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**A comparative quantitative analysis of the mineral
composition of human premolar cementum after the
application of orthodontic forces – an EPMA study.**

Teriko Rex B.D.S.(Hons.)

A Thesis submitted in partial fulfilment of the requirements for the degree of
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Discipline of Orthodontics

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Dedication

To my partner in life and best friend in the world, Darin. Thank-you for your love, encouragement, commitment and support in the pursuit of my aspirations.

To my mother, Keiko and father, Dennis. Thank-you for your love, guidance, continual support and words of wisdom generated from a lifetime of experiences.

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Declaration

CANDIDATE CERTIFICATE

This is to certify that the candidate carried out the work in this thesis in the Orthodontic Department, University of Sydney, and has not been submitted to any other University or Institution for a higher degree.

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Abbreviations

Mx	maxillary
Md	mandibular
RME	rapid maxillary expansion
AW	archwire
SS	stainless steel
1	central incisor
2	lateral incisor
4	first premolar
5	second premolar
6	permanent first molar
U	upper
R	right
L	left
NiTi- SE -SS	nickel titanium superelastic stainless steel
SEM	scanning electron microscope
PDL	periodontal ligament
EPMA	electron probe microanalysis
Ca	calcium
P	phosphorus
F	fluoride
%wt	percent weight
AAC	acellular afibrillar cementum
PAIFC	primary acellular intrinsic fibre cementum
PAEFC	primary acellular extrinsic fibre cementum
SCIFC	secondary cellular intrinsic fibre cementum
SCMFC	secondary cellular mixed fibre cementum
CMSC	cellular mixed stratified cementum
IC	intermediate cementum

Abstract

There have been some suggestions in the literature that the mineral content of cementum may influence resistance or susceptibility to root resorption. Less mineralised cementum has been reported to be more susceptible to root resorption. The mineral composition of cementum after the application of orthodontic forces is to date unexplored and may reveal important information regarding the mechanism of root resorption. The aims and objectives of this study were twofold: (1) to evaluate the calcium (Ca), phosphorus (P) and fluorine (F) content in orthodontically untreated human first premolar cementum at various root positions, and, (2) to perform a comparative quantitative analysis of the Ca, P and F content in intact cementum between human first premolars subjected to 25g and 225g of orthodontic force and those premolars subjected to no orthodontic force (controls). Thirty-six upper and lower first premolar teeth (eighteen experimental, eighteen control) were extracted from sixteen individuals (10M, 6F), mean age 13.9 years (range 11.7–16.1 years) who were randomly assigned to one of two groups, (1) light force (25g), and (2) heavy force (225g). The light force group consisted of nine experimental and nine control first premolar teeth in which 25g of buccally directed force was applied to one of the upper and/or lower first premolars, while the contralateral premolar served as the control. The heavy force group consisted of nine experimental and nine control first premolar teeth in which 225g of buccally directed force was applied to one of the upper and/or lower first premolars while the contralateral premolar served as the control. The experimental and control premolar teeth were extracted 28-29 days after initial force application, and prepared for electron probe microanalysis (EPMA). The Ca, P and F concentrations were measured on the buccal and the lingual surface of the cementum at

the midpoint of the cervical, middle and apical third of the root. At each measurement at the cervical, middle and apical third, 15 points were measured. Results showed that in untreated human first premolar cementum there was a very highly significant inter-individual variation in the Ca, P and F concentrations ($p=0.000$, 0.005 & 0.000 , respectively). There was no significant difference in the Ca, P and F concentrations of cementum between the buccal and lingual surface, except for a significantly higher F content at the cervical region on the buccal surface ($p=0.000$). There was a decreasing gradient in Ca, P and F concentrations from the cervical to apical third of the root which was very highly significant from the cervical to middle third ($p=0.000$) and middle to apical third ($p=0.000$), except for F where there was no significant difference from the cervical to middle third on the lingual surface ($p=0.966$). There was a significant increasing gradient in Ca and P concentrations from the outer to inner third of cementum at the cervical ($p<0.01$) and middle ($p<0.01$) third of the root, with more variable trends at the apical third. For F, there was a significant decreasing gradient from the outer to inner third of cementum at the cervical ($p<0.01$), middle ($p<0.01$) and apical ($p<0.01$) third of the root. With the application of both light (25g) and heavy (225g) orthodontic forces, this study found that there was an overall decrease in the Ca, P and F concentration in cementum. This was only significant for Ca and P concentrations in the heavy force group ($p=0.000$ & 0.004 , respectively). In the heavy force group, there was a significant decrease in Ca at the cervical ($p<0.01$), middle ($p<0.01$) and apical ($p<0.01$) third of the root on the buccal surface, and the middle third of the root on the lingual surface ($p<0.01$). In the same group, there was a significant decrease in P at the cervical ($p<0.01$) and middle ($p<0.01$) third on the lingual surface, and a significant increase in P

at the middle third on the buccal surface ($p < 0.01$). In conclusion, the results of this study show that in untreated human first premolar teeth there is a large inter-individual variation in the Ca, P and F concentrations in human first premolar cementum. There is no difference in the Ca, P and F concentrations of cementum between the buccal and lingual surface except for a higher F content at the cervical region on the buccal surface. There is a decreasing gradient in Ca, P and F concentrations from the cervical to apical third of the root. There is an increasing gradient in Ca and P concentrations from the outer to inner third of cementum at the cervical and middle third of the root and there is a decreasing gradient in F concentrations from the outer to inner third of cementum at the cervical, middle and apical third of the root. With orthodontic force application there is a decrease in the Ca and P concentrations in cementum that is more pronounced with heavier forces. Although there is a trend toward a decreasing F content in cementum with the application of orthodontic forces, a definitive conclusion could not be made due to the large interindividual variation in F content. If less mineralised cementum is more susceptible to resorption as various authors claim, then it is hypothesised that this process of demineralisation that occurs concurrently with orthodontic force application may explain why orthodontically treated teeth are prone to the resorptive process.

Keywords: root resorption, orthodontic force, cementum, mineral composition, calcium, phosphorus, fluoride, fluorine, electron probe microanalysis (EPMA)

1. Introduction

Root resorption is an undesirable complication associated with orthodontic treatment. Although various risk factors have been identified with this pathological process, the exact etiology and underlying mechanism is unknown.

The fundamental mechanism behind the root resorption process is a local inflammatory reaction (Bosshardt *et al.*, 1998). Resorption of the calcified dental tissues occurs when the root resorbing cell or odontoclast obtains access to the mineralised tissue through a breach in the formative cell layer covering the tissue (Tronstad, 1988; Jones and Boyde, 1988), if the mineral and matrix surfaces coincide (Jones and Boyde, 1988), or when the precementum is mechanically damaged or scraped off (Tronstad, 1988). The denuded root areas attract hard tissue resorbing cells to colonize the damaged areas of the root (Tronstad, 1988).

Root resorption occurring in connection with orthodontic tooth movement is associated with local over-compression of the periodontal membrane with development of a sterile coagulation necrosis (a hyalinized zone) (Reitan, 1951; Kvam, 1973; Rygh, 1977; Nakane and Kameyama, 1987; Tanaka *et al.*, 1990). The yielding of the periodontal ligament is a two-step process: an initial morphometric change (compression) followed by biochemical changes. The histochemical changes seen in the periodontal ligament include: fibre coalescence; hyalinisation (Reitan, 1985); degradation of connective tissue matrices by both an extracellular pathway (matrix metalloproteinases) and intracellular phagocytic pathway (lysosomal enzymes) (Sodek and Overall, 1988); and

demineralisation of Sharpey's fibres (Jones and Boyde, 1988). An odontoclastic process follows these changes.

In rats and mice, the first cells to be involved in the initial stage of root resorption at the periphery of the necrotic zone have been shown to be mono-nucleated, TRAP (tartrate resistant acid phosphatase) negative (non-clast) cells resembling macrophages and/or fibroblasts (Brudvik and Rygh, 1993a,b). In the later stage of root resorption beneath the main hyalinized zone, both multi-nucleated, TRAP positive, giant cells without a ruffled border and mono-nucleated, TRAP positive, macrophage-like cells appear to be responsible for removal of the necrotic tissue and resorption of the surface part of the root cementum (Brudvik and Rygh, 1994a,b). It is assumed that these multi-nucleated giant cells without a ruffled border are derived from the mono-nucleated phagocytic system (Brudvik and Rygh, 1994b).

Root resorption at the hyalinized zone occurs in two stages: (1) initially at the circumference of the necrotic hyalinized zone followed several days later by (2) resorption on the root surface situated beneath the main, central part of the necrotic zone (Brudvik and Rygh, 1993a,b). At the latter stage, repair in the periphery of the resorption lacunae is already taking place (Brudvik and Rygh, 1995a,b).

Of all the calcified tissues, cementum is most similar to bone and has been described as a bone-like structure (Hassel, 1993). Bone and cementum, however, behave differently to the application of orthodontic forces. Unlike bone, which undergoes resorption and

apposition of a continual remodelling process, cementum is not normally resorbed. The exact mechanism by which the resorption process is inhibited is as yet unclear, however, several theories exist to explain the resistance of cementum to resorption.

Andreasen (1988) related cementum's resistance to resorption to the innermost cellular layer of the PDL (cementoblasts, fibroblasts, osteoblasts, endothelial and perivascular cells) and discluded the peripheral part of the PDL (Sharpey's fibres, cementum, precementum and epithelial rests of Mallassez). Jones and Boyde (1988), however, did not rule out the Sharpey's fibres, precementum, predentin and elements of the organic matrix as participating in resistance to resorption. It has been reported that various uncalcified mineralised tissues in response to orthodontic force are more resistant to resorption. This has been demonstrated in precementum (Gold and Hasselgren, 1992), osteoid (Chambers et al., 1984), and predentin (Stenvik and Mjör, 1970; Wedenberg, 1987).

Another theory suggests that the mineral content of cementum may play a role in cementum's resistance to root resorption. Certain authors have reported a decreased susceptibility to root resorption where cementum is more mineralized (Henry and Weinmann, 1951; Reitan and Rygh, 1985; Alatli *et al.*, 1996). From histological studies on 261 permanent teeth from untreated individuals, Henry and Weinmann (1951) found that the cervically positioned, more mineralised, acellular cementum was more resistant to root resorption than the apically positioned, less mineralised, cellular cementum.

Reitan (1969) reported that the density and hardness of cementum may influence its resistance to root resorption, where the harder the cementum, the greater the resistance to root resorption. This has been extrapolated from the retarded resorption seen in deciduous teeth during tooth eruption where the hardness of the deciduous tooth substance may retard the resorption process (Rygh and Reitan, 1964). Since hardness has been found to be positively correlated to mineral content (Tesch et al., 2001), it can be extrapolated that cementum with a higher mineral content may also be more resistant to root resorption. Alatli et al., (1996) found in rats, that roots lacking acellular cementum were readily resorbed and concluded that acellular cementum might confer some protective mechanism against root resorption. Fluoride, in particular, has been associated with a reduced risk of both bone (Goldhaber, 1967; Miyagi *et al.*, 1994) and root resorption (Shulman *et al.*, 1968; Bjorvatn and Massler, 1971; Coccia, 1980; Mahajan and Sidhu, 1981; Kameyama *et al.*, 1994). The mechanism whereby fluoride inhibits root resorption is unknown but may be similar to its action on other mineralized tissues such as enamel and bone. In bone, four mechanisms of action have been proposed: (1) promotion of osteoblastic activity or inhibition of osteoclastic activity (Shulman *et al.*, 1968; Hudson, 1961; Schenk *et al.*, 1970; Rich and Feist, 1970); (2) degradation of bone collagen, thus protecting bone from the action of osteoclasts (Messer *et al.*, 1973); (3) an increase in crystallite size (Linkins *et al.*, 1964; Eanes *et al.*, 1965) which is more resistant to dissolution and subsequently resorption (Misra, 1984), and (4) transformation of the surface of hydroxyapatite to that of fluorapatite (Spinelli *et al.*, 1971) which has been reported to be more resistant to resorptive processes (Linkins *et al.*, 1963).

Cementum is a non-uniform, mineralised connective tissue (Soni *et al.*, 1962). On a wet weight basis, human cementum contains 65% inorganic material, 23% organic material and 12% water (Berkovitz *et al.*, 1992). The organic component comprises Type I and Type III collagen and various noncollagenous proteins. The mineral component is hydroxyapatite [$\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$], with small amounts of amorphous calcium phosphates (Bosshardt and Selvig, 1997). The hydroxyapatite in cementum is not chemically pure but contains other elements that have been taken up from the tissue fluid during initial crystallization. Other elements include carbonate (CO_3), citrate, fluoride (F), magnesium (Mg), sulfur (S), sodium (Na), iron (Fe), copper (Cu), zinc (Zn), tin (Sn) and silver (Ag) (Schroeder, 1986). The amount of these ions initially incorporated into the mineral phase reflects their concentration in the fluid environment during mineralization. Over time, the concentration may change by additional uptake or substitution by other ions (Bosshardt and Selvig, 1997). The crystallinity of the mineral component in cementum is lower than in other hard tissues (Selvig, 1965), which means that cementum has a greater capacity for adsorption of fluoride and other elements over time.

Microradiographic, chemical and electron probe microanalysis (EPMA) studies have demonstrated that cementum is less calcified than dentin (Selvig and Selvig, 1962; Selvig and Zander, 1962; Neiders *et al.*, 1972; Hals and Selvig, 1977). There is a rhythmic mineralisation pattern to cementum formation (Soni *et al.*, 1962; Tohda *et al.*, 1996). This incremental pattern of mineralisation creates alternating bands of high and low mineral content, seen as lamellae within the cementum (Soni *et al.*, 1962). The dentino-cementum junction (DCJ) commonly shows a zone of high mineral content delineated by zones of

low mineral content on the dentine side and sometimes on the cementum side as well (Röckert, 1956,1958; Yamamoto *et al.*, 1962; Soni *et al.*, 1962; Selvig and Zander, 1962; Anneroth *et al.*, 1966; Andersen, 1967; Furseth and Johansen, 1968; Neiders *et al.*, 1972). The localization of this hypermineralized zone has not been determined. Boyde and Jones (1968) believe that it is a part of cementum. Other investigators designate it as the CDJ (Selvig and Zander, 1962; Soni *et al.*, 1962) or as a part of dentin (Neiders *et al.*, 1972).

Differences in mineral composition exist from one individual to another, from tooth to tooth in the same individual (Cohen *et al.*, 1992) and between the various cementum types (Soni *et al.*, 1962). Microradiographs of cementum have shown that cervically located acellular extrinsic fibre cementum (AEFC) is more radiodense and, therefore, more mineralised than the apically positioned cellular intrinsic fibre cementum (CIFC), and variably located cellular mixed fibre cementum (CMFC) (Soni *et al.*, 1962). The difference can be explained by the presence of uncalcified spaces, such as lacunae in CIFC and by an uncalcified core of extrinsic Sharpey's fibres in the CMFC (Dreyfuss and Frank, 1964). In addition, the matrix of AEFC tends to be more completely mineralised because its formation is a slower process that allows longer direct contact of tissue fluids (Soni *et al.*, 1962).

There are very few quantitative studies in the literature on the mineral composition of human cementum. These studies have used either chemical analysis (Selvig and Selvig, 1962; Selvig and Zander, 1962; Nakata *et al.*, 1972; Stepnick *et al.*, 1975) or EPMA (Neiders *et al.*, 1972; Hals and Selvig, 1977; Totdal and Hals, 1985; Hennequin and

Douillard, 1995) to gain quantitative data on the mineral composition of cementum. Existing quantitative studies are limited by small samples sizes (Neiders *et al.*, 1972; Tötdal and Hals; 1985), non-homogeneous tooth samples (Nakata *et al.*, 1972; Tötdal and Hals, 1985), different ages of individuals from which the teeth are obtained, different preparation techniques, lack of distinction between the root position examined (buccal vs lingual vs mesial vs distal; cervical vs middle vs apical; outer vs middle vs inner surface) and lack of information regarding the individual's F exposure.

