800	20400	223	205	75	105	12	481	21	157	37	181.74
GEOROC NZ300				samp. AU39369		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	106700	134200	467600	3400	8400	98100	21900	1800	20300	215	179	67	107	11	426	20	142	29	155.27
GEOROC NZ301				samp. AU39376		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	110600	130800	457700	4300	10500	100800	23300	1800	20300	219	218	68	104	14	487	21	159	39	189.39
GEOROC NZ302				samp. AU39375		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	105800	134700	464100	3800	8900	98800	22800	1800	20300	202	180	69	107	13	454	19	148	33	171.7
GEOROC NZ303				samp. AK111		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	107600	137900	464500	3300	7300	100000	22000	1800	20500	221	184	60	107	8	444	20	143	31	159.22

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ304				samp. AK113		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	103200	136300	468100	3400	8400	99500	21900	1800	20400	224	173	44	107	11	412	20	139	28	144.56
GEOROC NZ305				samp. AK112		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	105100	137100	467900	3400	7400	99600	22000	1800	20300	218	176	65	107	9	437	20	143	31	158.32
GEOROC NZ306				samp. AK114		NEW ZEALAND / NORTH ISLAND / AUCKLAND VOLCANIC FIELD / CRATER HILL	BASALT	104500	135900	468700	3500	8300	98600	21600	1800	20200	217	176	61	106	12	409	20	141	29	144.49
GEOROC NZ307				samp. V16/265267		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / OKAREKA EPISODE	BASALT	54900	183700	514200	1500	6000	109900	8900	1500	0	258	19		96	19	355	20	73	2	231
GEOROC NZ308				samp. V16/274230 A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA - TARAWERA / OKAREKA EPISODE	ANDESITE	31500	169500	625900	2000	16400	58200	5700	1100	0	125	8		62	55	223	24	112	6	639
GEOROC NZ309				samp. EB-4B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	BASALT	44500	177800	513300	2800	18700	96900	9900	1700	0	289	18	104	77	40	608	21	92	6	726
GEOROC NZ310				samp. E03-618		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	BASALT	43900	179800	511300	2800	18600	98700	10500	1800	0	227	19	29	85	43	628	19	104	7	740
GEOROC NZ311				samp. EB-24C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	38000	173000	545900	2500	21700	83800	8200	1700	0	220	15	30	101	51	598	21	101	5	783
GEOROC NZ312				samp. E03-19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	38500	171000	547700	2500	22000	85300	8200	1700	0	227	19	29	85	47	604	19	104	7	756

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ313				samp. EB-4P		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	38600	174400	536000	2700	20800	87700	8600	1700	0	226	15	92	82	48	604	21	103	6	785
GEOROC NZ314				samp. E03-50		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	33800	177600	547200	2700	23400	80400	9000	1600	0	230	6	97	81	55	599	21	111	6	836
GEOROC NZ315				samp. E03-57		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	34500	177700	542900	2700	23100	81900	9200	1600	0	246	8	106	80	55	603	23	106	5	836
GEOROC NZ316				samp. EB-26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / EGMONT (MOUNT TARANAKI)	ANDESITE, BASALTIC	32700	173200	555900	3000	27000	76000	8700	1600	0	207	12	74	72	59	625	21	127	7	798
GEOROC NZ317				samp. P17223		NEW ZEALAND / SOUTH ISLAND / SOLANDER (HAUTERE) ISLAND	ANDESITE	26000	179100	610300	2900	21600	57400	5600	900	0	129	9	6	33	39	1060	12	112	17	783
GEOROC NZ318				samp. BL2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / LOWER BULLOT FORMATION	ANDESITE	28000	166900	600700	1700	17700	56500	8600	1100	18400	180	17	42	64	68	250	22	141	5	490
GEOROC NZ319				samp. BL3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / LOWER BULLOT FORMATION	ANDESITE, BASALTIC	58400	173400	523700	1200	7600	64500	7700	1300	37700	162	107	78	62	32	237	23	111	4	388
GEOROC NZ320				samp. BL4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MIDDLE BULLOT FORMATION	ANDESITE	47600	164100	574200	1400	14100	73300	7400	1500	19800	215	26	52	67	56	220	20	118	5	384

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ321				samp. BL5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MIDDLE BULLOT FORMATION	ANDESITE, BASALTIC	49300	177100	543500	1200	10500	73800	8000	1500	21200	211	31	57	77	43	227	23	111	4	419
GEOROC NZ322				samp. BL7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MIDDLE BULLOT FORMATION	ANDESITE, BASALTIC	47200	183600	543000	1200	9900	72500	8100	1500	30700	230	33	50	78	39	231	20	109	4	363
GEOROC NZ323				samp. BL11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	42000	182000	554400	1300	11300	70200	7900	1400	29400	223	25	50	81	46	232	20	108	4	367
GEOROC NZ324				samp. BL13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	BASALT	36500	201400	513400	1200	6900	70900	9200	1400	45400	204	8	32	82	29	279	22	102	4	436
GEOROC NZ325				samp. BL14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	41800	180700	531500	1800	10800	69000	9000	1500	33800	265	17	37	61	41	233	20	127	5	306
GEOROC NZ326				samp. BL15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	41400	188300	533100	1300	9600	70500	8700	1500	38400	211	16	36	76	38	293	22	110	5	432

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ327				samp. BL16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	39000	198300	518800	1400	7900	69100	9200	1400	40200	207	17	35	80	31	329	23	125	5	411
GEOROC NZ328				samp. SHAWCRAFT		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE	36400	175000	576000	1200	14400	68100	7000	1200	0	160	50	36	71	54	255	22	119	4	331
GEOROC NZ329				samp. BL17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	37100	197900	531700	1300	8800	70600	8200	1400	36000	236	27	34	155	33	258	22	112	4	824
GEOROC NZ330				samp. BL18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE	39000	179100	573900	1500	13200	71000	7700	1400	25000	219	16	40	69	52	233	21	118	5	342
GEOROC NZ331				samp. NG-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	ANDESITE, BASALTIC	42000	193100	528800	1400	7500	74000	8200	1500	34400	261	11	35	67	29	219	17	100	4	238
GEOROC NZ332				samp. NG-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / UPPER BULLOT FORMATION	BASALT	41000	198100	508100	1600	7300	68200	8500	1400	36200	276	14	33	58	29	219	16	119	5	215

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ333				samp. HH1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE, BASALTIC	93200	144300	538700	800	4000	82300	5600	1400	0	199	116	93	55	4	491	15	53	4	88
GEOROC NZ334				samp. HH2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE, BASALTIC	91300	148600	537000	800	3600	72400	5900	1300	0	184	126	133	71	5	433	15	54	4	187
GEOROC NZ335				samp. HH3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE, BASALTIC	90000	146600	530800	900	5000	74200	5600	1400	0	200	113	55	59	9	394	14	57	4	87
GEOROC NZ336				samp. HH4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE	95000	141200	545700	900	3900	90000	5500	1300	0	196	115	83	54	3	511	14	52	4	70
GEOROC NZ337				samp. HH5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE	93400	143800	548900	800	3900	94100	5400	1300	0	192	123	55	55	5	564	14	52	4	64
GEOROC NZ338				samp. HH10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE, BASALTIC	89800	143600	536200	800	3800	88700	5700	1400	0	195	108	112	73	6	509	14	53	4	91
GEOROC NZ339				samp. HH11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE	49400	175800	542200	900	5700	76400	6700	1400	0	223	30	58	88	14	198	16	61	4	115

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ340				samp. HH19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE	86800	148600	550700	800	4200	91100	5500	1300	0	187	115	143	58	4	567	16	57	4	103
GEOROC NZ341				samp. VUW14816		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - HAUHINGATAHI	ANDESITE	71500	150400	555000	800	6100	94800	5600	1100	0	223	37	69	72	15	457	17	57	2	179
GEOROC NZ342				samp. AU43909		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE	24800	180900	609300	2300	15000	56700	7900	900	16800	135	15.1	16.7	105	44	334	32.7	138	12	474
GEOROC NZ343				samp. AU43906		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE	28400	173200	611700	2300	15600	60900	7100	800	16200	116	13.2	18.9	72	53	395	17.6	137	11.6	543
GEOROC NZ344				samp. AU43904	10056 5	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE	28300	174000	611900	2200	15500	60700	7100	800	16100	173	13.5	37	98	51	251	39.3	135	6.4	555
GEOROC NZ345				samp. AU40672		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - NESS VALLEY	ANDESITE, BASALTIC	38900	179500	558100	1500	10200	78800	9700	1700	20500	211	6.4	26.7	91	31	228	25.3	109	4	191
GEOROC NZ346				samp. AU40674		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - NESS VALLEY	ANDESITE	30300	177600	585100	1300	10200	69300	7700	1300	21000	167	17.7	50.1	112	33	218	22.3	108	3.4	173

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ347				samp. AU40673		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - NESS VALLEY	ANDESITE	38200	168900	586000	1500	10400	65200	8400	1600	22700	175	12.4	40.6	81	34	244	25.1	111	4.4	208
GEOROC NZ348				samp. AU40676		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MIRANDA	ANDESITE, BASALTIC	44900	178100	559800	1300	8300	81400	7700	1800	19500	180	25.2	32.1	76	24	228	20.4	90	4.1	154
GEOROC NZ349				samp. AU40703		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MIRANDA	ANDESITE, BASALTIC	43600	180600	562600	1300	8400	80000	7700	1400	19000	176	21.6	42.7	76	26	232	18.8	89	4.1	151
GEOROC NZ350				samp. AU40702		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MIRANDA	ANDESITE	37200	183200	578100	1200	9300	75700	7300	1300	19200	179	7.1	28.8	75	30	209	18.7	94	4	140
GEOROC NZ351				samp. AU40681		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - PUKEKAMAKA	ANDESITE	20700	188700	598900	1700	11500	73000	5700	1400	16600	124	2.2	30.4	74	39	466	17.8	113	3.6	257
GEOROC NZ352				samp. AU40682		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - PUKEKAMAKA	ANDESITE	24000	184100	601500	1600	13500	69000	5900	1200	16600	142	5	35.5	76	40	413	23.9	108	3.5	291
GEOROC NZ353				samp. AU40680		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - PUKEKAMAKA	ANDESITE	19200	188000	603200	1700	12000	70800	5700	1400	16500	124	2.4	32.5	74	37	453	13.3	110	3.5	272

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ354				samp. AU40683		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -PUKEKAMAKA	ANDESITE	28700	182000	605700	1500	12400	66600	5800	1200	16200	139	5.7	28.4	68	34	365	14.2	101	3.3	245
GEOROC NZ355				samp. AU40706		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -RURU	ANDESITE, BASALTIC	86700	139200	535000	900	8700	105300	6800	1500	21500	236	62.8	78.4	72	13	372	22	75	2	142
GEOROC NZ356				samp. AU40707		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -RURU	ANDESITE, BASALTIC	56500	171200	538200	1100	8900	89300	7900	1700	22700	237	19.7	89.3	60	11	376	84	84	2.1	195
GEOROC NZ357				samp. AU40708		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -RURU	ANDESITE, BASALTIC	53200	157100	565000	1100	11100	95200	6500	1200	19000	190	17.7	24.7	47	13	449	30.7	79	2.1	170
GEOROC NZ358				samp. AU42562	10058 3	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -TE TAPUI	ANDESITE, BASALTIC	84800	131600	556900	900	9400	96100	5600	1500	20900	206	67.3	261	87	18	378	151	71	2.1	168
GEOROC NZ359				samp. AU40712		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -TE TAPUI	ANDESITE, BASALTIC	83400	135600	563400	900	10000	87600	5700	1400	20500	206	66.4	189.5	68	24	399	29	73	2.4	237
GEOROC NZ360				samp. AU40713		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -TE TAPUI	ANDESITE, BASALTIC	64200	142400	571900	1000	13100	84300	6100	1300	23500	217	28	76.5	67	18	532	53.8	76	1.6	271
GEOROC NZ361				samp. AU40692		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN -MAUNGAKAWA	ANDESITE, BASALTIC	72200	141800	555400	900	10000	93600	6200	1500	21500	204	40.6	128	73	14	497	26.9	72	1.7	159

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ362				samp. AU40711		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MAUNGAKAWA	ANDESITE, BASALTIC	71500	142800	555400	800	9600	94800	6200	1300	21400	218	29.9	47.1	79	13	483	97	72	1.6	135
GEOROC NZ363				samp. AU40710		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MAUNGAKAWA	ANDESITE, BASALTIC	61200	144700	575100	1000	13200	82600	5900	1300	22900	213	24.5	44.6	63	20	562	177	84	2	229
GEOROC NZ364				samp. AU42559	10058 0	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MAUNGATAPU	ANDESITE, BASALTIC	61100	163800	551300	1100	8000	90000	7200	1400	20700	209	26.9	68.7	73	16	372	106.5	76	2.4	162
GEOROC NZ365				samp. AU40686		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - MAUNGATAPU	ANDESITE, BASALTIC	60200	163400	554200	1100	8800	86900	7200	1700	20800	210	26.9	67.4	237	20	370	115	79	2.5	191
GEOROC NZ366				samp. AU42563	10057 0	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE, BASALTIC	82500	157300	528300	1700	7500	93500	10800	1500	20300	218	100.5	73.4	82	15	308	68	110	5	183
GEOROC NZ367				samp. AU42564	10056 9	NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KIWITAHU VOLCANIC CHAIN - WAIHEKE ISLAND	ANDESITE, BASALTIC	53000	173200	539800	2100	8700	91200	12400	1400	19600	239	20.2	52.7	78	18	376	23	130	5.9	203
GEOROC NZ368				samp. 41384		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- KARIKARI	ANDESITE, BASALTIC	77540.3 8	141940	559534. 6	1805.59 7	17855.3 5	83759.6 5	7924.56 6	1905.90 8	20116.2 1	230.973 9	47.1940 1	14.3949 5	138.913	71.6197 9	329.853 2	19.0746 3	113.851 3	4.98959 1	379.716 3

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ369				samp. 41386		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- KARIKARI	ANDESITE, BASALTIC	68030.6 9	156726. 3	565115. 1	1023.01 8	14015.3 5	66189.2 6	6751.91 8	2250.63 9	21719.4 6	193.446 4	96.7039 3	74.1975 2	77.1906 7	39.3906 7	210.969 2	16.8112 6	84.3587 3	3.75544	260.564 3
GEOROC NZ370				samp. 41339		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- KARIKARI	ANDESITE, BASALTIC	55572.3 3	167925. 1	569213. 7	1510.11 8	20638.2 8	67049.2 3	8758.68 3	1510.11 8	17285.0 4	178.68	31.8549 2	6.46081 4	102.834 5	35.3447 8	251.138 5	18.7539 5	125.442 9	7.36178 4	600.353
GEOROC NZ371				samp. 41382		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- KARIKARI	ANDESITE, BASALTIC	71766.0 1	146647. 9	573223. 4	1809.22 7	19398.9 3	63825.5 1	7739.47 1	2010.25 2	23296.5 9	215.278 7	47.9552 9	6.85778 9	106.569 7	63.6406 5	315.066	19.2800 9	123.799 3	5.39632 1	506.550 9
GEOROC NZ372				samp. 41335		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- KARIKARI	ANDESITE	54379.4 5	155212. 2	592354. 8	1203.97 3	17658.2 7	72740.0 4	6421.19	802.648 7	18520.3 8	148.090 3	56.8717	13.9211	36.6225 1	76.0997 1	317.226	15.3350 6	121.334 3	5.9181	239.039 9
GEOROC NZ373				samp. 37987		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / NORTH CAPE (TANGIHUA) COMPLEX	ANDESITE, BASALTIC	47823.9 1	183391. 7	546873. 4	1400.7	7003.50 2	89144.5 7	9704.85 2	1700.85	18170.6 2	238.540 2	23.6123 4	23.1946 5	67.7349 2	29.8891 6	293.478 4	19.6092 7	81.5998	4.12851 1	252.013 2
GEOROC NZ374				samp. 38649		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / NORTH CAPE (TANGIHUA) COMPLEX	ANDESITE, BASALTIC	38150.4	147708	547688	1897.53 3	8089.48 4	82992.1 1	11684.8 1	1997.40 3	28808.7	444.142 8	14.4889 6	165.825 1	89.2040 6	16.7331 4	261.340 4	27.0457 7	84.8374 9	2.58180 5	345.224
GEOROC NZ375				samp. 38651		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / NORTH CAPE (TANGIHUA) COMPLEX	ANDESITE	43999.1 9	170660. 5	596657. 3	1510.27	11377.3 7	67660.0 9	7249.29 5	1006.84 7	15923.0 9	152.005 4	35.5987 5	31.6391 5	52.2844 4	64.3629	295.413 3	14.0114 9	105.276 1	5.15663 9	423.149 5
GEOROC NZ376				samp. 5715		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA / OMAPERE CONGLOMERATE	ANDESITE, BASALTIC	60946.2 7	169907. 8	562951. 1	1202.88 7	7518.04 3	82197.2 7	7217.32 2	1403.36 8	17696.3 2	197.699 3	49.4455 3	29.4009 3	54.5426 1	34.8959 2	243.452	16.4319	101.747 5	4.57948	313.042 2
GEOROC NZ377				samp. 5716B		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA / OMAPERE CONGLOMERATE	ANDESITE	3218.99 2	209536. 3	623478. 5	804.748	52710.9 9	31586.3 6	2917.21 2	201.187	4850.84 2	42.2998 7	3.93986 4	9.51810 2	60.1231 1	129.436 7	365.445 2	1.78711 2	135.015 1	5.50668 1	1527.90 3

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ378				samp. 5716A		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA / OMAPIERE CONGLOMERATE	ANDESITE	7220.21 7	208383. 5	624448. 5	802.246 3	47533.0 9	32691.5 4	2206.17 7	100.280 8	4549.77 6	57.3515	6.87607 8	18.5073	65.3422 3	136.293 1	333.147 2	1.37886 4	106.355	3.18047 5	1113.94 1
GEOROC NZ379				samp. 3840		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	BASALT	83684.1 1	125876. 9	477149. 7	4610.14 2	8318.3	118761. 3	28763.2 8	2806.17 4	18641.0 1	283.807 3	77.8403 2	61.5517 2	90.4396 3	15.2386 9	373.409 1	25.1381 5	188.738 2	45.6056 9	295.693 9
GEOROC NZ380				samp. 33142		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	73024.7 4	167198. 7	547286. 5	1097.36 6	8878.69 1	83300.0 8	8679.17	1296.88 7	18486.4	222.661 1	121.092 5	43.3647 7	56.6633	28.6349 8	178.828 3	18.9519 6	80.6012 6	2.95058 2	184.793 8
GEOROC NZ381				samp. 33115		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE, BASALTIC	80978.5 3	159760. 4	556465. 3	998.502 2	11283.0 8	79181.2 3	6889.66 6	1098.35 2	17581.3 2	177.516 2	140.640 5	44.3528 3	52.8235 8	38.9472 5	177.845 1	18.2801 7	79.3326 9	3.73622 6	225.400 6
GEOROC NZ382				samp. 32975		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE, BASALTIC	78501.6 9	161386. 7	559872. 5	1095.83 6	8467.82 2	78700.9 4	6774.25 8	1295.07 9	17724.9 5	167.092 5	126.531 9	43.3091 7	52.0906 2	39.3957 2	211.301 1	16.0375 7	83.9538 2	3.91889 5	264.244 5
GEOROC NZ383				samp. 33059		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE, BASALTIC	70893.6 6	161657. 5	568547. 2	998.502 2	12081.8 8	74987.5 2	6590.11 5	1098.35 2	17005.2 6	180.148 6	111.187 5	47.6034 9	50.3739 4	45.0750 5	162.848 4	16.9007	71.0261 9	3.03899 7	228.901 4
GEOROC NZ384				samp. 33054		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE, BASALTIC	63460.1 9	160357. 5	585500. 6	1204.94	16668.3 4	66974.6	7129.23	1104.52 9	17806.3 4	153.273 6	97.1385 9	27.5027 8	52.9954 2	62.1498 2	195.816 7	18.0146 4	110.608 6	4.86729 5	335.939 2

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ385				samp. 19901		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	31935.1 3	177695. 5	590950	1501.65 2	16418.0 6	67073.7 8	10011.0 1	2202.42 3	19336.0 8	165.349 6	7.06290 2	29.7913 3	672.751 3	48.8120 3	272.408 5	22.161	82.0295 6	6.43384 6	255.096 5
GEOROC NZ386				samp. 33161		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	50250.7 5	171815. 4	594383. 1	1103.31	12838.5 2	65697.0 9	6218.65 6	902.708 1	16850.5 5	128.921 9	58.3988 8	36.6277 9	52.5427 7	111.562 2	234.914	15.9412 1	103.147 4	4.99040 6	480.028 9
GEOROC NZ387				samp. 32942		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	22420.1 8	185667. 1	606045. 4	2302.07 2	13712.3 4	59553.6	8707.83 7	800.720 6	15076.5 3	71.0042 6	11.8745 7	17.7063 6	53.0667 7	43.0248 4	323.140 3	12.7529 6	265.699 5	7.86928 8	299.999 2
GEOROC NZ388				samp. 33070		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	48712.0 4	162774. 4	610905. 1	1102.53 6	16638.2 7	57732.7 9	5713.14	902.074 8	14422.0 6	130.371 4	75.3343 1	30.1587 2	46.8451 7	65.1034 3	202.146 3	15.6302 6	102.613 2	5.19647 4	390.222 4
GEOROC NZ389				samp. 32993		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	ANDESITE	40900.4 1	168726. 8	616119	1205.90 9	16179.2 8	52356.5 5	5627.57 5	904.431 7	14329.4 7	118.374 7	52.7859 8	29.7275 3	46.6684 7	61.6288	216.593 4	15.8834	108.197	4.66112 8	356.880 4
GEOROC NZ390				samp. 39823		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI HEADS VOLCANIC COMPLEX	BASALT	65640.9 2	148266. 6	507543. 2	1898.29 2	3696.67 3	104505. 9	18583.2 8	1998.20 2	20448.2 6	366.274 5	63.6088 8	55.2390 9	74.9695 2	17.9223 9	142.636 5	39.8636	125.604 7	3.17134 3	47.3650 6
GEOROC NZ391				samp. 39832		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAREI- WAIRAKAU / WAIRAKAU ANDESITE	BASALT	48493.9 8	161345. 4	558534. 1	2208.83 5	17871.4 9	79718.8 8	10341.3 7	1907.63 1	18929.5 6	210.663 1	23.4866 6	25.5555 7	64.8199 4	51.1004 3	388.766 3	22.6857 9	144.465 4	6.32030 4	460.012 2

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ392				samp. 34917		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE, BASALTIC	85457.2 7	138830. 6	559520. 2	1599.2	18690.6 5	78060.9 7	8195.90 2	1399.3	19282.6 7	211.109 4	114.289 3	48.2864 6	54.4646 2	50.7822 9	337.706 7	17.7703 7	112.762 8	4.55677 7	356.052 5
GEOROC NZ393				samp. 34924		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE, BASALTIC	49985.0 3	166117. 9	568093. 4	2594.03 4	18258.0 1	75825.6	12471.3 2	1097.47 6	16761.4 5	238.907 2	28.7792 5	39.3469 5	63.4064 4	50.6725 4	424.480 1	23.9466 4	131.557	6.95663 1	404.624 1
GEOROC NZ394				samp. 34930		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE	63387.3 2	146770. 6	581083. 8	1699.66	21395.7 2	75384.9 2	8098.38	1299.74	19181.3 5	202.776 7	61.6473 4	41.7486 6	53.7338 6	57.9983 1	348.356 8	18.1770 1	123.330 7	5.18540 4	412.382 3
GEOROC NZ395				samp. 34918		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE	28265.0 1	183522. 1	587551. 4	2405.53 3	18141.7 3	63846.8 5	9221.20 9	801.844 2	16838.7 3	155.168	11.3614	21.0052 9	55.3466 3	51.4995 9	367.105 3	25.1532 7	164.078 1	6.73176 4	388.878 3
GEOROC NZ396				samp. 34929		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE	32886.8 5	167233. 1	587764. 9	2199.12	20891.6 4	67473.0 1	9696.12 2	1599.36	19255.2 6	196.601 6	16.0683 8	20.4054	59.5273 3	57.8621 4	393.741 4	21.8571 5	147.815 7	7.15666 7	506.312 3
GEOROC NZ397				samp. 39762		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WHANGAROA- WAIRAKAU / WAIRAKAU ANDESITE	ANDESITE	27794.4 4	174765	624275. 1	2099.58	27094.5 8	53089.3 8	8098.38	599.88	12079.0 7	156.393 7	29.4034 7	38.6856 9	53.3207 3	90.1558 1	357.214 7	19.6241 5	168.194 1	6.93768 1	483.275 7
GEOROC NZ398				samp. 36210		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- HUKATERE	BASALT	108752. 3	152613. 7	480873. 2	2102.94 4	12116.9 6	99639.5	10414.5 8	1802.52 4	18058.6 2	282.401 9	199.117 1	63.2558 2	58.1784 7	34.2153 2	293.533	18.7362 9	82.4404 7	4.77823 3	325.026 1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ399				samp. 38494		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- HUKATERE	BASALT	43142.3 7	176582. 7	521019. 4	1605.29 7	12942.7 1	97521.8 2	10936.0 9	3210.59 5	24010	316.531	11.4877 2	16.0998 5	70.9634 2	34.1821 7	266.438 7	29.4313 2	108.003 7	5.45301 3	326.942 4
GEOROC NZ400				samp. 38510		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- HUKATERE	BASALT	65773.5 7	164585	527296. 5	2316.68	13497.1 8	86422.2 4	11180.5	1611.60 4	21454.4 7	206.011 3	141.876 7	73.3391 7	64.7277 6	42.4684 4	255.703	20.6501 2	144.097 9	11.3258 9	291.607 5
GEOROC NZ401				samp. 38504		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- HUKATERE	BASALT	54949.4 5	169052. 1	533580. 2	1901.71 2	12311.0 8	88079.2 7	10509.4 6	1601.44 1	22450.9 8	247.741 8	36.3774	36.5370 4	67.6459	47.7202 2	273.498 1	21.0289 7	106.479 9	5.84480 8	255.714 9
GEOROC NZ402				samp. 38515		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- HUKATERE	ANDESITE	24175.8 2	180619. 4	586913. 1	2497.50 2	20579.4 2	61238.7 6	9490.50 9	1598.40 2	19166.0 2	169.900 9	10.4504 2	16.1780 1	175.662 2	56.7108 1	280.789 4	57.5365	153.063	7.66978 1	425.443 9
GEOROC NZ403				samp. 7841		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- TOKATOKA	BASALT	74582.0 4	165081. 6	487035. 7	1301.43 2	8609.47	111522. 7	10811.8 9	1701.87 2	18470.3 2	408.540 7	42.3145 4	61.1958 6	56.6761 6	20.0157 7	291.629 7	17.4951 6	69.9626 7	2.53195 9	319.533 7
GEOROC NZ404				samp. 6754		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- TOKATOKA	BASALT	89544.7 7	170085	509854. 9	1600.8	7603.80 2	96248.1 2	9104.55 2	1400.7	13673.5	243.453 5	128.442	62.4021 3	45.1178 8	16.6923 9	377.863 2	18.9100 8	90.1227 8	3.10834 1	261.181 5
GEOROC NZ405				samp. 7831		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- TOKATOKA	ANDESITE, BASALTIC	27048.6 9	155780. 4	551793. 2	4307.75 4	21438.5 9	80745.3 4	11019.8 4	1903.42 6	24944.9	168.983	10.1163 2	107.012 9	68.5140 7	50.2775 6	340.138 3	40.6483 1	156.801 4	5.75125	943.818 6
GEOROC NZ406				samp. 7305		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / KAIPARA- TOKATOKA	ANDESITE	62782.0 7	165078. 7	586902	1103.19 9	11433.1 6	69601.8 5	6418.61 4	1103.19 9	16484.8 4	164.856 4	97.1110 6	48.5740 3	62.8294 2	40.1131 6	204.766 9	65.5833 1	91.1874 4	3.02559 8	293.028 9
GEOROC NZ407				samp. 26720		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	61967.3 1	177479. 2	485009. 5	2005.41 5	7420.03 4	124837. 1	10327.8 9	1704.60 2	17380.2 6	306.674 3	56.0492 5	148.390 7	53.8005	15.7329	396.951 9	17.2979 3	65.1361 9	4.93484 7	249.300 6