Mean Ca concentrations in human cementum have been found to vary from 24.0% - 29.24% dry wt (Selvig and Selvig, 1962; Neiders *et al.*, 1972; Tötdal and Hals, 1985; Hennequin and Douillard, 1995) or 35.6% - 42.4% ash (Nakata *et al.*, 1972). Mean P concentrations in human cementum have been found to vary from 11.6% - 13.49% dry wt (Selvig and Selvig, 1962; Neiders *et al.*, 1972; Tötdal and Hals, 1985; Hennequin and Douillard, 1995) or 16.6% - 20.0% ash (Nakata *et al.*, 1972). Existing studies show no significant differences in the Ca and P concentration between cervical and mid-root cementum (Neiders *et al.*, 1972), between cervical and apical cementum (Nakata *et al.*, 1972), or between cervical, middle and apical cementum (Selvig and Selvig, 1962), despite the fact that microradiographic studies demonstrate that cervical AEFC is more highly mineralised than apical CMSC or CIFC (Soni *et al.*, 1962). No change in Ca or P concentrations have been demonstrated with age or fluoride exposure (Nakata *et al.*, 1972), except for Selvig and Selvig (1962) who found a higher combined Ca and Mg and P content in cervical cementum from teeth greater than 50 years old that had been exposed to the oral cavity, suggesting an uptake of minerals from the oral environment

over time. Tötdal and Hals, (1985) demonstrated an increasing concentration of Ca and P from the outer surface of cementum to the CDJ, however, Hals and Selvig, (1977) reported little variation in the Ca and P profiles in cervical cementum from the outer surface to the CDJ. Tohda *et al.*, (1996) also demonstrated little variation in the Ca profiles in cervical cementum. No comparison of Ca and P concentrations has been made in the literature between the buccal, lingual, mesial or distal root surfaces.

Cementum has been reported to have the highest F content of all the calcified tissues, up to 5 times as much as enamel, and 3 times as much as alveolar bone. There could be several reasons why cementum has a higher F content than all other calcified tissues. The crystallinity of the mineral component in cementum is lower than in other hard tissues, which means that cementum is more permeable and has a greater capacity for adsorption of F over time. Cementum is also exposed to the circulating tissue fluids in the periodontal ligament from which F can be absorbed (Nakagaki *et al.*, 1985; Sugihara *et al.*, 1991).

F concentrations in cementum show an increase with age (Yoon *et al.*, 1960; Nakata *et al.*, 1972; Nakagaki *et al.*, 1985,1987; Weatherell and Robinson, 1988; Sugihara *et al.*, 1991; Kato *et al.*, 1997; Tsuboi *et al.*, 2000), increasing F concentrations in the drinking water and with greater duration of exposure to the oral environment (Nakata *et al.*, 1972; Stepnick *et al.*, 1975; Kato *et al.*, 1997). There is a general decrease in F content from the cervical to apical cementum, with the mean F content of cervical AEFC being greater than that of apical CMSC and CIFC (Brudevold *et al.*, 1960; Stepnick *et al.*, 1975;

Nakagaki *et al.*, 1988). F concentrations in cementum demonstrate a decreasing concentration gradient from the outer root surface to the CDJ suggesting an uptake over time from the surrounding fluids (Hals and Selvig, 1977; Nakagaki *et al.*, 1985,1987; Murakami *et al.*, 1987; Kato *et al.*, 1991; Tohda *et al.*, 1996; Tsuboi *et al.*, 2000). This uptake of ions from the surroundings has also been thought to explain why root cementum exposed to the oral environment was more mineralised than non-exposed surfaces (Selvig and Zander, 1962; Selvig, 1969; Hals and Selvig, 1977).

In an optimally fluoridated area (1.0-1.3ppm), concentrations at the cervical, middle and apical third of permanent anterior teeth have been reported to range from 0.3->0.9%wt, 0.25-0.79%wt, and 0.3-0.8%wt, respectively (Kato *et al.*, 1997). Nakata *et al.*, (1972) and Stepnick *et al.*, (1972), however, reported lower F concentrations at the cervical and apical third in a large sample of teeth obtained from individuals living in an optimally fluoridated community (0.8-1.2ppm). In a low fluoridated area (0.1ppm or less), lower F concentrations have been found in permanent teeth with a range varying from 0.02-0.79%wt (Nakagaki *et al.*, 1985,1987; Sugihara *et al.*, 1991; Kato *et al.*, 1997). Only two EPMA studies exist that have examined the F concentration in cementum quantitatively. Hals and Selvig (1977) found the fluoride concentration to be higher in the outer cementum (0.5-0.6%wt) compared with the cementum at the CDJ (0.15%wt) in a sample of teeth obtained from individuals living in a low F area. Tötdal and Hals (1985), found the F concentration of cementum to be an average of 0.37%wt, with a range of 0.16-0.7%wt. They did not state what level of fluoridation there was.

Various techniques have been employed to determine the mineral composition of cementum, however, electron probe microanalysis (EPMA) and chemical analysis are the only techniques that can yield fully quantitative data. One of the major problems with chemical analysis of cementum is that it is difficult to obtain large enough samples that are free of dentin and connective tissue (Neiders *et al.*, 1972). EPMA is a technique that does not require the separation of cementum from dentin. It is a fully quantitative method for the non-destructive analysis of μm -sized volumes at the surface of materials, with sensitivity at the level of ppm. EPMA appears to be the most suitable technique for examining elemental composition within localized small areas of mineralised tissue such as cementum. Furthermore, unlike chemical analysis, the composition of a number of elements can be determined at any one time (Andersen, 1967). It has been reported to be the most precise and accurate microanalysis technique available with routine quantification to 1% reproducibility (http://www.cameca.fr/html/epma_technique.html).

The high degree of accuracy obtained with EPMA comes from the use of wavelength dispersive spectroscopy (WDS). The WDS detectors are significantly more sensitive than standard scanning electron microscopy/energy dispersive spectroscopy (SEM/EDS) systems and allow very high precision chemical analysis to be performed (http://srv.emunit.unsw.edu.au/Facilities2000_files/Equipment/_sx50.htm). With WDS, one X-ray wavelength is separated from all others by diffraction from a crystal of known lattice spacing. This provides very fine separation of closely spaced spectral lines, enabling clear recognition of all the overlapping lines due to different elements.

Its spectral resolution is good. The peak to background ratio is high, and therefore elements with a relatively low concentration can be detected (Höhling & Krefting, 1984). To the author's knowledge, the mineral composition of cementum after the application of orthodontic forces is to date unexplored and may reveal important information regarding the mechanism of root resorption. In the present study, it was hypothesized that the application of orthodontic force may cause a demineralization of cementum, and that the magnitude of this demineralization may vary according to the magnitude of applied orthodontic force. The aims and objectives of this study were twofold: (1) to evaluate the Ca, P and F concentrations in orthodontically untreated human first premolar cementum on the buccal and lingual surface at the cervical, middle and apical third from the outer to middle to inner third of cementum using EPMA, and, (2) to perform a comparative quantitative analysis of the Ca, P and F concentrations in intact cementum between human first premolars subjected to 25g and 225g of orthodontic force and those premolars subjected to no orthodontic force (controls) using EPMA.

2. Review of the Literature

2.1 Root Resorption

2.1.1 Definition

Becks and Marshall (1932) defined resorption as the destruction of formed tooth structure. Brudvik and Rygh (1994a) defined root resorption as the active removal of mineralised (and a thin layer of non-mineralized) cementum and dentine.

2.1.2 Classification

Andreasen (1988b) defined 3 types of external root resorption:

1. *Surface resorption*, a self-limiting process usually involving small outlining areas followed by spontaneous repair from adjacent intact parts of the periodontal ligament.
2. *Inflammatory resorption*, where initial root resorption has reached the dentinal tubules of an infected necrotic pulpal tissue or an infected leukocytic zone.
3. *Replacement resorption*, where bone replaces the resorbed tooth material that leads to an ankylosis.

Tronstad (1988) defined 2 types of external root resorption:

1. ***Inflammatory resorption*** occurs when the preentin or precementum becomes mineralised or, in the case of precementum, is mechanically damaged or scraped off. Tronstad (1988) further categorizes inflammatory resorption into 2 types:
 - a. *Transient inflammatory resorption* occurs when the stimulation for resorption is minimal and for a short period. The defect is usually undetected radiographically and is repaired by a cementum-like tissue.
 - b. *Progressive inflammatory resorption* occurs when the stimulation for resorption is for a longer period and is seen radiographically as a shortening of roots.
2. ***Replacement resorption*** where the tooth structure is replaced by bone.

Ghafari (1994) classified 3 types of external root resorption:

1. ***Inflammatory resorption*** where resorption is a result of an inflammatory response to a specific stimulus. Inflammatory mediators and phagocytic cells colonize mineralised or denuded cemental surfaces and later dentinal tubules or pulpal tissues.

2. *Surface resorption*, a transient inflammation in the outlining area of the root surface (cementum and possibly dentin or pulpal tissues), usually followed by repair with a cementum-like tissue. Generally it is undetected radiographically.
3. *Progressive resorption*:
 - a. *With bone substitution*. This involves replacement of the resorbed tooth with bone and a resultant ankylosis.
 - b. *Without bone substitution*. This involves resorption of the tooth without replacement with bone. This appears to be an uncommon outcome.

Root resorption after orthodontic treatment is most commonly surface resorption (Andreasen, 1988b), or transient inflammatory resorption (Tronstad, 1988). Replacement resorption rarely occurs after orthodontic treatment (Brezniak & Wasserstein, 1993a).

2.1.3 History

Bates (1856) was the first to discuss root resorption of permanent teeth followed by Ottolengui (1914) and Ketcham (1927, 1929) who related root resorption directly to orthodontic treatment. Ketcham (1927,1929) was the first to report on radiographic evidence of root resorption and observed that root resorption occurred in all orthodontically treated patients, regardless of the technique. He cited hormonal imbalance and dietary deficiencies as possible causative factors.

From Ketcham's work has followed extensive histological, clinical and physiological research into root resorption and orthodontic treatment. Despite this extensive research, there is still an unknown component surrounding root resorption.

2.1.4 Prevalence

Root resorption has been reported in both orthodontically untreated and treated populations.

2.1.4.1 Untreated Individuals

Prevalence of 0% (Dermaut & De Munck, 1986) to 90% (Henry & Weinmann, 1951) has been reported in untreated individuals. Resorption has been determined both histologically (Henry and Weinmann, 1951) and radiographically (Dermaut & De Munck, 1986). The histological studies give a more accurate indication considering the difficulty of accurately assessing root resorption on radiographs.

From histological studies on 261 permanent teeth from untreated individuals, Henry and Weinmann (1951) found that 90% of teeth exhibited histological evidence of root resorption with 76.8% of resorption areas occurring in the apical third of the root, 19.2% in the middle third and 4% in the gingival third. The average size of the resorption areas measured 0.73mm in length, and 0.10mm in depth. The number of resorption areas increased with age. Resorption areas were more numerous on the mesial than on the

distal surface, and more numerous on the buccal than on the lingual surface. Little difference was noted between the right and left or upper and lower teeth. Repair was evident in 85% of the resorption areas. They concluded that it is normal for a tooth to incur resorption to some degree during its life and that age is a contributory factor in the causation of resorption. Resorption occurs more readily on surfaces facing physiological tooth movement. Resorptions are usually small, shallow and readily repaired. The size of the resorption area is a good index of its severity while the number of resorption areas is an index of the number of incidents that caused root resorption. Acellular cementum, found mainly in the cervical region of the tooth root, is more resistant to root resorption than the more apically positioned cellular cementum.

2.1.4.2 Orthodontically Treated Individuals

In treated subjects, root resorption has been recorded in 93% of adolescents (Kurol *et al.*, 1996). Moderate to severe root resorption ($>2\text{mm}$ - $<1/3$ of root length) has been found in 12-17% of treated patients (Linge and Linge, 1991; Hollender *et al.*, 1980) and excessive root resorption ($>1/3$ of root length) in 1-5% of treated patients (Davidovitch, 1996; Levander and Malmgren, 1988). There is an increasing incidence of root resorption during orthodontic treatment (Lupi *et al.*, 1996). Lupi *et al.*, (1996) using periapical radiographs of maxillary and mandibular incisors reported from their adult sample of 88 that 15% had resorption prior to treatment which increased to 73% after 12 months of fixed appliance treatment.

2.1.5 Aetiology

Numerous factors have been implicated in the aetiology of root resorption and may be classified into biologic (patient-related) factors and mechanical (treatment) factors.

2.1.5.1 Biologic (Patient-Related) factors

2.1.5.1.1 Individual Susceptibility

The incidence of root resorption varies among persons and within the same person at different times (Rygh, 1977). It also occurs in varying degrees in different teeth (Massler and Malone 1952,1954). Becks (1936) stated that orthodontically induced root resorptions were the result of individual predisposition due to endogenous factors.

2.1.5.1.2 Genetics

Massler and Perreault (1954) and Newman (1975) have suggested a genetic component to root resorption with autosomal dominant, autosomal recessive and polygenic modes of inheritance as possibilities (Newman, 1975). Harris *et al.*, (1997) measured crown and root lengths on lateral cephalograms and OPGs in a sample of 103 pairs of full siblings who had orthodontic treatment with the same technique and same orthodontist. They found a significantly greater among-than within-sibship variances, meaning that there

was a substantive genetic factor in susceptibility for external apical root resorption (EARR). Heritability estimates were fairly high, averaging 70% for three roots, except for the mandibular incisor where estimates were low. They concluded that siblings experience similar levels of EARR in response to orthodontic treatment and a prior sibling's outcome should be a useful gauge of another siblings' risk of EARR.

2.1.5.1.3 Systemic Factors

2.1.5.1.3.1 Endocrine Imbalance

Endocrine problems such as hyperparathyroidism (Goultschin *et al.*, 1982; Engström *et al.*, 1988), Paget's disease (Smith, 1978), hypophosphatemia (Tangney, 1979), hypothyroidism, hypopituitarism and hyperpituitarism (Becks, 1939; Hemley, 1941) have been related to root resorption. Linge and Linge (1983), however, suggest that hormonal imbalance does not cause but influences the process of root resorption. Also, Goldie and King (1984) in a study on orthodontically treated, hypocalcemic and lactating rats did not support the hypothesis that secondary hyperparathyroidism created in response to excessive PTH secretion from low blood calcium concentrations is primarily responsible for increased root resorption. Engström *et al.*, (1988), however, in a histologic and biochemical study in normal and hypocalcemic rats observed an increase in the occurrence and severity of root resorptions in the hypocalcemic situation.

2.1.5.1.3.2 Asthma/Allergy

There has been the suggestion that patients with a history of allergies and/or asthma are at a higher risk for developing excessive root resorption during orthodontic treatment (McNab *et al.*, 1999; Owman-Moll and Kurol, 2000; Davidovitch *et al.*, 2000).

McNab *et al.*, (1999) using panoramic films showed that asthmatics had significantly more external apical root resorption of the posterior teeth after treatment compared with the healthy control group ($p=.0194$), however, this increased incidence was only associated with Grade 1 (root blunting). Maxillary first molars were more susceptible than mandibular first molars. It was proposed that inflammatory mediators produced in asthma might enter the periodontal ligament and act to enhance root resorption.

Owman-Moll and Kurol (2000) histologically looked at the extent of root resorption after orthodontic tooth movement of maxillary premolars in a sample of 50 individuals and divided the sample up into a high risk and low risk group for root resorption. They found an association between allergy and the extent of root resorption, but no statistically significant difference between the 2 groups.

Davidovitch *et al.*, (2000) compared the radiographic records of 102 orthodontically-treated patients who presented with excessive root resorption in one or more teeth at the completion of orthodontic treatment with 102 pair-matched controls who had received

orthodontic treatment but had no root resorption. They found an increased incidence of allergies and asthma in the root resorption cohort.

Ong *et al.*, (2000) found that steroid-treated rats displayed significantly less root resorption than controls after orthodontic tooth movement, suggesting that steroid treatment suppresses clastic activity.

2.1.5.1.3.3 Psychological Stress

A recent study revealed that orthodontic patients with psychological stress were at a higher risk for developing excessive root resorption (Davidovitch *et al.*, 2000).

2.1.5.1.3.4 Alcoholism

Circulating ethanol inhibits the hydroxylation of vitamin D3 in the liver, impeding calcium homeostasis and causing a rise in PTH. This has the effect of enhancing the resorption of mineralised tissues, including dental roots. According to Davidovitch, (1996), chronic alcoholics are at a higher risk of developing severe root resorption during the course of orthodontic treatment.

2.1.5.1.4 Nutrition

Marshall (1929) advocated that malnutrition could cause root resorption and Becks (1936) and Engström *et al.*, (1988) demonstrated root resorption in animals deprived of dietary calcium and vitamin D. Contrary to these findings, Linge and Linge (1983) and Goldie and King (1984) suggested that nutritional imbalance is not a major factor in root resorption during orthodontic treatment.

2.1.5.1.5 Chronological Age

Age related changes in the dental hard and soft tissues include reduced vascularity, plasticity and width of the periodontal ligament, increased density and reduced vascularity and plasticity of bone and an increase in width of the cementum. These changes have been reported to be responsible for the increased incidence of root resorption seen in adults (Reitan and Rygh, 1985). Most studies agree that adults are more susceptible to root resorption (Rudolph 1936,1940; Dougherty 1968a,b; Stenvik, 1969; Rosenberg, 1972; VonderAhe, 1973; Reitan, 1964,1974; Reitan and Rygh, 1985; Kennedy *et al.*, 1983; Linge and Linge, 1983; Goldin, 1989; Thilander *et al.*, 2000; Sameshima & Sinclair, 2001a). Only a few studies disagree (Massler and Malone, 1952,1954).

2.1.5.1.6 Dental Age

Partially formed roots appear to develop normally during orthodontic treatment (Fenn *et al.*, unpublished thesis) and certain authors suggest that teeth with open apices may be more resistant to apical root resorption (Rudolph, 1940; Rosenberg, 1972; Linge and Linge, 1983; Fenn *et al.*, unpublished thesis). Fenn *et al.*, (unpublished thesis) found no difference in root length between orthodontically moved maxillary central and lateral incisors with incomplete root formation and control teeth after the root apices had closed. Hendrix *et al.*, (1994), however, found that teeth with incomplete root formation at the onset of orthodontic treatment did not reach “normal tooth length.” Vlaskalic *et al.*, (1998) proposed that the difference in results might be due to differences in study design. The study by Hendrix *et al.*, (1994) employed panoramic radiographs with no adjustment for radiographic projection difference between pre-treatment and post-treatment films and they suggest that this might have introduced inaccuracies.

2.1.5.1.7 Gender

Several studies show no correlation between gender and the extent of root resorption (Massler and Malone, 1954; Kennedy *et al.*, 1983; McFadden *et al.*, 1989; Goldin, 1989; Harris 1997; Sameshima and Sinclair, 2001a), however, other studies suggest that females are more susceptible to root resorption (Massler and Perreault, 1954; Dougherty 1968; Kinsella 1971; Newman, 1975), with Newman (1975) reporting a root resorption ratio of 3.7:1 females to males, respectively. Dougherty (1968) suggested that this might

reflect the difference in root maturity between males and females at the same chronological age, with females having greater root maturity at the same chronological age.

2.1.5.1.8 Ethnicity

Sameshima and Sinclair (2001a) found in a sample of 868 orthodontically treated patients that Asian patients experienced significantly less root resorption than white or Hispanic patients.

2.1.5.1.9 The Presence of Root Resorption Prior to Orthodontic Treatment

There is a high correlation between the amount and severity of root resorption present before treatment to the amount and severity of root resorption present after treatment (Massler and Malone, 1954). Roots demonstrating resorption prior to treatment are at a greater risk of developing further root resorption during orthodontic treatment (Harris and Butler, 1992).

2.1.5.1.10 Habits

Habits such as nail-biting (Odenrick and Brattstrom, 1985), finger sucking beyond 7 years old (Linge and Linge, 1991), lip and/or tongue dysfunction (Newman, 1975; Linge and Linge, 1991) have been shown to predispose roots to root resorption.

2.1.5.1.11 Abnormal Root Form

Abnormal root shape in the form of dilacerated, pointed, and pipette-shaped roots are more susceptible to root resorption (Newman, 1975; Levander and Malmgren, 1988; Linge and Linge, 1991; Kjaer, 1995; Mirabella and Artun, 1995; Thongudomporn and Freer, 1998; Levander *et al.*, 1998; Sameshima and Sinclair, 2001a). Blunt or “shortened” roots have been shown to be both more susceptible to root resorption (Newman, 1975; Thongudomporn and Freer, 1998; Levander *et al.*, 1998) and less susceptible to root resorption (Kjaer, 1995; Lee *et al.*, 1999; Sameshima and Sinclair, 2001a). Sameshima and Sinclair (2001a) compared the amount of root resorption in normal, blunted, pipette-shaped, pointed, dilacerated and incomplete roots after orthodontic treatment and found that dilacerated roots had the most resorption, followed by pipette-shaped and pointed roots. Blunted roots demonstrated the least amount of resorption. It is not known why a deviant root form is more susceptible to root resorption, however, Sameshima and Sinclair (2001a) suggest it may be a result of the deviant process that caused the abnormal root shape, a genetic component to shape inheritance, or disruption of the path of eruption.

2.1.5.1.12 Previous Trauma

Traumatized teeth with a history of root resorption have been shown to be more susceptible to further root resorption during orthodontic treatment (Phillips, 1955; Andreasen, 1988), however, traumatized teeth without signs of resorption do not appear to be resorbed more than nontraumatized teeth (Malmgren *et al.*, 1982). Linge and Linge (1983) found that the average root loss after orthodontic therapy on teeth with a history of trauma was 1.07mm compared with 0.64mm for untraumatized teeth.

2.1.5.1.13 Endodontically Treated Teeth

Conflicting views exist regarding the susceptibility of endodontically treated teeth to root resorption. Wickwire *et al.*, (1974) reported a greater incidence of root resorption in endodontically treated teeth during orthodontic treatment, whereas Reitan and Rygh, (1985), Remington *et al.*, (1989), Mirabella and Artun (1995) and Thilander *et al.*, (2000) suggested that endodontically treated teeth are more resistant to root resorption due to an increase in dentin hardness and density.

2.1.5.1.14 Alveolar Bone Density

Conflicting views exist regarding the relationship between alveolar bone density and susceptibility to root resorption. Various authors have found greater root resorption where tooth movement occurs adjacent to dense alveolar bone (TenHoeve and Mulie, 1976;

Hall, 1978; Goldie and King, 1984; Remmelnick, 1984; Reitan and Rygh, 1985) and this is thought to be due to the fact that there is a reduced number of marrow spaces in dense alveolar bone and, therefore, less bone resorptive cells to remodel bone (Reitan and Rygh, 1985). Goldie and King (1984) used lactating, calcium deficient rats to produce a decrease in bone density concomitant with an increase in parathyroid hormone and found a reduced amount of root resorption where bone density was decreased. Goldson and Henrikson (1975) found an increase in frequency (2x) and severity (8x) of apical root resorption of upper and lower incisors during Stage II of Begg treatment, due to approximation of the apices to the labial compact cortical bone. Wainwright (1973), however, reported that bone density has no relation to the extent of root resorption and Engström *et al.*, (1988) reported conflicting results to Goldie and King (1984) where they demonstrated in calcium deficient rats, an increase in the amount of root resorption where bone density was decreased. Vardimon *et al.*, (1991) also found in monkeys that bone density was only a secondary predisposing factor for root resorption as roots located near the dense buccal cortical plate failed to demonstrate greater resorption than roots near the less dense palatal cortical plate.

2.1.5.1.15 Malocclusion

Again, conflicting views exist in the literature regarding the relationship between malocclusion and the extent of root resorption. VonderAhe (1973) did not find a correlation between root resorption and malocclusion classification, however, other authors have found that an increased overjet (Linge and Linge, 1991; Harris and Butler,

1992; Hendrix *et al.*, 1994; Sameshima and Sinclair, 2001a), openbite (Harris and Butler, 1992) and a Class III malocclusion (Kaley and Phillips, 1991) are more susceptible to root resorption. Sameshima and Sinclair (2001a), however, did not find a correlation between overbite and the amount of root resorption.

2.1.5.1.16 Specific Tooth Vulnerability to Root Resorption

Different teeth have different susceptibilities to root resorption. Most authors agree that the maxillary incisors are the teeth most affected by root resorption and this may be related to the distance moved by the roots during orthodontic treatment (VonderAhe, 1973; Dermaut and DeMunck, 1986; Hollender *et al.*, 1980; Sharpe *et al.*, 1987, Sameshima and Sinclair, 2001b). Maxillary incisor roots tend to be moved more than any other tooth roots and have one of the highest incidences of root resorption (Phillips, 1955; DeShields, 1969; Sjolien and Zachrisson, 1973; Goldson and Henrikson, 1975; Hollender *et al.*, 1980; Kennedy *et al.*, 1983; Reitan and Rygh, 1985; Sharpe *et al.*, 1987; Sameshima and Sinclair, 2001a).

In an extensive review of the literature on root resorption, Brezniak and Wasserstein (1993b) list the most frequently affected teeth, according to severity as the maxillary lateral incisors, maxillary central incisors, mandibular incisors, distal root of mandibular first molars, mandibular second premolars and maxillary second premolars.

Sameshima and Sinclair (2001a) found that most root resorption of clinical interest was found in the anterior segment and that the maxillary anterior teeth were more severely affected than the mandibular anterior teeth by a factor of 2, with incisors demonstrating more resorption than canines. The most severely resorbed teeth were maxillary lateral incisors, followed by maxillary central incisors, maxillary canines, mandibular canines, mandibular central incisors, and mandibular lateral incisors.

2.1.5.1.17 Missing Teeth

Levander *et al.*, (1998b) found a higher risk of apical root resorption during orthodontic treatment in patients with multiple aplasia (four or more missing teeth), in particular in teeth with an abnormal root form and lengthy treatment with elastics and rectangular archwires.

2.1.5.2 Mechanical (Treatment) Factors

Mechanical factors implicated in root resorption include extraction versus non-extraction, extent of tooth movement, type of orthodontic appliance, type of orthodontic movement, and magnitude of orthodontic force.

2.1.5.2.1 Extractions, No Extractions and Serial Extractions

McFadden (1989) and VonderAhe (1973) found no difference in the extent of root resorption in patients treated with or without extractions. Sameshima and Sinclair (2001b), however, found that patients who underwent 4 first premolar extractions had greater resorption than those patients who were treated non-extraction or with upper premolar extractions only. Patients with other extraction patterns (4 second premolar extractions, a mandibular incisor and asymmetric extractions) also demonstrated increased resorption. Kennedy *et al.*, (1983) found that serial extractions without fixed appliance therapy gave less root resorption than serial extractions with fixed appliance therapy.

2.1.5.2.2 Extent of Tooth Movement

Most authors believe that root resorption is directly related to the distance moved by the roots (VonderAhe, 1973; Dermaut and DeMunck, 1986; Hollender *et al.*, 1980; Sharpe *et al.*, 1987, Sameshima and Sinclair, 2001b). Maxillary incisor roots tend to be moved more than any other tooth roots and have one of the highest incidences of root resorption (Phillips, 1955; DeShields, 1969; Kinsella, 1971; Sjolien and Zachrisson, 1973; Goldson and Henrikson, 1975; Hollender *et al.*, 1980; Kennedy *et al.*, 1983; Reitan and Rygh, 1985; Sharpe *et al.*, 1987; Sameshima and Sinclair, 2001a). Baumrind *et al.*, (1996), however, in a study analysing the relationship between upper central incisor displacement measured on lateral cephalograms and apical root resorption measured on anterior

periapical films in orthodontically treated adults found that only a relatively small portion of the observed apical resorption could be accounted for by tooth displacement alone.

2.1.5.2.3 Type of Orthodontic Appliance

Fixed appliances have been shown to cause more root resorption than removable appliances (Linge and Linge, 1983). The standard edgewise technique has been shown to cause more root resorption than the straight-wire technique (Mavragani *et al.*, 2000). No significant difference in the amount of root resorption was found between the Speed and Edgewise techniques (Blake *et al.*, 1995) and between sectional and continuous mechanics (Alexander, 1996). It is controversial as to whether there is a difference in root resorption between the Begg and Edgewise technique. Kinsella (1971) found less resorption in the Begg technique, however, Malmgren *et al.*, (1982) found no difference between the two techniques. It has been suggested that magnets may stimulate a more physiologic tissue response and decrease the potential for root resorption (Blechman & Smiley, 1978; Kawata, 1987). Linge and Linge (1983) found that the use of intermaxillary elastics increased the amount of root resorption, whereas Sameshima and Sinclair (2001b) found no difference in the amount of resorption with the use of elastics. The use of Class III elastics for anchorage preparation has been shown to increase resorption of the distal root of the mandibular first molar (Rudolph, 1940). The use of rapid maxillary expanders has been shown to cause resorption of maxillary first molars and premolars (Barber and Sims, 1981; Odenrick *et al.*, 1991, Vardimon *et al.*, 1991; Thilander *et al.*, 2000), however, Sameshima and Sinclair (2001) proposed no difference

in the amount of root resorption between rapid expansion, slow expansion and no expansion. No difference in the amount of root resorption has been reported between the 0.018" slot and 0.022" slot or between steel or titanium archwires (Sameshima and Sinclair, 2001).

2.1.5.2.4 Type of Orthodontic Tooth Movement

Of all orthodontic tooth movements, it appears that intrusion causes the most root resorption (Stenvik and Mjör, 1970; Reitan, 1974; Dermaut and De Munck, 1986; McFadden *et al.*; 1989; Beck and Harris, 1994; Faltin *et al.*, 1998,2001; Thilander *et al.*, 2000), however, tipping, torque, bodily movement and palatal expansion have also been shown to cause root resorption (Ketcham, 1929; Hemley, 1941; Gottlieb, 1942; Phillips, 1955; VonderAhe, 1973; Linge and Linge, 1983; Reitan and Rygh, 1985; Casa *et al.*, 2001). Reitan (1964), Reitan and Rygh (1985) and Thilander *et al.*, (2000) suggest there is less root resorption with bodily movement compared with tipping due to less stress distribution along the roots during bodily movement.

Ambiguity still exists as to whether continuous or discontinuous forces produce more or less root resorption, however, the pause in treatment with intermittent forces allows the resorbed cementum to heal and many believe that discontinuous forces produce less root resorption (Oppenheim, 1930,1942; Reitan 1964; Dougherty, 1968; Levander & Malmgren, 1994; Maltha and Dijkman, 1996; Acar *et al.* 1999).

Maltha and Dijkman (1996) compared the amount of root resorption after continuous (24 hours a day) and discontinuous (16 hours per day) force applications in beagle dogs and showed that discontinuous forces caused less extensive root resorption.

Acar *et al.* (1999) examined 22 human first premolar teeth from individuals 15–23 years old after the application of a 100gm continuous (24 hours per day) tipping force on one side and a discontinuous (12 hours per day) force on the other side over 9 weeks. Force was applied by means of elastics. The results of this study showed that discontinuous forces resulted in less root resorption than continuous forces. Dr Gregory King, however, discussed various flaws of this study. Force application with elastics relies on subject compliance and this study had no means of assessing compliance. Furthermore, elastics do not deliver forces as reliably as other means. Also maxillary premolars were treated as equivalent to mandibular premolars that may not be valid as there is some evidence in the literature that different tooth types respond differently to root resorption. Furthermore their data was not analysed statistically.

Owman-Moll *et al.* (1995a) disagree with the conclusions of Maltha and Dijkman (1996) and Acar *et al.*, (1999). They examined 32 maxillary first premolars from individuals aged 11.8-15.8 years old after the application of a buccally directed continuous (24 hours a day) and interrupted continuous (interrupted one week every fourth week) force of 50g over 4 and 7 weeks and found no difference in the amount or severity of root resorption between the two forces.

2.1.5.2.5 Magnitude of Orthodontic Force

Conflicting evidence exists in the literature regarding the relationship between force magnitude and root resorption. According to Schwartz (1932), applied force exceeding the optimal level of 26gm/cm^2 causes periodontal ischemia that may lead to root resorption. Various animal (Dellinger, 1967; Kvam, 1967; King and Fischlschweiger, 1982; Vardimon *et al.*, 1991) and human studies (Harry and Sims, 1982; Faltin *et al.*, 1998; Faltin *et al.*, 2001; Casa *et al.*, 2001) agree that there is an increase in the severity of root resorption with increasing force magnitude. However, contradictory findings have been reported by Stenvik and Mjör (1970) and Owmann-Moll *et al.*, (1996a,b), who found no correlation between force magnitude and the extent of root resorption.

Most orthodontic investigations concerning tissue reactions have been performed in animals, and different species have been used (Kvam, 1967; Dellinger, 1967; King and Fischlschweiger, 1982; Vardimon *et al.*, 1991; Maltha *et al.*, 1993). However, there are essential morphological and functional differences in teeth and supporting tissues between animals and man (Reitan and Kvam, 1971), e.g. denser alveolar bone containing fewer marrow spaces in animals compared with humans. Such anatomical differences may influence the resorption process in experiments of longer duration. Rats reveal root resorptions more or less regularly even without previous orthodontic movement, and this may explain the high incidence of root resorptions in both test and control teeth of rats. Therefore, animal studies should always be looked at cautiously.