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ408				samp. 26412		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	49979.8 9	181617. 1	495173	1709.57 4	6637.16 8	114340. 3	10358	1910.7	18453.3 4	357.854 5	35.3610 3	99.2627 7	62.3927	12.1166 5	324.943 7	19.8235 9	66.0523 6	3.73417	242.994 4
GEOROC NZ409				samp. 23223		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	43169.0 7	178585. 7	500500. 8	2203.52 6	8413.46 2	105969. 6	11919.0 7	1903.04 5	19297.5 4	370.222 7	23.2307 1	114.970 2	68.9954 7	14.4554 6	330.121 9	22.8480 6	84.4844 4	4.57065 3	322.488 1
GEOROC NZ410				samp. 26723		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	38623.1 7	191114. 7	501200. 7	1801.08 1	7004.20 3	110766. 5	10506.3	1801.08 1	17743.9 8	344.964 3	27.4688 6	359.130 6	72.1398 2	11.3711 8	338.699 4	20.5139 1	70.7805 1	3.38220 4	248.604 7
GEOROC NZ411				samp. 26724		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	39475	179641. 3	502755. 2	2604.94 9	8516.18 1	104298. 2	12523.8	2003.80 7	19420.2 3	364.806 3	20.6764 1	125.512 9	71.1486 3	13.8342 7	371.262 7	23.6169 4	92.3281 3	5.05539 4	424.411 6
GEOROC NZ412				samp. 26408		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	41356.4 1	169651. 8	503924. 3	3119.34	11772.9 9	99114.5 1	14691.0 8	2012.47 7	19906.7 6	403.816 3	21.1912 5	123.331 7	76.3239 9	22.0602 8	380.942 4	26.2222 9	107.575 1	6.97995 8	529.729 7
GEOROC NZ413				samp. 26406		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	37722.6 3	200520. 3	505203. 1	1500.90 1	6603.96 2	114468. 7	9605.76 3	1600.96 1	15742.7 8	313.855 2	22.8297 9	80.7650 5	55.0282 8	10.7575 5	332.543 5	20.9951 4	58.8886 2	3.02090 3	219.052 2
GEOROC NZ414				samp. 26407		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	37107.4 2	185937. 2	506501. 3	2400.48	9201.84	102220. 4	12302.4 6	1700.34	18437.0 2	366.663 5	18.3924	111.345	64.0775	16.6031 6	358.650 7	23.4004 6	84.6207 2	5.08410 3	318.703 7
GEOROC NZ415				samp. 23222		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / WAIPOUA	BASALT	44052.8 6	152683. 2	509211. 1	2102.52 3	8410.09 2	91509.8 1	13816.5 8	2302.76 3	23728.4 7	457.229	15.0456 9	138.460 8	89.6554 2	14.0455 1	292.615 1	26.8484 5	84.8107 8	3.90253 9	304.590 4
GEOROC NZ416				samp. 24275		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU	BASALT	60790.5 8	206528. 2	465961. 3	199.640 6	598.921 9	127370. 7	8684.36 8	1696.94 5	18350.3	423.299 2	14.5577 8	36.8843	56.7333 1	0.77763 6	291.732 2	6.58673 5	9.05684 3	0.32532 9	35.2724 9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ417				samp. 24154		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU	BASALT	47709.5 4	190038	496499. 3	1100.22	2000.4	121324. 3	8901.78	2100.42	17386.8 1	337.162 8	25.1142 5	233.261 8	63.1309 1	1.77270 5	244.453 2	20.1110 5	48.2734 2	1.64249 5	28.2105
GEOROC NZ418				samp. 33489		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU	ANDESITE, BASALTIC	39419.7 1	176288. 1	552176. 1	1800.9	13106.5 5	82441.2 2	9104.55 2	1700.85	21056.6 8	275.390 9	11.1159 8	36.4268 6	64.0541 3	32.7656 8	257.6	24.1517 4	107.588 8	3.78396	260.748 3
GEOROC NZ419				samp. 24175		NEW ZEALAND / NORTH ISLAND / NORTHLAND VOLCANIC ZONE / MANUKAU	ANDESITE	11852.5 9	159561. 8	634462. 2	3486.05 6	26494.0 2	41533.8 6	9063.74 5	1294.82 1	19465	66.0219 8	4.41411 2	16.9783 3	73.1341	78.5030 6	198.719 9	41.9346 3	239.312 7	7.22911 9	442.464 8
GEOROC NZ420				samp. T5-7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47900	170500	566100	800	6500	79700	6500	1500	25063.5 8	212.6	24	45.7	71.8	13.7177 6	206.816 7	17.6444 4	52.1	2.1	174.8
GEOROC NZ421				samp. T5-8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47400	172800	563448	800	5500	78700	6500	1500	27402.0 5	213.8	23.1	50.6	74.1	6.44148 9	214.687 8	21.1308	50.6	1.4	173.9
GEOROC NZ422				samp. T5-10A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48750	170950	569874	800	6450	79650	6500	1500	23565.6	205.7	23.7	67.8	70.1	13.8817 8	206.406 7	17.7081 4	50.5	1.6	175.6
GEOROC NZ423				samp. T5-10B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47300	172900	564264	800	6500	77900	6400	1500	27471.1 3	189.2	19	106.1	74.2	13.5037 5	209.363 1	17.8199 6	49.9	0.5	199.3

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ424				samp. T5-37		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE	45100	168300	579564	800	6900	74500	6600	1400	26910.4 8	206.4	22.1	28.4	69.4	14.0047 3	212.291 8	19.4542	50.8	2.3	182.8
GEOROC NZ425				samp. T5-38		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48500	172400	564570	800	6700	77500	6500	1500	27929.9 9	216.4	24	34	72.1	13.4347 4	207.227 4	19.8935 7	52.6	1.1	180.4
GEOROC NZ426				samp. T5-47		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47300	172100	567528	800	6300	75700	6400	1500	26457.7 8	214.7	26	38.5	77.1	13.0448 1	200.627 8	18.5386	52.4	1.4	221
GEOROC NZ427				samp. T5-73		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	44600	176700	562632	900	7900	76500	6500	1400	25766.3 8	212	30.1	54	77.5	16.8301	250.029 2	17.4723 7	57.2	1.5	253.1
GEOROC NZ428				samp. T6-7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48700	169400	563228	800	6700	79300	7000	1500	22400	235	23.3	45	73.8	13.7390 8	206.402 3	20.3158 5	53.1	2.8	178.8
GEOROC NZ429				samp. T6-8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE	46600	171400	570622. 9	800	6500	77800	6800	1500	26700	232.6	23	36.1	74.4	13.3052	205.933 9	19.6764 4	50.2	1.9	166.7

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ430				samp. T6-9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE	46200	167400	572142. 4	800	7300	74800	6500	1400	27200	201.1	24	30.8	68.2	15.6590 4	217.296 7	18.2786 4	55.7	2	203.5
GEOROC NZ431				samp. T6-11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE	46200	168500	573661. 9	800	7300	76500	6600	1400	22600	196.3	22.5	34.1	63.1	15.4512 5	217.357 8	18.7643 2	54.4	1	208.9
GEOROC NZ432				samp. T6-12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE	46600	169500	571230. 7	800	7400	75800	6600	1400	24000	192.4	23.9	36.9	65.1	15.6815	222.222 6	19.5212 8	55.7	1.3	231.6
GEOROC NZ433				samp. T6-13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48100	174500	563329. 3	800	6500	78700	6500	1500	24700	196.9	22	46.9	66.7	13.7282 3	213.592 7	17.5093 7	53.8	1.9	192.7
GEOROC NZ434				samp. T6-14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48200	172500	559783. 8	800	6400	80200	6600	1500	27100	201.1	19.7	51.5	64.3	9.59998	222.030 4	19.8200 9	52.1	1.1	184.6
GEOROC NZ435				samp. T6-15	34360 5	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	49500	173600	561202	900	8200	79300	6700	1400	29500	187.6	28.7	36	66.1	17.4592 3	252.804 8	17.5211 5	53.3	0.7	346.8

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ436				samp. T6-16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47800	173700	560391. 6	900	7100	79900	6700	1500	27900	180.3	23.5	52.2	63.2	14.3108 2	225.605 8	18.4594 4	51.6	2.6	200.6
GEOROC NZ437				samp. T6-17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48000	174000	565861. 8	900	7000	79500	6600	1500	29600	170.9	20.6	28.5	63.9	14.2511 4	221.256	17.8753	51.7	1.5	238
GEOROC NZ438				samp. T6-18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47300	173700	567482. 6	900	7500	78900	6500	1400	35000	180	25.3	29.3	65.7	16.4207 1	233.576 5	17.6639 2	55.3	1.9	237.6
GEOROC NZ439				samp. T6-19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47200	175000	560189	900	7800	75700	6600	1400	34200	174.9	24	79.8	65.1	16.6693 1	235.447 8	18.2600 8	53.2	1.8	238.7
GEOROC NZ440				samp. T6-20		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	45300	170100	565963. 1	800	6500	77300	6800	1500	28700	210	19.6	27.8	67.5	13.1808 1	208.390 4	19.4375	50.2	1.4	173.1
GEOROC NZ441				samp. T6-21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47000	171700	567178. 7	700	6800	77600	6400	1500	27700	207.3	24.9	17.1	73.3	15.4592 2	212.163 4	17.8004 1	52.2	2.2	180.7

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ442				samp. T6-22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	50300	172100	561100. 7	800	6400	80200	6700	1500	31400	214.6	24.2	46.9	73.9	10.0414 6	212.9	19.2735	53.7	2.5	183.4
GEOROC NZ443				samp. T6-24		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	49500	172400	556035. 7	900	7700	79500	6700	1400	33500	211.8	29	45.3	75.5	16.0797	241.679	19.0581 1	54.2	2	269.9
GEOROC NZ444				samp. T6-25		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	46800	173700	564646. 2	1000	7900	77200	6600	1400	18300	191	29	44.6	73.4	17.8179 6	229.923 5	18.1463	56.1	2.3	244
GEOROC NZ445				samp. T6-26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	46800	173600	563430. 6	900	7900	77300	6600	1400	23800	193.1	29.1	36.2	79.2	17.2612 6	230.664 2	17.7016 4	57.1	2	248.5
GEOROC NZ446				samp. T6-27	16035 8	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	46700	176000	560189	900	7900	74800	6700	1400	28200	185.8	25.7	50.4	73.2	17.3784 4	227.044 2	18.3113 9	56.9	1.1	279.9
GEOROC NZ447				samp. T6-28		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	47700	170600	565254	800	6800	80100	6600	1500	33500	204.9	18.7	51.7	62.5	13.6556 5	215.373 6	17.9354 2	49.9	1.2	184.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ448				samp. T6-29		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	48700	171800	562316. 3	800	6400	79400	6500	1500	21400	198	19.7	48.4	65.9	10.7147 6	213.812	18.3550 9	52.5	2.5	196
GEOROC NZ449				samp. T6-83		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	53800	172700	548742. 1	700	6700	82300	6500	1500	28300	217.3	24.5	39	74.3	45.0060 9	277.15	19.2878	54.8	1.4	213.1
GEOROC NZ450				samp. T6-84		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / TE HERENGA FORMATION	ANDESITE, BASALTIC	52100	172400	551578. 5	800	6700	82100	6500	1500	27900	202.5	21.7	24.9	69.2	15.1565 5	204.116 7	18.9725 1	52.7	1.4	205.7
GEOROC NZ451				samp. R94/6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	48058.7 4	174256. 9	569850. 5	1666.01 3	10783.8	77115.8 1	6519.55 5	1251.43	20911.3 3	185.941 1	46.7957 6	35.9404 4	61.0551 5	30.1763 8	273.139 3	18.2299 6	76.3881 4	1.86099 9	305.057 6
GEOROC NZ452				samp. R94/8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	55225.2 3	169116. 4	566779. 5	1379.11 6	8959.37 4	79743.7	6531.91 9	1389.00 8	19665.5 8	211.378 8	43.2770 9	76.2113 6	69.3339 5	25.6777	252.435	16.5867 9	66.2868 7	2.24337 2	253.443 4
GEOROC NZ453				samp. R94/9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	49213.3 4	174518. 1	571241. 7	1395.00 3	9359.70 1	77288.1 7	6525.45 6	1342.05 1	26072.5 9	192.655 2	38.4075 5	77.8540 3	68.3776 9	22.8501	280.279 3	17.5654 6	64.5385 1	0.77478 1	258.362 5

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ454				samp. R94/11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	36380.1 6	157907. 4	618937. 6	1929.95 7	23061.3 3	57455.8	6910.81 6	1065.95 5	14049.7 9	129.214 8	24.8627 7	28.1043 1	52.5856 7	95.0018 8	237.319 7	20.9657 3	161.569 4	5.07680 5	451.571 7
GEOROC NZ455				samp. R95/17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	35500	189000	566596. 8	1100	11300	79400	6600	1000	22191.9	189.103 9	34.5903	49.6199 4	60.3130 6	32.8170 2	317.834	16.8090 5	100.070 7	0.52306 6	346.675 7
GEOROC NZ456				samp. R95/18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	23400	192200	579902. 4	1100	11900	74400	6800	900	21358.7	193.540 5	13.7883 5	64.7823 4	66.6192 9	33.0038 5	300.750 9	19.8117	105.359 7	2.89837	356.929 8
GEOROC NZ457				samp. R95/19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	23300	192100	579700. 8	1100	12100	72900	6900	1000	19713.7 5	193.169 3	14.9351 8	77.2675 6	68.7525 5	33.8906 2	295.229 4	22.0901 8	106.565 7	1.50736 3	360.180 3
GEOROC NZ458				samp. R95/20		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	66500	151500	559843. 2	800	9400	87800	6800	1300	20843.4 1	238.386 9	54.8250 3	78.5177	67.5832 7	28.0173 4	198.170 9	18.7787 6	89.2009 5	1.13332 1	279.014 5
GEOROC NZ459				samp. R95/21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	43100	169600	576172. 8	1200	13100	71300	7500	1300	15798.4 6	230.563 2	13.2303 5	43.8067 3	73.2984 8	39.5106 3	262.301 7	22.9816 6	115.757 1	3.04105	390.695 2

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ460				samp. R95/22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	43000	169300	575064	1200	13200	71700	7400	1300	15876.4	229.637 6	12.4442 1	50.9632	73.9854 5	41.3811 3	265.589 4	21.6634 3	119.550 4	3.56075 5	391.648 3
GEOROC NZ461				samp. R95/23		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	42600	167400	580910. 4	1200	14200	69100	7300	1200	14709.8	223.077 5	15.4220 4	43.1561 7	74.3222 1	46.6367 5	258.472 9	21.9823 3	127.431 9	3.30803 3	389.973 1
GEOROC NZ462				samp. R95/26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	53200	167600	568209. 6	900	8900	78900	6300	1300	26190.0 3	233.831	48.5810 3	74.4694 7	74.9995 8	23.5467 8	263.972 7	17.6450 6	79.7521 7	1.19294 6	273.097 5
GEOROC NZ463				samp. R95/27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	24000	198700	577584	1200	12400	77600	6600	900	18003.2 4	176.256 6	16.3887 4	38.6965 3	61.5894 4	35.0554 2	333.001	19.0818 7	105.288 6	2.24617 4	398.479 7
GEOROC NZ464				samp. R95/28		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	23800	198100	574761. 6	1200	12300	77300	6600	900	19303.6 5	181.299 6	18.8181 7	51.1961 4	56.7444 3	35.6718 2	328.821 1	20.2077	107.250 4	1.20082 5	373.075 3
GEOROC NZ465				samp. R96/2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	34900	171900	594200	1400	16300	64100	7500	1100	18966.7 2	181	13	32	67	57	270	24	130	5	392

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ466				samp. R96/3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	35200	171400	594200	1400	16200	64200	7400	1100	17477.4 4	185	13	33	67	57	266	23	129	5	393
GEOROC NZ467				samp. R96/4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	43700	172800	569600	1100	11000	76300	7000	1400	28288.1 6	229	15	41	75	31	245	24	87	3	316
GEOROC NZ468				samp. R96/5	16035 5	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	23500	194400	582600	1300	12300	75500	7000	900	18757.6 6	180	14	73	64	36	313	21	101	4	328
GEOROC NZ469				samp. R96/6	25159 5	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	34200	172300	591400	1400	16100	64400	7500	1100	17144.2 4	187	12	31	70	57	267	23	129	5	401
GEOROC NZ470				samp. R96/7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	28700	174900	604800	1300	16900	62300	7100	1000	19868.3 8	166	12	38	72	60	246	26	130	6	409
GEOROC NZ471				samp. R96/8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	32200	183500	586800	1200	12900	69600	6500	1100	18211.6 7	165	5	14	67	42	252	22	103	5	319

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ472				samp. R96/9	16035 6	NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	42400	176500	565500	1200	10900	77600	7200	1400	29365.8 9	231	12	43	75	32	253	20	84	4	324
GEOROC NZ473				samp. R96/15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	46900	169900	573300	1100	11400	76500	6700	1200	18687.3 2	212	35	59	72	37	228	22	90	4	290
GEOROC NZ474				samp. R96/16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	55800	166400	564200	1000	10200	80200	6800	1300	20009.1 8	229	51	46	71	32	225	20	84	3	269
GEOROC NZ475				samp. R96/17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	49000	172000	563700	1200	10700	79900	7200	1400	20853.0 9	241	22	51	74	32	226	24	85	4	293
GEOROC NZ476				samp. R96/18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	53700	171200	549500	1100	9400	85900	7500	1400	28631.4 5	259	25	54	78	27	226	21	78	3	258
GEOROC NZ477				samp. R96/19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	47500	172100	569100	1100	10800	76900	6700	1300	21354.1 3	215	35	60	74	34	232	23	86	3	271

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ478				samp. R96/20		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	48800	171800	566800	1100	10400	76500	6700	1300	25043.8 3	219	30	48	76	32	241	22	86	4	289
GEOROC NZ479				samp. R96/21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	49400	170900	569200	1100	10400	78300	6700	1300	23832.4 8	218	33	50	75	31	238	21	85	4	262
GEOROC NZ480				samp. R96/22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	44000	173200	574400	1100	11900	73400	6800	1300	26833.3 2	205	31	55	72	38	243	20	92	4	293
GEOROC NZ481				samp. R97/50		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	47592.2	171356. 4	564990. 3	1111.50 4	8755.35 4	78822.7 2	6980.04 9	1560.63	19177.6	215	23.1365 1	50.7952 2	68.3577 4	28.6104 5	234.987 8	17.4708 8	80.2024 5	3.19426 5	234.9
GEOROC NZ482				samp. X1-9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	50500	170700	553600	1100	10000	82100	7500	1500	23800	236	17	78	86	32	226	25	85	5	244
GEOROC NZ483				samp. X1-10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	41100	181700	559200	1400	11600	78800	7600	1300	22100	214	14	65	78	37	270	24	94	6	279

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ484				samp. X1-11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	42000	179500	558300	1200	11300	79400	7500	1300	21600	208	16	53	75	35	266	24	95	6	273
GEOROC NZ485				samp. X1-12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	53200	169300	555800	1200	10800	80000	7400	1400	20000	216	36	54	77	34	250	24	91	6	264
GEOROC NZ486				samp. X1-13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	44600	166800	584200	1000	12600	70100	6600	1200	17300	189	22	62	74	45	223	25	98	6	284
GEOROC NZ487				samp. X1-14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	42900	170600	585100	1000	12200	70900	6600	1200	17300	189	21	54	74	42	299	23	96	6	322
GEOROC NZ488				samp. X1-15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	49600	167800	573000	1000	12100	77100	6700	1300	16900	194	24	61	79	39	248	23	98	6	280
GEOROC NZ489				samp. X1-25		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	44500	168100	581300	1000	11300	71500	6700	1300	26700	200	18	54	75	38	220	25	93	5	253

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ490				samp. X1-41		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	45300	168200	579500	1100	11300	75900	6700	1300	25000	195	25	57	82	35	251	24	99	6	325
GEOROC NZ491				samp. X1-52		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	52100	171300	562200	1200	11100	82300	7500	1400	23298.7 3	216	34	56	73	35	247	26	91	6	272
GEOROC NZ492				samp. X1-56		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	46900	167800	577000	900	11200	74500	6800	1300	20843.7 2	201	16	54	73	28	219	24	92	6	256
GEOROC NZ493				samp. X1-92		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	52900	170100	556700	1100	10900	81100	7500	1400	27510.9	203	31	40	69	33	248	23	90	6	252
GEOROC NZ494				samp. W9-3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	25450	195500	575800	1000	10500	79700	6700	1000	15290.8 6	160.35	6.15	46.15	66.15	33.4	274.3	22.2	96.5	5.6	235.55
GEOROC NZ495				samp. W9-4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	25600	162550	601300	1200	12100	58400	8500	1350	15215.0 6	204.6	0	37.5	96	37.5	222.75	27.55	105	6	287.25

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ496				samp. W9-5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	38550	156600	614600	1250	20300	62350	6350	1100	9199.91 3	140.85	21.7	36.5	62.2	86.1	244.2	22.4	130.75	7.4	349.8
GEOROC NZ497				samp. W9-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	55700	162350	575050	900	9050	79450	6000	1300	16098.8 7	195.4	40.9	85.05	72	27.2	290.05	18.05	80.1	4.75	212.55
GEOROC NZ498				samp. W9-27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	47400	169000	573650	1100	11950	77900	6600	1400	20053.7 1	191.5	10.85	60.1	81.85	37.3	252.95	23.25	89.4	5.45	311.75
GEOROC NZ499				samp. W9-28		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	48550	174200	568600	850	9450	80300	6100	1500	17124.7 4	194.45	10.05	52.1	97.65	30.4	207.85	21.5	74.95	4.4	211
GEOROC NZ500				samp. W9-29		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	48850	168800	573600	1200	11400	79200	7700	1400	18592.1 6	207.2	11.05	63.1	76.8	36.55	246.2	25.15	98.45	4.85	256.35
GEOROC NZ501				samp. W9-39		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	41050	147250	635700	1600	23200	51400	7600	900	7306.62 3	129.1	56.1	71.9	60.85	94.4	210.85	25.85	175.6	9.15	446.95

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ502				samp. W9-41		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	51300	170100	571000	800	9300	81400	6300	1500	24810.2 2	196.05	11.95	38.5	71.3	29.25	210.05	24.35	76.55	5.5	211.35
GEOROC NZ503				samp. W9-42		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	43900	148350	628350	1600	22750	53300	7550	900	5256	135.1	68.3	53.65	60.25	91.65	211.05	25.65	168.8	8.45	438.35
GEOROC NZ504				samp. W9-43		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	49900	145550	630050	1600	22750	54850	7550	1000	9367.54 9	138.55	85.4	79.8	62.5	91.7	212.8	26.1	166	9.1	417.3
GEOROC NZ505				samp. W9-44		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	48350	172100	558400	900	9450	79900	7400	1500	24325.9 8	234.8	6.6	29.15	75.65	29.35	232.7	19	77.95	4.7	220.4
GEOROC NZ506				samp. W9-45		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	42950	168000	600600	1100	14550	69850	6300	1150	7698.87 4	149.35	22.15	40.2	68.95	51.5	288.4	20.35	116.8	6.15	303.6
GEOROC NZ507				samp. W9-46		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	48300	172450	553300	900	9200	80850	7400	1500	19441.7 5	244.65	7.25	37.9	83.7	28.65	237.3	23.25	80.6	4.75	222.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ508				samp. W9-47		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	25100	194800	579050	1100	10950	78700	6750	1000	13834.7 7	158.65	3.6	57.7	66.75	34.2	276.75	22.6	99.35	5.4	248.8
GEOROC NZ509				samp. W9-48		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE, BASALTIC	46400	172400	569100	1150	10650	80000	7700	1400	16358.3 5	220.05	8	69.85	82.15	34.35	247.3	23.3	94.65	5.3	235.2
GEOROC NZ510				samp. W9-49		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	25100	197200	576700	1000	10500	80150	6600	1000	17102.4 1	157.75	5.7	52.05	65.1	34	276.65	21.1	97.35	5.85	216.85
GEOROC NZ511				samp. W9-50		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	22650	199100	575800	900	10450	80500	6600	950	25800	170.9	4	47.4	62.3	30.45	283.45	21.1	98.9	5.25	221.9
GEOROC NZ512				samp. W9-51		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	33400	157300	575450	1200	19300	55350	6550	1050	14896.1 1	117.3	6.85	46.8	53.95	89.05	220.6	24.1	148.55	8.85	415.65
GEOROC NZ513				samp. W9-52		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	45500	165850	582050	1150	14650	74900	7350	1400	22427.0 2	183.75	11.35	32.35	68	56.5	235.15	23.2	110.25	7.55	289.4

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ514				samp. W9-53		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	46600	165500	580350	1100	14100	74950	7400	1400	23382.4 8	195.4	10.15	40.2	71.7	55.15	233.35	24	109.55	6.2	279.3
GEOROC NZ515				samp. W9-54		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	44650	167450	583450	1200	14900	74300	7400	1350	23177.4 4	193	12.35	58.85	69.55	55.6	232.7	23.7	112.05	6.35	283.25
GEOROC NZ516				samp. W9-55		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	44150	164550	589700	1200	15850	72350	7400	1300	22266.3	175.5	13	37.35	69.2	62.5	231.55	24.2	117	6.55	286.95
GEOROC NZ517				samp. W9-57		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	34850	168200	605900	1200	15600	66500	7300	1250	22345.8 8	172.95	13.5	38.45	77.25	53.75	275.95	28.5	124.05	6.15	331.35
GEOROC NZ518				samp. W9-58		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	55550	163550	576800	850	9000	78550	6100	1300	12464.6 4	198	42.15	58.5	74.4	27.1	289.4	19.05	81.4	5	219.2
GEOROC NZ519				samp. W9-77		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WAIHIANOA FORMATION	ANDESITE	46150	165850	592800	1200	14350	72100	7000	1200	21284.1 5	172.15	27.3	27.15	61.95	50	242.4	23.9	114.45	6.9	318.85

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ520				samp. R94/5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	27434.5 3	171031. 3	606708. 5	2308.83 3	19992.6 7	59955.8 9	8826.46 3	1056.72	12398.3 8	169.107 8	10.8166 4	30.8676 7	58.1771 6	75.6072 9	274.367	20.2393 1	143.851 4	5.78781 3	438.151 5
GEOROC NZ521				samp. R95/3A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	44700	169800	565992	1300	14100	76100	7800	1300	16687.1 2	243.474 6	11.5865 5	28.3069	78.5447 9	48.7178 2	258.324 8	22.3483 5	121.34	3.16010 7	362.077 4
GEOROC NZ522				samp. R95/3B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46700	163900	581011. 2	1200	15700	71000	7100	1300	16243.4 1	200.922 9	26.8389 3	44.1333 8	70.9585	59.3200 4	213.661 5	21.4813 3	133.584	4.02393 2	372.673 5
GEOROC NZ523				samp. R95/4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44900	162800	578793. 6	1200	16400	68000	7200	1200	20078.0 6	201.502 5	29.1771	40.1482 1	70.2014 9	62.2268 1	220.634 8	21.8679 9	141.942	3.33442 8	375.367 8
GEOROC NZ524				samp. R95/5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	51500	162800	560750. 4	1200	13000	78100	7300	1400	21788.1 6	242.978 6	26.5463 2	26.3650 3	77.1569 7	45.8333 9	223.432 3	20.8549 2	123.041 3	3.75543	316.867 4
GEOROC NZ525				samp. R95/6D		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46100	164900	582926. 4	1200	15300	72300	7000	1200	12253.9 2	192.677 3	28.3764 8	47.1764 2	71.2194 7	56.5589 3	217.300 4	20.8628 7	131.661 4	2.85895 2	355.025 6

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ526				samp. R95/8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43100	169300	576676. 8	1200	14700	71900	7200	1300	21032.9	210.834 1	19.8509 7	47.5635 1	76.6960 7	53.3111 9	227.074 6	21.1455 1	126.046	3.14475 8	363.516 2
GEOROC NZ527				samp. T5-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	36400	163700	601596	1800	20400	60900	8400	1000	15760.8 5	179.3	29.7	47.1	61.5	71.7743 1	265.816 3	23.2576 4	146.9	4.9	429.2
GEOROC NZ528				samp. T5-20		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	47900	171500	571506	900	8600	78100	6100	1300	18387.7 6	189.2	33.7	52.7	68.5	23.4745 9	213.549	19.2813	66.7	3.8	238.9
GEOROC NZ529				samp. T5-22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46800	173800	575178	900	9200	74600	6200	1300	19329.0 9	180.8	31.9	38.2	65.6	25.4948 3	219.881 5	18.2698 8	67.9	3.1	260.6
GEOROC NZ530				samp. T5-228		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40500	160100	604146	1600	21600	61200	8400	1000	17901.9 3	166.1	44.4	53.2	59.3	84.5291 1	235.733	24.3869 1	170.2	6.6	423.9
GEOROC NZ531				samp. T5-24		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46900	164600	587826	1400	16400	69900	7400	1100	17794.8 9	166.8	54.6	55.6	57.4	59.1863 4	248.915 9	20.2540 3	124.6	5.8	342