Dellinger (1967) applied a 10g, 50g, 100g and 300g intrusive force to the maxillary first premolars of four *Macaca speciosa* monkeys for 60 days and found that root resorption was directly related to force magnitude. The 10g and 50g forces resulted in only slight to moderate root resorption, whereas the 100g force gave an increased amount of root resorption and the 300g force resulted in severe resorption. King and Fischlschweiger (1982) applied 50-200g of force in rats and reported that light forces produced more rapid tooth movements with insignificant cementum cratering whereas intermediate or heavy forces resulted in slower displacements and a substantial amount of root resorption. Vardimon *et al.*, (1991) in short-term experiments (33 – 135 days) in monkeys found that the magnitude of force is the predominant factor when aggravation of root resorption is concerned.

Harry and Sims (1982) examined 36 human premolar teeth (18 experimental, 18 control) from individuals 11-18 years old by SEM after the application of a 50g, 100g and 200g intrusive force over experimental periods of 14, 35 and 70 days. The results showed that the distribution of resorbed lacunae was directly related to the amount of stress on the root surface and the rate of lacunae development was more rapid with increasingly applied forces. They concluded that higher stress causes more root resorption. Faltin *et al.*, (1998) and Faltin *et al.*, (2001) applied 50 or 100 cN of continuous intrusive force to 12 upper first premolars, orthodontically indicated for extraction in six individuals, mean age 15.3 years, for 4 weeks. Examination under the transmission electron microscope demonstrated greater root resorption in those teeth intruded with the heavier force. They concluded that a reduction of continuous force magnitude should be considered to

preserve the integrity of the root. Casa *et al.*, (2001) applied 300 or 600cN of continuous torque to 28 upper first premolars orthodontically indicated for extraction from 14 patients with a mean age of 13.8 years, for 1, 2, 3 and 4 weeks. Examination under the SEM demonstrated that teeth that had been moved with a higher magnitude of force showed a higher degree of root resorption in width and depth.

Contradictive findings have been reported by Stenvik and Mjör (1970), Reitan (1974) and Owmann-Moll *et al.*, (1996a,b), who found no correlation between force magnitude and the extent of root resorption. Stenvik and Mjör (1970), in a sample of 70 human premolar teeth (35 experimental, 35 control) from individuals aged 10-13 years, applied 35g – 250g of intrusive force over a period of 4-35 days. The results showed no correlation between the magnitude of force applied and the extent of root resorption, however, the observation period may have been too short to show the full extent of the resorptions. The distribution of the resorption areas were the same in both the apical and cervical parts of the root implying no difference in the susceptibility to root resorption between acellular extrinsic fibre cementum (AEFC) and cellular mixed stratified cementum (CMSC) or cellular intrinsic fibre cementum (CIFC).

Reitan (1974) examined 72 premolars from individuals 9-16 years old after the application of 25g to 240g of intrusion, extrusion and tipping movements over 10 to 47 days and found that external root resorption was poorly correlated to force magnitude.

Owman-Moll *et al.*, (1996a), examined 32 maxillary premolars from individuals aged 10.1-15.8 years old after the application of a buccally directed continuous force of 50g in 16 teeth and 100g in the other 16 teeth. The right premolar served as the experimental tooth, the left the control. The experimental period was for 4 and 7 weeks. The results of this study showed that the severity of root resorption did not differ significantly when the applied force was doubled to 100g and that great individual variation existed regarding both the magnitude of tooth movement and the amount of root resorption. They concluded that force magnitude was independent of the extent of root resorption and that individual reactions may have more impact than the increase in force or length of the experimental period on both the tooth movement achieved and occurrence of root resorption.

Owman-Moll *et al.*, (1996b) applied a buccally directed continuous force of 50g to the maxillary first premolar on one side and 200g to the maxillary first premolar on the other side in 8 individuals, mean age 13yrs, during a 7-week experimental period. They found when the applied force was increased to 200g, there was a 50% increase in the rate of tooth movement without any significant difference in the frequency and severity of root resorption. Individual variation was large.

The results of Owman-Moll *et al.*, (1996a) and Owman-Moll *et al.*, (1996b) have clinical implications that suggest that by using heavier forces, the rate of tooth movement is increased without any detrimental effects with regard to root resorption. This should be

looked at cautiously as the experimental period was 4-7 weeks only; it is unknown what would happen long-term so long-term studies are needed.

2.1.5.2.6 Treatment Duration

The majority of studies agree that the severity of root resorption is directly related to treatment duration, with the longer the treatment time, the greater the extent of root resorption (Rudolph, 1936,1940; Dougherty, 1968; DeShields, 1969; Stenvik and Mjör, 1970; Kinsella, 1971; Morse, 1971; Kvam, 1972; Reitan, 1974; Goldson and Henriksson, 1975; Harry and Sims, 1982; Williams, 1984; Sharpe *et al.*, 1987; Levander and Malmgren 1988; Goldin, 1989; McFadden *et al.*, 1989; Linge and Linge, 1991; Vardimon *et al.*, 1991; Brezniak and Wasserstein, 1993; Baumrind *et al.*, 1996; Kurol *et al.*, 1996; Vlaskalic *et al.*, 1998; Sameshima and Sinclair, 2001b; Casa *et al.*, 2001). Only a few studies have not supported this finding (Phillips, 1955; VonderAhe, 1973; Lilja and Odenrick, 1982; Dermaut and DeMunck, 1986; Linge and Linge, 1991).

Animal studies by Williams (1984) in rats and Vardimon *et al.*, (1991) in monkeys have demonstrated an increased incidence of root resorption with longer treatment periods.

SEM studies on extracted human premolar teeth subjected to orthodontic force have demonstrated an increase in the severity of root resorption with increasing treatment duration. Stenvik and Mjör (1970), in a sample of 70 human premolar teeth (35 experimental, 35 control) from individuals aged 10-13 years, applied 35g – 250g of

intrusive force over a period of 4-35 days. The results showed an increase in root resorption with an increase in treatment time. They concluded that the duration of force application was a more critical factor than force magnitude with regard to root resorption. Kvam (1972) examined 40 human premolar teeth (23 experimental, 17 control) by SEM from individuals 10-12 years old after application of a 50gm buccally directed force for 5-76 days and found that the amount of root resorption increased with time. Reitan (1974) examined 72 premolars from individuals 9-16 years old after the application of 25g to 240g of intrusion, extrusion and tipping movements over 10 to 47 days and found that external root resorption was directly related to treatment time. Harry and Sims (1982) examined 36 human premolar teeth (18 experimental, 18 control) from individuals 11-18 years old by SEM after the application of a 50g, 100g and 200g intrusive force over experimental periods of 14, 35 and 70 days. The results showed that the severity of root resorption increased with an increase in treatment time. They also concluded that the duration of force application was a more critical factor than force magnitude with regard to root resorption. Kurol *et al.*, (1996) examined 112 human maxillary premolars (56 experimental, 56 control) from individuals aged 10.5-17.5 years old after the application of a buccally directed continuous force of 50g over 1-7 weeks. The results of this study showed that the number of resorptions increased with time. Casa *et al.*, (2001) applied 300 or 600cN of continuous torque to 28 upper first premolars orthodontically indicated for extraction from 14 patients with a mean age of 13.8 years, for 1, 2, 3 and 4 weeks. Examination under the SEM demonstrated that teeth that had been moved for a longer time period showed a higher degree of root resorption in width and depth.

Similar conclusions regarding treatment time and the severity of root resorption have been drawn from radiographic studies. DeShields (1969) in a radiographic study on root resorption of the anterior maxillary teeth in class II division I malocclusions found a statistically significant correlation between treatment time in months and the degree of apical root resorption. Morse (1971) found those patients with marked root resorptions had been treated for a longer period of time than a random sample of orthodontic patients. Goldson and Henrikson (1975) looked at root resorption radiographically and suggested a relationship between the amount of resorption and duration of treatment. McFadden *et al.*, (1989) in a radiographic study examining the relationship between incisor intrusion and root shortening found that treatment time was the most significant factor for the occurrence of root shortening. Goldin (1989) in a radiographic study examining the effect of labial root torque on the maxilla and incisor root apex found that apical root resorption occurred at a rate of 12.7% per year. Root resorption was, therefore, greater with longer treatment times. Baumrind *et al.*, (1996) in a study analysing the relationship between upper central incisor displacement measured on lateral cephalograms and apical root resorption measured on anterior periapical films in orthodontically treated adults found that treatment time displayed statistically significant associations with apical resorption.

The following investigators have reported contradictory findings. VonderAhe (1973) in a radiographic study of orthodontically treated patients and Lilja and Odenrick (1982) could not find a correlation between duration of force application and the extent of root resorption. Linge and Linge (1984) examined radiographically the incidence and extent of apical root resorption in maxillary incisors in 719 consecutively treated orthodontic

patients. Mean age at treatment initiation was 12.8yrs and mean observation time was 3.6yrs. Root lengths were measured to the nearest 0.1mm on standardized intraoral radiographs taken before and after treatment. They found that treatment time was not closely related to the amount of apical root resorption. Dermaut and DeMunck (1986), using periapical X-rays, examined the extent of root resorption after the application of intrusive force on the maxillary central and lateral incisors via a modified Burstone intrusion arch (0.18" Australian wire) engaged in Begg brackets in 20 patients, age range from 11-37yrs (average age 15years) for a mean intrusive period of 29 weeks (range of 8-64 weeks). They found no correlation between the duration of force application and root resorption.

2.1.6 Mechanism of Root Resorption

The exact mechanism of root resorption is not yet fully understood, however, the fundamental component behind the root resorption process is a local inflammatory reaction (Bosshardt *et al.*, 1998). For this reason, Brezniak and Wasserstein (2002) suggest that orthodontic force-induced root resorption should be more accurately termed orthodontically induced inflammatory root resorption (OIIRR).

Resorption of the calcified dental tissues occurs when the root resorbing cell or odontoclast obtains access to the mineralised tissue through a breach in the formative cell layer covering the tissue (Tronstad, 1988; Jones and Boyde, 1988), if the mineral and matrix surfaces coincide (Jones and Boyde, 1988), or when the precementum is

mechanically damaged or scraped off (Tronstad, 1988). The denuded root areas attract hard tissue resorbing cells to colonize the damaged areas of the root (Tronstad, 1988).

Root resorption occurring in connection with orthodontic tooth movement is associated with local over-compression of the periodontal membrane with development of a sterile coagulation necrosis (a hyalinized zone) (Reitan, 1951; Kvam, 1973; Rygh, 1977; Nakane and Kameyama, 1987; Tanaka *et al.*, 1990). The yielding of the periodontal ligament is a two-step process: an initial morphometric change (compression) followed by biochemical changes. The histochemical changes seen in the periodontal ligament include: fibre coalescence; hyalinisation (Reitan, 1985); degradation of connective tissue matrices by both an extracellular pathway (matrix metalloproteinases) and intracellular phagocytic pathway (lysosomal enzymes) (Sodek and Overall, 1988); and demineralisation of Sharpey's fibres (Jones and Boyde, 1988). An odontoclastic process follows these changes.

In rats and mice, the first cells to be involved in the initial stage of root resorption at the periphery of the necrotic zone have been shown to be mono-nucleated, TRAP (tartrate resistant acid phosphatase) negative (non-clast) cells resembling macrophages and/or fibroblasts (Brudvik and Rygh, 1993a,b). TRAP staining is used as a marker of osteoclasts and their precursors (Minkin, 1982; Cole and Waters, 1987) and works on the principle that the main acid phosphatase of osteoclasts (a specific isoenzyme) is resistant to tartrate (Hammarström *et al.*, 1971). In the later stage of root resorption beneath the main hyalinized zone, both multi-nucleated, TRAP positive, giant cells without a ruffled

border and mono-nucleated, TRAP positive, macrophage-like cells appear to be responsible for removal of the necrotic tissue and resorption of the surface part of the root cementum (Brudvik and Rygh, 1994a,b). It is assumed that these multi-nucleated giant cells without a ruffled border are derived from the mono-nucleated phagocytic system (Brudvik and Rygh, 1994b).

Studies in mice and rats have confirmed that OIIRR is part of the hyaline zone elimination process (Brudvik and Rygh, 1993a,b; 1994a,b; 1995a,b). Root resorption at the hyalinized zone occurs in two stages: (1) initially at the circumference of the necrotic hyalinized zone followed several days later by (2) resorption on the root surface situated beneath the main, central part of the necrotic zone (Brudvik and Rygh, 1993a,b). At the latter stage, repair in the periphery of the resorption lacunae is already taking place (Brudvik and Rygh, 1995a,b).

2.1.7 Repair of Root Resorption

The reparative process begins when no hyaline tissue is present and/or the applied orthodontic force is discontinued or reduced to below a certain level (Reitan, 1974, 1985; Rygh 1977, 1985; Brudvik and Rygh, 1995a,b). According to Schwartz (1932), when pressure decreases below the optimal force ($20-26\text{g/cm}^2$) root resorption ceases. Vardimon *et al.*, (1991) found that all resorptions heal provided that the resorbed surface area does not exceed the unresorbed surface.

Repair has been recorded 35-70 days after force application (Stenvik and Mjör, 1970; Harry and Sims, 1982), within 2 weeks after force cessation (Sismanidou and Lindskog, 1995) and during the first week of retention (Owman-Moll *et al.*, 1995b). The healing process increases with time (Barber and Sims, 1981; Langford and Sims, 1982; Odenrick *et al.*, 1991, Owman-Moll *et al.* (1995b); Owman-Moll and Kurol, 1998). After 5-6 weeks of retention, the repair of root resorption seems to slow down and reach a steady phase (Vardimon *et al.*, 1993; Owman-Moll *et al.*, 1995b). Vardimon *et al.*, (1993) found that the healing process in monkeys reached a steady state after 42-56 days of retention.

Owman-Moll *et al.*, (1995b) and Owman-Moll and Kurol (1998) examined maxillary first premolars from adolescents after the application of a buccally directed continuous force of 50g, reactivated weekly over 6 weeks. After that, the appliance was made passive for 1-8 weeks (Owman-Moll *et al.*, 1995b) and 1-7 weeks (Owman-Moll and Kurol, 1998) to retain the test teeth and prevent relapse. The percentage of root resorptions with varying degrees of repair was reported to be 28% after 1 week (Owman-Moll *et al.*, 1995b), 35% at 2 weeks (Owman-Moll and Kurol, 1998), 44% at 3 weeks (Owman-Moll and Kurol, 1998), and 82% after 6 and 7 weeks of retention.

Repair is predominantly characterised by cellular cementum (Barber and Sims, 1981; Lilja and Odenrick, 1982; Langford and Sims, 1982; Vardimon *et al.*, 1993; Bosshardt and Schroeder, 1994; Owman-Moll *et al.*, 1995b; Owman-Moll and Kurol, 1998). Owman-Moll and Kurol, (1998) examined 32 maxillary first premolars from 16 adolescents (mean age 13.8yrs) after the application of a buccally directed force of 50g,

reactivated weekly, for 6 weeks, after which the appliance was made passive for 1-7 weeks. They found that most of the reparative cementum was of the cellular type and always covered an initially formed acellular cementum. This was supported by Vardimon *et al.*, (1993) in monkeys, by Bosshardt and Schroeder (1994), who suggests that the initial reparative cementum is often of an acellular type, but that the continued repair process occurs with rapidly formed cellular cementum and by Sismanidou and Lindskog (1995) who described a healing phase characterised by an initial deposition of acellular cementum within 2 weeks of force cessation, followed by a slower deposition of cellular cementum at more advanced stages of healing. It has also been suggested that root resorption and repair with secondary cementum may occur simultaneously (Stenvik and Mjör, 1970; Barber and Sims, 1981; Harry and Sims, 1982).

Bosshardt and Schroeder (1994) described the attachment of repair cementum to the resorbed roots of permanent teeth. A 1-2µm thick seam of exposed collagen fibrils of the residual dentinal matrix lines the resorbed root surfaces. Mononuclear cells repopulate these surfaces and attach to newly produced collagenous matrix fibrils of the exposed dentin matrix. Increasing fibril formation and bundling results in a collagenous fibrous fringe oriented perpendicular to the bottom of Howship's lacunae. Following the implantation and establishment of this initial fibrous fringe, a fine granular material indicating the advancing front of mineralization progressively obscures the junctional zone between the two matrices. The initially produced matrix is AEFC, whereas further apposition is with CIFC.

Different spacial repair patterns have been reported. Animal studies have shown that early repair proceeds from the periphery of the resorption cavity (Lindskog *et al.*, 1987; Vardimon *et al.*, 1993; Brudvik and Rygh, 1995a,b). Brudvik and Rygh (1995a,b) demonstrated in rats that the repair process was characterised by an invasion of fibroblast-like cells from the circumference into the active root resorption site. Furthermore, they found that at the same time that repair was occurring in the periphery of the resorption lacunae, active resorption by multi-nucleated odontoclast-like cells took place in the central parts. Vardimon *et al.*, (1993), in an investigation on rapid maxillary expansion in 8 monkeys, studied the repair process after 16 weeks of retention followed by a relapse period of 8 weeks. They described two types of repair patterns: functional rapid cellular repair and non-functional retarded acellular repair. The latter type was mainly seen at the onset of the reparative phase. They found that repair was mainly a partial restoration – functional or non-functional depending on the rate of deposition of repair tissue (rapid/slow) and the development of extrinsic fibres (present/absent).

Human studies, however, have demonstrated early repair proceeding from the centre of the resorption cavity (Barber and Sims, 1981; Owman-Moll and Kurol, 1998). Sismanidou and Lindskog (1995) observed both types of repair patterns in adolescents. Owman-Moll and Kurol (1998) suggest that the difference observed in cementum deposition between humans and animals may be explained by certain morphological differences between human cementum and the cementum of various animals, such as rats and dogs as indicated by observations in the scanning electron microscope (Boyde and Jones, 1968; Jones and Boyde, 1972).

Owman-Moll *et al.*, (1995b) commented that Vardimon's studies might be invalid due to the relapse period. They noted that contraction of PDL fibres during the relapse period might be strong enough to create hyalinized areas in the PDL (Reitan, 1960, 1985), which may alter the remodelling process on the root surface and surrounding tissues. Furthermore, if the time factor after retention is too long, factors such as habits, function, and trauma may obscure the repair process.

Owman-Moll *et al.*, (1995b) examined 64 maxillary first premolars from individuals aged 11.3-17.3 years old after the application of a buccally directed continuous force of 50g, reactivated weekly over 6 weeks. After that, the appliance was made passive for 1-8 weeks to retain the test teeth and prevent relapse. The following registrations of repair were made: 1) *no repair*, 2) *partial repair*; part of the surface of the resorption cavity is covered with reparative cementum, 3) *functional repair*; the total surface of the resorption cavity is covered with reparative cementum without re-establishment of the original root contour, and, 4) *anatomic repair*; the total surface of the resorption cavity is covered with reparative cementum to such an extent that the original root contour is re-established. The results of this study showed that partial repair was the most frequent type of repair during the first 4 weeks of retention (17-31%) and most commonly seen in the cervical third of the root. Functional repair dominated the healing pattern after 5, 6, 7, and 8 weeks of retention (33-40%) and anatomical repair was most often seen in the apical third. Almost every second resorption showed resorption surfaces with open dentin tubuli after 8 weeks of retention. There were no large differences in the healing potential

in the cervical, middle and apical thirds of the root, however, there were large individual variations.

2.1.8 Diagnosis of Root Resorption

Radiographs are the most commonly used tools in the diagnosis of root resorption, however, they have several limitations with respect to accurate diagnosis. The advantage of CT scans over radiographs in the diagnosis of root resorption is significant, but at this stage due to its expense it is generally limited to research. Buccal and lingual root resorption defects are not visible with currently used imaging technologies (Brezniak and Wasserstein, 2002). Additional mesial or distal periapical views might increase the accuracy of the diagnosis of root resorption (Andreasen *et al.*, 1987; Goldberg *et al.*, 1998). Digital reconstruction using computer software may also enable more accurate analyses of the extent of root resorption (Reukers *et al.*, 1998a,b; Heo *et al.*, 2001).

2.1.9 Prevention and Management of Root Resorption

Various approaches to prevention of root resorption have been suggested in the literature and were summarized by Vlaskalic *et al.*, (1998). These include a short duration of treatment (Stenvik and Mjör, 1970, Levander and Malmgren 1988), the use of light intermittent forces (Rudolph, 1940; Stenvik and Mjör, 1970; Rygh, 1977; Reitan, 1974; Harry and Sims, 1982), habit control (Newman, 1975; Odenrick and Brattstrom, 1985)

and detailed assessment of medical history and familial tendency (Jacobson, 1952; Newman, 1975; McFadden *et al.*, 1989). Interruption of treatment (Schmid, 1931; Levander *et al.*, 1994) or removal of appliances with relapse of tooth position have been shown to initiate repair and stop the resorptive process (Rygh, 1977; Reitan, 1985). Levander and Malmgren (1994) found that in patients who demonstrated some apical root resorption a pause in treatment of 2-3 months significantly reduced the amount of radiographic root resorption compared to those patients treated without interruption. Based on the findings of Fenn *et al.*, (unpublished thesis) that teeth with open apices may be more resistant to root resorption, Vlaskalic *et al.*, (1998) suggest that it might be beneficial to begin treatment of moderate to severe malocclusions before the age of 9 years, when most incisors have open apices (Moorees *et al.*, 1963). Avoiding intermaxillary elastics to decrease jiggling forces was recommended by Linge and Linge, (1991) and limiting tooth movements associated with increased risk of root resorption namely intrusion and torque was recommended by Parker and Harris (1998). Despite all these recommendations, no data exists to confirm that such strategies result in a lower incidence of root resorption.

It has been recommended that after 6 months of treatment, periapical radiographs be taken and where resorption is detected, treatment should be halted for 2-3 months with passive archwires (Levander and Malmgren, 1994,1998a,2000). Ghafari (1994) suggests that where resorption is detected, an additional radiograph be taken in 3 months time. Levander *et al.*, (1998a) suggest 3-monthly radiographic review of blunt and pipette-shaped apices. Where severe resorption is identified, the treatment goals should be

reassessed with the patient and a compromised treatment result may have to be accepted (Brezniak and Wasserstein, 2002).

Final records including radiographs are mandatory (Brezniak and Wasserstein, 2002) at the time of deband. For teeth with severe resorption, follow-up radiographic examinations are recommended until further root resorption is no longer evident (Levander and Malmgren, 2000). In cases of extreme resorption, endodontic treatment may need to be considered (Gholston and Mattison, 1983; Brezniak and Wasserstein, 1993). Retaining teeth with fixed appliances should be done with caution. Occlusal trauma of the fixed teeth or segments might lead to extreme resorption (Roberts, 2000).

2.1.10 The Clinical Significance of Root Resorption

Despite the fact that most orthodontically treated patients experience some degree of root resorption, this does not appear to increase their future risk of tooth loss (VonderAhe, 1973; Remington *et al.*, 1989; Parker, 1997). Fortunately, loss of root length by apical root resorption is far less detrimental than an equivalent amount of periodontal attachment loss at the alveolar crest particularly in the initial stages (3mm or less) of root resorption (Kalkwarf *et al.*, 1986; Lupi *et al.*, 1996). Kalkwarf *et al.*, (1986), using a computer graphics system, calculated the area of periodontal attachment remaining after various lengths of root loss on a central incisor tooth and found that 1mm of apical root loss was equivalent to 5% of periodontal attachment loss. Similarly, a tooth with 5mm of apical root resorption would still have 75% of periodontal attachment remaining.

2.1.11 Sequelae of Root Resorption

There is very little in the literature regarding the sequelae of root resorption associated with orthodontic treatment. In a review of the literature on root resorption, Vlaskalic *et al.*, (1998) found only 6 articles published between 1914 and 1997 that reported cases of apical root resorption posing a problem for either the clinician or patient (Crane, 1926; Miller, 1930; Lussier, 1936; Lyndon Carmon, 1936; Langford and Sims, 1981). None of these authors reported tooth loss resulting from severe apical root resorption after orthodontic treatment. Of the few studies that have looked at the long-term outcome of apical root resorption (VonderAhe, 1973; Remington *et al.*, 1989), neither demonstrated any instances of tooth loss. VonderAhe (1973) reported on 57 patients who experienced mild, moderate and severe degrees of root resorption during orthodontic treatment and after an average post-retention period of 6.5 years, found no cases of hypermobility or other negative sequelae. Remington *et al.*, (1989) looked at 100 cases that experienced root resorption and found that the worst outcome was hypermobility, which occurred in only 2 cases. Examining the literature up until 1997, Vlaskalic *et al.*, (1998) concluded that the sequela of orthodontically related resorption does not pose a long-term threat to the patient.

In a more recent study, however, Levander and Malmgren (2000) performed a long-term follow-up of maxillary incisors with severe apical root resorption 5 to 15 years after active treatment and found a significant correlation between tooth mobility, total root length and intra-alveolar root length. They concluded that there is a risk of tooth mobility

in a maxillary incisor that undergoes severe root resorption during orthodontic treatment if the remaining total root length is less than or equal to 9mm. The risk is less if the remaining root length is greater than 9mm. They recommend follow-up of teeth with severe orthodontically induced root resorption.

2.1.12 Cementum and Resistance to Root Resorption

Of all the calcified tissues, cementum is most similar to bone and has been described as a bone-like structure (Hassel, 1993). Bone and cementum, however, behave differently to the application of orthodontic forces. Unlike bone, which undergoes resorption and apposition of a continual remodelling process, cementum is not normally resorbed. The exact mechanism by which the resorption process is inhibited is as yet unclear, however, several theories exist to explain the resistance of cementum to resorption.

2.1.12.1 Cellular Barriers

The simplest explanation for the resistance of cementum to resorption would be that the cells covering the dental tissue provide a barrier against the invades of the odontoclast (Gottlieb, 1946) and that resorption would ensue if the cellular barrier were breached. Andreasen (1988) using replantation as a root resorption model in monkeys, related the resistance of cementum to root resorption to the innermost cellular layer of the periodontal ligament (cementoblasts, fibroblasts, osteoblasts, endothelial and perivascular cells) and discluded the peripheral part of the PDL (Sharpey's fibres, cementum,

precementum and epithelial rests of Mallassez). Andreasen (1988) believes that this innermost layer provides both a protective mechanism against resorption as well as the mechanism for repair.

2.1.12.2 Sharpey's Fibres

Sharpey's fibres may constitute a physical barrier for odontoclasts (Jones and Boyde, 1988), however, the arrangement of the fibres at the alveolar side of the periodontal ligament is not too dissimilar from regions of cellular cementum, yet the bundle bone of the cribriform plate is more prone to resorption. Also, the fibrocytes may be active in collagen turnover right up to the level of mineralization of the Sharpey's fibres and appear to have no problem in approaching the cementum surface (Deporter and Ten Cate, 1980).

2.1.12.3 Precementum or Cementoid

It has been suggested that the first formed unmineralized matrix, precementum and elements of the organic matrix may confer protection against root resorption (Emslie, 1978; Jones and Boyde, 1988; Brudvik and Rygh, 1995b; Roberts, 2000). It has been reported that various uncalcified mineralised tissues in response to orthodontic force are more resistant to resorption. This has been demonstrated in precementum (Gold and Hasselgren, 1992), osteoid (Chambers et al., 1984), and predentin (Stenvik and Mjör, 1970; Wedenberg, 1987).

2.1.12.4 Cementum

Alatli *et al.*, (1996) attribute cementum's resistance to root resorption to cementum itself. They used an injection of 1-hydroxyethylidene-1,1-bisphosphonate (HEBP) to inhibit the formation of acellular extrinsic fibre cementum in rat molars, applied an orthodontic force and found that roots lacking acellular cementum were readily resorbed. They concluded that acellular cementum might confer some protective mechanism against root resorption.

2.1.12.5 Mineral Content of Cementum

Various authors have reported a difference in susceptibility to root resorption based on the degree of mineralization of cementum (Henry and Weinmann, 1951; Reitan and Rygh, 1985; Jones and Boyde, 1987a,b). From histological studies on 261 permanent teeth from untreated individuals, Henry and Weinmann (1951) found that the cervically positioned, more mineralised, acellular cementum, was more resistant to root resorption than the apically positioned, less mineralised, cellular cementum. Reitan and Rygh (1985) reported that the density and hardness of cementum may influence its resistance to root resorption, where the harder the cementum, the greater the resistance to root resorption. This has been extrapolated from the retarded resorption seen in deciduous teeth during tooth eruption where the hardness of the deciduous tooth substance may retard the resorption process (Rygh and Reitan, 1964). Reitan and Rygh, (1985) also suggested that endodontically treated teeth are more resistant to root resorption due to an increase in

dentin hardness and density. Since the hardness of dentin has been directly correlated to mineral composition (Tesch *et al.*, 2001), it can be extrapolated that the hardness of cementum is also directly correlated with mineral composition and that cementum with a higher mineral content is more resistant to root resorption.

Jones and Boyde (1987a,b) showed that carious dentin in deciduous teeth was more resistant to resorption and it was hypothesised that this may be due to changes in the chemistry of the mineral or protein in the dentin. It can be extrapolated from these results that in opposition to the beliefs of Reitan (1985), that less mineralised tissues may be more resistant to root resorption. In a later publication, however, Jones and Boyde (1988) reported that they did not believe that the mineral content of dental tissues could influence susceptibility to root resorption. They supported their argument with the fact that osteoclasts cultured on bone resorb bone of greater to lesser and lesser to greater mineral density (Reid, 1986).

Fluoride, in particular, has been associated with a reduced risk of both bone (Miyagi *et al.*, 1994; Goldhaber, 1967) and root resorption (Shulman *et al.*, 1968; Bjorvatn and Massler 1971; Coccia 1980; Mahajan and Sidhu 1981; Kameyama *et al.*, 1994). Fluoride has been used for the treatment of destructive bone diseases such as Paget's disease, osteoporosis and multiple myeloma (Purves, 1962; Rich *et al.*, 1964; Riggs *et al.*, 1982; Bernstein *et al.*, 1963). Its mechanism of action in these bone diseases is thought to be due to retention of calcium (Purves, 1962; Rich *et al.*, 1964). Bone biopsies from these patients treated with fluoride demonstrated increased mineralization (Bernstein *et al.*,

1963). Studies in bone have shown that immersion in a 0.1M sodium fluoride solution can reduce the amount of bone resorption in tissue culture (Goldhaber, 1967).

Fluoride has also been shown to decrease the risk of root resorption. Shulman *et al.*, (1968) found that soaking teeth in 1M sodium fluoride solution for 18-54 hours to be effective in decreasing root resorption in the reimplanted teeth of monkeys. Bjorvatn and Massler (1971) found that the application of a 2% sodium fluoride or 1% stannous fluoride solution for five minutes to reimplanted teeth of rats had significantly less root resorption than controls at 3 weeks. Coccia (1980) soaked avulsed teeth from children in 2% neutral sodium fluoride for five minutes prior to reimplantation and found after three years that there was a significantly greater amount of root resorption in those teeth not treated with fluoride. Mahajan and Sidhu (1981) examined the effect of soaking human autogenous reimplanted teeth in 2% sodium fluoride for four minutes prior to reimplantation and found at 6 and 12 months less root resorption in those teeth treated with fluoride. Kameyama *et al.*, (1994) found significantly less root resorption in rats administered systemic sodium fluoride than controls.

The mechanism whereby fluoride inhibits root resorption is unknown but may be similar to its action on other mineralized tissues such as enamel and bone. In bone, four mechanisms of action have been proposed:

1. Fluoride has been thought to either promote osteoblastic activity or to inhibit osteoclastic activity (Shulman *et al.*, 1968; Hudson, 1961; Schenk *et al.*, 1970;

Rich and Feist, 1970). Shulman *et al.*, (1968) suggested that dissolution of mineral containing a high concentration of fluoride might impair the activity of adjacent resorbing cells, thereby slowing down the resorptive process. Hudson (1961) observed that fluoride specifically inhibited the activity of adjacent resorbing cells.

2. Fluoride is thought to inhibit the degradation of bone collagen, thus protecting bone from the action of osteoclasts (Messer *et al.*, 1973).
3. Fluoride has been reported to improve the crystallinity of the mineral phase of bone, thus reducing the susceptibility of bone to resorptive processes (Linkins *et al.*, 1964). Eanes *et al.*, (1965) have shown that an increase in the percentage of fluoride in bone ash is accompanied by an increase in crystallite size. The solubility of a material will increase as its specific surface increases (i.e. the size of the crystallites decreases) (Misra, 1984). A larger crystallite size is, therefore, more resistant to dissolution, and subsequently resorption.
4. The interaction of F^- with hydroxyapatite is of immense significance. In general, this interaction may transform the surface of hydroxyapatite to that of fluorapatite (Spinelli *et al.*, 1971) which has been reported to be more resistant to resorptive processes (Linkins *et al.*, 1963). The phase rule defines the basic characteristics of the fluorapatite system. This is a quaternary system and may be represented by four components: $Ca(OH)_2$, H_3PO_4 , HF and H_2O . There is, therefore an extra

degree of freedom in the fluorapatite system as compared to that of hydroxyapatite for the same number of phases present, or for the same degree of freedom there is one more phase present in the fluorapatite system. The presence of F^- on tooth mineral, therefore, may render it less soluble and accelerate mineralization processes (Moreno et al., 1977).