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ532				samp. T5-28C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40700	176000	572526	900	8600	73200	5700	1300	28184.8	170.7	19	35.7	68.9	23.3014 6	227.538 5	17.1818 6	63.3	2.8	233.2
GEOROC NZ533				samp. T5-28D		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46900	173000	571506	800	8700	77300	6100	1300	21505.1 1	183	33.7	58.1	66.1	23.5975 2	216.059 4	19.0218 1	64.5	2.6	230.6
GEOROC NZ534				samp. T5-29		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	27500	164500	616080	1600	21000	54800	8800	900	13503.6 7	193	21.5	32.8	59.4	79.7664	245.969 5	23.2038 1	154.1	5.5	411.1
GEOROC NZ535				samp. T5-30		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48100	172500	570996	800	8700	76500	6200	1300	21539.4	184.6	36.7	47.9	68.5	23.5713 8	217.972 9	21.7943 5	66.1	1.9	238.1
GEOROC NZ536				samp. T5-36		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	30900	166900	602718	1600	20000	61300	8000	1000	15652.1	167.7	23	40.7	60.8	74.4627 2	257.671	21.6000 8	152.2	7	415.3
GEOROC NZ537				samp. T5-53B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	21900	159600	632808	1800	23700	45600	7800	900	9611.08 4	106.1	19.6	25.3	59.9	89.7202 2	228.267 7	24.8499 1	177	6.9	468.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ538				samp. T5-54		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45400	166300	587622	1300	16700	67800	7500	1000	18685.0 5	157.3	48.9	37.8	53.4	60.1312 3	249.721 5	20.6251 9	127.4	5.2	354.5
GEOROC NZ539				samp. T5-62		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	61700	147600	598842	1300	17800	64200	7100	1100	12061.6 5	165.4	108.7	62.8	61.2	68.9383	214.369	19.7515 5	136.1	5.4	364.8
GEOROC NZ540				samp. T5-64		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	36300	165900	608532	1500	18800	62700	7500	1000	13880.0 9	155.7	34.7	20	57.4	68.3098 1	260.394 4	22.0668 3	138.7	7.1	386.3
GEOROC NZ541				samp. T5-65		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44100	168700	580380	1500	17000	71800	7900	1100	783.173	165.9	50.4	21.2	54.6	61.4614 6	268.993 4	19.7023 7	130.4	3.7	369.4
GEOROC NZ542				samp. T5-66		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35100	163300	597924	1700	20200	60000	8400	1000	13879.5 1	187	31.1	46.3	63.3	73.4685 7	266.969 8	24.3466 3	146.3	6.4	445.1
GEOROC NZ543				samp. T5-71		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	28000	165400	616488	1500	20800	55300	8700	900	8435.94 4	182.9	21.7	41.6	61.3	77.0749 2	242.644 4	22.4694 1	153.8	6.9	419.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ544				samp. X1-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40400	160900	607900	1300	19200	62100	6900	1100	16879.8 4	139	27	56	61	78	262	24	143	9	395
GEOROC NZ545				samp. X1-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	51900	162000	578700	1200	15200	74000	7100	1300	21600	185	28	54	68	60	225	24	118	8	290
GEOROC NZ546				samp. X1-16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	42100	161100	605500	1400	18700	63200	6900	1100	15223.7 2	148	33	52	67	75	259	23	137	8	368
GEOROC NZ547				samp. X1-17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	49500	157300	585700	1300	17200	71700	7200	1300	17300	182	29	66	74	69	227	26	122	7	348
GEOROC NZ548				samp. X1-19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48200	159100	588300	1300	16900	71200	7400	1300	18700	177	20	68	73	67	230	25	119	7	302
GEOROC NZ549				samp. X1-21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48100	155900	593800	1300	17600	68800	7200	1300	24300	174	27	41	73	71	228	25	126	8	330

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ550				samp. X1-22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	49400	158300	583400	1300	16500	71500	7300	1300	24300	186	24	40	73	65	240	25	121	7	329
GEOROC NZ551				samp. X1-26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45700	156600	596200	1300	18300	67700	7400	1300	25200	186	24	48	71	74	227	24	133	8	341
GEOROC NZ552				samp. X1-27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48700	157800	591600	1300	17700	69500	7300	1300	24500	178	26	45	73	72	226	25	127	7	327
GEOROC NZ553				samp. X1-31		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48600	159600	588000	1400	16800	72600	7300	1300	27200	191	25	67	75	67	241	27	121	8	322
GEOROC NZ554				samp. X1-32		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	50600	154400	587400	1300	17300	68900	7100	1300	23300	176	27	49	74	71	224	24	124	7	317
GEOROC NZ555				samp. X1-35		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35600	162600	615800	1300	19200	59000	6800	1100	16900	142	18	27	68	77	268	22	142	8	370

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ556				samp. X1-39		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	39900	167800	583200	1200	16000	71000	7200	1300	21400	180	11	33	74	59	232	24	114	7	284
GEOROC NZ557				samp. X1-40		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45600	159600	585100	1200	15500	72700	7000	1400	25300	178	26	54	76	62	213	24	114	7	282
GEOROC NZ558				samp. X1-47		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	47200	156500	594100	1300	17500	69400	7300	1300	24300	181	25	58	74	70	229	26	126	8	340
GEOROC NZ559				samp. X1-48		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	39500	170000	581700	1200	14900	71400	7400	1300	29000	193	9	34	75	56	229	25	112	7	285
GEOROC NZ560				samp. X1-49		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48100	160600	580500	1300	16900	72000	7300	1300	17500	178	18	40	69	67	245	25	124	7	315
GEOROC NZ561				samp. X1-50		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46000	158100	592400	1300	18500	66600	7300	1200	20100	155	23	49	64	76	222	24	134	9	323

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ562				samp. X1-53		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46000	162100	580500	1300	17200	70000	7500	1300	20800	180	18	56	71	69	245	25	128	8	358
GEOROC NZ563				samp. X1-54		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	47800	155300	593200	1300	17600	69200	7200	1300	23900	146	12	41	65	71	239	25	129	8	343
GEOROC NZ564				samp. X1-55		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45600	157100	598000	1400	18600	67500	7400	1200	25300	176	22	44	71	75	244	24	131	8	353
GEOROC NZ565				samp. X1-58		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	41000	166400	586500	1400	16300	69900	7900	1200	24700	180	15	79	66	62	279	24	127	8	302
GEOROC NZ566				samp. W9-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44200	169050	572000	1350	14000	77050	7750	1400	13758.3 5	211.6	5.35	32.7	81.8	52.2	259.75	24.6	108.05	5.95	278.95
GEOROC NZ567				samp. W9-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45600	163850	585250	1200	14950	72800	6900	1300	13709.3 8	172.3	21.45	52.6	75.5	59.2	219.8	23.95	111.85	7.15	274.4

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ568				samp. W9-7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44800	164550	578200	1100	14300	74800	7300	1400	17637.1 2	195.85	13.05	32.6	74.6	56.25	229.5	24.35	109.85	5.75	273.45
GEOROC NZ569				samp. W9-8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45550	160900	580550	1200	15400	72250	7000	1300	11714.4 3	183.75	20.6	47.45	74.75	62.75	214.5	24.65	115.1	7.15	272.95
GEOROC NZ570				samp. W9-9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43600	169250	570750	1350	14000	76800	7750	1400	17614.8 5	217.6	5.2	35.95	83.7	50.65	259.95	26	109	6	277.45
GEOROC NZ571				samp. W9-10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44100	165250	578550	1200	14450	74500	7400	1300	17220.5 2	202.6	12.85	43.7	74.65	54.85	232.35	25.1	111.6	6.8	275.4
GEOROC NZ572				samp. W9-11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	42150	169400	578750	1200	14500	72450	7150	1350	16337.1 2	189.6	14.3	53.45	77.75	56	230.95	25.65	110	7.2	283.15
GEOROC NZ573				samp. W9-11A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	42350	162850	588050	1250	16100	70400	7250	1300	13770.5 2	181.7	15.8	38.55	72.5	63.8	226.85	24.65	119.3	6.95	290.8

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ574				samp. W9-12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43400	170600	571750	1300	13950	77050	7800	1400	19781.8 6	216.25	6.05	35.9	82	51.2	261.8	24.75	108.75	6.95	281.8
GEOROC NZ575				samp. W9-13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	34950	160150	618550	1300	20250	58450	6750	1000	2127.22 9	131.65	19.5	39	66.25	83.55	261.8	23.45	146.05	7.6	373.6
GEOROC NZ576				samp. W9-14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35700	162250	616600	1300	19250	59200	6900	1050	3754.96 1	135.7	17.65	34.85	67.4	77.25	268.95	22.7	142.4	9.5	378.75
GEOROC NZ577				samp. W9-15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	27350	162600	624700	1500	20200	54500	8050	1000	8567.13 4	135.75	9.6	30.4	69.5	77.55	264.45	25.75	145.4	8.5	394.25
GEOROC NZ578				samp. W9-21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40550	169650	588450	1200	15200	72100	7400	1300	18571.1 4	171.9	8.45	29.4	71.8	58.65	234.8	23.9	113.4	6.65	272.9
GEOROC NZ579				samp. W9-22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40850	168750	584600	1200	15050	71200	7350	1300	14175.7 7	173.5	7.15	32.6	72	58.9	233.85	26.3	114.75	7.4	272.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ580				samp. W9-23		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44400	170600	573050	1300	13950	77450	7800	1400	14297.4 2	214.9	4.3	36.65	80	50.55	260.15	24.85	108.75	5.9	280.1
GEOROC NZ581				samp. W9-24		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44450	171450	574450	1350	13800	77250	7800	1400	15508.7 6	211.6	5.05	33.65	78.6	49.2	260.9	24.8	108.85	6.85	290.75
GEOROC NZ582				samp. W9-25		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44550	171650	573950	1300	13850	77600	7850	1400	22304.5 5	213.95	4.9	36.25	76.45	49.35	263.35	25.3	110.5	6.05	291.9
GEOROC NZ583				samp. W9-26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44900	169000	571050	1300	13800	75000	7800	1400	21821.1 4	208.3	5.75	33.3	84.1	50.55	251.25	24.75	109.6	7.05	267.25
GEOROC NZ584				samp. W9-30		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44200	170800	575150	1350	14200	76950	7800	1400	20109.8	213.2	4.95	32.95	82.4	50.3	260.45	24.85	109	7.3	289.9
GEOROC NZ585				samp. W9-31		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	42250	168600	580300	1250	14650	72800	7150	1400	14775.7 7	186.1	14.9	53.15	80.15	55.95	228.05	23.85	109.65	6.3	276.65

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ586				samp. W9-32		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44400	171050	575500	1350	14050	76400	7800	1400	12513.8 1	212.8	5.2	37.8	81.45	50.65	257.55	24.85	108.3	6.9	287.8
GEOROC NZ587				samp. W9-33		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	46150	164650	589400	1200	15400	73000	7100	1300	14598.2 5	166.85	20.2	50.45	74.15	60.1	217.55	24.15	112.55	6.9	266.65
GEOROC NZ588				samp. W9-35		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44600	164900	577900	1150	14450	74100	7400	1350	15614.4 3	199.2	12.95	34.2	74.9	57.25	230.1	22.6	110.4	5.85	278.5
GEOROC NZ589				samp. W9-38		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40400	169000	582600	1200	14800	71400	7400	1300	28600	174.9	8.1	34.2	70.35	56.75	230.7	24.45	112.1	6.6	282.75
GEOROC NZ590				samp. W9-62		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45650	164600	589000	1200	15300	72800	6900	1300	17643.6 2	171.4	21.3	48.6	74.2	59.35	220.2	23.45	114.05	7.5	271.6
GEOROC NZ591				samp. W9-63		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45750	164300	588400	1200	15350	72550	6950	1300	9653.09	168.1	22.05	51.05	73.5	60.5	218.75	23.5	113	6.55	273.8

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ592				samp. W9-67		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	26200	165250	627200	1650	20500	54150	8700	1000	17868.8	162.15	9.45	43.45	67.65	75.3	270.25	36.55	145.95	9.45	400.55
GEOROC NZ593				samp. W9-68		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45900	164550	588250	1250	15950	71200	7050	1300	12631.4 5	176.1	19	38.9	70.7	62.4	214.3	24.2	115	6.7	285.25
GEOROC NZ594				samp. W9-70		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	42900	170500	571050	1300	13950	77150	7800	1400	16481.0 3	221.9	4.65	30.8	82.5	51.5	262.35	24.8	109.35	6.7	283.45
GEOROC NZ595				samp. W9-71		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43950	170350	568150	1350	13800	75300	7800	1400	14464.0 2	210.5	4.2	32.35	82.2	50.05	255.85	21.15	107.95	5.95	279.95
GEOROC NZ596				samp. W9-72		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43950	169050	566300	1350	13850	75750	7700	1400	22543.6 2	206.45	6.05	33.95	80.75	51.05	253.7	23.85	108.35	7.45	274.9
GEOROC NZ597				samp. W9-73		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45550	164050	585450	1200	15600	71350	7100	1300	15420.7 3	185.85	22.1	36.45	75.55	62.8	213.55	22.4	115.35	6.4	277.35

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ598				samp. W9-75		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	41200	160200	617050	1350	19350	63000	6900	1100	19196.9 4	137.9	28.7	76.35	63.4	76.2	259.6	26	140.75	8.1	388.25
GEOROC NZ599				samp. W9-76		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40550	170500	585400	1200	14900	72000	7400	1300	27650.7 4	170.1	7.6	27.6	64.85	58.2	233	23.1	111.75	6.3	305
GEOROC NZ600				samp. W9-78		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40400	170600	586300	1200	15150	71850	7400	1300	23044.2 4	178.45	8.65	29.45	68	56.8	230.5	24.8	111.85	6.3	289.6
GEOROC NZ601				samp. W9-79		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40050	171300	583700	1200	14900	72600	7450	1350	26500.3 3	178.75	6.8	27.5	68.9	57.75	239.7	28.05	113.1	7.1	296.15
GEOROC NZ602				samp. W9-80		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	40750	160550	615950	1350	19100	62250	6850	1100	15762.9 2	141.65	27.3	33.4	60.85	75.65	260.3	25.35	141.4	7.4	381.35
GEOROC NZ603				samp. W9-81		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45450	162500	582150	1200	15400	72150	7000	1300	13798.2 5	188.75	19.05	49.35	75.75	62.15	213.1	24.45	114.75	7.4	270.95

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ604				samp. R97/5B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37890.2 5	173765. 5	583091. 1	1334.00 7	15781.7 2	68484.3 1	7197.46 5	1207.92 2	15898.8 4	171.65	15.9414 7	29.5183 6	68.7343 5	61.9223 3	229.113 5	21.2993 3	121.364 6	4.89115 1	347
GEOROC NZ605				samp. R97/5C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	38197.3 3	175255. 1	589308. 5	1448.63 2	16042.7	69822.0 3	7268.58 8	1199.24 4	16423.7 7	166.6	13.9586 5	22.5705	67.0651 2	61.9370 1	228.055 7	21.1733 6	120.746 6	4.79567	352.2
GEOROC NZ606				samp. R97/6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35265.5 2	172494. 6	587482. 3	1370.01 5	15502.6 6	69383.7 9	7188.28 8	1428.35 6	15597.1 5	169.4	14.0808 3	24.7947 7	68.5178 6	62.6936 7	229.328 5	21.0673 8	121.505	4.94200 7	345.85
GEOROC NZ607				samp. R97/9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	74012.7	141340. 2	593401. 8	1407.62 6	16564.4 3	67955.1 1	6580.52 6	1101.52 5	9792.80 6	151.2	106.843 2	40.5130 8	52.2876 7	61.4517 6	257.752 5	18.3988 2	126.919 3	4.57823 8	356.4
GEOROC NZ608				samp. R97/10A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	24822.5 3	165027. 3	625620. 8	2003.89	21424.4	52484.4 9	8003.44 1	1112.82 7	14451.4 5	124.6	9.74166 1	24.5634 9	59.4058 4	82.8612 8	302.288 9	22.4131 9	160.244 9	6.54094 8	499.25
GEOROC NZ609				samp. R97/10B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	36029.7 1	166368. 8	601720. 1	1802.87 6	19316.1 9	61458.7 2	7938.78 5	1064.64 5	11425.8 4	147.55	18	30	63	72	290	21	148	6	430.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ610				samp. R97/11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	51704.9	165039. 9	588654. 3	1582.04	16673.8 9	71314.4 5	7404.39 2	1029.17	16614.8 8	160.35	66.8952 7	33.7202 7	55.5471 8	63.3792 8	249.343 8	18.9365 3	129.283 9	4.91159 5	385.15
GEOROC NZ611				samp. R97/12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37494.5 2	173844. 4	586156. 7	1337.12 8	15834.4 9	69550.6 4	7305.83 6	1181.03 6	14668.1 7	166.7	15.8607 4	27.6550 9	69.0821 3	62.7116 7	230.000 8	21.1293	120.826 7	5.05232 8	339.15
GEOROC NZ612				samp. R97/13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	33491.2 4	163397. 7	617360. 1	1530.9	20197.1 5	57811.2 9	6926.44 9	1171.09 9	9127.28 3	129.2	23.6933 8	29.0162 1	57.1231 6	84.3987 3	260.576 3	19.8587	151.451 2	6.14236 3	438.8
GEOROC NZ613				samp. R97/39		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	34285.4 8	161204. 4	614558. 5	1548.63	20137.8 6	58758.6 3	6925.71	1165.41 1	6484.91 2	133.4	27.2971 9	28.1033 5	56.6829 2	82.7729 4	259.155 8	20.6197 2	151.070 3	6.21233 9	428.55
GEOROC NZ614				samp. R97/46		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	61839.1 5	150747. 8	592119	1518.81	17247.8 4	67462.2 1	7039.57 9	1289.25 9	9863.63 4	156.6	122.210 4	51.7784 1	53.7183 1	68.9881 2	227.029 2	20.1246 6	132.632 4	4.99991 5	388.1
GEOROC NZ615				samp. R97/49		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	44836.4 5	176047. 7	559223. 7	1180.47 7	10031.6 9	75477.4 6	7593.97 6	1603.23 6	24525.1 5	219.25	15.0848 4	38.7966 7	71.9215 1	33.4949 2	239.980 5	18.6474	87.8799	3.49726 8	265.35

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ616				samp. R97/51		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	38589.5 6	171158. 7	590872. 3	1436.09 2	16942.2 3	68290.2 7	7283.76 2	1171.83 7	16413.8 6	168.2	15.2010 3	32.3209 2	67.0887	68.8626	241.894 6	21.2088 5	129.408 4	5.20488 6	369.25
GEOROC NZ617				samp. R97/52		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	38396.4 9	173961. 5	584271. 2	1310.53 4	15765.2 4	69638.6	7283.83 1	1183.14 6	19919.2 4	162.25	14.8509 4	22.0571 5	69.2028 3	62.346	230.176 3	21.2740 8	121.479	5.06772 1	333.25
GEOROC NZ618				samp. R97/58		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	59793.5 5	152811. 6	588193. 8	1596.20 6	15769.8 9	71477.7 7	7160.76 2	1384.54 1	15102.9 5	171.55	85.9048 4	48.9640 3	59.8122 2	60.9226 6	230.395 8	20.3792 7	124.322 4	4.85811 9	373.55
GEOROC NZ619				samp. R97/59		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	36163.4 6	163567. 3	617263. 9	1668.68 1	21436.8 5	57237.9 6	7650.46 1	962.368 6	7550.65 8	129.4	26.8143 5	28.2726	57.7263 8	85.7443 2	261.052	21.6852 7	159.497 5	6.79984 7	460.85
GEOROC NZ620				samp. R97/60A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37112.1 8	165627. 5	613867. 1	1481.40 4	19341.9 8	59866.1 2	6934.58 3	996.536 2	10843.7 1	133.1	23.6188 6	27.0061	59.0537 6	75.7725 7	269.844 7	19.9572 7	145.160 5	5.79193 4	421.95
GEOROC NZ621				samp. R97/60B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	36446.5 1	164736. 4	611770. 6	1485.61 9	20036.9	58948.7 8	6927.04 2	952.992	7883.12 9	128.2	23.7704 9	30.0116 1	57.0477 8	80.8923 9	264.418 2	19.8150 2	147.751 4	5.87230 7	425.7

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ622				samp. R97/65A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	51728.5 8	151322. 5	600683. 6	1738.90 5	18815.2 8	63868.4 2	7893.00 1	1259.62 1	12408.3 1	163.95	80.2330 2	19.3709 9	59.1816 3	72.8154 5	231.15	22.0259 7	147.528	5.40246	433.5
GEOROC NZ623				samp. R97/65B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	35668.1	171884. 1	587040. 5	1371.82 8	15497.4 6	69262.4 1	7227.09 2	1445.12 3	16008.3 6	171.7	15.1530 6	29.5004 5	70.1209	61.7753 5	229.358	21.7460 4	121.398 7	4.98069 1	352.3
GEOROC NZ624				samp. R97/65C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	45320.2 2	164008. 8	588898. 1	1421.18 3	15861.2 8	68998.5 8	6943.31 2	1424.64	13142.2 9	168.15	48.5114 6	31.4434 1	65.4909 7	63.3324 9	235.710 5	20.3422 2	123.397 4	4.89711 5	353.15
GEOROC NZ625				samp. R97/65D		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	34803.1 4	170452. 6	591709. 7	1457.06 2	16753.6 4	68382.4 7	7195.33 2	1382.76 6	14235.3 9	161.45	13.3836	25.7064 4	65.7324 9	68.0225	239.814 9	21.2095 5	128.518 5	5.17221 6	366
GEOROC NZ626				samp. R97/105		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	64364.7 5	151927. 3	588535	1436.88 7	16053.1	72715.5 9	7166.13 5	1153.05 5	11859.5	168.7	83.1909 9	65.7440 4	60.7949 8	61.9379 3	227.812 3	19.4975 1	123.268 9	4.92800 5	371.9
GEOROC NZ627				samp. R97/107B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	43528.2 8	159025. 1	598472. 7	1484.71 1	17875.3 1	63478.1 5	7193.68	1211.74 2	11703.4 7	156.85	44.8690 4	21.1518 2	53.2475 1	69.6467 9	238.278 1	19.7903 3	139.762 7	5.42530 2	396.8

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ628				samp. R97/108		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	52104.2 2	154113. 1	594323. 7	1326.81 6	15019.8 4	72586.5 5	6852.33	1394.86 5	11531.9 1	172.55	37.6360 3	41.9039 4	61.5620 5	57.6871 3	254.603 7	19.3463 8	124.094 5	5.09928 7	365.5
GEOROC NZ629				samp. R97/109		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48384.1 3	149411. 2	612919. 1	1737.58 9	22548.2 3	57919.4 3	7404.22 2	1172.48 3	7881.78 8	141.15	77.3345 3	64.6102 6	53.7376 1	93.2623 6	221.964 5	22.8719 4	159.764 1	6.47141 3	458.5
GEOROC NZ630				samp. R97/112		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	55317.1 8	147805. 1	599442. 5	1398.13 2	16361.9 6	69356.6 5	6596.68 8	1286.05 1	8191.13 3	151	63.8226	65.0411 3	57.7087	63.4761 5	339.349 6	19.2622	137.039 2	5.44676 2	376.75
GEOROC NZ631				samp. R97/113		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37092.3	163873. 6	617392. 3	1566.70 5	20524.1	59039.7 6	7017.12 2	973.533 8	7240.96 1		23.2553 4	26.9836 7	57.8004 7	84.4611 7	263.005 5	20.7727 1	152.042 5	6.09728 4	
GEOROC NZ632				samp. R97/114		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37003.0 8	159259. 6	608218. 2	1499.37 5	20871.2	55947.9 7	6864.85 6	962.466 2	9084.05	125.7	24.4314 1	33.9257 2	53.8069 7	84.1760 8	253.283 5	20.3371 5	152.715 8	6.07129 2	434.3
GEOROC NZ633				samp. R97/115A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	34875.0 3	169739. 7	593770. 5	1445.20 2	16691.2 5	67803.5 2	7160.95	1387.81 7	12999.6 4	165.6	14.8046 8	28.1907 5	64.1597 4	67.6331 8	237.492 8	21.3349 2	127.294 1	5.35756 2	364.7

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC N2634				samp. R97/1158		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	54864.4 1	152216	599111. 9	1710.02 8	19491.5 9	62925.7	7720.26 4	1033.92 1	13044.5 7		79.9410 8	42.1804 4	58.0992	75.0978 4	227.311 6	20.2878 5	149.709 8	5.63096	
GEOROC N2635				samp. R02/08A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	59600	157300	573100	1200	12100	79100	6700	1200	0	214	61	53	63	39	326	20	100	4	337
GEOROC N2636				samp. R02/08B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	29600	156800	629900	1800	26700	51000	8100	800	0	143	34	38	53	114	234	26	205	8	593
GEOROC N2637				samp. R02/09		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	29900	158100	628600	1900	26900	51500	8200	800	0	149	35	42	49	110	234	31	202	8	600
GEOROC N2638				samp. R02/10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	58400	158100	570100	1200	12100	79100	6700	1200	0	204	60	48	65	40	328	19	101	4	335
GEOROC N2639				samp. R02/11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	53100	162300	577000	1300	12900	76600	6900	1200	0	202	49	61	65	43	323	20	106	5	379

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ640				samp. R02/12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	37500	172600	585600	1400	15800	70100	7300	1200	0	202	16	21	69	60	252	22	127	5	381
GEOROC NZ641				samp. R/04-1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	65179.7 9	156507. 9	562363. 3	1174.20 8	10211.8 4	82678.4 1	6782.01 1	1325.63 8	0	216.9	71.4	63.2	72.6	30	334.1	20.4	97.3	4.1	313.2
GEOROC NZ642				samp. R/04-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	27038.6 8	180198. 3	585604. 9	1443.94 8	15540.6 7	65928.5 5	7646.22 7	1073.80 9	0	203.1	9.2	47.1	78.2	49.9	289.3	23.1	123.2	5	392.7
GEOROC NZ643				samp. R/04-3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	50259.2 1	178901. 9	546716. 2	1185.29 4	7864.19 8	85077.4 6	6887.29 9	1550.18 4	0	235.9	21.5	53.8	78.3	19.1	229.1	19.6	73.4	3	254.5
GEOROC NZ644				samp. R/04-4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	90130.2 7	155003. 3	527887. 4	971.717 7	5689.03 5	96348.8 4	6559.47 6	1543.11 7	0	256.2	136	75.5	76.9	12.1	200.8	18.1	56.8	2.1	202.2
GEOROC NZ645				samp. R99/1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	41292.2 1	162395. 1	615094. 3	1420.65 3	19375.7 1	62233.4 9	6955.50 4	987.062 4	0	150.379	36.7708 3	54.3865	59.7963 8	75.1334 9	264.575 2	24.9601 5	144.271 4	5.97444 4	426.865

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ646				samp. R99/3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE, BASALTIC	66192.0 3	154105. 8	564671. 3	974.082 4	9238.81 1	87502.8 3	6782.61 2	1290.68 4	0	228.979 8	57.2205	70.5668 6	66.4894 9	28.8474 8	204.648 5	18.9171	83.8229 3	3.47205 9	239.406 6
GEOROC NZ647				samp. R99/4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / MANGAWHERO FORMATION	ANDESITE	48487.1 8	170820. 4	571686. 6	1305.43 3	11751.3 8	77971.9 2	7697.16 2	1306.72 5	0	233.619 5	20.4916 3	41.2991 1	71.7630 5	37.5586 2	253.607 4	21.9501 7	103.045 5	4.34237 8	323.034 8
GEOROC NZ648				samp. R94/10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	38980.3 2	157995	610702	1958.25 6	21491.2 8	61381.9 8	7250.52 6	1141.40 9	15994.2 5	147.868 5	25.8531 6	29.8936 3	58.7674 8	88.1749 3	249.193 1	21.2856 1	158.890 2	6.34105 4	442.717 5
GEOROC NZ649				samp. R94/12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44483.5 2	166663. 8	584536. 1	1800.01 8	15831.2 8	69351.9 1	6845.59 6	1268.08 4	16266.0 2	144.43	30.2368	51.8584 3	63.1121 9	56.6033 3	263.091 5	19.1499	112.161 2	3.31366 8	369.009 9
GEOROC NZ650				samp. R95/1A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	48100	162200	584136	1100	14900	69600	6400	1100	14344.2 4	188.432 6	44.3100 2	50.9171 9	69.0977 6	52.8107 3	253.384 8	18.9822	128.757 8	4.3635	382.498 3
GEOROC NZ651				samp. R95/1B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	53800	159200	578491. 2	1100	14200	72000	6400	1200	21967.7 6	196.618 2	42.5889 9	56.4351 5	66.8183 6	50.5990 6	260.371	19.0808 1	122.501 8	1.85868 1	395.899