2.1.13 Methodology of Orthodontic Tooth Movement in Previous Root Resorption Studies

Animal studies investigating root resorption are important for obtaining information about tissue reactions within the periodontal ligament at both the cellular and molecular level. However, there are essential morphological and functional differences in teeth and supporting tissues between animals and man, e.g. denser alveolar bone containing fewer marrow spaces in animals compared with humans (Reitan, 1964; Reitan and Kvam, 1971). Such anatomical differences may influence the resorption process in experiments of longer duration. Rats reveal root resorptions more or less regularly even without previous orthodontic movement, and this may explain the high incidence of root resorptions in both test and control teeth of rats. Ethically, however, it is not possible to perform the same experimental procedures in humans, and therefore root resorption studies in humans have been limited to radiographic investigations examining apical root resorption on teeth after orthodontic tooth movement, and studies examining root resorption on extracted teeth after the application of orthodontic forces. In the present

study, investigation of cementum on extracted teeth after the application of orthodontic forces was required, and therefore, in this literature review, only the methodology of previous human clinical studies examining root resorption on extracted teeth will be explored.

Numerous studies of this type exist in the literature (Stenvik and Mjör, 1970; Kvam, 1972; Reitan, 1974; Barber and Sims, 1981; Harry and Sims, 1982; Langford and Sims, 1982; Odenrick et al., 1991; Erverdi *et al.*, 1994; Owman-Moll *et al.*, 1995a; Owman-Moll *et al.*, 1995b; Owman-Moll *et al.*, 1996a; Owman-Moll *et al.*, 1996b; Lundgren *et al.*, 1996b; Kurol *et al.*, 1996; Owman-Moll and Kurol, 1998; Acar *et al.*, 1999; Casa *et al.*, 2001), and their methodology have been summarized in Table II-a. What can be seen from Table II-a is the large variability in study design with respect to the type of tooth movement (intrusion, extrusion, tipping, torque and translation), the magnitude of applied force (0.8g-600g), the duration of force application (4–76 days), whether there was reactivation of the force during the experimental period, the type of appliances used to exert the orthodontic force (fixed appliances with springs or sectional archwires, Hyrax appliances, Quad helix, elastics), the type of tooth to which orthodontic force was applied (first or second premolars) and its' location in the dental arches (maxillary or mandibular).

Variation in studies regarding the type of tooth movement is a function of what the investigator wants to examine. Variation in the duration and reactivation of force application appears to be driven by clinical validity. Variation in the type of appliance

used to exert an orthodontic force appears to be dependent on the type of tooth movement required as well as clinical validity, and variation in the type of tooth used for orthodontic movement is dependent on what teeth are being planned for extractions. In all the studies examined, premolars are used due to their frequently planned extraction in an individual's overall orthodontic treatment plan. Variation in studies regarding the magnitude of force applied is a result of the subjective nature of what is a light, optimal and heavy orthodontic force. There appears to be no consensus as to what is an optimal, light or heavy orthodontic force.

The "*optimal force*" theory was put forward by Smith and Storey (1952) who showed that in humans, forces between 150-200g produced the maximum rate of tooth movement for distalisation of maxillary canines. Below this range there is little movement, and above this range movement is slowed. Boester and Johnston (1982), however, in a carefully constructed study found that the amount of space closure after premolar extraction was about the same if the applied force was 140g, 225g, 310g but significantly less if only 55g was used. They concluded that there was a direct relationship between the magnitude of the applied force and the rate of tooth movement, but once a certain stress level was reached (140g), further increases in stress failed to produce continued increases in the rate of movement. Other investigators (Reitan, 1960; Burstone and Groves, 1961; Maltha *et al.*, 1993) have suggested similar findings to Boester and Johnston (1982).

Boester and Johnston (1982) suggested that Smith and Storey's investigations were not valid based on their lack of statistical analysis and their canine retraction mechanism.

They examined Smith and Storey's results statistically, and found that "light" and "heavy" forces produced statistically indistinguishable movement of the canine, but the "heavier" forces moved the molar segment further than did the light forces. At both force levels, the canine moved more than the molar, but the difference was greater with the "light" springs. They also noted that Smith and Storey's method of canine retraction allowed canines to tip and molars and premolars to move bodily. Therefore, even though force levels on either side of the extraction space were equal, force distribution in the PDL would have been unequal which may have exaggerated the differences in movement observed between the canine and premolar/molars.

Other investigators (Andreasen and Johnston, 1967; Hixon *et al*, 1969, 1970; Andreasen and Zwanziger, 1980) have suggested a linear relationship between force magnitude and tooth movement. Investigations by Hixon *et al.*, (1970), however, have been criticized for their small sample size ($n = 6$) and short observation period (8 weeks), whereas Andreasen and Zwanziger (1980) have been criticized for large measurement errors and lack of statistical analysis.

The literature tends to support Boester and Johnston's theory that increasing mean stress produces a higher rate of tooth movement but beyond a certain stress level, increasing stress no longer alters the rate of tooth movement (Quinn and Yoshikawa, 1985). However, there is still no consensus as to what is the optimal magnitude of orthodontic force, and therefore, a light or heavy force. As a result the magnitude of orthodontic forces used in root resorption studies has been quite variable.

2.1.13.1 Measuring the Magnitude of Orthodontic Force

Orthodontic force measurements are usually performed by means of some type of mechanical strain gauge, however, almost no reports concerning methodological errors in conjunction with such measurements seem to be available in the literature. Lundgren *et al.*, (1996b) appear to be the only ones to have investigated the accuracy of the strain gauge in assessing the magnitude of applied orthodontic force. They took 10 consecutive measurements with a strain gauge calibrated to the nearest 1cN (Haldex, Halmstad, Sweden), placed in the vertical plane and perpendicular to the archwire at its end corresponding to the area just mesial to the bracket so as not to interfere with it and found both the validity and precision of the force measurements to be high with standard deviation values of 1.0cN and 0.4cN, respectively.

2.1.13.2 Force Decay

Once again, very little has been published in the literature regarding force decay over time after the application of an orthodontic force. Lundgren *et al.*, (1996b) applied a 50g buccally directed horizontal force to 112 maxillary first or second premolars for 1 to 7 weeks, with weekly reactivations. A fixed orthodontic appliance consisting of a lingual arch with an anterior biteblock soldered to molar bands on the first permanent molars, 0.018" brackets bonded to the experimental upper premolars, and a 0.018" Sentalloy Heavy sectional archwire extending from the first permanent molar to the experimental premolar was used to apply the 50g force. They found that after the application of a 50g

force, the applied force had decreased from 50g to 40 ± 2.5 g (20%) after 1 day, to 38 ± 2.3 g (22%) after 2 days and to 38 ± 3.5 g (24%) after 3 days. Lundgren et al., (1996a) gave 3 possible explanations for the observed force reduction: 1) tooth movement, 2) plastic deformation of the archwire due to the bending for activation of the archwire, and 3) plastic deformation due to factors within the oral environment. They suggest that the oral environment influences the force reduction significantly, whereas tooth movement and bending of the archwire are likely to play a negligible role. The authors recommend that because of this large force reduction over a few days, care should be taken to reactivate the force in all orthodontic studies aimed at having the applied force under continuous control. In their series of studies, they reactivate the applied force weekly. However, it may also be argued that to simulate a typical clinical situation, where, on average, patients would be seen every 4 weeks, reactivation should be performed monthly.

2.1.13.3 Movement Pattern of Teeth after the Application of a Buccally Directed Force

Lundgren et al., (1996b) measured tooth displacement on dental casts after the application of a 50g buccally directed horizontal force to 112 maxillary first or second premolars for 1 to 7 weeks, with weekly reactivations. A fixed orthodontic appliance consisting of a lingual arch with an anterior biteblock soldered to molar bands on the first permanent molars, 0.018" brackets bonded to the experimental upper premolars, and a 0.018" Sentalloy Heavy sectional archwire extending from the first permanent molar to the experimental premolar was used to apply the 50g force. A coordinate measuring

machine (Validator 100, TESA SA, Renens, Switzerland) was used to measure tooth displacement in 3 dimensions. The movement pattern of the test teeth was found to be a combination of horizontal and vertical displacements, including tipping. The horizontal movement of the tooth crown was on average 0.8mm during the first week and 3.7mm after 7 weeks. The vertical movements were intrusive in 45% and extrusive in 55% of the teeth. The individual variations in tooth displacements were considerable.

2.1.13.4 Why a Buccally Directed Force?

Lundgren *et al.*, (1996b) utilized a buccally directed force to perform multiple detailed studies of orthodontic tooth movement under controlled force conditions, as well as detailed histological analysis of related root resorption. It may be argued that a buccally directed tooth movement would limit the application of the results to a true clinical situation, since movement of premolars is most commonly mesio-distally directed. They argue, however, that displacement in a buccal direction in this region is not uncommon, and that this model imitates the common tipping of maxillary incisors in a labiolingual direction.

<i>Authors</i>	<i>Sample Size</i>	<i>Teeth</i>	<i>Type of Tooth Movement</i>	<i>Type of Appliance</i>	<i>Magnitude of force (g)</i>	<i>Duration of Force Application</i>	<i>Reactivation of Force</i>
Stenvik and Mjör, 1970	70	Mx & Md 1 st premolars (10-13yrs)	Intrusion Tipping	Fixed Appliances - Molar bands on 6's and 4's. Intrusion spring from 6 to 4.	35-250	4 - 35 days	Not reactivated
Kvam, 1972	40	Premolars (10-12yrs)	Tipping	Fixed Appliances - Molar bands on 6's, brackets on 4's. 0.016" spring from 6 to 4.	50	5 - 76 days	Not reactivated
Reitan, 1974	72	Premolars (9-16yrs)	Intrusion Extrusion Tipping	Fixed appliances - Molar bands on 6's, brackets on 4's. 0.014" to 0.018" sectional AW from 6 to 4.	25 - 240	10 - 47 days	Weekly
Barber and Sims, 1981	18	Mx 1st premolars (adolescents)	Buccal tipping/ Translation	RME - 1.1mm wire soldered to bands on the U6's, U4's and a central expansion screw. 0.5mm expansion per day.	Not measured	Until the crossbite was overcorrected. Retention up to 9 months.	2 times per day
Harry and Sims, 1982	36	Premolars (11-18 yrs)	Intrusion	Fixed Appliances - 0.016, 0.018 & 0.020" SS AW from 6's to 1's, ligated to the 4 with a SS tie.	50,100 & 200	14,35 & 70 days	Not reactivated
Langford and Sims, 1982	34	Mx 1st premolar s (adolescents)	Buccal tipping/ Translation	RME - 1.1mm wire soldered to bands on the U6's, U4's and a central expansion screw. 0.4mm expansion per day. Retention 14-53 weeks.	Not measured	Until the crossbite was overcorrected	2 times per day
Odenrick <i>et al.</i> , 1991	26	Mx & Md premolars (10-13yrs)	Buccal tipping/ Translation	RME (Haas) - 0.5mm expansion per day.	Not measured	14 days	2 times per day
Ervedi <i>et al.</i> , 1994	38	Mx 1st premolars (15.1yrs)	Buccal tipping/ Translation	RME (Haas and cast-cap splint). 0.4mm expansion per day.	Not measured	2mm overcorrection of the crossbite	2 times per day
Owman-Moll <i>et al.</i> , 1995a	32	Mx 1st premolars (13.9yrs)	Buccal tipping	Fixed Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4. 0.018" Sentalloy sectional AW from U6 to U4.	50g continuous 50g discontinuous	4 & 7 weeks	Continuous: weekly Discontinuous: 4 weekly
Owman-Moll <i>et al.</i> , 1995b	64	Mx 1st premolars (13.7yrs)	Buccal tipping	Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4. 0.018" Sentalloy heavy sectional AW from U6 to U4.	50	6 weeks Retention period 1-8 weeks	Weekly

Owman-Moll <i>et al.</i> , 1996a	32	Premolars (13.1yrs)	Buccal tipping	Fixed Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4s. 0.018" Sentalloy heavy sectional AW from UR6 to UR4 for 50g force. 0.016" Australian Wilcock wire from UR6 to UR4 for 100g force.	50 & 100	4 & 7 weeks	Weekly
Owman-Moll <i>et al.</i> , 1996b	16	Premolars (13.0yrs)	Buccal tipping	Fixed Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4s. 0.018" Sentalloy heavy sectional AW from UR6 to UR4 for 50g force. 0.018" Australian Wilcock wire from UR6 to UR4 for 200g force.	50 & 200	7 weeks	Weekly
Sismanidou <i>et al.</i> , 1996	10	Mx premolars (11-14yrs)	Buccal tipping/ Translation	Quad helix – 0.9mm Remanium wire.	0.8	27 - 114 days	Not reactivated
Lundgren <i>et al.</i> , 1996b	112	Mx 1 st or 2 nd premolars (13.8yrs)	Buccal tipping	Fixed Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4s or U5s. 0.018" Sentalloy heavy sectional AW from UR6 to UR4.	50	1 - 7 weeks	Weekly
Kurol <i>et al.</i> , 1996	112	Mx 1 st or 2 nd premolars (13.8yrs)	Buccal tipping	Fixed Appliances – Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4s or U5s. 0.018" Sentalloy heavy sectional AW from UR6 to UR4.	50	1 - 7 weeks	Weekly
Owmann-Moll and Kurol, 1998	32	Mx 1st premolars (13.8yrs)	Buccal tipping	Fixed Appliances - Lingual arch with anterior biteblock soldered to molar bands on 6's. 0.018" brackets bonded to U4s. 0.018" Sentalloy heavy sectional AW from U6 to U4.	50	6 weeks Retention for 2,3,6 & 7 weeks	Weekly
Acar <i>et al.</i> , 1999	22	1st premolars (15-23yrs)	Tipping	Fixed Appliances – Molar bands on 6's, brackets on 2's and 1's. 0.017" x 0.025" SS utility arch. Button bonded to buccal surface of 4. Elastic from button to utility arch.	100g continuous 100g discontinuous	9 weeks	Continuous: 24hr wear Discontinuous: 12hr wear, 12 hour rest Elastic changed every 24hrs.

Faltin <i>et al.</i> , 1998, 2001	12	Mx 1 st premolars (14.1-16.7yrs)	Intrusion	Fixed Appliances – Nance or TPA connected to molar bands on U6’s, edgewise bracket on U4’s, NiTi-SE (0.016” x 0.022”) –SS (0.017” x 0.022”) spring from U6 to U4.	50 & 100	4 weeks	Not reactivated
Casa <i>et al.</i> , 2001	28	Mx 1st premolars (13.8yrs)	45° Torque	Fixed Appliances – Nance or TPA connected to molar bands on U6’s, edgewise bracket on U4’s, NiTi-SE (0.016” x 0.022”) –SS (0.017” x 0.022”) spring from U6 to U4.	300 & 600	1 - 4 weeks	Not reactivated

Table II-a: Summary of the methodology of previous clinical studies examining root resorption on extracted human teeth after the application of orthodontic forces.

2.2 Cementum

2.2.1 Definition

Cementum is a non-uniform mineralised connective tissue covering the dentine of the tooth root. Several types of cementum are found on human teeth; all differ with respect to location, structure, function, composition and degree of mineralization.

2.2.2 Distribution

Cementum varies in thickness at different levels of the root. It is thinnest cervically (10-50 μ m) and thickest in the interradicular areas of multi-rooted teeth and at the root apex (50–200 μ m but this may exceed 600 μ m) (Berkovitz *et al.*, 1992).

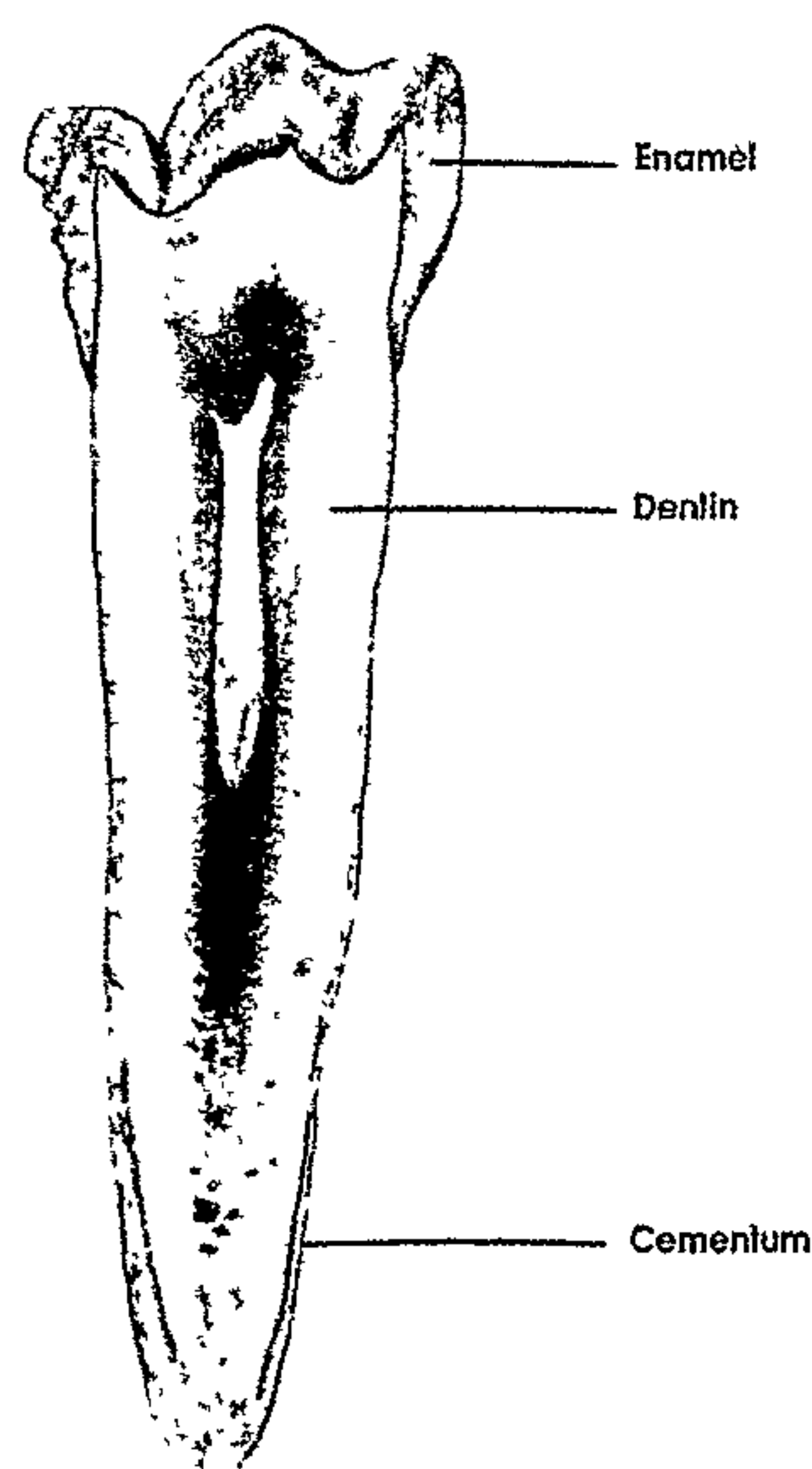


Figure 2.1: Ground section of a premolar showing the distribution of cementum around the root. Cementum is thinnest cervically and thickest apically (*Source: Ten Cate AR: Oral Histology; Development, Structure, and Function, 5th edition; 1998*).

2.2.3 Classification, Location, Composition & Function

Cementum has been classified according to the time of formation (*primary* or *secondary*), the presence or absence of cells within its matrix (*acellular* and *cellular*), and the origin of the collagenous fibres of the matrix (*intrinsic* fibres resulting from cementoblast activity or *extrinsic* fibres resulting from the incorporation of periodontal ligament fibres). Accordingly, the following types of cementum have been described (Schroeder, 1986,1993; Ten Cate, 1998) and are summarized in Table II-b.

2.2.3.1 Acellular Afibrillar Cementum (AAC)

This type of cementum is composed entirely of a mineralised ground substance. AAC is deposited as isolated patches (islands or spurs) over minor areas of enamel just coronal to the CEJ (Figure 2.2). AAC may cover some dentine or may be covered by PAEFC and/or by junctional epithelium. AAC varies in location from tooth to tooth and along the CEJ of the same tooth. It plays no role in tooth attachment and is regarded as a developmental anomaly formed as a result of local disruptions in the reduced dental epithelium that permits follicular cells to come into contact with the enamel surface (Bosshardt and Selvig, 1997; Ten Cate, 1998). Its thickness ranges from 1 - 15µm. The cells responsible for its formation are thought to be connective tissue cells (Schroeder, 1986), however, this has not been determined with accuracy.



Figure 2.2: Light micrograph showing acellular afibrillar cementum (AAC) overlapping the enamel on the crown (ES; enamel space), opposing the dentin (D) and merging into the acellular extrinsic fibre cementum (AEFC). (*Magnification: x440. Source: Bosshardt and Selvig, 1997*).

2.2.3.2 Primary Acellular Intrinsic Fibre Cementum (PAIFC)

This cementum extends 15-20 μ m at the most cervical region of the tooth root before its fibrous fringe becomes connected to the PDL fibre bundles. This cementum was previously classified as primary extrinsic fibre cementum, however, the collagenous matrix of the first-formed cementum is the result of cementoblast activity and is elaborated before the PDL forms, and, therefore, the collagen must be considered intrinsic.

2.2.3.3 Primary Acellular Extrinsic Fibre Cementum (PAEFC)

This cementum extends from the PAIFC at the cervical margin of the tooth root to cover at least two thirds of the root and often more (Figure 2.3 & 2.4). In incisors and canines, often this is the only form of cementum found. This cementum forms once the PDL fibre bundles are connected to the fibrous fringe bundles of the PAIFC and there is mineral deposition amongst these fibres. This type of cementum lacks any cells and is composed almost entirely of densely packed bundles of Sharpey's fibres ($30.000/\text{mm}^2$) (Schroeder, 1986), reflecting its function of tooth anchorage to the surrounding bone. No cementoid exists on the surface of this cementum. Its thickness ranges from $50\mu\text{m}$ cervically to some $200\mu\text{m}$ apically. It is the most highly mineralised cementum with an overall degree of mineralization of $\sim 60\%$. Cementum formation is constant but slow. Post-eruptive tooth movements can change the direction of Sharpey's fibres resulting in incremental lines within the cementum.

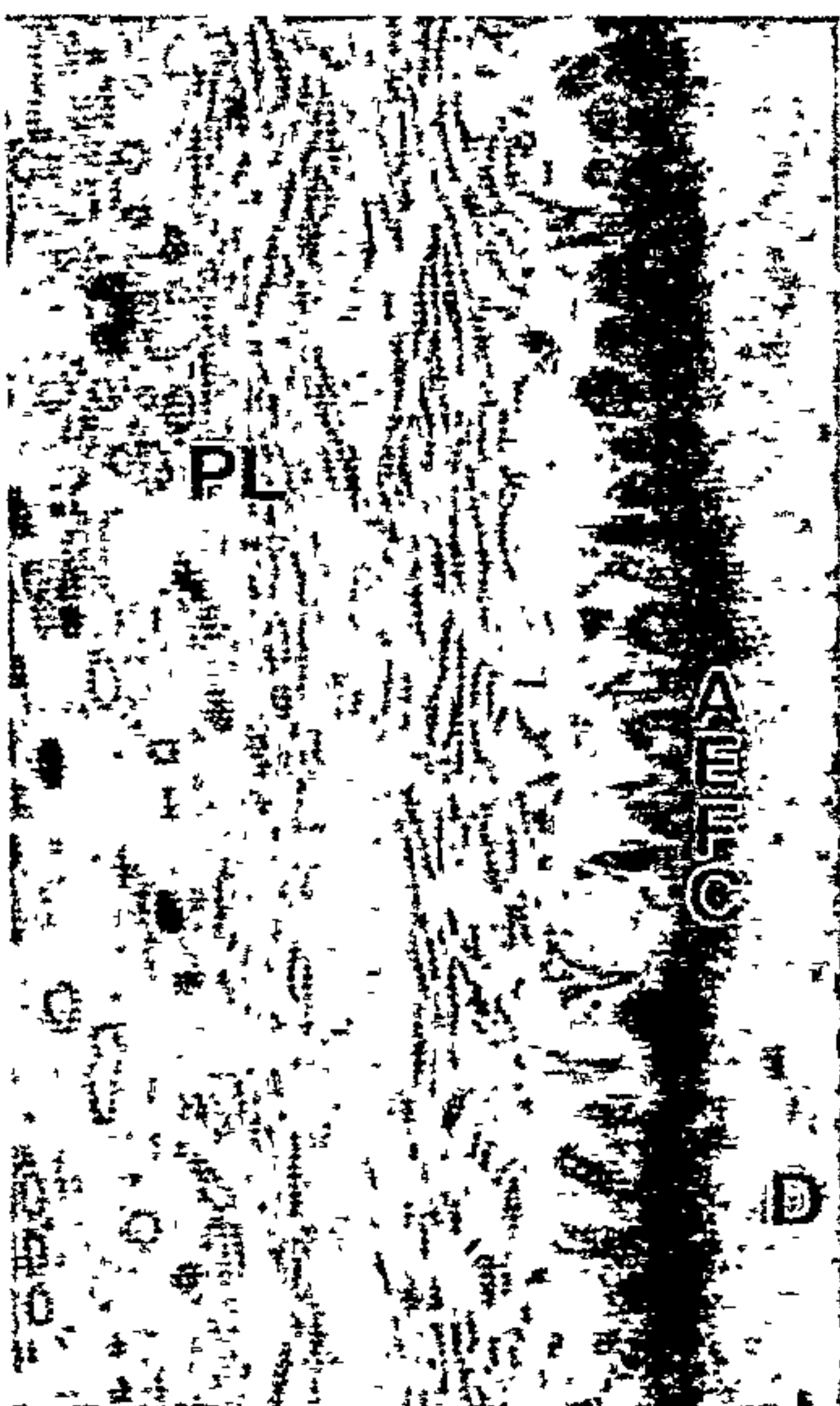


Figure 2.3: Acellular extrinsic fibre cementum (AEFC) is usually found on the cervical half to two thirds of the root. The extrinsic matrix fibres remain short during pre-functional development. (*Magnification: $\times 440$.* Source: Bosshardt and Selvig, 1997).

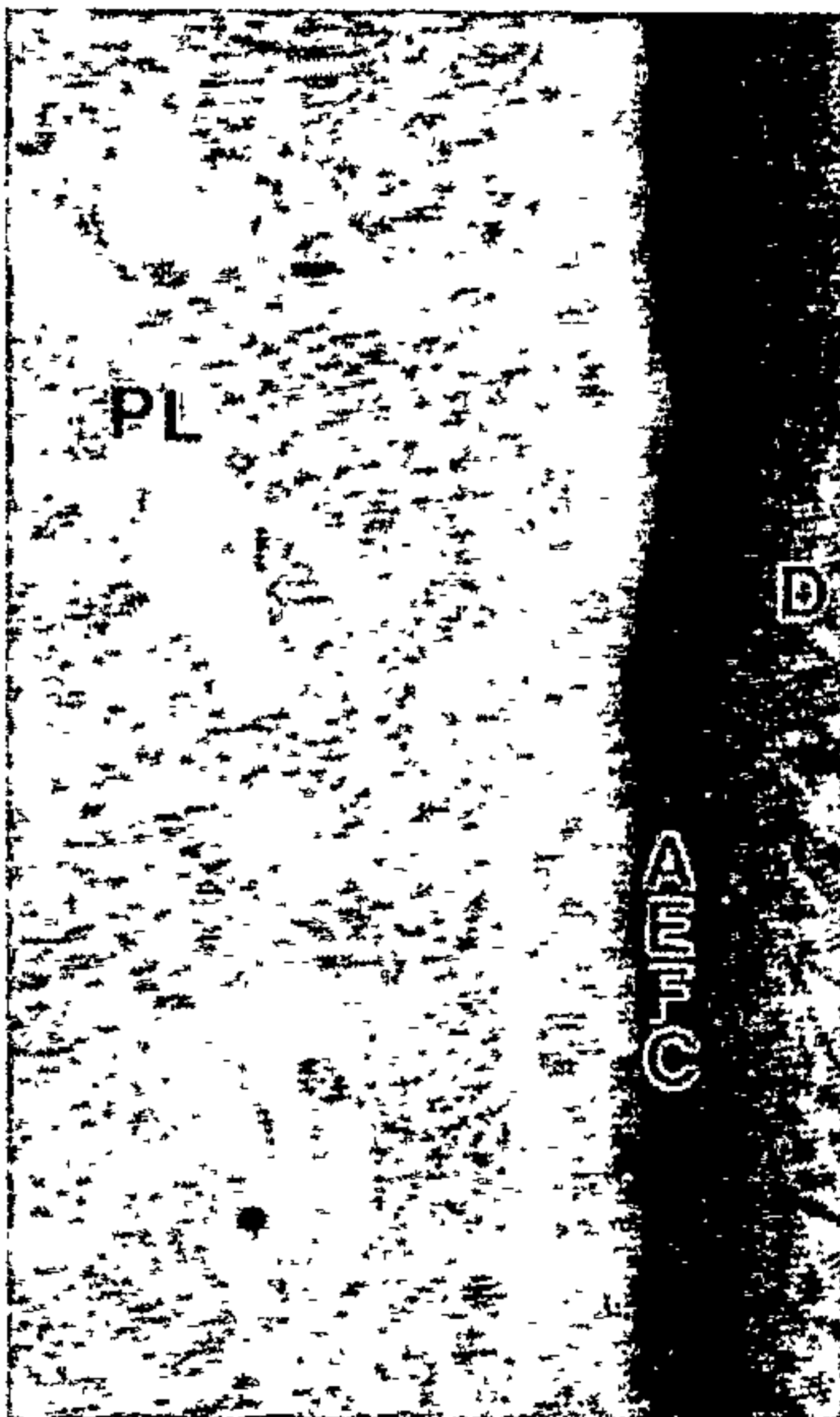


Figure 2.4: Acellular extrinsic fibre cementum (AEFC) later in development when the extrinsic matrix fibres become continuous with the principal fibres of the periodontal ligament (PL) when the tooth is in functional occlusion. (*Magnification: x440. Source: Bosshardt and Selvig, 1997*).

2.2.3.4 Secondary Cellular Intrinsic Fibre Cementum (SCIFC)

This cementum is confined to the apical and interradicular regions of the root (Figure 2.5). It is made up of cementocytes housed in lacunae, collagen fibres derived from cementoblasts and a surface layer of cementoid. Formation is rapid. There are no fibres that are continuous with the PDL and hence this cementum does not play a part in tooth attachment, rather it plays an important reparative role in the repair of resorption lacunae (Figure 2.6).