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ652				samp. R95/2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43900	165300	582926. 4	1100	15400	71000	6600	1100	18823.2 2	206.918 5	36.3437 7	18.1203 5	69.5414 7	54.1006 9	268.742 4	19.5969 9	127.934 6	1.68821 4	409.395 9
GEOROC NZ653				samp. R95/7A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	48000	160800	574761. 6	1100	15000	73300	7300	1300	18843.6 2	190.718 6	20.8323	30.8974 5	65.1675	56.7941 6	228.484 4	20.9496 9	130.359 8	4.13741 9	373.709 1
GEOROC NZ654				samp. R95/7B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	50800	165200	558532. 8	1200	13100	75200	7400	1400	18509.5 9	237.504 3	26.6211 7	51.0812	75.8528 7	46.8696 6	214.658 4	20.5231 7	125.232 2	5.60952 7	327.215
GEOROC NZ655				samp. R95/9		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40600	161400	596534. 4	1400	18400	65200	7500	1200	13799.7 1	177.460 9	17.3641	29.5563 9	67.0817 6	67.9376 7	286.533 1	21.0570 5	162.465 9	4.97611	473.484 9
GEOROC NZ656				samp. R95/10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41800	159200	596030. 4	1400	18400	66500	7400	1200	15633.3 2	171.232 3	14.4240 2	29.2994 2	62.7347 1	68.2242 7	288.483 6	21.7156 8	159.372 5	6.28447 6	461.914 5
GEOROC NZ657				samp. R95/11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41100	158800	597542. 4	1400	18700	64700	7500	1200	14277.6 4	169.890 3	18.6682	27.9005 7	65.0994 9	70.1086 6	280.457 7	21.9565 3	159.399 7	5.60832	479.232 6

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ658				samp. R95/12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40400	159800	596433. 6	1300	18700	64800	7400	1200	28191.9	164.702 8	14.4990 7	32.1302 1	59.8412 9	69.8846	279.570 9	21.8641	158.859 1	6.15521 1	491.847 7
GEOROC NZ659				samp. R95/13A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40600	159600	590990. 4	1400	18500	65400	7400	1200	12232.9	183.229 4	16.3300 8	27.3569 3	66.4332 4	67.4716	282.250 9	21.3107 9	156.720 9	3.67840 1	485.251 5
GEOROC NZ660				samp. R95/14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33700	171200	591192	1300	17200	65600	7400	1200	14421.7 7	172.256 9	8.66190 5	28.3197 6	71.2333 2	64.5420 3	244.636 7	22.8103 2	146.562 5	5.14257 7	420.276 8
GEOROC NZ661				samp. R95/15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33700	170300	589478. 4	1300	17100	64600	7300	1200	18289.1 9	182.605 7	8.56737 9	23.9316 2	74.0514 6	63.7416 4	239.465 6	22.5969 4	146.253 8	6.65360 1	431.469 7
GEOROC NZ662				samp. R95/16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33300	170300	589881. 6	1200	17300	64700	7300	1200	17255.7 9	186.434 1	10.2067 3	26.7327 9	75.3998 9	63.8347 7	238.206 6	22.5594 3	148.074 7	5.42409 3	432.576 8
GEOROC NZ663				samp. R95/29		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	54100	158700	581313. 6	1100	15000	74600	6500	1200	22990.0 3	196.670 7	45.0198 1	66.0169 4	65.9113 8	53.1541 6	258.553	19.3314 9	124.044 3	2.72382 5	384.872 4

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ664				samp. R95/30		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45200	166400	579297. 6	1100	14600	71600	6600	1100	28347.3 6	207.699 4	37.6136	53.2792 5	69.3868 9	49.4727 6	264.250 5	18.7898 6	120.936 2	1.93069 4	364.767 4
GEOROC NZ665				samp. R96/10		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	35000	172600	598400	1300	15900	64800	7400	1200	17366.5 1	177	12	24	66	67.95	243.65	25.7	117	6	397
GEOROC NZ666				samp. R96/11		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	32100	173700	603800	1300	16300	63600	7200	1200	13844.2 4	168	13	25	67	69.05	246.6	25.65	118	6	399
GEOROC NZ667				samp. R96/12		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	29300	175000	609500	1200	16600	62700	7000	1100	9866.30 3	179	12	23	66	68.55	244.2	24.75	116	5	393
GEOROC NZ668				samp. R96/13		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	31300	179500	601100	1200	14600	66300	6600	1200	11777.4 4	176	12	24	66	68.9	245.2	26.5	117	5	396
GEOROC NZ669				samp. R96/14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33000	183600	592500	1100	12800	69500	6400	1200	19400.9 5	147	75	56	56	93.45	210.15	26.8	176	7	495

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ670				samp. R96/23		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41500	170400	595300	1200	15000	68200	6400	1200	11700	177.5	30.4	23.95	61.5	53.1	293.9	21	107.15	4.5	379.15
GEOROC NZ671				samp. R96/24		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	37900	178400	577600	1100	12300	70500	6900	1300	19500	193	14.2	23.7	67.75	43.7	256.3	24	85	4	322.95
GEOROC NZ672				samp. R96/25		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46400	168300	572300	1200	14700	72700	7200	1300	20200	206.25	26.85	35.6	65.05	56	237.2	24	103	5	342.6
GEOROC NZ673				samp. R96/26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46000	164800	582500	1300	15900	71500	7100	1300	16700	196.1	27.35	30.95	62.75	61.9	234.7	24	109.8	5	358.05
GEOROC NZ674				samp. R96/27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46600	164000	583800	1200	15800	72200	7200	1300	20000	184.25	27.05	40.85	61.3	62.2	236.3	24	109.2	5	353.95
GEOROC NZ675				samp. T5-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45200	164400	592518	1200	16000	69000	6700	1200	15912.4 4	162.6	35.5	55.8	62.7	56.5544 9	266.384 6	19.6436 3	114.6	4.5	351.4

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ676				samp. T5-18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	39800	169400	585684	1200	15300	70200	7300	1300	17871.8 4	185.3	18.5	40.1	70	54.9275 4	240.689 3	21.8115 1	114.6	5.6	325.5
GEOROC NZ677				samp. T5-27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47100	167900	588030	1200	16400	70900	6900	1200	15585.3 8	159.9	35.5	42.3	62.9	56.5820 8	263.451 7	19.7982 3	112.5	5.4	360.9
GEOROC NZ678				samp. T5-31		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40000	169400	587214	1200	15400	70800	7300	1300	21145.7 4	176.4	18.1	26.6	69.1	55.6255 3	242.749 3	21.9302 7	115.1	4.5	313.1
GEOROC NZ679				samp. T5-32		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40100	169200	585582	1200	15300	69900	7300	1300	19155.3 3	179.4	18.3	37.4	69.6	56.7786 4	239.709 3	21.8015 1	115.1	6.3	318.8
GEOROC NZ680				samp. T5-44		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45900	164000	592110	1200	15900	69300	6700	1200	15115.5 3	164.5	36.5	49.9	62.8	55.4894 3	265.914 8	19.8738 2	112.7	5.8	360.1
GEOROC NZ681				samp. T5-46		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45500	164700	590886	1200	15900	68700	6700	1200	17400.4 8	170.1	37.6	51.6	64.7	54.8924 6	261.933 2	19.7023	112.8	4.6	351.8

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ682				samp. T5-51		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	39800	168500	585786	1200	15500	70100	7300	1200	16425.0 1	184.9	19	29.3	71.3	57.9661 4	240.203 9	21.5795 7	119.6	3.9	329.4
GEOROC NZ683				samp. T5-55		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44400	163800	581808	1400	16300	71800	7600	1300	16020.9 6	203.9	21.7	39.4	73.2	60.5542 1	259.414 1	21.6914 4	112.5	5.6	356.4
GEOROC NZ684				samp. T5-56		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43100	164800	583032	1400	16600	70600	7700	1300	22011.1	197.1	18.8	35.6	67.3	60.3263 5	261.25	21.4530 2	115.1	5.3	368.4
GEOROC NZ685				samp. T5-58		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41800	168300	586500	1200	15200	71200	7300	1300	22280.3 6	179.5	19.7	25.6	67.8	56.1349 9	240.610 5	21.2426	112.6	4.6	313.9
GEOROC NZ686				samp. T5-59		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	38500	169600	587928	1200	15700	68700	7200	1200	17222.0 3	189.9	20.2	29.3	69.8	55.7739 4	247.357 1	21.9743 9	116.6	5	334.1
GEOROC NZ687				samp. T5-60		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40300	168000	586806	1200	15500	69900	7300	1300	21216.8 9	183	20.2	28.5	69.8	58.1588 5	238.974	21.4601 1	118.6	4.6	324.2

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ688				samp. T5-68		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43600	164700	581910	1400	16300	72100	7600	1300	17501.2 9	200.4	21.9	32.1	71	59.764	260.542 6	21.8043 8	110.5	5.2	371.1
GEOROC NZ689				samp. T5-74		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43800	164600	590580	1200	16100	68900	6600	1100	12586.4 7	163.3	34.9	56.2	62.5	56.4656 8	267.534 1	19.9138 1	113.7	5.2	372.7
GEOROC NZ690				samp. T5-87		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44700	164000	589356	1200	16000	68000	6600	1200	15643.6 8	159.9	36.7	52.8	65.9	56.3756 1	266.464 9	19.9746 2	115.9	5.2	366.5
GEOROC NZ691				samp. T6-30		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51500	164600	570724. 2	1100	13700	74700	6800	1300	13000	194.9	42.9	39.3	68.4	45.0663 8	275.648	19.1401 8	92.7	3.2	329.6
GEOROC NZ692				samp. T6-35		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45300	165500	593820. 6	1200	16100	69200	6700	1200	9600	170.2	37	40.3	62.6	56.0773 4	266.910 1	19.5053	113.1	4.9	356.2
GEOROC NZ693				samp. T6-36		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51400	165700	578423	1100	13800	75800	6800	1300	12400	182	39.3	48.5	64.6	45.3937 3	281.435 1	19.4219 9	93.1	4.3	322.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ694				samp. T6-38		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	50400	165300	571129. 4	1100	13600	74500	6800	1300	17800	195.1	41.2	40.9	66.3	44.9842 8	277.554 1	18.2906 7	94.9	3.2	340
GEOROC NZ695				samp. T6-40		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51400	165000	574776. 2	1100	13800	75800	6800	1300	15100	185.4	40	61.1	66.3	44.8728 2	277.077 2	18.6991 4	91.9	3.8	329.7
GEOROC NZ696				samp. T6-45		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51500	164000	574371	1200	13800	75900	6800	1300	15900	198.7	42.3	80	67.6	44.1898 8	278.819 8	18.2994 3	91.8	2.8	343.2
GEOROC NZ697				samp. T6-46		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46400	163300	587843. 9	1200	16000	69000	6700	1200	15300	169.1	37.4	44.3	65.7	55.3754 5	263.818 9	20.2921 4	113.5	4.3	353.6
GEOROC NZ698				samp. T6-48		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51300	163200	572041. 1	1200	14000	75300	6900	1300	20200	189.6	41.7	52.1	67.3	46.4080 6	276.839 1	18.0806 6	93.3	4	344.9
GEOROC NZ699				samp. T6-49		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	50300	162800	585000	1100	13400	73300	6500	1200	20300	184.4	40.8	81.4	66.1	45.8213 9	282.596 1	19.6540 9	92.5	2.9	328.5

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ700				samp. T6-51		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45800	162900	584095. 8	1200	15800	68700	6600	1200	23600	174.2	38.1	49.1	63.6	55.4608 1	262.407 3	19.6552 4	110.8	4.2	350.1
GEOROC NZ701				samp. T6-62		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45300	164500	589667. 3	1200	16000	69000	6700	1200	23600	158.9	35.9	50.7	61.9	56.3645 5	266.100 6	20.1915 4	111.6	4.8	358.1
GEOROC NZ702				samp. T6-63		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51400	165400	574371	1200	13900	75100	6700	1300	20300	184.7	40.8	58.6	66	45.2778 7	280.533 7	18.9361 2	91.3	4.1	327.5
GEOROC NZ703				samp. T6-64		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51300	163800	575789. 2	1100	13800	76100	6700	1300	20300	180.2	39.8	65.7	63.2	46.5499 3	284.003 8	19.2929 4	91.2	2.9	323.1
GEOROC NZ704				samp. T6-65		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51000	165000	569812. 5	1100	13800	74700	6800	1300	18700	185.1	41.5	56.2	65.7	45.5702 2	278.762 1	19.4083 9	93.3	3.8	323.6
GEOROC NZ705				samp. T6-66		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51800	165200	580752. 9	1100	13900	75100	6800	1300	20600	190.1	41.8	52	65.8	46.1611 1	277.068 1	18.9786 3	92.8	4.4	334.5

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ706				samp. T6-67		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	52700	163100	573560. 6	1100	13600	76300	6800	1300	17500	192.4	41.5	49.6	67.5	45.9964	278.692 4	19.0179 2	92.1	2.9	328.4
GEOROC NZ707				samp. T6-68		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51300	165800	574371	1100	13800	75500	6700	1300	16000	186.4	40.9	57.9	66.7	45.0571 8	277.943 3	18.7719 7	90.4	3.2	319.6
GEOROC NZ708				samp. T6-69		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51800	162700	570724. 2	1100	13700	75300	6700	1300	22600	188.5	41.2	53.5	64.1	45.5073 5	279.467 7	19.1981 7	91.4	2.8	328.5
GEOROC NZ709				samp. T6-70		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51100	165200	570015. 1	1200	13800	74300	6600	1300	16200	182.7	38.6	46.3	64.6	45.2886 7	276.039 8	19.0825 7	92	3.5	325.9
GEOROC NZ710				samp. T6-71		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46100	164200	590072. 5	1200	16000	69300	6700	1200	17300	165	37.7	43.9	63	44.7745 7	277.237 2	19.3605	113.8	3.1	360.1
GEOROC NZ711				samp. T6-72		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46700	163700	588046. 5	1200	15700	70100	6700	1200	26000	153.1	31.7	36.2	55.9	55.9700 7	263.772	19.6398 9	109.1	4	346.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ712				samp. T6-73		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44600	163800	586628. 3	1200	16100	68900	6600	1100	15900	163.2	34.7	29	60.7	54.8543 2	270.623	19.5644 1	112	4.2	352.1
GEOROC NZ713				samp. T6-74		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44300	164700	588654. 3	1200	16100	68800	6700	1100	13000	158.8	34.7	38.2	60.5	56.3003 9	265.612 9	19.9232	112.9	4.2	362.6
GEOROC NZ714				samp. T6-75		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45200	163500	587742. 6	1200	16100	68700	6700	1200	17200	167.2	43.4	49	61.7	56.7423 3	266.925 4	19.8036 9	111.4	5	348.8
GEOROC NZ715				samp. T6-76		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44900	164800	585817. 9	1200	15900	68600	6700	1200	16500	168.7	36.4	29.6	62.9	56.1944 5	262.644 1	19.8457 5	113.3	4.2	355.9
GEOROC NZ716				samp. T6-77		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51700	165400	576093. 1	1100	13800	75700	6800	1300	21500	195.8	43.1	47.7	66.1	55.8534	264.505 7	19.1401 2	91.2	5	339.5
GEOROC NZ717				samp. T6-78		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51200	165100	577207. 4	1100	13800	75300	6800	1300	15500	193.6	42.6	52.7	66.5	44.6888 3	275.812 8	18.4381 8	92.2	4.1	337.7

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ718				samp. T6-79		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51200	163800	571332	1100	13700	75700	6700	1300	18200	185.2	40.9	59.6	66.1	45.1858 6	278.586 2	19.1676 1	91.2	3.6	332.5
GEOROC NZ719				samp. T6-80		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51300	165200	569508. 6	1100	13700	75100	6700	1300	13500	195.6	42.8	61.3	67.4	46.0843 1	281.68	18.9712 8	92.6	3.6	333.4
GEOROC NZ720				samp. T6-93		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45500	162400	585817. 9	1200	16100	68100	6700	1200	14400	169.7	36.3	45.4	63.3	13.9407 3	204.911 5	18.5226 7	112.2	5.4	360.2
GEOROC NZ721				samp. T6-94		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44300	164600	589363. 4	1200	16300	68700	6700	1200	14000	155.4	32	46.4	61.3	15.0332 3	203.523 4	18.5219 1	111.4	3.1	345.2
GEOROC NZ722				samp. T6-96		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46000	163200	587033. 5	1100	15900	69600	6700	1200	13000	158.2	35	47.9	60.3	56.7461 4	259.916 8	19.5867 1	112.1	4.6	364
GEOROC NZ723				samp. R97/5A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	75169.2 6	142889. 4	587280. 2	1402.68 4	16820.8 7	69392.8 3	6626.33 2	1131.31 1	10681.7 8	154.35	105.244 9	74.8545 2	58.8392 8	63.2230 6	265.689 8	18.3411 4	130.063 5	4.61625 5	359

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ724				samp. R97/7		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33553.7 9	161998. 7	629135. 8	1593.42 7	23543.2 9	54383.8	6870.01 1	904.935 2	6529.68 8	116.25	20.0428 5	34.0736	52.9481 9	100.582 9	244.799 6	21.1922 4	161.765	6.40496	461.8
GEOROC NZ725				samp. R97/14		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44278.4 6	171410. 2	573406	1516.76 1	15201.9 2	74444.8 4	7728.64 8	1257.35 5	22266.7 9	203.2	15.0423 6	31.3490 7	71.2531 6	55.6748 5	247.033 7	20.9665 9	119.438 9	4.75782 3	346.2
GEOROC NZ726				samp. R97/15		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	63048	151399. 6	589285. 8	1546.03 1	17242.1 6	69479.2 6	7308.43 8	1099.36 6	11212.7 9	168.1	94.6641 4	64.1319 6	54.9976 2	68.7305 4	218.030 9	19.3146 4	128.851 1	4.84329 2	386.4
GEOROC NZ727				samp. R97/16		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25593.5 9	178182. 4	603202. 3	1672.31 4	18646.3 3	62234.2 7	7918.87 3	965.076 8	13908.3 9	170.4	6.49700 9	29.1508 1	62.8918 2	69.1942 2	297.065 1	20.0681 1	143.323 3	5.55010 6	419.15
GEOROC NZ728				samp. R97/17		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	24546.6 8	178227. 9	609195. 6	1741.85 5	19255.4 9	60965.2 6	8058.29 3	944.896 6	13321.6	175.95	4.93759 5	37.6493 9	59.8640 1	71.4246 3	296.832 2	21.1518 7	147.207 9	5.50969	432.05
GEOROC NZ729				samp. R97/18		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25418.6 5	176796. 9	607036. 6	1751.01 1	18905.6 6	62312.1 2	7907.71 5	975.307 6	12936.1	167.05	5.33558 8	36.078	61.3327 4	69.5897 1	298.575 7	20.7972 2	144.484	5.61497 4	416.05

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ730				samp. R97/19		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46799.1 2	159885. 4	590772. 3	1452.99 5	16115.2 9	71155	7043.18 7	1436.06 2	23296.4 2	125.75	21.5196 3	26.8583 3	56.3776 9	80.7662 7	267.659 5	20.4310 1	148.037 1	5.90914 3	432.65
GEOROC NZ731				samp. R97/21		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	37431.5 9	162296. 7	614257. 5	1532.47	20740.4 1	58186.9 5	7028.22 8	979.586 4	9276.24	133.55	25.3535 7	31.4849 4	55.9242 9	85.5862 4	257.634 2	20.5444 2	153.145 2	6.24371 4	438.95
GEOROC NZ732				samp. R97/22		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	28324.6 9	171114	606060. 2	1796.07 3	20277.3 8	60460.7 5	8836.14 2	950.355 9	12271.6 6	165.2	11.9225 4	29.9792 9	57.6737 7	78.7626 8	284.396 4	20.2736 2	147.138 4	5.84534 5	444.25
GEOROC NZ733				samp. R97/23		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25800.8 6	168484	617063. 8	1970.71 4	20652.4 8	58037.3 5	8269.07 2	1126.3	8563.78 9	166.6	5.85430 2	33.5213 2	62.3131 1	70.6652	297.927	20.3910 5	144.215 9	5.59780 1	419.9
GEOROC NZ734				samp. R97/26		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	30102.2 1	171247. 4	599589. 5	1704.16 8	19468.5 4	61842.7 7	8551.27 7	953.887 3	14024.1 8	171.35	14.0433 7	28.1911 2	58.4041 3	74.3764	284.218 9	19.9728 9	142.011 3	5.86265	425.9
GEOROC NZ735				samp. R97/27		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	23191.2 7	176507. 6	607680. 6	1755.38 1	18577.7 1	61654.4 2	7844.54 5	1157.88 4	11842.1 5	153.2	13.6639 8	27.3408 5	55.2217 6	82.1763 1	280.772 5	20.8363 6	150.248 1	6.15243 2	459.6

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ736				samp. R97/28		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	28615.4 9	169169. 1	599297. 3	1666.96 1	19552.6 9	60219.6 4	8697.33 3	929.142 8	12887.6 5	175.6	13.2094 2	33.2246 9	57.4969 6	75.7079 4	280.956 5	20.0662	143.813 3	5.91269 2	433.25
GEOROC NZ737				samp. R97/29		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	27793.2 4	173428. 4	608462. 1	1764.46 3	20049.6 4	61494.6 9	8968.73 7	929.292 8	13298.7 6	179.7	10.9420 2	30.3196 6	58.2540 6	76.8187 6	290.524 3	20.5610 4	146.933 6	6.12763 8	442.5
GEOROC NZ738				samp. R97/30		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25253.5 2	178013. 8	610642. 8	1674.10 1	18842.1 4	62136.0 2	7953.49 5	958.052 6	13673.1 8	162.75	5.55068 2	29.2676 1	60.4379 6	68.5889 2	288.349 4	19.8561 2	140.282 9	5.56141 1	417.65
GEOROC NZ739				samp. R97/33		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	27636.0 1	171569. 4	609691. 7	1883.7	20801.3	57426.8 9	8576.15 6	931.274 6	16519.3 7	161.65	13.1624	36.8626 6	56.9596 2	79.3016 5	280.754 6	20.8949 3	149.916 3	6.08640 2	462.9
GEOROC NZ740				samp. R97/34		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	33683.6	164211. 9	615393. 1	1534.39 4	19567.2 3	60030.9 4	6861.19	1171.36 5	200	166.85	42.1360 4	43.8053 1	60.5021 1	64.1621 6	226.986 5	20.3525 4	120.677 6	4.80841 4	344.7
GEOROC NZ741				samp. R97/35A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	22902.4 1	175367. 5	606847. 6	1688.35 9	18516.2	61939.7 9	7873.84 1	1138.13 7	11160.1 4	162.05	5.01108	39.8151 8	60.1845	70.1598 5	297.348 2	20.6188 9	144.688 5	5.40153 9	420.15

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ742				samp. R97/35B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45443.6 2	170607. 1	574009. 5	1499.12 7	14881.6 6	75118.3 5	7822.97 6	1283.32	22807.5 1	203.35	14.2491	25.0130 2	69.1063	55.2293 4	241.788 9	20.3190 4	116.109	4.76245 8	333.85
GEOROC NZ743				samp. R97/35C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	27984.4 5	173042. 2	608810. 6	1754.22 3	20282.5 6	61010.1	9002.42 4	955.961 9	14285.8 2	169.95	11.3953 4	25.7677 7	56.7320 2	76.5500 3	280.103 1	20.0150 8	143.704 9	5.97586 9	438.4
GEOROC NZ744				samp. R97/36		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41693.9 1	169595. 7	576639. 3	1481.00 2	14488.3 5	74224.4 5	7506.01 3	1510.48 9	16010.6 3	199.15	21.1128 3	48.0185 6	68.8992 3	56.4358	234.346 5	20.9427 3	115.112 3	4.50170 4	320.95
GEOROC NZ745				samp. R97/37		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	42258.1 3	170971. 5	586046	1494.06 5	15832.7 3	69962.4 4	7223.17 4	1194.54 5	19667.8 3	170.75	21.8054 8	37.4609 2	65.9145	64.0839 3	235.544 5	21.0710 4	123.539 6	4.58333 1	342.75
GEOROC NZ746				samp. R97/38		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	42351.0 5	169187. 3	584481	1455.86 9	15754.5 6	71151.4 9	7217.12 4	1223.25 5	17711.4 9	165.65	19.3200 9	47.2069 6	66.3265 2	61.2501 6	237.968 6	21.4779 4	122.296	4.70983 4	337.35
GEOROC NZ747				samp. R97/40		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45352.5 4	170171. 4	577715. 9	1425.15 5	14683.4	74808.1 6	7591.51	1272.47 6	19197.3 8	192.95	20.5170 5	38.7555 3	69.7521 9	57.8435	241.521 6	21.3765 8	117.392 9	4.54726 4	320.5

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ748				samp. R97/41		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	27842.1	171403. 1	611874. 8	1945.51 2	20793.2 7	58775.5 1	8437.09 4	933.962 6	12855.3 3	156.25	13.1795 1	27.0360 2	56.0939 8	79.3762 3	281.542 3	20.4403 5	148.482 2	6.12603 2	460.4
GEOROC NZ749				samp. R97/43		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	27080	171043. 9	612684. 5	1972.68 4	21089.1 6	58447.1	8366.03 6	923.059 1	11108.6 1	149.1	12.2613 1	26.5505 5	57.7681 1	81.8515 8	283.197 9	21.0038 8	151.154 2	6.23504 4	453.85
GEOROC NZ750				samp. R97/44		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47489.6 4	156870	598039. 2	1520.35 2	16835.6 7	68856.5	6996.52 2	1354.53 8	9918.71 9	165.45	35.1021 4	41.202	62.5242 5	65.6275 3	276.916 5	19.8383 5	132.957 2	5.15555 1	389.9
GEOROC NZ751				samp. R97/55		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	53690.8 3	149165. 9	610825. 7	1672.60 2	22685.2 1	58747.8 8	7394.2	996.746 5	11531.5 2	142.95	80.673	37.3475 7	53.6563 5	94.2997 1	212.683 7	21.5140 5	160.385 9	6.27160 7	452.05
GEOROC NZ752				samp. R97/56		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	32922.9 9	160979. 9	623518. 1	1809.24	20315.8 4	57120.3 6	6716.11 2	1173.44 1	7689.30 2	115	26.7647 1	25.6437 6	58.0664 8	82.7544 9	254.3	20.9011 8	149.171 9	6.11649 1	439.75
GEOROC NZ753				samp. R97/67		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	28118.5 9	176939. 9	604355. 9	1766.37 5	20162.4	60667.6 5	7944.81 5	934.791 8	25087.1 7	138.8	14.2251 4	33.7285	59.5234 6	76.4683 1	266.634 6	22.9482 1	151.829 7	5.95272 1	459.9

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ754				samp. R97/69		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25465.9 4	171401. 2	608067. 2	1747.22 4	19700.3 2	60689.0 1	8925.12 7	1133.61 5	9809.28 5	171	9.92407 8	26.5305 6	55.0623 2	78.2716 1	290.545 5	20.5755 6	146.782 6	6.06203 6	439.6
GEOROC NZ755				samp. R97/70		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	25397.6 6	178406. 5	606126. 3	1673.64 8	18778.3 9	62340.6	7899.26 7	934.829 7	15027.9 6	168.6	5.64084 2	37.3149 1	61.6012 1	69.0084 3	300.279 1	21.3569 5	144.796 9	5.32372 5	428.25
GEOROC NZ756				samp. R97/74		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43641.9 6	168588. 2	579156. 6	1354.88 8	12296.8 5	75635.8 6	7103.31 3	1540.04 3	15721.8 4	183.65	26.7696 6	27.2591 5	66.8555 7	46.8007 8	239.086 8	20.0381 2	109.375 1	4.11695 2	270.85
GEOROC NZ757				samp. R97/76		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45308.8 6	169205. 6	587956	1414.69 7	16134.6 8	69785.6 6	6758.24 9	1125.58 5	16319.7 7	215.55	34.3632 1	46.6630 4	61.3304 8	59.2579 7	271.964 6	19.9415 2	123.671	4.70317 1	386.55
GEOROC NZ758				samp. R97/77		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45772.1 8	166789	589461. 4	1390.94 9	16302.9 3	69229.4 4	6835.87 1	1145.70 2	16868.9 1	167.3	32.7977 5	48.0120 3	62.3716 9	61.1506 9	270.728 9	19.6779 7	125.652 8	4.72652	388.2
GEOROC NZ759				samp. R97/78		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41100	170400	586700	1500	16100	69900	6700	1400	11599.1 9	166	32.7977 8	38.3327 4	59.3176 8	58.3937 5	268.879 6	19.7631 1	122.339 5	4.50531 6	380.25

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ760				samp. R97/79A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	37900	168700	598800	1500	16800	65500	6070.81 9	1400	13100.4 2	139.8	27.3215 2	40.4407 6	57.0419 6	63.7273 7	247.640 6	19.2453 9	117.446 9	4.71813 3	342.75
GEOROC NZ761				samp. R97/79B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	42300	171000	587100	1500	16200	70400	6700	1400	14410.7 3	154.85	32.1770 4	41.0146 2	60.1399	58.8741 8	269.230 1	19.1905 1	121.617 1	4.71432 8	373.3
GEOROC NZ762				samp. R97/79C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47245.6 6	165372. 6	570227	1416.09 3	13723.3 2	76426.0 1	6646.51	1482.09 9	13090.1 4	182.75	43.0103 9	40.9226 3	61.5215 4	47.3970 3	281.181 6	17.5044 6	104.318 5	4.05797 3	343.05
GEOROC NZ763				samp. R97/81		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41801.2 4	167886. 2	592151. 6	1445.06 9	15924.0 9	70032	6651.30 4	1361.56 5	12197.4	156.75	31.0651 8	51.6437 3	60.5236 5	58.8817 9	272.421 6	19.6076 7	121.488 6	4.57376 6	368.5
GEOROC NZ764				samp. R97/82		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41629.2 9	167216. 7	588133	1446.92 7	15877.9 4	69772.6 2	6663.53	1358.25 4	12531.5 8	158.5	32.6465 5	51.5232	63.0744	61.2475 8	273.211 1	19.8183	124.369 1	4.70571 9	374.2
GEOROC NZ765				samp. R97/85		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47691.8 5	167436. 2	577573. 9	1451.65	13961.6 7	76370.0 3	6769.90 8	1504.05 1	13472.0 3	181.85	40.2499	65.2430 8	66.4499 5	50.0385 6	287.069 5	18.5030 5	107.549 8	3.75587 5	345.95

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ766				samp. R97/86		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45022.3 6	166271. 2	580393. 2	1376.94 5	16151.9 7	69307.4	6639.79 6	1127.07 6	15889.9 7	155.45	31.3654 9	43.3652 2	63.3010 6	60.5773 1	270.97	19.4674	122.505 7	4.67295 4	364.7
GEOROC NZ767				samp. R97/87		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41189.9	172664. 3	582968. 2	1459.59 7	16146.0 4	68654.6 3	6879.79 3	1100.45	16708.0 3	152.15	22.3872 5	37.7102 9	63.6545	58.2101 1	293.128 6	19.0501 6	124.587 6	4.67244 9	385.7
GEOROC NZ768				samp. R97/89		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44571.5	166304. 8	578931. 3	1364.15 7	15981.4 1	68770.2 2	6607.31 7	1103.09 6	20724.5 9	153	31.3912 4	32.1869 4	60.9507 7	59.3742 4	272.693 5	18.8334 3	123.528 9	4.67066 8	379.85
GEOROC NZ769				samp. R97/90		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47242.5	167359. 9	576960. 2	1441.41 7	13899.1 8	75641.9 9	6760.25 5	1504.29 3	13000.3 9	185.45	38.1129	43.2771 2	66.1251 6	48.8675	287.535	17.9121 4	107.191	4.00320 2	358.05
GEOROC NZ770				samp. R97/91		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	45765.8 4	168310. 7	587979. 4	1432.84	16136.6 8	70579.9 3	6795.65 3	1150.37 1	20920.0 3	149.75	30.5657 3	49.4050 1	63.3119 4	60.2830 3	273.834 5	19.2227 7	123.047 2	4.68954 2	374.8
GEOROC NZ771				samp. R97/92A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	37939.4 9	171042. 4	584840. 4	1369.20 4	14871.9 6	72140.7	7171.92 1	1428.32	13760.3 2	181.65	17.2792 5	30.4106 3	69.1324 4	59.8246 4	234.215 2	20.2086 2	118.790 2	4.89260 2	330.45

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ772				samp. R97/92B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	38474.9 5	171788	586397. 9	1381.36 2	15003.6 8	72600.9 6	7238.64 8	1448.13 3	16942.1	182.55	15.1741 3	34.0783 4	70.6548	59.9235 9	233.184 3	20.8209 6	118.101 4	4.60224 6	329.75
GEOROC NZ773				samp. R97/93		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43523.1 2	170780. 5	585275. 3	1618.26 9	17073.7 7	69930	7501.40 8	1044.92 5	21787.0 1	167.65	45.925	62.0818	59.2107 1	64.8724 7	258.746 7	21.8875	133.166 3	4.92950 5	379.6
GEOROC NZ774				samp. R97/94		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41945.2	167957	588795. 9	1426.24 8	15691.4 9	70190.6 2	6692.29 8	1369.37 7	14052.8 9	158.95	31.6875 1	48.1241 4	63.8723	60.5026 6	271.772 7	19.5238 4	122.214	4.71291 4	375.4
GEOROC NZ775				samp. R97/95		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	51438.9 4	168329. 6	572001. 1	1417.47 7	14079.3	76631.4 1	6817.23 3	1269.37 2	16668.6 2	186.25	39.2358 2	48.2474 7	66.0007	49.7342 9	285.083 4	18.1422 1	108.416 3	3.92076 3	357.8
GEOROC NZ776				samp. R97/96		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	41762.1 8	167945. 8	592572. 4	1487.07 5	15910.6 3	68977.4	6666.70 8	1362.56	13146.4 8	160.6	33.1463 9	42.8228 1	64.2142 7	60.9197 8	271.338 3	19.1765 7	123.383 1	4.78609 8	381.2
GEOROC NZ777				samp. R97/97		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	42940.0 6	167290. 7	587701. 4	1441.20 2	15399.2	71425.1 7	6689.80 4	1391.70 5	17207.0 3	165.55	34.1018 8	38.4126 5	62.9740 6	58.3861	271.796 6	19.3841 3	120.216 2	4.43190 8	373.75

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ778				samp. R97/98		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44114.0 5	167458. 5	595208. 6	1441.54 5	16775.7 2	68363.9	6818.19 2	1126.93 4	15685.1 1	157.15	30.9869 8	38.4108 3	61.6765 9	63.4400 5	251.253 7	19.4678 3	125.601	4.83448 5	380.25
GEOROC NZ779				samp. R97/99		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	39002.9 7	171904. 1	591126. 2	1528.62 1	15600.1 1	69381.7 8	6784.52 1	1360.64	14035.0 2	169.1	23.7065 9	39.8648 2	63.3264 3	57.0029	295.871 5	19.6189 8	123.950 3	4.50906 8	393.95
GEOROC NZ780				samp. R97/100		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	36337.5 6	164673. 2	611709. 3	1408.03 8	17381.9 8	63337.5 3	6093.27 8	1344.78	14856.8	141.1	25.3759 4	39.9547 4	57.3247 2	67.4867 2	243.767 6	19.1991 6	118.342 2	4.72696 1	378.5
GEOROC NZ781				samp. R97/101		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	38701.4 9	172774. 7	590128. 3	1532.09 1	15757.5 4	68930.0 9	6800.01 1	1344.61 9	14280.4 6	165.45	22.0701 6	41.3910 8	63.5690 9	56.2699 4	293.201 5	19.1175 8	122.726 2	4.71176	383.35
GEOROC NZ782				samp. R97/102		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	47751.9 7	167993	574483. 4	1440.24 7	13569.6	77364.1 7	6737.50 3	1506.63 7	16756.7 7	189.45	37.9806	49.6521 9	67.5688 4	48.6616	287.737	17.9067 1	106.726 5	4.20819 4	346.65
GEOROC NZ783				samp. R97/103		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	40456.8	164742. 8	607778. 7	1461.71	17933.2 8	64087	6466.98 4	1104.11 3	14115.5 4	146.5	27.1459 2	40.9752 4	59.3823 3	69.5467 5	242.121 7	20.0429 2	125.443 7	5.12401 1	388.35

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ784				samp. R97/107A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	70207.3 8	151505. 2	571349. 1	1288.06 4	14773.0 1	76388.3	6785.43 6	1190.39	12099.9 6	177.05	117.812 8	67.8679 2	61.7424	55.8101 3	235.280 4	18.5958 4	113.174 2	3.95807 9	334.45
GEOROC NZ785				samp. R97/111		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	52727.3 2	150122. 4	604974. 4	1701.36 9	21467.3	58798.6 9	7278.55	1185.52 5	6986.99 2	145.95	96.0247 7	62.1533	53.5569 3	88.9252 9	216.790 2	20.8532 4	156.690 3	6.29504	444.9
GEOROC NZ786				samp. R02/07		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	36700	172200	585500	1400	15800	70500	7300	1200	0	190	14	28	68	61	257	22	127	5	374
GEOROC NZ787				samp. R/04-5		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44704.4 3	165335. 4	584585. 6	1357.62 3	15557.1	72319.6 4	7113.83 1	1222.90 1	0	182	26.6	34	64.6	59.5	246.1	22.3	125.7	5.3	346.6
GEOROC NZ788				samp. R/04-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	44875.8 5	168209. 6	581388	1326.49 4	14949.6 4	73195.2 3	7173.70 9	1192.25 8	0	185	26.5	40.5	65.6	56.6	248.2	22.6	123.4	5.1	326.9
GEOROC NZ789				samp. R/04-8		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	46983.0 4	164420. 7	579986. 2	1353.83	14818.1 1	73639.6 8	7137.03 3	1183.85 3	0	197.5	28.6	30	65.6	54.7	239.7	21.7	121.5	4.7	333.1

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ790				samp. X1-P1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	36600	163100	594300	1300	19500	60000	6800	1200	19100	139	12	36	67	80	217	25	139	8	378
GEOROC NZ791				samp. W9-40		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	52300	170400	575800	1200	13000	77050	7350	1400	22198.6 7	192.5	16.5	47.5	72.45	50.3	221.1	22.7	106.5	5.15	246.1
GEOROC NZ792				samp. W9-59		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU / WHAKAPAPA FORMATION	ANDESITE	43650	166300	583350	1100	13600	71200	7500	1350	17743.2	198.85	10.15	33.75	75.7	46.25	264.5	22.85	105.35	6.65	292.55
GEOROC NZ793				samp. 22/5/69- 1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	40000	157900	611000	1600	21500	61000	6500	900	0	153	41	59	61	83	243	21	154	7	422
GEOROC NZ794				samp. 130896		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER - RUAPEHU	ANDESITE	53700	164000	575700	1000	13200	78700	6400	1200	0	196	59	72	68	47	264	19	106	4	352
GEOROC NZ795				samp. BN14-1A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MOUNT EDGE CUMBE (PUT AUAU)	ANDESITE	33700	166800	606900	1200	16200	67500	7000	1300	0	189				52	230	20	101	5.3	442
GEOROC NZ796				samp. BN2-2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MOUNT EDGE CUMBE (PUT AUAU)	ANDESITE	29800	163300	623600	1200	17800	59400	6800	1300	0	163				61	240	17	107	5.7	486

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC NZ797				samp. BN2-3		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MOUNT EDGE CUMBE (PUT ALAKI)	ANDESITE	26200	162200	627000	1400	18400	57900	7300	1300	0	161				62	251	21	114	5.5	471
GEOROC NZ798				samp. BN2-4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MOUNT EDGE CUMBE (PUT ALAKI)	ANDESITE	29200	159900	628300	1300	18500	58400	7000	1200	0	160				64	235	22	113	5.5	488
GEOROC NZ799				samp. BN2-6		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MOUNT EDGE CUMBE (PUT ALAKI)	ANDESITE	34700	167200	604300	1200	16000	69700	6900	1300	0	186				55	242	20	96	4.7	437
GEOROC NZ800				samp. B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAROA VOLCANIC CENTER	BASALT	67300	169500	497800	2400	4400	106100	12600	1700	0	239	41	23	78	12	307	23	130	4	125
GEOROC NZ801				samp. S2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / MAROA VOLCANIC CENTER	BASALT	61700	171600	520800	2200	5600	98600	13000	1700	0	226	32	41	81	18	295	27	139	4	176
GEOROC NZ802				samp. 4ONG1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / KAPENGA	BASALT	92600	157100	505300	2400	5400	103600	10500	1700	0	242	130		75	7	302	24	101	7	171
GEOROC NZ803				samp. 88EN1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER	BASALT	57800	179500	496500	1700	3200	94800	11400	1800	0	266	24		89	4	296	34	88	5	494
GEOROC NZ804				samp. 9MAR1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TAUPO VOLCANIC CENTER	BASALT	69800	181200	474000	1300	1300	116300	11000	1700	0	310	53		80	2	309	26	58	4	67
GEOROC NZ805				samp. 10TAT1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / KAPENGA	BASALT	62100	170900	503300	2400	4100	103400	13100	1700	0	240	27		82	2	335	29	147	8	143

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC N2806				samp. 11MAT1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA	BASALT	61100	172800	519400	1200	6500	111300	8000	1700	0	291	4		82	14	296	20	66	5	223
GEOROC N2807				samp. 12IOH2		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / KAPENGA	BASALT	57500	172000	505800	2100	6500	107100	12600	1800	0	292	16		88	9	355	26	101	6	158
GEOROC N2808				samp. 13TRI1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / KAPENGA	BASALT	59300	174100	510200	1900	7300	105300	11000	1700	0	267	21		80	16	344	24	99	6	206
GEOROC N2809				samp. 14TER2/3/4		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA	ANDESITE, BASALTIC	27800	196400	552900	1700	14200	77700	9700	1200	0	176	5		80	41	372	47	126	6	518
GEOROC N2810				samp. 17LAK1		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / OKATAINA CALDERA	ANDESITE, BASALTIC	34500	172100	574200	2400	12500	76400	9800	1500	0	222	0		79	35	301	29	144	8	0
GEOROC N2811				samp. RPC070		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	26800	173000	599400	1700	17800	59400	7700	1030	0	155	7	7	131	71	256	28	140	6	349
GEOROC N2812				samp. RPC077		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	31500	171500	588400	1700	13500	67300	8500	1140	0	251	7	16	94	48	271	23	133	5	291
GEOROC N2813				samp. RPC078		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	30600	174700	595000	1700	13600	64700	8800	1050	0	261	6	14	91	45	260	25	123	4	298
GEOROC N2814				samp. RPC088C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	17000	175500	612400	1800	18800	51200	8500	610	0	183	4	7	109	74	268	28	156	6	380

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC N2815				samp. RPC090		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / TONGARIRO VOLCANIC CENTER	ANDESITE	46200	170000	581400	1300	11900	71900	6800	1180	0	197	32	49	88	41	225	22	103	4	245
GEOROC N2816				samp. T89/5E		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	BASALT	48700	184500	499200	4100	18100	108700	9700	1900	0	277	8	211	75	69	612	22	86	2.3	644
GEOROC N2817				samp. T89/5C		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	BASALT	45800	185200	501300	4100	18300	108700	9700	1800	0	259	7	170	71	69	620	23	88	2.6	647
GEOROC N2818				samp. T89/5D		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	ANDESITE, BASALTIC	36000	186000	545700	2300	15400	90300	9200	1700	0	222	4	101	80	42	537	21	87	2.5	597
GEOROC N2819				samp. T89/5F		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	ANDESITE, BASALTIC	31400	181300	569400	2300	18700	79900	8300	1500	0	183	4	72	70	47	565	20	99	2.1	696
GEOROC N2820				samp. T89/5A		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	ANDESITE	1400	191800	584500	14900	37700	30300	6000	56800	0	153	6	13	53	44	551	14	68	1	851
GEOROC N2821				samp. T89/5B		NEW ZEALAND / COROMANDEL- TAUPO / TAUPO VOLCANIC ZONE / POUAKAI	ANDESITE	1600	189600	570700	12700	36700	30600	6900	64000	0	162	6	27	64	36	518	20	82	2.4	793

Kermadec Islands

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K1				samp. 7125	BASALT	Kermadec Arc/ Kermadec Islands	64300	176900	495200	600	1800	129700	7200	1900	0	309	44	92	0	2.6	158	14	33	0.25	87
GEOROC K2				samp. R34	BASALT	Kermadec Arc/ Kermadec Islands	49500	153400	516700	1000	3300	102900	10200	3000	0	477	15	226	0	4.5	167	23	43	0.29	111
GEOROC K3				samp. T2	BASALT	Kermadec Arc/ Kermadec Islands	48200	191700	490100	900	2500	128100	7500	1800	0	319	23	143	0	3.4	203	16	38	0.24	87
GEOROC K4				samp. R38	BASALT	Kermadec Arc/ Kermadec Islands	46100	180300	514400	1000	2800	111200	8200	1900	0	312	21	178	0	4.5	185	22	41	0.32	108
GEOROC K5				samp. 7090	BASALT	Kermadec Arc/ Kermadec Islands	46000	151500	532600	900	3400	93200	10100	2500	0	532	15	184	0	4.9	178	22	42	0.32	121
GEOROC K6				samp. T5	BASALT	Kermadec Arc/ Kermadec Islands	35500	158100	565000	1400	4700	84100	9700	2200	0	329	8	102	0	8.2	189	27	57	0.42	120
GEOROC K7				samp. T16	BASALT	Kermadec Arc/ Kermadec Islands	32900	175300	567700	800	2600	95900	7000	1800	0	251	10	67	0	3.2	169	24	37	0.17	83
GEOROC K8				samp. T9	BASALT	Kermadec Arc/ Kermadec Islands	32400	182000	555300	800	2600	102300	7100	1800	0	280	10	88	0	2.5	184	22	37	0.14	71
GEOROC K9				samp. 7088	BASALT	Kermadec Arc/ Kermadec Islands	29300	141000	572700	1900	6200	75200	12300	2300	0	294	4	102	0	8.5	188	37	75	0.82	202
GEOROC K10				samp. R4	BASALT	Kermadec Arc/ Kermadec Islands	15600	149900	662800	1100	5600	55500	5000	1600	0	53	2	16	0	8.9	160	33	65	0.4	174
GEOROC K11				samp. R29	BASALT	Kermadec Arc/ Kermadec Islands	12200	143200	684700	1600	5900	47300	5900	2000	0	27	1	3	0	8.7	165	40	75	0.52	176
GEOROC K12				samp. 45657	BASALT	Kermadec Arc/ Kermadec Islands	70600	150300	492200	1200	4700	121300	8800	2200	0	391	37	222	0	9.1	248	20	41	1.3	131
GEOROC K13				samp. 45658	BASALT	Kermadec Arc/ Kermadec Islands	57200	193300	483000	1000	3700	132800	6500	1700	0	305	33	108	0	6.9	281	13	32	0.29	91
GEOROC K14				samp. 45653	BASALT	Kermadec Arc/ Kermadec Islands	54500	194500	485500	1500	6600	132900	6200	1700	0	304	26	139	0	12.9	324	13	38	0.45	119

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K15				samp. 37478	BASALT	Kermadec Arc/ Kermadec Islands	48700	164200	516200	1200	3900	100200	9400	2300	0	297	12	36	0	9.6	224	19	37	0.48	121
GEOROC K16				samp. 37486	BASALT	Kermadec Arc/ Kermadec Islands	49400	163500	519600	1000	4200	102200	9700	2300	0	363	16	57	0	9.8	222	21	39	0.32	134
GEOROC K17				samp. 7128	BASALT	Kermadec Arc/ Kermadec Islands	67700	177300	485800	200	1300	128400	6900	1800	22400	350	33	94	76	2.3	175	9.4	16	0	47
GEOROC K18				samp. 7101	BASALT	Kermadec Arc/ Kermadec Islands	41400	185900	504200	500	2800	121500	8400	1900	25900	360	15	87	83	4.5	200	21	32	0	98
GEOROC K19				samp. 7098	BASALT	Kermadec Arc/ Kermadec Islands	45200	170700	506400	700	2800	102500	9800	2000	44000	385	16	135	94	5.5	190	21	41	0	145
GEOROC K20				samp. 7122	BASALT	Kermadec Arc/ Kermadec Islands	88200	151000	511000	100	1500	123000	6400	1800	18600	295	64	95	71	1.3	135	12	24	0	62
GEOROC K21				samp. 7125	BASALT	Kermadec Arc/ Kermadec Islands	66200	163900	514000	200	1700	127800	7400	1800	19400	315	47	100	68	3.3	155	16	27	0	82
GEOROC K22				samp. 7104	BASALT	Kermadec Arc/ Kermadec Islands	49300	151000	519300	800	3000	98300	10000	1900	36500	445	14	225	100	5.2	160	20	38	0	130
GEOROC K23				samp. 7119	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	47000	145900	534900	700	2700	97000	9400	2200	43500	430	16	200	97	3.7	170	19	36	0	105
GEOROC K24				samp. 7092	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	31000	175200	555400	700	2300	105100	7600	1800	23300	270	12	94	78	2.7	175	26	30	0	115
GEOROC K25				samp. 7088	ANDESITE	Kermadec Arc/ Kermadec Islands	30700	130000	564900	1500	5300	95100	12900	2300	32700	310	6	130	130	7.5	185	38	69	0	205
GEOROC K26				samp. 14770	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	41400	179200	516000	400	2900	90800	8700	1700	45600	295	15	140	89	4.7	175	23	48	0	94
GEOROC K27				samp. 14761	BASALT	Kermadec Arc/ Kermadec Islands	41800	177500	529300	800	2400	98800	9200	1700	31100	350	21	130	81	2.6	190	19	45	0	110
GEOROC K28				samp. 14666/1	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	50400	179300	548400	800	3700	86500	7200	1700	22400	235	25	86	87	3.4	165	26	56	0	130

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K29				samp. 14764	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	37800	169600	550000	600	3300	81600	9800	1700	52200	350	13	110	88	3.9	160	27	56	0	120
GEOROC K30				samp. 14775	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	50400	178900	530000	300	1200	102100	7700	1700	20800	340	18	400	77	1.2	155	18	32	0	74
GEOROC K31				samp. 14782	BASALT	Kermadec Arc/ Kermadec Islands	73300	177500	487600	800	1200	114400	7900	1900	28000	330	36	145	83		155	16	33	0	40
GEOROC K32				samp. 14790	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	40200	186400	528400	300	2800	99600	8100	1700	19400	310	16	175	88	5.3	155	24	45	0	110
GEOROC K33				samp. 14789/1	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	34600	192000	532400	400	2100	99700	8000	1600	18000	295	12	160	93	2.4	160	23	47	0	80
GEOROC K34				samp. 14796	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	38300	185700	526000	100	2400	105400	7400	1700	20600	305	13	135	83	4.4	175	21	37	0	90
GEOROC K35				samp. 14807/1	ANDESITE	Kermadec Arc/ Kermadec Islands	18800	165600	601700	900	4800	59900	8100	1900	25500	165	4	40	94	7.2	165	36	63	0	170
GEOROC K36				samp. 14814	ANDESITE	Kermadec Arc/ Kermadec Islands	19000	156000	612100	800	4700	61100	8100	1800	17800	175	4	41	99	7.7	165	36	65	0	175
GEOROC K37				samp. 14816	ANDESITE	Kermadec Arc/ Kermadec Islands	22300	152200	620300	1100	3300	61900	7900	1800	26100	155	4	28	98	3.2	170	34	64	0	175
GEOROC K38				samp. 10364	BASALT	Kermadec Arc/ Kermadec Islands	51500	203500	483000	400	4000	131900	5900	1200	23400	290	25	140	57	8.3	300	13	33	0	98
GEOROC K39				samp. 10415	BASALT	Kermadec Arc/ Kermadec Islands	82700	173300	488100	100	1400	137000	5500	1700	21600	280	49	84	60	1.6	185	13	15	0	59
GEOROC K40				samp. 10418	BASALT	Kermadec Arc/ Kermadec Islands	46200	209800	488700	700	2600	119700	5700	1500	25600	245	22	150	60	4.6	265	11	25	0	91
GEOROC K41				samp. 10379	BASALT	Kermadec Arc/ Kermadec Islands	57800	191300	492000	400	3200	128100	6200	1700	31300	255	34	140	62	6.7	260	14	28	0	120
GEOROC K42				samp. 10380	BASALT	Kermadec Arc/ Kermadec Islands	72500	156700	492000	700	4000	122900	8900	2300	41700	365	37	185	87	8.6	235	13	37	0	145

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K43				samp. 10378	BASALT	Kermadec Arc/ Kermadec Islands	47400	179900	495000	1000	5200	129900	7000	2000	25900	315	27	125	75	11	280	14	39	0	145
GEOROC K44				samp. 10373	BASALT	Kermadec Arc/ Kermadec Islands	55600	182800	497000	600	4900	129200	6800	1600	29900	305	27	155	68	10	290	12	34	0	130
GEOROC K45				samp. 10371	BASALT	Kermadec Arc/ Kermadec Islands	57200	197100	498000	400	2500	124300	6200	1600	25300	255	37	125	59	6.4	275	14	31	0	100
GEOROC K46				samp. 14840	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	44700	185400	508300	3700	3300	88900	10000	2900	46900	315	10	11	105	6.2	235	18	40	0	155
GEOROC K47				samp. 14837	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	49700	181800	516400	600	3000	92700	10100	2400	55700	360	15	42	99	6.7	210	20	45	0	135
GEOROC K48				samp. 14835	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	45000	180500	516700	1000	4200	87100	10500	2800	53100	370	9	76	105	10	220	23	38	0	165
GEOROC K49				samp. 14831	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	48500	176600	526600	1400	3300	86300	10500	2400	89300	345	9	8	107	9.5	220	22	42	0	160
GEOROC K50				samp. 14826/1	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	45100	166300	536400	800	3900	86500	10200	2400	61700	340	9	9	108	8	215	22	42	0	155
GEOROC K51				samp. 7101	BASALT	Kermadec Arc/ Kermadec Islands	41900	187900	509800	500	2800	122800	8500	1900	26200	360	15	87	83	4.5	200	21	32	0.4	0
GEOROC K52				samp. 23376	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	72200	140000	539000	700	2900	113100	6400	1800	21800	301	0	0	0	4.3	153	16.1	44.9	0.46	0
GEOROC K53				samp. 10415	BASALT	Kermadec Arc/ Kermadec Islands	83100	174100	490400	100	1400	137700	5500	1700	21700	280	49	84	60	1.6	185	13	15	0.22	0
GEOROC K54				samp. 14837	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	49900	182600	518700	600	3000	93100	10100	2400	55900	360	15	42	99	6.7	210	20	45	0.41	0
GEOROC K55				samp. AU23387	BASALT	Kermadec Arc/ Kermadec Islands	77500	168500	487200	1100	2400	120000	7300	1700	14300	351	29	124	84	5	200	16	23	2	81
GEOROC K56				samp. AU23396	BASALT	Kermadec Arc/ Kermadec Islands	119800	140100	507800	1200	1700	96400	7700	2500	13500	275	28	130	88	4	173	24	32	1	105

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K57				samp. AU23378	BASALT	Kermadec Arc/ Kermadec Islands	71300	149100	519800	800	1800	116800	6800	2000	13100	323	35	130	78	3	140	18	29	1	83
GEOROC K58				samp. AU23376	BASALT	Kermadec Arc/ Kermadec Islands	75700	142800	529500	1200	2600	111800	6000	1900	12800	290	39	120	90	4	170	19	37	1	92
GEOROC K59				samp. AU23374	BASALT	Kermadec Arc/ Kermadec Islands	83400	152900	516800	1000	2000	115500	6100	2000	12600	308	34	118	83	4	144	18	29	2	75
GEOROC K60				samp. AU37542	BASALT	Kermadec Arc/ Kermadec Islands	60700	205700	479500	900	3500	138400	4900	1400	10500	232	48	114	57	7	291	12	23	2	97
GEOROC K61				samp. AU37543	BASALT	Kermadec Arc/ Kermadec Islands	58100	170200	489700	1500	5600	122200	7200	2000	14600	433	24	184	87	10	267	18	40	2	127
GEOROC K62				samp. AU37546	BASALT	Kermadec Arc/ Kermadec Islands	80600	173700	483600	1600	1600	141900	5200	1700	12000	300	50	120	65	2	194	11	20	1	48
GEOROC K63				samp. AU37548	BASALT	Kermadec Arc/ Kermadec Islands	80100	173400	483900	400	1600	141500	5200	1800	12000	297	54	121	66	2	193	11	18	1	47
GEOROC K64				samp. AU37556(K12)	BASALT	Kermadec Arc/ Kermadec Islands	76600	170900	489800	500	1000	154700	4500	1400	9900	254	30	10	36	2	161	12	18	2	54
GEOROC K65				samp. AU37556(K13)	BASALT	Kermadec Arc/ Kermadec Islands	60200	203300	486800	600	2000	143200	4100	1500	9700	218	29	38	49	3	271	8	16	2	67
GEOROC K66				samp. AU37560	BASALT	Kermadec Arc/ Kermadec Islands	81600	173700	482500	300	900	151400	3600	1400	10500	211	40	104	55	2	156	9	12	2	27
GEOROC K67				samp. AU14837	BASALT	Kermadec Arc/ Kermadec Islands	49700	181800	516400	600	3000	92700	10100	2400	15700	388	19	47	109	8	220	21	37	1	115
GEOROC K68				samp. 374888	BASALT	Kermadec Arc/ Kermadec Islands	42300	203800	495400	400	1700	127800	5800	1800	0	323	11	0	0	2	183	14	19	0	75
GEOROC K69				samp. 45662	BASALT	Kermadec Arc/ Kermadec Islands	57200	229100	473600	900	4400	137900	3600	1200	17500	171	46	93	43	7	318	8	3	4	88
GEOROC K70				samp. 45663	BASALT	Kermadec Arc/ Kermadec Islands	46700	195900	483400	900	2200	129300	6100	1700	33100	291	21	169	64	2	262	13	5	3	108

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K71				samp. 45665	BASALT	Kermadec Arc/ Kermadec Islands	95200	162400	486900	600	2500	130300	4500	1600	20000	209	126	82	53	4	251	12	1	8	103
GEOROC K72				samp. 45661	BASALT	Kermadec Arc/ Kermadec Islands	47500	210900	487100	600	3300	131600	6000	1600	22600	272	17	162	55	4	260	12	4	4	95
GEOROC K73				samp. 45664	BASALT	Kermadec Arc/ Kermadec Islands	56400	177200	495700	900	2700	121400	6600	1700	27300	301	20	77	71	2	251	15	5	10	119
GEOROC K74				samp. 45654	BASALT	Kermadec Arc/ Kermadec Islands	57100	198100	485100	800	4000	133200	6100	1700	25800	286	28	130	59	7	260	13	0	6	115
GEOROC K75				samp. 45655	BASALT	Kermadec Arc/ Kermadec Islands	51900	205100	487800	900	4000	134300	5500	1500	30100	231	27	147	55	6	281	12	4	12	109
GEOROC K76				samp. 45659	BASALT	Kermadec Arc/ Kermadec Islands	55400	197700	488800	700	3200	131200	6100	1700	32100	276	27	126	61	4	254	12	2	9	102
GEOROC K77				samp. 45658	BASALT	Kermadec Arc/ Kermadec Islands	57100	192100	490500	900	4100	131200	6300	1700	29800	284	26	147	58	6	266	13	2	10	107
GEOROC K78				samp. 45660	BASALT	Kermadec Arc/ Kermadec Islands	65600	170300	493000	900	4000	127000	7300	2000	31100	355	32	177	71	6	239	14	0	6	111
GEOROC K79				samp. 45627	BASALT	Kermadec Arc/ Kermadec Islands	57100	184300	496500	1200	5900	127900	6400	1900	19700	307	20	134	63	9	276	14	6	3	134
GEOROC K80				samp. 45657	BASALT	Kermadec Arc/ Kermadec Islands	69800	148800	498300	1100	4800	120300	8700	2300	26500	396	30	224	79	7	230	17	4	10	144
GEOROC K81				samp. 45653	BASALT	Kermadec Arc/ Kermadec Islands	54100	193800	490900	1400	6600	130300	6000	1700	18200	297	22	140	62	11	303	13	5	9	139
GEOROC K82				samp. 45634B	BASALT	Kermadec Arc/ Kermadec Islands	65700	161800	487800	1100	2200	128700	7400	2000	20300	342	56	79	72	2	201	14	2	2	71
GEOROC K83				samp. 45634C	BASALT	Kermadec Arc/ Kermadec Islands	84700	158900	493800	500	1200	126900	6000	1800	18000	319	73	78	69	0	156	15	0	0	68
GEOROC K84				samp. 45634E	BASALT	Kermadec Arc/ Kermadec Islands	60900	166400	501100	500	1800	130600	6500	2100	16300	340	40	80	75	2	168	15	1	0	66

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K85				samp. 45634H	BASALT	Kermadec Arc/ Kermadec Islands	49400	159500	543900	1300	6000	103600	7600	1900	18500	233	15	84	88	8	204	26	2	6	182
GEOROC K86				samp. 23382	BASALT	Kermadec Arc/ Kermadec Islands	45600	144700	528800	1300	4400	89900	11300	2300	0	493.9	15.5	195.3	121.1	6.8	178.7	28.7	58.9	1.6	132.8
GEOROC K87				samp. 23399	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	54800	165600	535400	800	2400	107000	6200	2000	0	297.8	17.5	88.3	89.7	4.1	160	19.7	33	0.9	84.7
GEOROC K88				samp. 46299	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	53900	168200	536300	900	2400	106500	6300	2200	0	304.5	16.5	92.8	88.8	3.3	160.8	20.5	32.9	1.3	82.2
GEOROC K89				samp. 46300	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	55300	169100	530000	800	2200	106800	6100	2500	0	300.5	16.4	90.5	88.5	3.9	160.6	19.9	32.2	1.4	76.2
GEOROC K90				samp. 46301	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	50900	165500	548300	800	2400	101500	6000	1900	0	283.3	15	82.4	89.7	3.8	159.9	21.3	35.2	1.1	83.1
GEOROC K91				samp. 46302	ANDESITE	Kermadec Arc/ Kermadec Islands	28900	154300	621900	900	3800	75100	5300	2200	0	136.5	8.1	39.5	91.4	5.8	157.7	30	49.6	1.6	137.4
GEOROC K92				samp. 46303	ANDESITE	Kermadec Arc/ Kermadec Islands	25900	152800	634600	800	3800	71400	5100	1800	0	115.7	8.9	32.4	90.9	5.7	156.5	30.8	50	1.1	143.4
GEOROC K93				samp. 46304	ANDESITE	Kermadec Arc/ Kermadec Islands	30700	150000	605100	1000	4200	74900	7500	2200	0	222.8	9.4	61.6	102.3	6.7	174.2	31.4	55	1.6	156.4
GEOROC K94				samp. 46298	ANDESITE	Kermadec Arc/ Kermadec Islands	17000	133400	605600	1400	8400	45800	5100	1500	0	23.1	1.3	8.5	65.1	4	156.6	32.3	67	2	147.5
GEOROC K95				samp. 46388	ANDESITE	Kermadec Arc/ Kermadec Islands	17300	129800	607400	1400	6200	49200	5500	1700	0	19.4	2.6	6.9	59.2	8	144.3	34.8	70.4	1.8	115.2
GEOROC K96				samp. 7081	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33400	174000	562500	900	2600	96200	7100	2000	0	263.6	12.8	78.7	84.3	2.2	174.9	26.2	38.8	1.4	101.3
GEOROC K97				samp. 7082	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32100	176400	566400	900	2500	98600	7100	1800	0	288.2	15.6	126.7	83.2	2.8	177	25.2	37.9	1.4	105.1
GEOROC K98				samp. 46369	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32000	176500	562200	900	2500	99100	7000	1900	0	268	13.4	121.9	81.6	3	180	25.3	38.2	1.4	105

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K99				samp. 46355	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32900	181700	562000	900	2600	99600	6900	2000	0	267.6	11.9	94.4	79	4.1	179.5	26	38.8	1.3	108.1
GEOROC K100				samp. 46370	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33100	178100	558800	800	2500	99000	7000	1800	0	270.7	11.5	92.5	85.8	3.1	179.4	25.2	37.3	1.2	99.5
GEOROC K101				samp. 23386	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32800	179500	562200	900	2700	99400	7100	1800	0	268.9	11.7	60.8	81.6	3.5	178.2	25.4	37.7	1.5	101.8
GEOROC K102				samp. 46371	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32300	175600	568200	900	2500	98900	7100	1800	0	283.8	12.3	58	81.6	3.3	178.7	24.8	37.4	1.6	101.5
GEOROC K103				samp. 7083	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33100	177800	566000	900	2500	98900	7000	2000	0	283.9	13	166.9	85.4	4	178.3	25.1	37.5	1.3	93
GEOROC K104				samp. 7084	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33000	176900	563100	900	2500	99100	7000	1800	0	283.3	12.9	99.6	84.3	3.1	178.7	24.8	37.7	1.1	93.8
GEOROC K105				samp. 46372	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33000	174000	563700	800	2500	98100	6900	2000	0	267.6	12.1	107.4	81.7	3.7	178.8	24.6	37.8	1.4	89.1
GEOROC K106				samp. 7085	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	29300	181800	561900	800	2500	99500	7100	1700	0	296.5	11.1	62.6	80.2	3.6	183.8	25.3	38.6	1.2	99.4
GEOROC K107				samp. 46373	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	29200	183800	558500	900	2600	100800	7100	1700	0	295.4	11.8	88.5	82.3	4.1	184.5	25.1	38.3	1.2	106.6
GEOROC K108				samp. 7086	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	30600	182900	553400	900	2700	101500	7200	1700	0	304.8	11.7	127.3	84.9	4.4	184.6	25.3	39	1.3	90.2
GEOROC K109				samp. 46359	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32100	181800	558500	900	2600	102600	7100	1900	0	299.2	11.5	96.6	81.1	4.1	185.2	24.5	38	1.5	88.7
GEOROC K110				samp. 23388	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32600	181100	554800	900	2700	102300	7100	1900	0	298.5	12.8	103	82.2	4.1	185.3	25	37.6	1.1	97.9
GEOROC K111				samp. 46360	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32600	181600	554000	900	2600	103000	7100	1900	0	295.9	13.2	129.5	81.9	4.1	185.8	24.7	38.8	1.1	106.5
GEOROC K112				samp. 46361	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32000	181600	554500	900	2600	102400	7100	1800	0	305.3	12.2	100.1	80.8	4	185.8	24.6	37.7	1.4	101.4

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K113				samp. 7097	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33700	170400	567200	800	2500	95200	7000	1800	0	248.1	12.3	159.7	83.1	3.2	175.4	26.2	38.6	1.1	108.2
GEOROC K114				samp. 23381	BASALT	Kermadec Arc/ Kermadec Islands	41500	165100	530100	900	3000	97800	9700	2200	0	440.8	10.8	180.8	111.6	4.2	154.6	26.9	42	1.2	89.1
GEOROC K115				samp. 46331	BASALT	Kermadec Arc/ Kermadec Islands	39600	192400	506500	900	2600	114800	8200	1900	0	371.9	16.4	104.9	82.9	4.1	213.2	20.4	39.1	1.7	109.5
GEOROC K116				samp. 46332	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	30000	183800	554400	900	2600	103500	7100	1900	0	297.8	10.2	106.9	79.7	3.7	187	24.9	38	1	108.5
GEOROC K117				samp. 7101	BASALT	Kermadec Arc/ Kermadec Islands	41700	196900	496000	900	2600	118000	7700	1700	0	340.9	18	84.9	79.6	3.9	214.2	19.5	37.7	1.7	88
GEOROC K118				samp. 46356	BASALT	Kermadec Arc/ Kermadec Islands	42400	194700	499900	900	2700	117200	7800	1700	0	343.5	14.8	110.7	79.8	4.3	213.3	21.1	38.5	1.5	101.6
GEOROC K119				samp. 7100	BASALT	Kermadec Arc/ Kermadec Islands	44100	200500	490800	800	2600	123200	7200	1900	0	307.9	20.8	110.1	74.5	4.7	216	18.1	36.8	1.3	77.6
GEOROC K120				samp. 46367	BASALT	Kermadec Arc/ Kermadec Islands	46700	203100	491200	900	3200	124600	6900	2000	0	298.7	23.9	150	72.4	4.2	214.6	16.7	35.7	0.9	90.9
GEOROC K121				samp. 7099	BASALT	Kermadec Arc/ Kermadec Islands	45900	195200	487000	900	2700	124800	7500	1900	0	324.1	23.6	126.6	78.4	5.2	215	18.4	39.4	1.5	110.2
GEOROC K122				samp. 7098	BASALT	Kermadec Arc/ Kermadec Islands	43700	172300	508600	1200	4000	106000	8600	2200	0	386.6	18.6	161.4	95.7	5.8	203	23.7	48.5	1.4	118.5
GEOROC K123				samp. 46363	BASALT	Kermadec Arc/ Kermadec Islands	48000	202300	486300	900	2800	126000	6900	1400	0	289.2	24.3	123.1	70.3	4.6	233.7	16.3	36	1.3	106.4
GEOROC K124				samp. 46364	BASALT	Kermadec Arc/ Kermadec Islands	46600	180000	502400	1000	2900	110100	8500	2100	0	354.1	17.8	106	92.1	4.7	207	22.6	47.3	1.5	107.8
GEOROC K125				samp. 7093	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	30800	183400	558100	900	2700	101600	7200	1800	0	300.3	11.8	125.9	82.7	4	185.3	24.9	38.3	1.6	99.3
GEOROC K126				samp. 7094	BASALT	Kermadec Arc/ Kermadec Islands	47300	195800	488200	1000	3000	124100	7700	2000	0	299.3	25	94.8	78.3	4.7	213.6	17.9	40	1.6	99

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K127				samp. 7095	BASALT	Kermadec Arc/ Kermadec Islands	48400	193900	489800	800	3000	122800	7300	1700	0	328.3	25.3	117.3	77.6	4.9	211	18.2	37.9	1.4	102.3
GEOROC K128				samp. 23387	BASALT	Kermadec Arc/ Kermadec Islands	66800	177300	494600	800	2500	122200	6800	2000	0	356.3	25.1	121	78.3	5.5	203	15.8	32	1.5	88.1
GEOROC K129				samp. 46365	BASALT	Kermadec Arc/ Kermadec Islands	35300	196000	505800	900	2700	113300	8100	1600	0	355.8	14.9	97.5	82.3	5	219.7	19.9	40.4	1.4	93.3
GEOROC K130				samp. 46366	BASALT	Kermadec Arc/ Kermadec Islands	35600	193800	514300	900	3000	111600	8300	2000	0	287.4	14	54.7	77.3	4	224.5	21.2	40.3	1.4	127.9
GEOROC K131				samp. 7103	BASALT	Kermadec Arc/ Kermadec Islands	48100	197700	497200	700	2300	125600	6900	1700	0	296.2	18.7	192.8	69.3	2.7	200.6	17.1	32.3	1.2	93.5
GEOROC K132				samp. 46324	BASALT	Kermadec Arc/ Kermadec Islands	45200	199100	493500	700	2200	126900	6700	1800	0	278.6	18.2	201	66.7	3.1	198.2	16.8	31.2	1.3	87.4
GEOROC K133				samp. 7104	BASALT	Kermadec Arc/ Kermadec Islands	49600	153100	519700	900	3300	103700	10200	2500	0	480.7	16.3	201.6	105.7	5.1	175.3	25.7	44.8	1.5	104.9
GEOROC K134				samp. 7045	ANDESITE	Kermadec Arc/ Kermadec Islands	19000	142100	631700	1800	5400	62200	9100	2400	0	88.4	2.5	16.6	129.4	8.6	174.4	46.1	70.9	1.7	181
GEOROC K135				samp. 7089	BASALT	Kermadec Arc/ Kermadec Islands	46900	191400	495300	1000	2900	122300	8100	1900	0	291.2	23.4	143.1	74.9	5.1	217.3	19.6	40.3	1.1	124.6
GEOROC K136				samp. 7105	BASALT	Kermadec Arc/ Kermadec Islands	48600	179700	504000	700	2600	117800	8000	2100	0	377.6	17.9	245	84.3	4.1	184.9	20.2	36.9	1.2	102.4
GEOROC K137				samp. 46327	BASALT	Kermadec Arc/ Kermadec Islands	50400	187100	499200	700	2400	122800	7200	2100	0	386	21.6	187	79.6	3.7	185.3	18.1	33.3	1.3	86.3
GEOROC K138				samp. 23369	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	45600	146500	538200	1000	3500	93100	10400	2200	0	509.9	22.6	126.7	109	4.6	168.8	28	49.4	1.4	122.9
GEOROC K139				samp. 23370	BASALT	Kermadec Arc/ Kermadec Islands	39600	142500	512600	800	4400	73900	9200	1900	0	410.6	15.8	191.9	106.9	6.1	185.4	25.9	47.4	1.4	121.5
GEOROC K140				samp. 23372	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	45800	147500	531400	1400	4500	92900	11500	2400	0	523.2	20.4	233.2	120.8	7.7	181.7	29.3	57.3	1.4	129.7

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K141				samp. 23389	BASALT	Kermadec Arc/ Kermadec Islands	50000	178600	502600	700	2700	119500	7900	2100	0	378.5	17.5	171.2	83.2	4	199.3	20	36	1.4	95.6
GEOROC K142				samp. 7058	BASALT	Kermadec Arc/ Kermadec Islands	133100	98800	522100	500	2100	130500	4400	1700	0	235.1	185.1	99	67.5	2.8	120.5	13.2	30.6	1.3	66.6
GEOROC K143				samp. 7120	BASALT	Kermadec Arc/ Kermadec Islands	79300	160000	492700	600	1800	128300	7600	2200	0	332.5	58.8	99.2	70.2	2.9	163.5	16.7	33.7	1.4	92.5
GEOROC K144				samp. 7121	BASALT	Kermadec Arc/ Kermadec Islands	63800	176500	477500	700	2400	132100	7800	2100	0	405.8	49.2	110.9	82.2	2.3	165.2	17.6	36.4	1.3	77.7
GEOROC K145				samp. 7122	BASALT	Kermadec Arc/ Kermadec Islands	83500	160300	495000	500	1700	132600	6000	1900	0	280.1	64.7	89	63.7	1.5	146.7	14.6	27.8	1.1	74
GEOROC K146				samp. 7123	BASALT	Kermadec Arc/ Kermadec Islands	75200	143100	533100	800	2900	113800	6000	2100	0	291.3	43.4	118.7	84.7	4.6	171.2	18.5	44.5	1.3	93.8
GEOROC K147				samp. 7126	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	53800	159200	541100	900	2400	102500	8700	1600	0	304.5	31.7	88.8	79.3	3.3	143.6	27.3	64.4	1.7	98.4
GEOROC K148				samp. 7127	BASALT	Kermadec Arc/ Kermadec Islands	76700	145400	523000	500	1500	116300	5600	2000	0	308.4	47.3	60.2	76.6	1	122.1	18.8	34.4	1.1	69.8
GEOROC K149				samp. 7128	BASALT	Kermadec Arc/ Kermadec Islands	66000	190900	479800	500	1300	132300	6200	1900	0	377.4	32.2	88.1	72.9	1.6	183.2	12.5	20.4	0.9	42.4
GEOROC K150				samp. 7129	BASALT	Kermadec Arc/ Kermadec Islands	64700	190200	480100	500	1300	131200	6400	2000	0	376	30.8	81	72.2	1.6	183.3	12.5	21.9	1	49.4
GEOROC K151				samp. 7131	BASALT	Kermadec Arc/ Kermadec Islands	101800	161100	470800	400	1100	134000	5600	1900	0	325.6	72.4	127.9	66.3	1.9	159.5	11.7	19	1	52.5
GEOROC K152				samp. 7132	BASALT	Kermadec Arc/ Kermadec Islands	55200	193500	486000	800	1800	124900	7400	1800	0	369.1	24.5	104.7	78.5	3	212.3	15.1	27.9	1.2	66.2
GEOROC K153				samp. 7133	BASALT	Kermadec Arc/ Kermadec Islands	68100	177400	486800	700	1700	125100	7400	2100	0	370	34.3	118.7	75.9	3.3	198.9	15	27.5	1.2	56.7
GEOROC K154				samp. 7134	BASALT	Kermadec Arc/ Kermadec Islands	104400	155500	476700	500	1000	134500	5300	1900	0	318.6	78.8	80.6	65.2	1.8	153.4	10.9	18.1	1.2	37.7

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K155				samp. 7136	BASALT	Kermadec Arc/ Kermadec Islands	86300	170900	480900	600	1500	130100	6100	2200	0	314.1	55.2	57.9	71.1	2.7	184.2	12.6	23.6	1.1	55.4
GEOROC K156				samp. 7137	BASALT	Kermadec Arc/ Kermadec Islands	103400	157100	474800	500	1100	134800	5400	2000	0	330.5	76.6	80.3	67.8	1.4	156.5	11.3	19.2	0.6	41.1
GEOROC K157				samp. 7138	BASALT	Kermadec Arc/ Kermadec Islands	105000	157200	477900	400	1100	136200	5400	2200	0	310.7	73.5	76.2	62.3	2.3	156.9	11.1	18.9	1.1	52.9
GEOROC K158				samp. 7139	BASALT	Kermadec Arc/ Kermadec Islands	103100	157300	472700	400	1000	134400	5600	2100	0	317.2	74.4	144.2	67.5	1.6	156.5	11.6	19.5	1.3	38.5
GEOROC K159				samp. 23376	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	75400	143800	537900	900	2900	113700	6000	1900	0	294.7	40.3	115.3	85.2	4.6	171.7	18.9	45.2	1.3	110.8
GEOROC K160				samp. 7107	BASALT	Kermadec Arc/ Kermadec Islands	46300	177300	516300	1000	2700	112700	8300	1900	0	357.3	21.2	154.6	87.5	3.6	186.3	25.3	43.6	1.3	109.5
GEOROC K161				samp. 7108	BASALT	Kermadec Arc/ Kermadec Islands	49100	178500	511100	1000	2600	113100	8100	1600	0	332.2	26.5	152.6	80.3	5	199.9	23.1	42.5	1.4	109
GEOROC K162				samp. 7109	BASALT	Kermadec Arc/ Kermadec Islands	45300	176900	522400	1000	2700	111000	8400	1800	0	377.1	23.4	251.4	87.5	4	184.6	24.4	42.5	1.2	99.9
GEOROC K163				samp. 7110	BASALT	Kermadec Arc/ Kermadec Islands	62100	178400	496700	1100	3400	126800	6900	2000	0	309.4	41.3	152.7	74.3	5.6	228.4	18.3	40.2	1.5	129.6
GEOROC K164				samp. 7111	BASALT	Kermadec Arc/ Kermadec Islands	60200	156300	526500	1300	4100	106100	8300	2200	0	347.7	36.3	124.4	86.2	6.4	200.6	27.1	54.4	1.5	143.8
GEOROC K165				samp. 7112	BASALT	Kermadec Arc/ Kermadec Islands	46400	210300	486400	600	1400	131100	6400	1900	0	351.6	13.8	68.9	68.4	2.3	209.4	13.5	23.2	0.9	63.2
GEOROC K166				samp. 7115	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	46400	146600	534700	900	3500	92100	10300	2400	0	521.7	18.6	203.6	115.6	3.5	181.2	26.3	45	1.4	100.5
GEOROC K167				samp. 7116	BASALT	Kermadec Arc/ Kermadec Islands	72600	175700	486700	700	1900	124900	7200	2000	0	351.8	43.3	104.5	79.4	2.7	195.8	15.1	26.7	0.9	69
GEOROC K168				samp. 7117	BASALT	Kermadec Arc/ Kermadec Islands	44900	214800	481600	500	1400	129900	6400	1700	0	351.2	14.2	119.5	70.9	2.6	207.2	13.2	23.2	1.2	51.1

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K169				samp. 7118	BASALT	Kermadec Arc/ Kermadec Islands	44500	213500	484700	500	1400	130600	6400	1800	0	354	13.2	80.5	66.8	2.7	209.7	12.5	23.4	1	48.8
GEOROC K170				samp. 7119	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	47900	147100	537300	900	3300	94000	9600	2300	0	456.1	20.1	94.1	107.3	3.8	180.7	25.9	43.5	1.1	108.4
GEOROC K171				samp. 7140	BASALT	Kermadec Arc/ Kermadec Islands	41800	194600	501900	800	2700	115900	7900	2100	0	337	16.7	112	82.1	4.2	212	19.4	38.9	1.3	98.9
GEOROC K172				samp. 7141	BASALT	Kermadec Arc/ Kermadec Islands	41600	192500	500300	900	2700	116100	7900	1700	0	358.9	18.9	107.1	85	3.8	222.5	20	39.3	1.5	93.7
GEOROC K173				samp. 7142	ANDESITE	Kermadec Arc/ Kermadec Islands	30000	181800	562500	800	2500	99000	7000	1800	0	265.8	11.2	121.1	80.6	3.8	184.5	26.2	37.9	1.5	102.6
GEOROC K174				samp. 23375	ANDESITE	Kermadec Arc/ Kermadec Islands	34900	150900	579300	1000	3100	83300	9300	2400	0	337	4.7	68.3	113.5	4.4	180.5	28	49	1.4	106.5
GEOROC K175				samp. 23396	BASALT	Kermadec Arc/ Kermadec Islands	57500	169000	522000	1000	2700	106000	8300	1900	0	292.2	28.6	131.2	85.8	5	177.1	25.1	40.8	1.4	111.4
GEOROC K176				samp. 23397	BASALT	Kermadec Arc/ Kermadec Islands	46400	143000	526400	1300	4900	92600	12100	2300	0	545.6	16.5	256.9	119.1	7.3	179.4	29.9	60	1.8	128.6
GEOROC K177				samp. 46328	BASALT	Kermadec Arc/ Kermadec Islands	40600	182200	518200	1300	3100	109800	9500	1900	0	298.2	21.9	107.4	87.4	6	207.3	28.3	49.7	1.6	130.8
GEOROC K178				samp. 7143	BASALT	Kermadec Arc/ Kermadec Islands	44200	174600	510200	1200	4000	105400	8900	2300	0	369.9	15.3	117	95.2	6.2	205.5	23.9	47.8	1.5	135.2
GEOROC K179				samp. 7145	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	37500	177200	536900	800	3600	102700	7500	1800	0	342.4	13.8	157.4	89.6	6.2	169.3	23.8	49.9	1.4	115.7
GEOROC K180				samp. 7146	BASALT	Kermadec Arc/ Kermadec Islands	59500	166700	513500	600	2500	115100	7000	2000	0	348.6	23.8	159.3	82.7	4.7	148.4	19.3	39.3	1.2	66.7
GEOROC K181				samp. 23402	BASALT	Kermadec Arc/ Kermadec Islands	59200	167200	516000	600	2600	113700	6900	2000	0	351.3	20.4	160.3	84.1	3.6	148.3	19.9	39.7	1.5	83.1
GEOROC K182				samp. 7151	BASALT	Kermadec Arc/ Kermadec Islands	40500	185500	512000	1000	4400	106800	7900	1900	0	370.9	17.6	141.7	92.1	4.6	180.4	26.8	52.5	1.5	117.2

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K183				samp. 7152	BASALT	Kermadec Arc/ Kermadec Islands	51100	176500	518400	600	2700	111600	6500	2000	0	323.4	20.6	144.5	83.3	4	161.9	19.3	38.1	1.2	78.5
GEOROC K184				samp. 23373	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	39000	165400	543500	1000	3500	98700	7900	1900	0	368.8	14.6	186.6	96.7	5.7	154.3	25.9	52.9	1.4	114.6
GEOROC K185				samp. 23374	BASALT	Kermadec Arc/ Kermadec Islands	71200	158400	521000	600	2500	117900	6000	2100	0	309.2	37.1	117	76.3	4.2	147.4	18.4	37.2	1	90.3
GEOROC K186				samp. 23378	BASALT	Kermadec Arc/ Kermadec Islands	72900	156200	517800	600	2100	118500	6400	2000	0	332.3	35.6	126.7	75.2	2.7	142.9	18.3	35.9	0.9	80.5
GEOROC K187				samp. 23379	BASALT	Kermadec Arc/ Kermadec Islands	42700	185300	515400	700	2100	112400	7400	1900	0	343.6	18.3	122.8	87	3.2	172.5	31.3	45.3	1.3	89.6
GEOROC K188				samp. 23403	BASALT	Kermadec Arc/ Kermadec Islands	49700	177600	519300	800	2700	112400	6700	1800	0	323.4	20.1	131.6	82.6	4.1	165.3	19.7	38.6	0.9	88.7
GEOROC K189				samp. 14761	BASALT	Kermadec Arc/ Kermadec Islands	42300	186400	521000	1000	2700	107800	8500	1800	0	373.4	21.6	133.1	82.5	3	198.1	23.3	51.7	1.4	101.6
GEOROC K190				samp. 14764	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	39100	171900	536000	1000	3600	93700	9200	2000	0	384.6	15	116.6	94.1	4.2	173.3	27.9	59.7	1.5	121.6
GEOROC K191				samp. 14766	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	50100	169500	545700	1100	4100	95700	6800	1800	0	214.8	18.5	67.1	68.6	1.9	142.2	22.2	51.1	1.4	107.8
GEOROC K192				samp. 14775	BASALT	Kermadec Arc/ Kermadec Islands	50400	178000	517100	700	1300	112200	7600	1800	0	373	22.9	354.6	80.2	1.1	176.8	21.5	39.9	1.3	67.4
GEOROC K193				samp. 14782	BASALT	Kermadec Arc/ Kermadec Islands	73300	159700	490400	1100	1200	122600	7000	2100	0	366	37.7	144.1	85.6	1.2	181.7	18.4	37.9	1.2	38.8
GEOROC K194				samp. 14789	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	35300	178600	542100	900	2500	101000	7500	1700	0	332	12.4	155.3	85.6	2.1	167.1	24.7	53.4	1.4	101.2
GEOROC K195				samp. 14790	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	41800	172100	539900	800	3200	99100	7400	1600	0	334.7	16	171	90.6	5.3	160.7	24.2	51.9	1.6	105.1
GEOROC K196				samp. 23395	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	41100	171200	542900	800	2700	99400	7500	1800	0	334.8	17.5	187.6	87.9	2.7	163.5	24.4	51.6	1.5	91.8

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K197				samp. 14796	BASALT	Kermadec Arc/ Kermadec Islands	39300	186600	527400	700	2700	108200	7000	2100	0	327.6	13.5	125.8	84.2	3.7	163	21.2	42.5	1.4	85
GEOROC K198				samp. 14807	ANDESITE	Kermadec Arc/ Kermadec Islands	19800	152800	607700	1500	5700	66000	7700	2000	0	183.1	2.8	44.1	97.3	7	173.5	35.6	72.5	1.7	159.8
GEOROC K199				samp. 14814	ANDESITE	Kermadec Arc/ Kermadec Islands	21200	151700	614800	1300	5300	66400	7600	2100	0	192.8	1.9	40.5	96.2	7.4	170.4	35.2	72.1	1.8	179.7
GEOROC K200				samp. 14816	ANDESITE	Kermadec Arc/ Kermadec Islands	22300	153300	616000	1500	3600	68100	7700	1600	0	186.2	3.2	33.6	96	3.7	176.3	37.5	72.3	1.5	163
GEOROC K201				samp. 23383	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	49100	176700	531200	500	1900	108200	6400	1800	0	306.1	18.5	92.9	83.3	3.2	135.2	21.8	36.9	1	61.1
GEOROC K202				samp. 23384	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	35000	179200	540900	1300	2300	99300	7500	1900	0	338.2	14.2	100.8	90.1	1.9	167.6	32.2	54.8	1.3	106.7
GEOROC K203				samp. 23385	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	36000	175600	540500	1300	3400	99100	7700	1700	0	395.5	16	101.5	90.6	4.8	166.6	29.8	55.1	1.4	97.1
GEOROC K204				samp. 6983	ANDESITE	Kermadec Arc/ Kermadec Islands	25600	167900	593800	1000	2600	85800	7500	2000	0	240.4	7.6	119.8	91.3	3.8	167.2	30.4	41.2	1.3	116.4
GEOROC K205				samp. 7002	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	44700	149000	540800	900	3800	91200	9900	2500	0	436	15.5	117.4	103.3	5.2	184.8	26.7	46.4	1.4	144.9
GEOROC K206				samp. 7003	BASALT	Kermadec Arc/ Kermadec Islands	37500	204300	501600	600	2000	123600	6900	1800	0	355.3	14.1	74	72.1	2.5	178.7	18	30.3	1	74.5
GEOROC K207				samp. 70128	BASALT	Kermadec Arc/ Kermadec Islands	49800	189600	500400	700	2400	123300	7300	2000	0	390.6	20.1	144.9	80.4	4.1	187	18.2	33.7	1	87.4
GEOROC K208				samp. 46294	ANDESITE	Kermadec Arc/ Kermadec Islands	29300	183600	560900	900	2600	100300	7100	1800	0	277.5	10.3	79	79.7	4	186.7	24.5	38.6	1.1	101.7
GEOROC K209				samp. 46295	BASALT	Kermadec Arc/ Kermadec Islands	50100	198100	490100	800	2600	124500	6800	2000	0	296.9	27	127.7	74.3	3.5	210.5	16.9	35.5	1.3	93.3
GEOROC K210				samp. 46318	ANDESITE	Kermadec Arc/ Kermadec Islands	34400	145800	586800	1400	4900	78200	9300	2100	0	297.6	13.2	88.7	107.9	8.1	190	33	66.3	1.8	178

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC K211				samp. 46321	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	29400	183100	557000	900	2700	100600	7100	1800	0	284.9	10.7	65.6	86.7	3.9	181.8	25.3	38.8	1.1	87.8
GEOROC K212				samp. 46322	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	40000	163800	564700	1300	3300	90300	6900	2000	0	271.1	10.3	37.2	87.8	5.5	192.5	27.8	52.7	1.4	124.7
GEOROC K213				samp. 46323	ANDESITE	Kermadec Arc/ Kermadec Islands	32800	150800	602400	1100	4200	73900	6400	1800	0	135.5	11	37.3	95.6	6	157.8	31.5	57.2	1.5	156.1
GEOROC K214				samp. 46350	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	29100	182500	560600	1000	2600	99400	7100	2000	0	295.2	12.8	130	84.4	4.1	184.4	25.3	39	1.3	88
GEOROC K215				samp. 46352	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	32300	179200	561700	900	2500	99200	6900	2100	0	288.3	12	63.1	84.2	2	177.6	25.1	37	1.2	104.3
GEOROC K216				samp. 46353	BASALT	Kermadec Arc/ Kermadec Islands	116300	112900	506600	700	2100	143800	5100	2200	0	298.3	92.2	58.7	67.3	2.4	152.7	12.5	26.7	1.3	69.8
GEOROC K217				samp. 46354	ANDESITE, BASALTIC	Kermadec Arc/ Kermadec Islands	33300	177700	561300	900	2800	97500	7000	2200	0	270.8	13.7	105.9	87.7	4.1	177.5	24.9	37.9	1.5	93.8

Pitcairn Island

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC P1				samp. P1	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	11800	173200	575300	3700	36700	34300	9800	2200	0	26	2	7	146	79	454	60	670	108	1012
GEOROC P2				samp. P3	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	56600	153300	485800	5900	16500	87300	36200	1600	0	262	97	43	116	38	602	36	318	43	476
GEOROC P3				samp. P4	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	39700	152600	488900	8900	22900	81300	42800	1800	0	281	28	63	121	46	673	45	412	60	653
GEOROC P4				samp. P5	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	38600	153600	487600	8800	22600	82900	42700	1800	0	280	28	68	126	44	675	45	425	61	629
GEOROC P5				samp. P7	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	65400	149300	478800	5700	16400	84400	37500	1700	0	263	127	39	107	34	591	35	308	43	484
GEOROC P6				samp. P8	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	55500	159300	487400	6100	16500	89700	35900	1500	0	239	89	32	99	35	736	32	301	43	530
GEOROC P7				samp. P9	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	70900	150600	473700	5300	14300	88200	35700	1700	0	269	166	42	120	28	591	30	282	39	410
GEOROC P8				samp. P10	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	38200	161700	499200	7100	19300	85400	39500	1500	0	282	42	27	116	40	647	40	366	50	523
GEOROC P9				samp. P11	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	39600	156900	475100	7200	16300	78500	38600	2000	0	229	17	24	132	38	636	36	318	52	438
GEOROC P10				samp. P12	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	51500	154200	470800	6900	16400	76200	38500	1800	0	215	18	22	121	38	578	36	304	49	412
GEOROC P11				samp. P14	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	4200	163600	626400	1100	56600	19300	6000	1900	0	14	2	4	143	84	59	64	703	93	1845
GEOROC P12				samp. P18	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	20400	175400	474500	7800	18100	55600	42800	2300	0	248	16	26	155	38	651	52	359	58	476
GEOROC P13				samp. P20	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	45700	155800	456100	4700	11000	88400	47700	1900	0	291	35	29	124	27	654	33	254	41	291
GEOROC P14				samp. P22	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	31600	164000	495500	8100	19100	68900	33700	1800	0	183	8	13	154	43	595	253	376	61	447

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC P15				samp. P26	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	42000	156900	473600	7200	15800	76700	39200	2100	0	227	15	24	127	37	654	40	315	49	472
GEOROC P16				samp. P28	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	34400	160700	486500	7800	17700	70200	36700	3000	0	200	12	20	167	40	638	171	358	58	551
GEOROC P17				samp. P30	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	36700	156900	495200	7700	18400	74900	32600	2000	0	204	4	7	137	44	615	43	361	58	433
GEOROC P18				samp. P31	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	45300	156600	475200	7200	14100	81000	38500	2000	0	235	15	20	145	34	628	37	332	53	376
GEOROC P19				samp. P34	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	34200	153000	496800	12400	19800	71600	28600	2200	0	142	2	13	154	42	611	51	396	63	506
GEOROC P20				samp. 642	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	0	0	0	0	0	0	0	0	0	109	10	12	174	62	503	60	592	86	340
GEOROC P21				samp. 647	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	0	0	0	0	0	0	0	0	0	170	10	14	237	50	498	138	509	74	422
GEOROC P22				samp. PIT-1	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	71000	143000	481000	9000	17000	72000	35000	1500	0	177	180	0	111	30.8	669	28	308	44	474
GEOROC P23				samp. PIT-3	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	77700	147600	487300	6200	17000	78200	32700	1500	0	171	180	0	113	32.5	0	30	318	46	487
GEOROC P24				samp. PIT-4A	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	42500	149700	489100	8200	21300	85300	43400	1700	0	251	47	0	140	41.7	616	38	439	67	560
GEOROC P25				samp. PIT-6	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	38300	159600	495400	11700	20000	75000	29900	2100	0	116	14	0	154	42.5	593	47	504	76	302
GEOROC P26				samp. PIT-7	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	63900	152800	481500	6000	15900	86900	35500	1600	0	226	105	0	15	28.2	595	30	325	48	434
GEOROC P27				samp. PIT-8	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	119100	133500	463200	4300	9800	83100	27700	1700	0	199	311	0	123	18	528	22	220	34	288
GEOROC P28				samp. PIT-11	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	120300	132400	464500	4200	9900	82100	27400	1700	0	198	312	0	123	18.1	519	22	218	34	289

File #	Date	Time	Operator	Name	ID	Field1	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
GEOROC P29				samp. PIT-12	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	62700	151400	492200	7300	18800	78700	33400	1600	0	207	102	0	124	34.8	666	33	364	54	541
GEOROC P30				samp. PIT-13	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	80600	144200	474700	6100	15900	81200	37500	1600	0	222	165	0	124	26.7	656	29	328	50	474
GEOROC P31				samp. PIT-16	PITCAIRN-GAMBIER CHAIN / PITCAIRN	BASALT, ALKALINE	44500	158200	487100	7900	20000	84500	40800	1700	0	238	54	0	121	37	562	43	397	61	568

New Caledonia

File #	Date	Time	Operator	Name	ID	Field1	Field2	MgO	Al2O3	SiO2	P2O5	K2O	CaO	TiO2	MnO	Fe2O3	V	Ni	Cu	Zn	Rb	Sr	Y	Zr	Nb	Ba
D. Chuzel et al. 2001 - ICPMS				N-MORB	PO 11	Voh	New Caledonia			46.11				1.17							5	261	25	11	1.64	
D. Chuzel et al. 2001 - ICPMS				N-MORB	BCE 6	Thio	New Caledonia			47.88				1.25							14	127	27	57	2.55	
D. Chuzel et al. 2001 - ICPMS				N-MORB	BCE 7	Thio	New Caledonia							1.33							6	59	35	94	2.3	
D. Chuzel et al. 2001 - ICPMS				P-MORB	PO 10	Voh	New Caledonia							1.49							3	233	26	91	4.09	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BCE 5	Thio	New Caledonia							1.4							0	29	28	92	4.22	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BP 84	Poindimié	New Caledonia							1.27							4	190	22	80	4.04	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BP 93	Poindimié	New Caledonia							1.65							9	63	29	80	6.09	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BCE 1	Canala	New Caledonia							1.42							1	62	28	88	4.4	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BCE 4	Thio	New Caledonia							1.39							24	206	26	86	3.92	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BP 86	Poindimié	New Caledonia							1.37							16	26	26	78	4.19	
D. Chuzel et al. 2001 - ICPMS				P-MORB	BP 95	Poindimié	New Caledonia							0.83							2	435	17	41	3.26	
D. Chuzel et al. 2001 - ICPMS				OIB	PO 7	Poya	New Caledonia							2.17							29	527	21	149	44.32	

Appendix V: Jorgensen, Way & Flexner 2024 Publication

Archaeology in Oceania



Archaeology in Oceania, Vol. 59 (2024): 138–148
DOI: 10.1002/arco.5307

A 600–700-year-old basalt adze production site from Mount Bates, Norfolk Island

Nicola Jorgensen, Amy Mosig Way and James Flexner

NJ: The University of Sydney; AMW: Australian Museum Research Institute, The University of Sydney; JF: The University of Sydney

ABSTRACT

While pre-European settlement of Norfolk Island has been recognised for many decades, particularly the larger settlement site at Emily Bay, until this point there has been limited understanding, and very little systematic recording of evidence for inland settlement. This report presents the location, chronology, stratigraphy and artefact assemblage of a previously undocumented lithic production site from Mount Bates in the north-western uplands of Norfolk Island. The site dates to approximately 600–700 calBP. Excavations recovered over 1200 basalt artefacts, representing various stages in the adze production process. Sites such as this contribute to a better understanding of the range of activities carried out by Polynesian settlers of Norfolk Island, the stone tool economies of marginal Polynesia and the importance of local stone sources for understanding Oceanic settlement.

Keywords: Polynesia, Norfolk Island, stone tools, stratigraphy, chronology, test excavation

RESUME

Alors que la colonisation pré-européenne de l'île Norfolk est reconnue depuis de nombreuses décennies, en particulier le plus grand site de colonisation d'Emily Bay. Jusqu'au présent, la compréhension de la situation et la prospection systématique des preuves d'une colonisation à l'intérieur de l'île étaient limitées. Ce rapport présente l'emplacement, la chronologie, la stratigraphie et l'assemblage d'artefacts d'un site de production lithique jusqu'alors non documenté du mont Bates, dans les hautes terres du nord-ouest de l'île Norfolk. Le site date d'environ 600 à 700 calBP. Les fouilles ont permis de récupérer plus de 1 200 objets en basalte, représentant les différentes étapes initiales du processus de production de l'herminette. Des sites comme celui-ci contribuent à une meilleure compréhension de la suite d'activités exercées par les colons polynésiens de l'île Norfolk, des économies d'outils en pierre de la Polynésie marginale et de l'importance des sources de pierre locales pour comprendre le peuplement océanique.

Mots-clés: Polynésie, Île Norfolk, technologies en pierre, stratigraphie, chronologie, sondage

Correspondence: Nicola Jorgensen, Archaeology, Quadrangle (A14), The University of Sydney, Sydney, NSW 2006, Australia. Email: nsim6903@uni.sydney.edu.au

INTRODUCTION

The timing and nature of Polynesian settlement has been one of the major research areas in Pacific archaeology since its inception (Kirch, 2010, 2017). An ongoing question surrounds the settlement of so-called 'mystery islands', which contain evidence for human settlement but were uninhabited at the time of European colonisation (Weisler, 1994). This report presents new evidence for pre-European settlement from Norfolk Island, which contributes to the current understanding of Polynesian occupation and specifically stone tool production on an island which was uninhabited at the time of British settlement in 1788.

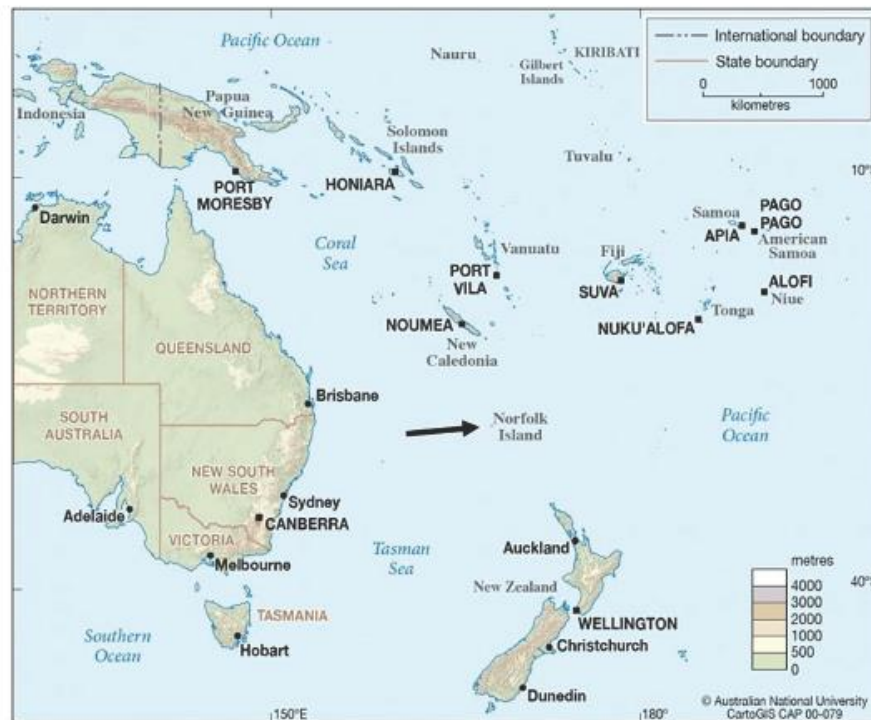
One of the key lines of evidence for tracing long-distance voyaging and exchange in Oceania has been basalt adzes and associated lithic artefacts (Collerson &

Weisler, 2007; Hermann et al., 2023; Jennings et al., 2023; Mills et al., 2008). Basalt adze studies have a long history in Pacific research, ranging from typological and technological (Best, 1977; Clarkson et al., 2014, 2015; Duff, 1950; Shipton et al., 2016) through to geochemical (Collerson & Weisler, 2007; Kahn et al., 2013; Pengilley et al., 2019; Rolett et al., 2015; Weisler, 1998). As a widespread non-perishable commodity, these objects provide valuable information on past cultural processes at both local and regional scales. Greater attention is often given to Pacific adze studies which focus on the largest or most widespread sources, such as Mauna Kea in Hawai'i (Mills et al., 2008) or Tutuila in Samoa (Cochrane & Rieth, 2016). While Pacific archaeologists in recent decades justifiably tend to emphasise artefacts that demonstrate evidence for long-distance voyaging, there were many other

© 2023 The Authors. *Archaeology in Oceania* published by John Wiley & Sons Australia, Ltd on behalf of University of Sydney.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

FIGURE 1. Location of Norfolk Island. Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.



minor, local sources of basalt throughout Oceania. Indeed these are probably the most common source of basaltic stone tool material in the region (Jennings et al., 2023; Mills & Lundblad, 2014; Sheppard et al., 1997; Weisler, 2011; Winterhoff et al., 2007).

The identification of *in situ* archaeological deposits remains a critical target to refine questions about chronology, interaction, and the nature of Polynesian settlement in order to better integrate Norfolk Island into broader discussions of Pacific prehistory. Here we report on a recently discovered basalt working site in Norfolk Island, which is the second stratigraphically definitive, securely dated pre-European Polynesian site in the island. The Mount Bates Saddle site is a Polynesian stone working site in the island's north-west, which was surveyed and excavated during a field expedition in October 2022.

GEOGRAPHIC AND HISTORICAL BACKGROUND

Norfolk Island lies approximately 750 km from both New Zealand and New Caledonia, and around 1400 km from the

Australian east coast (Figure 1). The island was formed through multiple eruptive phases that created a terrestrial landmass of basaltic lava flows and interbedded tuffs (Abell & Falkland, 1991; Green, 1973; Jones & McDougall, 1973). An elevated but deeply incised plateau forms the majority of the island's terrain and surrounds the two highest peaks of Mount Bates and Mount Pitt in the island's north-west. Towards the south coast, the landform drops swiftly to coastal lowland through the Kingston area. Here the volcanic geomorphology transitions to cross-bedded calcarenite formations deposited through Aeolian processes during periods of low sea level (Abell, 1993; Pees et al., 2003). Calcarenite outcrops in this area were quarried extensively for infrastructure during British settlement, but remnants of these geological formations remain around this foreshore.

Norfolk Island was uninhabited when Cook visited the island in 1774, but evidence of a pre-European occupation was uncovered soon after British settlement in 1788. It is now widely accepted that Norfolk Island was occupied by Polynesian people in the early thirteenth to early fifteenth centuries CE (Anderson et al., 2001).

PREVIOUS INVESTIGATIONS ON NORFOLK ISLAND

Prior to formal archaeological investigations, British settlers encountered stone tools, canoe fragments and remnant gardens that suggested a pre-European settlement of Norfolk Island (Hunter, 1793, p. 317, 345, 396; Thorpe, 1929; McCarthy, 1934). The first island-wide archaeological survey took place in 1976 (Specht, 1978, 1984). Recorded surface stone artefacts were interpreted at that time as primarily Polynesian forms, with several Melanesian styles also identified (Specht, 1978, p. 221; Specht, 1984, pp. 26–32). Early settlements from Polynesia and Melanesia were both considered possibilities and an estimated earliest arrival date was placed between 900 and 1100 CE (Specht, 1978, p. 223).

The Norfolk Island Prehistory Project (1995–1999) was a major step forward in confirming the timing and nature of Norfolk Island's pre-European settlement (Anderson & White, 2001). Excavations within sand dunes at the western end of Emily Bay, in the Kingston area, uncovered a Polynesian settlement site with structural remnants of habitation and ritual and a diverse array of shell, bone, plant and lithic materials. Local basalt was the dominant lithology, used in late stage adze manufacturing activities on site. Several obsidian artefacts were also retrieved and geochemical provenancing linked these to Raoul Island in the Kermadec archipelago, and tentatively Mayor Island, New Zealand (Anderson et al., 1997; Turner et al., 2001, p. 63). Occupation at the Emily Bay site was dated from the early thirteenth to the early fifteenth centuries CE (Anderson et al., 2001), establishing the first pre-contact chronology for Norfolk Island. Multiple stone artefacts have been reported since this fieldwork program ended, particularly from the Kingston area, but additional *in situ* deposits have remained elusive until the discovery of the Mount Bates Saddle site.

THE MOUNT BATES SADDLE SITE: SURVEY AND EXCAVATION

The Mount Bates Saddle (MBS) site is located approximately 5.5 km from the Emily Bay coastal site in the forested north-western region of Norfolk Island. The site is on a saddle landform at an elevation of 280 m above sea level between the two tallest mountains on Norfolk Island: Mount Pitt and Mount Bates (Figure 2). The site was first identified as a surface scatter of basalt flakes eroding from a walking track which extends from the peak of Mount Bates to its southern intersection with Mount Pitt Road. A subsequent pedestrian survey of the walking track established the visible extent of the surface scatter.

The survey identified artefacts over an 80 m² area centred along a 25 m section of track. These artefacts consisted of 576 unretouched basalt flakes and fragments and a single Polynesian adze preform (MBS100, Figure 8). A 1 m × 1 m test pit was excavated at the location of

highest surface artefact density (Figure 3) and recovered an additional 711 artefacts. Excavation proceeded in 5 cm spits to a depth of 35 cm. High artefact densities were recorded to a depth of 20 cm and culturally sterile soil was reached at 30 cm.

Three stratigraphic layers were identified (Figure 4). The uppermost layer (Layer I) was characterised by dense calcarenite rubble inclusions derived from the track laid during WWII. The depth of this layer varied, with depth increasing with the slope's descending gradient from north to south. Stone artefacts were intermixed with the calcarenite rubble and introduced gravels and surrounded by a dark brown matrix of moderately compact clay loam. Although artefacts were encountered at relatively high densities throughout this layer, their concentration increased with depth. It is assumed that various post-depositional processes, both natural (i.e., bioturbation and colluvial processes) and anthropogenic (i.e., trampling and vehicle crossings), have caused some upward movement of artefactual material into Layer I. A degree of interaction between Layer I and Layer II is supported by the gradual stratigraphic transition between the layers.

Layer II consisted of a moderate brown compact clayey loam with intermittent lenses of orange and brown clays. This layer included large pieces of natural decomposing basalt which concentrated in the north-eastern corner of the test pit and dispersed out to the south and west. Unlike Layer I, Layer II displayed decreasing depth from north to south. The decomposing basalt inclusions, as well as higher compaction and clay content, may have contributed to greater stability within this depositional layer. Layer II held the highest density of stone artefacts.

A clear transition was evident between Layer II and Layer III, the latter forming the culturally sterile soil layer. Layer III consisted of a distinctive red brown clay with inclusions of grey and yellow clays throughout and was excavated to a depth of approximately 10 cm below the base of Layer II. Layer III held a small number of dispersed flake fragments in the upper 5 cm. The small size of these artefacts and their location close to the transition with Layer II suggests these artefacts were derived from the overlying Layer.

Chronology

The stratigraphic layers were dated from charcoal fragments collected *in situ* during excavation. No charcoal concentrations were encountered. The University of Waikato Radiocarbon Dating Laboratory conducted AMS radiocarbon analysis on four charcoal samples weighing between 0.05 and 0.6 g. The results were calibrated using OxCal v4.4.4 and r:5 atmospheric data (The University of Waikato: Radiocarbon Dating Laboratory (2023; S1). The samples returned an age range of 686–599 (±23) BP for the MBS site (Table 1). The wood species of the samples was not identified and therefore these results may represent maximum dates for the site. However, this relatively short timeline aligns with the radiocarbon dating from the Emily Bay settlement site (c.800–600 calBP; Anderson et al.,

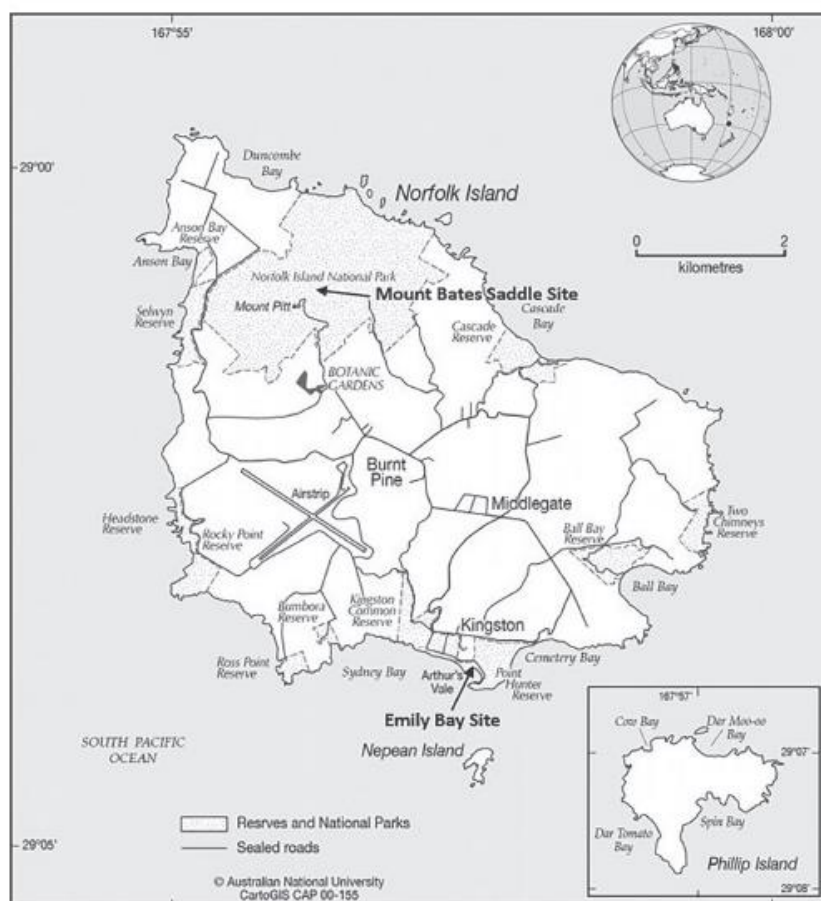
Table 1. AMS radiocarbon dates from the Mount Bates Saddle site.

Stratigraphic layer	Approx. depth	Internal ID	Waikato Lab ID	Material	Uncalibrated ^{14}C age	Calibrated age (68.3% probability)	Calibrated age (95.4% probability)	% Modern carbon ($\text{P}^{14}\text{C}\%$)
I	0–50 mm	CHD8	Wk-55374	Charcoal	590 ± 23 BP	1320–1420 calCE	1320–1430 calCE	$92.8 \pm 0.3\%$
II	50–100 mm	CHI4	Wk-55375	Charcoal	636 ± 23 BP	1320–1400 calCE	1320–1410 calCE	$92.4 \pm 0.3\%$
II	100–150 mm	CHI7	Wk-55376	Charcoal	686 ± 23 BP	1290–1390 calCE	1290–1400 calCE	$91.8 \pm 0.3\%$
Transition of II–III	200 mm	CHI8	Wk-55377	Charcoal	647 ± 23 BP	1320–1400 calCE	1300–1410 calCE	$92.3 \pm 0.3\%$

© 2023 The Authors. *Archaeology in Oceania* published by John Wiley & Sons Australia, Ltd on behalf of University of Sydney.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

FIGURE 2. Location of archaeological sites on Norfolk Island. Adapted from basemap produced by CartoGIS Services, College of Asia and the Pacific, The Australian National University and shared under a Creative Commons CC-BY-SA license.



2001). As the dated samples from Layers I–III are constrained over a short time span, the site is considered to represent a single phase or period of activity.

Lithic assemblage

The excavation and surface survey recovered 1288 basalt artefacts. No other raw materials or non-stone artefacts were found. Unretouched flakes accounted for 99% of the assemblage, with the remainder consisting of two complete adze preforms (see Figure 8). Given the restricted lithology and presence of adze preforms, the MBS site was interpreted as a basalt adze manufacturing site. Following the stratigraphic and chronological analysis, the artefacts were analysed as belonging to a single assemblage.

Technological analysis followed the methods of Turner and Bonica (1994), including their flake weight analyses. We note that their experimental data only included adze making and so while other forms of flaking are known to also produce debitage in various size classes, these were not included in this analysis. The Tahanga basalt adze production complex in New Zealand provided a comparative quarry dataset for a corresponding time period to the MBS site. Some caution needs to be utilised in the employment of this data for comparative purposes in a new context. However, as the material involved the production of a similar tool technology on a similar raw material by people from a Polynesian culture with shared technological traditions, it provides a broadly relevant comparative dataset. Although Melanesian style

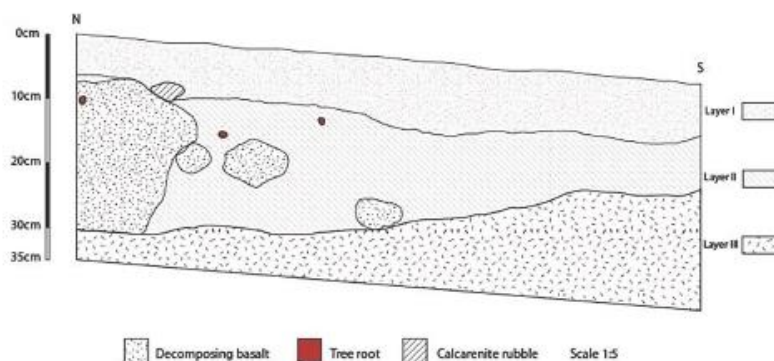
© 2023 The Authors. *Archaeology in Oceania* published by John Wiley & Sons Australia, Ltd on behalf of University of Sydney.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

FIGURE 3. Mount Bates Saddle site test pit, east profile.



FIGURE 4. Mount Bates Saddle site stratigraphy.



implements have been identified on Norfolk Island (Specht, 1978, 1984), the Mount Bates site was not considered 'Melanesian'. Two adze preforms recovered from the site rather fit Polynesian forms, as defined by Clarkson et al. (2014, 2015), and the assemblage was therefore analysed as such.

THE BASALT ARTEFACTS OF MOUNT BATES

The artefact analysis consisted of a comparison of a sample of the Mount Bates assemblage with the Emily Bay and Tahanga quarry assemblages to better understand MBS' position in the adze manufacturing sequence. The Emily Bay assemblage, as representative of the final adze

modification and use stage, and the Tahanga basalt adze quarry complex (New Zealand) thus provided bracketing – initial and final stage adze making – assemblages for comparison. Artefact analysis followed Turner (1992) and Turner and Bonica (1994). This method was designed from experimental adze manufacturing replications in New Zealand and was used for the Emily Bay analysis (Turner et al., 2001). This method utilises flake weight categories coupled with cortical and morphological analysis to provide a broad interpretive framework for the three key stages of adze manufacture: initial roughing out of blanks, preform shaping and fine working.

Seven size categories were established based on weight (Turner & Bonica, 1994, p. 7). Size 1 (>300 g) and Size 2 flakes (201–300 g) are associated with the first reduction

activities in the sequence, including roughing out of blanks over 2500 g. Size 3 (101–200 g) and Size 4 (51–100 g) flakes are commonly produced during roughing out of smaller blanks but can be frequent during preform shaping. Preform shaping flakes are more commonly those within the Size 5 (21–50 g) and Size 6 (3–20 g) categories. Size 7 (<3 g) flakes are the most frequently produced during adze manufacture. Although experimentation found this size to be more common during fine working, these flakes can be produced at any stage of manufacture and are therefore not a reliable indicator of late stage manufacture. As Size 7 (<3 g) flakes were excluded from the Emily Bay analysis (Turner et al., 2001, p. 55), they were similarly removed from the Mount Bates analysis, leaving an assemblage sample of 114 flakes >3 g.

Cortex was classified as primary (100% cortex), secondary (1–99% cortex) or tertiary (0% cortex). These three reduction categories correspond to the typology established by Turner and Bonica (1994, p. 8) as follows: primary = CO (cortex and no scarring), secondary = CP + CS (cortex and primary scarring + cortex and secondary scarring), tertiary = OO + OP + OS (no cortex and no scarring + no cortex and primary scarring + no cortex and secondary scarring). Primary flakes are associated with initial roughing out and blank production. Secondary flakes relate to the subsequent roughing out stage but can also be produced during preform shaping and fine working. Tertiary flakes are associated with the final stages of adze manufacture, including preform and adze shaping.

Flake shape and termination were described using a modified version of Turner and Bonica's (1994, pp. 8–9) six category system. In the original six category system, broken flakes were included as Category C and D flakes. However, due to the difficulty of comparing broken artefacts across assemblages, we reduced the system to the four categories which utilised complete flakes. The four categories retained in our analysis were:

- Category A: flakes with step and hinge terminations,
- Category B: elongated flakes (length > width) with feather terminations,
- Category E: flakes with plunging terminations,
- Category F: expanded flakes (width > length) with feather terminations.

According to Turner and Bonica (1994), Category A flakes often result from the unsuccessful shaping of preform sides and the reworking of adzes and preforms. Category B flakes are often associated with high quality stone and skilled manufacture. Category E flakes are commonly associated with the application of heavy force during manufacture and are frequent in the early reduction stages but are also produced during adze and preform reworking. Category F flakes are most frequent at the fine shaping stage.

'Special Flake Types' (Turner & Bonica, 1994, pp. 9–10) were additionally considered. Turner and Bonica (1994, pp. 9–10) define these as flakes with either a hammer dressed or ground surface, or flakes with retouch or usewear

representing the final modification and use stage. These flakes were present in the Emily Bay assemblage in the form of reworked preform flakes, reworked adze flakes and modified flakes (Turner et al., 2001, p. 55).

LITHIC ANALYSIS RESULTS

The MBS assemblage had a much higher frequency (25.4%) of larger (Size 2–4 flakes: 51–300 g) than the Emily Bay site (3.6%). The MBS frequency of larger artefacts was closer to the 34.5% seen at the Tahanga quarry, suggesting that initial roughing out was occurring at Mount Bates. No Size 1 flakes (>300 g) were recorded, however the presence of Size 2 flakes supports the reduction of blanks exceeding 2500 g. Flakes primarily associated with preform shaping (Size 5 and Size 6) constituted nearly 75% of the MBS flake assemblage, compared with 96.5% at Emily Bay and 65.4% at Tahanga (Figure 5).

In terms of elongation and termination, the MBS site aligned closely with Emily Bay, with high frequencies of Category A flakes (Table 2). Step and hinge terminations are associated with the preform shaping stage of manufacture, with higher rates of unsuccessful terminations and flake breakage occurring during the shaping of preform sides. Category A flakes are also frequent during preform and adze reworking, however no other evidence associated with preform and adze reworking such as grinding, retouch or usewear were identified in the MBS assemblage. Category A flakes can also be attributed to poor quality stone, but this does not appear to have been a factor at either Emily Bay or Mount Bates.

The MBS assemblage had the highest rate of expanding Category F flakes. These are associated with preform shaping, with their size informing whether they are produced during initial or final stage shaping. As shown in Figure 6, Category F flakes were the most frequent flake type in the large (>100 g) flake category, however they were present in all size categories. This suggests both early and later stage preform shaping were occurring at the MBS site. Category E flakes are commonly associated with either the application of heavy force during initial flake manufacture and are frequent in the early reduction stages or adze and preform reworking. The limited presence of Category E flakes at MBS additionally suggests a greater focus on preform shaping over either initial roughing out activities or final stage adze reworking.

In terms of cortex, MBS aligned closely with Emily Bay, with >99.5% of analysed flakes at both sites having had some or all of the cortex removed. No fully cortical flakes were present in either of these sites' analysed assemblages. This contrasted with the Tahanga quarry where 23% of the flakes retained a fully cortical dorsal surface (Figure 7). When combined with the size and morphological data, this suggests that first reduction occurred elsewhere and flake blanks were then transported to this site for further roughing out and preform shaping.

FIGURE 5. Funnel plot showing the percentage of flakes in each size category across Emily Bay (a), Mount Bates (b) and Tahanga Quarry (c).

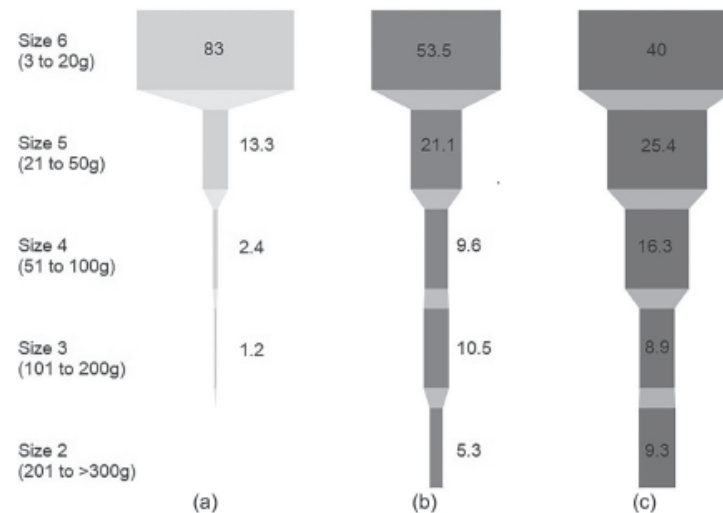


Table 2. Comparison of flake percentages in the four Categories. Note the Emily Bay and Tahanga Quarry percentages were recalculated following removal of Categories C and D.

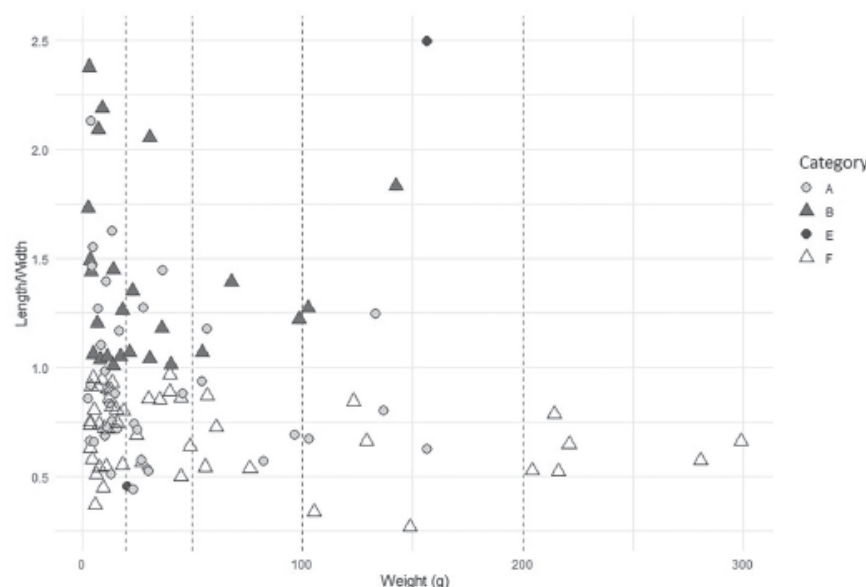
Description	Mount Bates Saddle (%)	Emily Bay (%)	Tahanga Quarry NZ (%)
Category A: Step/hinge termination	32.7	35.5	16.2
Category B: Feather termination + length > width	22.1	25.5	54.8
Category E: Plunging termination	1.8	14.2	9.6
Category F: Feather termination + width > length	43.4	24.7	19.4

At Emily Bay, 'special flakes' were also observed, with preform and adze reworking flakes accounting for 36.7% of the analysed assemblage (Turner et al., 2001, p. 56). Evidence of reworking was also found on adzes and preforms, with seven of the 14 adze and preform pieces showing failed reworking attempts before discard. MBS is clearly different to Emily Bay in this regard: reworked preform flakes and reworked adze flakes were not present in the MBS assemblage.

While no evidence for adze grinding or reworking were present at MBS, two complete adze preforms were uncovered (Figure 8). These consisted of a rectangular-sectioned adze preform (MBS100), partially exposed on the surface of Layer I, and a micro-adze preform (MBS256), recovered from Layer II at a depth of 15 cm below the surface. Classification of these adzes follows the

definitions provided by Clarkson et al. (2014, 2015). The front of MBS256 consists of an unworked ventral surface, a common feature of a micro-adze where grinding plays a larger role in producing the final shape (Clarkson et al., 2014, p. 364). Given this feature it is understood that adzes were manufactured from flake blanks at MBS. Both adzes are consistent with the small size typical of a micro-adze (<300 g) (Clarkson et al., 2014, p. 364). However, MBS100 features more precise flaking and a distinct expanded blade more akin to the rectangular-sectioned form (Clarkson et al., 2014, p. 364). Both adzes were discarded in the final stages of shaping prior to hammer dressing or grinding. This late stage discard (rather than onwards movement for grinding in a watered location elsewhere) may relate to a series of step and hinge terminations, visible along both sides of the preforms, which would have inhibited

FIGURE 6. Scatterplot of Mount Bates artefacts by Weight (g) and Length/Width ratio showing the position of the flakes in the four Categories. Vertical dashed lines mark the size class divisions.



subsequent shaping flake removal. The adze preforms provide robust evidence for adze manufacture at MBS.

DISCUSSION AND CONCLUSION

This evidence suggests the Mount Bates Saddle site consists of either a single adze making workshop, or multiple overlapping but short-lived adze making sessions spanning less than 100 years. The artefact analysis positions adze-making activities at this site mid-way between the quarry and final stages of use/reuse. Cortical analysis shows that no primary flake reduction occurred; rather the blanks must have been quarried elsewhere and carried in in large partly cortical pieces. Whether the ultimate source is a main quarry site elsewhere on Norfolk Island, or smaller local basalt outcrops or boulders is yet to be determined. While the terrain surrounding MBS and the nature of the assemblage suggests a basalt source is nearby, there are currently no known outcrops of suitable manufacturing material near the site. However, survey coverage in this area is extremely limited and a viable source may certainly be present.

The presence of two adze preforms, size class, flake termination and morphological analyses all suggest adze preform manufacturing was occurring at this site prior to

the onwards transportation for shaping at a water source. Emily Bay may have been the final destination for preforms produced at Mount Bates. However, the relationship between the Mount Bates Saddle site and the Emily Bay settlement site requires further investigation. Forthcoming geochemical provenancing research may provide further data on inter-site relationships on Norfolk Island.

In addition, further work is needed to resolve several limitations in this study, most pressingly extended excavation and the recovery of short-lived material for dating. The number of stone artefacts retrieved from the 1 m × 1 m excavation area and the length of the surface expression suggests the site has a much larger subsurface footprint than what was uncovered. Expanded excavations at the Mount Bates Saddle site may reveal further cultural and dateable materials to test the site interpretation established here. Identification of one or more Norfolk Island quarry sites also remains critical for expanding our understanding of local adze manufacturing. Despite these limitations, the Mount Bates Saddle site represents an important example of a Polynesian stone tool manufacturing site, using a local basalt source from the interior of Norfolk Island. It expands our understanding of Polynesian settlement in this remote island and demonstrates adaptation to the local environment and resources by Norfolk Island's pre-European settlers.

FIGURE 7. Stages of reduction based on percentage of artefacts with no cortex (tertiary), some cortex (secondary) and full cortex (primary). EB: Emily Bay, MBS: Mount Bates Saddle, TQ: Tahanga Quarry.

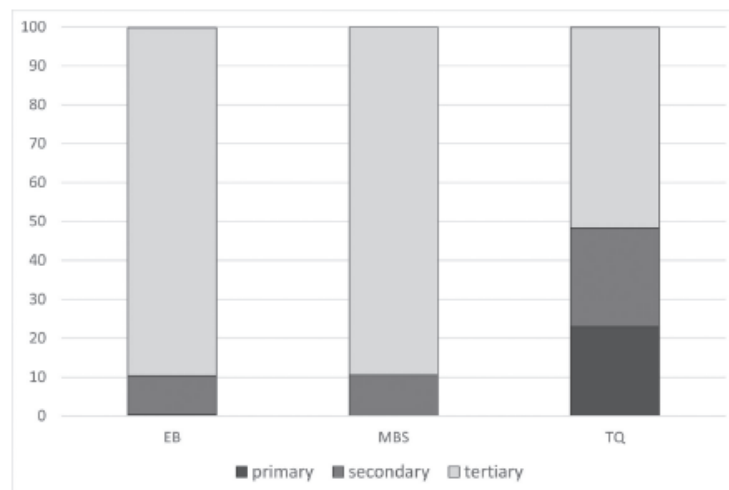
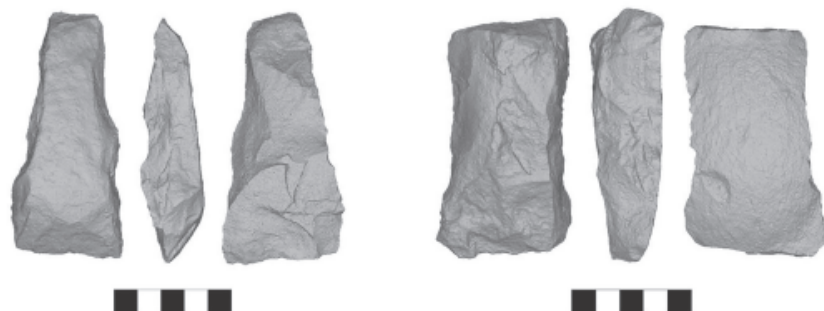


FIGURE 8. Adze preforms from the Mount Bates Saddle site. Left: MBS100. Right: MBS256. Adapted from 3D modelling by Thomas Peachey and Meagan Warwick.



ACKNOWLEDGEMENTS

This report presents the preliminary results of ongoing postgraduate research at the University of Sydney. Research was supported by expedition funding from the Australian Museum. Special thanks to Snowy Tavenor and Arthur Evans for their invaluable contributions to the project to date. Additional thanks to the staff and volunteers at the Norfolk Island National Park office for their support. To the Norfolk Island community, thanks f'ucklun (Norfolk language) for everything.

Open access publishing facilitated by The University of Sydney, as part of the Wiley - The University of Sydney agreement via the Council of Australian University Librarians.

© 2023 The Authors. *Archaeology in Oceania* published by John Wiley & Sons Australia, Ltd on behalf of University of Sydney.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

- Abell, R., & Falkland, A. (1991). The hydrogeology of Norfolk Island South Pacific Ocean. *BMR Bulletin*, 234, 1–57.
- Abell, R. (1993). Aquifer vulnerability on small volcanic islands in the southwest Pacific region – An example from Norfolk Island. *Journal of Australian Geology and Geophysics*, 14, 123–133.
- Anderson, A., & White, P. (Eds). (2001). *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27. Sydney: Australian Museum.

- Anderson, A., Ambrose, W., Leach, F., & Weisler, M. (1997). Material sources of basalt and obsidian artefacts from a prehistoric settlement site on Norfolk Island, South Pacific. *Archaeology in Oceania*, 32, 39–46.
- Anderson, A., Higham, T., & Wallace, R. (2001). The radiocarbon chronology of the Norfolk Island archaeological sites. *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, 33–42.
- Best, S. (1977). The Maori adze: An explanation for change. *Journal of the Polynesian Society*, 86(3), 307–337.
- Clarkson, C., Shipton, C., & Weisler, M. (2014). Determining the reduction sequence of Hawaiian quadrangular adzes using 3D approaches: A case study from Moloka'i. *Journal of Archaeological Science*, 49, 361–371.
- Clarkson, C., Shipton, C., & Weisler, M. (2015). Front, back and sides: Experimental replication and archaeological analysis of Hawaiian adzes and associated debitage. *Archaeology in Oceania*, 50, 71–84.
- Cochrane, E. E., & Rieth, T. M. (2016). Samoan artefact provenance reveals limited artefact transfer within and beyond the archipelago. *Archaeology in Oceania*, 51(2), 150–157.
- Collerson, K. D., & Weisler, M. I. (2007). Stone adze compositions and the extent of ancient Polynesian voyaging and trade. *Science*, 317, 1907–1911.
- Duff, R. (1950). *The Moa hunter period of Maori culture* (1st ed.). Government Printer, Wellington.
- Green, T. (1973). Petrology and geochemistry of basalts from Norfolk Island. *Journal of the Geological Society of Australia*, 20(3), 259–272.
- Hermann, A., Gutierrez, P., Chauvel, C., Maury, R., Liorzou, C., Willie, E., Phillip, I., Forkel, R., Rzymiski, C., & Bedford, S. (2023). Artifact geochemistry demonstrates long-distance voyaging in the Polynesian Outliers. *Science Advances*, 9(16), ead4487. <https://doi.org/10.1126/sciadv.adf4487>
- Hunter, J. (1793). *An historical journal of the transactions at Port Jackson and Norfolk Island*. University of Sydney Library.
- Jennings, C., Weisler, M., & Walter, R. (2023). An archaeological review of Polynesian adze quarries and sources. *Archaeology in Oceania*, 0, 1–28.
- Jones, J., & McDougall, I. (1973). Geological history of Norfolk and Philip Islands, southwest Pacific Ocean. *Journal of Geological Society of Australia*, 20(3), 239–254.
- Kahn, J. G., Sinton, J., Mills, P. R., & Lundblad, S. P. (2013). X-ray fluorescence analysis and intra-island exchange in the Society Island archipelago (Central Eastern Polynesia). *Journal of Archaeological Science*, 40(2), 1194–1202.
- Kirch, P. V. (2010). Peopling of the Pacific: A holistic anthropological perspective. *Annual Review of Anthropology*, 39, 131–148.
- Kirch, P. V. (2017). *On the road of the winds: An archaeological history of the Pacific Islands before European Contact* (2nd ed.). University of California Press.
- McCarthy, F. (1934). Norfolk Island: Additional evidence of a former native occupation. *The Journal of the Polynesian Society*, 43(4), 267–270.
- Mills, P. R., & Lundblad, S. P. (2014). Current perspectives on Hawai'i's stone tool economies. *Journal of Pacific Archaeology*, 5(2), 30–39.
- Mills, P. R., Lundblad, S. P., Smith, J. G., McCoy, P. C., & Naleimale, S. P. (2008). Science and sensitivity: A geochemical characterization of the Mauna Kea Adze Quarry Complex, Hawai'i Island, Hawaii. *American Antiquity*, 73(4), 743–758.
- Pees, S., Duvall, G., & Girault, J. (2003). Eolian calcarenite and heavy minerals from the southwest Pacific. *Carbonates and Evaporites*, 18(2), 108–119.
- Pengilley, A., Brand, C., Flexner, J., Specht, J., & Torrence, R. (2019). Detecting exchange networks in New Britain, Papua New Guinea: Geochemical comparisons between axe-adze blades and in situ volcanic rock sources. *Archaeology in Oceania*, 54, 200–213.
- Rolett, B. V., West, E. W., Sinton, J. M., & Iovita, R. (2015). Ancient East Polynesian voyaging spheres: New evidence from the Vitiara Adze Quarry (Rurutu, Austral Islands). *Journal of Archaeological Science*, 53, 459–471.
- Sheppard, P. J., Walter, R., & Parker, R. J. (1997). Basalt sourcing and the development of Cook Island exchange systems. In M. I. Weisler (Ed.), *Prehistoric long-distance interaction in Oceania: An interdisciplinary approach* (pp. 85–110). New Zealand Archaeological Association.
- Shipton, C., Weisler, M., Jacomb, C., Clarkson, C., & Walter, R. (2016). A morphometric reassessment of Roger Duff's Polynesian adze typology. *Journal of Archaeological Science: Reports*, 6, 361–375.
- Specht, J. (1978). The early mystery of Norfolk Island. *Australian Natural History*, 19(7), 218–223.
- Specht, J. (1984). The prehistoric archaeology of Norfolk Island. *Pacific Archaeological Records*, 34, 1–76.
- The University of Waikato: Radiocarbon Dating Laboratory. (2023). Report on Radiocarbon Age Determination for Wk-55374, Wk-55375, Wk-55376, Wk-55377, 10 January 2023, Hamilton, New Zealand.
- Thorpe, W. (1929). Evidence of Polynesian culture in Australia and Norfolk Island. *The Journal of the Polynesian Society*, 38(2), 122–126.
- Turner, M. (1992). *Make or break: Adze manufacture at the Tahanga Quarry* [Unpublished M.A. thesis]. Department of Anthropology, University of Auckland.
- Turner, M., & Bonica, D. (1994). Following the flake trail: Adze production on the Coromandel East Coast, New Zealand. *New Zealand Journal of Archaeology*, 16, 5–32.
- Turner, M., Anderson, A., & Fullagar, R. (2001). Stone artefacts from the Emily Bay settlement site, Norfolk Island. *Records of the Australian Museum: The Prehistoric Archaeology of Norfolk Island*, supplement 27, 53–66.
- Weisler, M. I. (1994). The settlement of marginal Polynesia: New Evidence from Henderson Island. *Journal of Field Archaeology*, 21(1), 83–102.
- Weisler, M. I. (1998). Hard evidence for prehistoric interaction in Polynesia. *Current Anthropology*, 39(4), 521–532.
- Weisler, M. (2011). A quarried landscape in the Hawaiian Islands. *World Archaeology*, 43(2), 298–317.
- Winterhoff, E. Q., Wozniak, J. A., Ayres, W. S., & Lash, E. (2007). Intra-island source variability on Tutuila, American Samoa and prehistoric basalt exchange in Western Polynesia-Island Melanesia. *Archaeology in Oceania*, 42(2), 65–71.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Supporting Information