Figure 2.5: Cellular intrinsic fibre cementum (CIFC) on the apical third of a premolar root. (*Magnification: x130. Source: Bosshardt and Selvig, 1997.*)

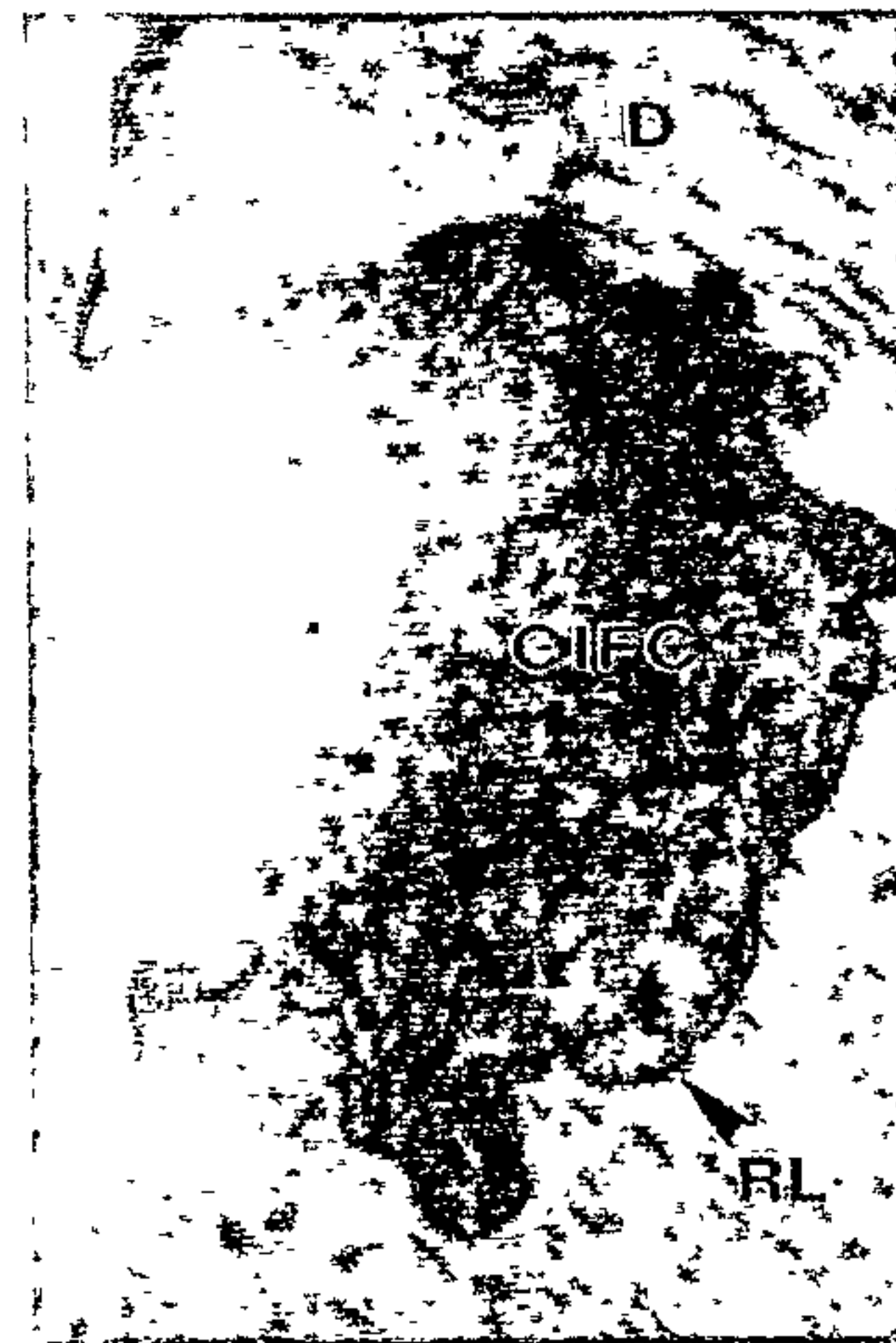


Figure 2.6: Cellular intrinsic fibre cementum (CIFC) is the main reparative tissue in the repair of root resorption defects. A reversal line (RL) demarcates the junction between old and new tissues. (*Magnification: x230. Source: Bosshardt and Selvig, 1997.*)

2.2.3.5 Secondary Cellular Mixed Fibre Cementum (SCMFC)

The extent and distribution of this cementum is extremely variable, reflecting its function as an adaptive tissue. It is composed of cementocytes housed in lacunae with processes in canaliculi directed toward the PDL, intrinsic fibres, extrinsic fibres and a surface layer of cementoid. The intrinsic fibres are fine fibred, densely packed and run parallel to the root surface, whereas the extrinsic fibres are larger and haphazardly incorporated, running at right angles to the root surface. The intrinsic fibres are uniformly mineralised, whereas

the extrinsic fibres are variably mineralised, with many having a central unmineralised core.

2.2.3.6 Cellular Mixed Stratified Cementum (CMSC)

This cementum is found on the apex, apical third of the root or more and the furcations of human teeth. It is composed of alternate layers of PAEFC and SCIFC (Schroeder, 1993) (Figures 2.7a,b,c,d). Its thickness varies between 100 and 1000 μ m. The PAEFC appears as a comparatively thin and even layer of densely compacted bundles of Sharpey's fibres oriented more or less vertical to the root surface. In contrast, the SCIFC is seen as a loose network of fibre bundles, a large part running parallel to the root surface. This network includes lacunae of variable shape and size that house cementocytes.

2.2.3.7 Intermediate Cementum (IC)

This is a form of SCIFC restricted to the apex of the tooth, which contains entrapped cellular debris derived from either the root sheath or the odontoblast layer. It is not involved in tooth attachment and has no functional significance.

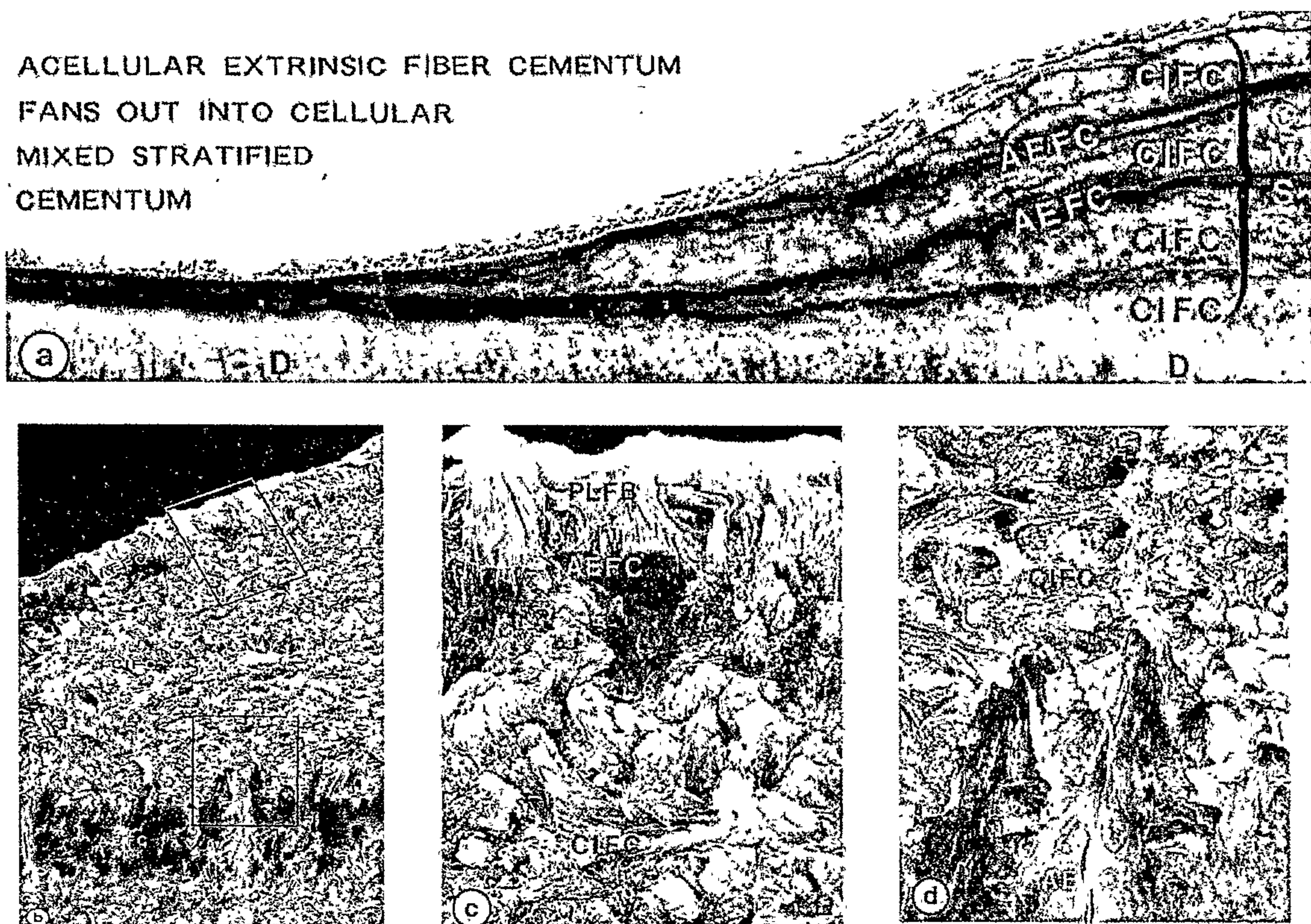


Figure 2.7: Light (a) and scanning electron (b-d) micrographs depicting the zone of transition from cervically located pure AEFC (a, left) that fans out toward the more apically located CMSC (a, right). In a celloidin section stained with H&E, AEFC appears dark violet (black) while CIEFC appears light-violet (grey). In a fracture surface through that zone, alternating AEFC and CIEFC layers can be distinguished, with former Sharpey's fibres of a deep, previously deposited AEFC layer being buried under CIEFC (b,d), and a new AEFC layer of Sharpey's fibres at the cementum surface (b,c). Note the lacunar network of intrinsic fibres in CIEFC. D = dentine; PLFB = periodontal ligament fibre bundles inserting in superficial AEFC. (*Magnification: a = x90; b = x1070; c,d = x2670. Source: Schroeder, 1993.*)

<i>Type</i>	<i>Fibres</i>	<i>Cells</i>	<i>Composition</i>	<i>Location</i>	<i>Function</i>	<i>Thickness (µm)</i>
PAIFC	Intrinsic	Follicle, surface cementoblasts	Collagen, ground substance	Most cervical region of the root to the start of the PAEFC	Anchorage	10-50
PAEFC	Extrinsic	PDL fibroblast?	PDL fibre bundles	From the end of the PAIFC at the cervical margin to the apical third	Anchorage	10-200
SCIFC	Intrinsic	Bonelike cementoblasts in lacunae	Collagen, ground substance, cementoid	Apical third & interradicular regions	Adaptation	50-200
SCMFC	Mixed	Nonfollicular	Collagen, ground substance, cementoid, PDL fibre bundles	Variable	Adaptation	50-200
AAC	None	Follicular cementoblasts	Ground substance	Spurs and patches on enamel at CEJ	No known function	1-15
IC	Intrinsic	Bonelike cementoblasts, trapped root sheath cells & odontoblasts	Collagen & ground substance	Root apex	None	?
CMSC	Mixed	PDL fibroblast?, bonelike cementoblasts in lacunae	Collagen, ground substance, cementoid, PDL fibre bundles	Root apex, apical third of the root & furcations	Anchorage, Adaptation	100-1000

Table II-b: Type, composition, location, thickness and function of the various types of cementum. *(Adapted from: Ten Cate AR, Oral Histology, Development, Structure and Function, 1998).*

2.2.4 Chemical Composition

Cementum is composed of water, organic matrix and mineral. On a wet weight basis, human cementum contains 65% inorganic material, 23% organic material and 12% water. By volume, the inorganic material comprises approximately 45% inorganic material, 33% organic and 22% water (Berkovitz *et al.*, 1992).

2.2.4.1 Organic Component

The organic component comprises collagen and various noncollagenous proteins.

2.2.4.1.1 Collagen

Biochemical analyses of human cementum have shown that the organic matrix is approximately 90% type I collagen and 5% type III collagen (Christner *et al.*, 1977). It has been suggested that the type I collagen fibrils are coated by type III collagen (Wang *et al.*, 1980), however, others have suggested that the type I collagen is co-localized with collagen/procollagen type III in the same fibril (Lapière *et al.*, 1977; Henkel and Glanville, 1982; Nakayasu *et al.*, 1986; Keene *et al.*, 1987; Geerts *et al.*, 1990; Becker *et al.*, 1991; Huang *et al.*, 1991). The collagens are composed of 3 polypeptide alpha chains coiled around each other to form the classic triple helix configuration. The procollagen molecules are secreted to form cross-striated collagen fibrils with the typical 67nm

banding pattern (Bosshardt and Selvig, 1997). The collagens in cementum have an important structural and morphogenic role (Hay, 1991), and also provide a scaffold for the mineralised crystals (Christoffersen and Landis, 1991).

2.2.4.1.2 Noncollagenous Proteins

The noncollagenous proteins of cementum are made up of various glycoproteins, enamel-related proteins, proteoglycans and osteocalcin. The glycoproteins in cementum include bone sialoprotein, osteopontin, osteonectin, fibronectin and tenascin. These proteins appear to play a role in the mineralization process. The proteoglycans of cementum are small proteins. Biochemical analyses of human cementum have identified chondroitin sulfate, dermatan sulfate and hyaluronic acid as the glycosaminoglycan constituents of these proteoglycans (Bartold *et al.*, 1988). Osteocalcin is another non-collagenous protein that also appears to be involved in the mineralization process (Hauschka and Wians, 1989). Enamel-related proteins have been detected in cementum by immunohistochemistry and biochemical analysis, however, their function is presently unknown.

2.2.4.2 Mineral Composition

Cementum is a non-uniform, mineralised connective tissue (Soni *et al.*, 1962). Microradiographic, chemical and electron probe microanalysis (EPMA) studies have

demonstrated that cementum is less calcified than dentin (Selvig and Selvig, 1962; Selvig and Zander, 1962; Neiders *et al.*, 1972; Hals and Selvig, 1977).

The mineral component in human cementum is hydroxyapatite $[\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2]$, with small amounts of amorphous calcium phosphates (Bosshardt and Selvig, 1997). The hydroxyapatite in cementum is not chemically pure but contains other elements that have been taken up from the tissue fluid during initial crystallization. The amount of these ions initially incorporated into the mineral phase reflects their concentration in the fluid environment during mineralization. Over time, the concentration may change by additional uptake or substitution by other ions (Bosshardt and Selvig, 1997).

Transmission electron microscopy and electron diffraction analyses have shown that the mineral crystals are arranged with their crystallographic *c*-axis parallel to the long axis of the collagen fibril (Selvig, 1965). This study has also shown that the crystallinity of the mineral component is lower in cementum than in other hard tissues. The small size of the mineral crystals in cementum compared with enamel means that cementum has a greater capacity for adsorption of fluoride and other elements over time, but also more readily decalcifies in the presence of acidic conditions.

Differences in mineral composition exist between the various cementum types, (Soni *et al.*, 1962) from the cervical to apical third of the root, (Soni *et al.*, 1962) from one individual to another, (Cohen *et al.*, 1992), and from tooth to tooth in the same individual

(Cohen *et al.*, 1992). There is no literature comparing the mineral composition of cementum on the buccal, lingual, mesial or distal surfaces.

Microradiographs of cementum have shown that cervically located PAEFC (Figure 2.8,2.9) is more radiodense and, therefore, more mineralised than the apically positioned SCIFC (Figure 2.9) and variably located CMFC (Figure 2.10) (Soni *et al.*, 1962). The difference can be explained by the presence of uncalcified spaces, such as lacunae in SCIFC (Figure 2.9) and by an uncalcified core of extrinsic Sharpey's fibres in the CMFC (Dreyfuss and Frank, 1964) (Figure 2.10). The difference in mineralisation between PAEFC and SCIFC is demonstrated very clearly in microradiographs of CMSC (Figure 2.9), which shows alternating radiopaque and radiolucent bands corresponding to PAEFC and SCIFC, respectively. In addition, the matrix of PAEFC tends to be more completely mineralised because its formation is a slow process that allows longer direct contact of tissue fluids (Soni *et al.*, 1962).

Mineralisation of cementum is relatively homogeneous, however, like other calcified tissues, there is a rhythmic pattern to cementum formation (Soni *et al.*, 1962; Tohda *et al.*, 1996). This incremental pattern of mineralisation creates alternating bands of high and low mineral content, seen as lamellae within the cementum (Figures 2.8,2.9 & 2.10). These lamellae are less distinct and narrower in PAEFC compared with CIFC (Soni *et al.*, 1962) (Figure 2.9). The lacunae in CIFC are distributed as several small dark spots, irregular in shape, position and number (Figure 2.9). The dentinocemental junction (DCJ) commonly shows a zone of high mineral content delineated by zones of low mineral

content on the dentine side and sometimes on the cementum side as well (Röckert, 1956,1958; Yamamoto *et al.*, 1962; Soni *et al.*, 1962; Selvig and Zander, 1962; Anneroth *et al.*, 1966; Andersen, 1967; Furseth and Johansen, 1968; Neiders *et al.*, 1972) (Figure 2.8). This “hypermineralised zone” has also been observed with the SEM in anorganic preparations (Boyde and Jones, 1968). Its width has been described as 10-20µm as measured on microradiographs (Furseth, 1965), and as 4-8µm with the SEM (Boyde and Jones, 1968). The localization of this hypermineralized zone has not been determined. Boyde and Jones (1968) believe that it is a part of cementum. Other investigators designate it as the CDJ (Selvig and Zander, 1962; Soni *et al.*, 1962). Neiders *et al.*, (1972) believe that it is a part of dentin.

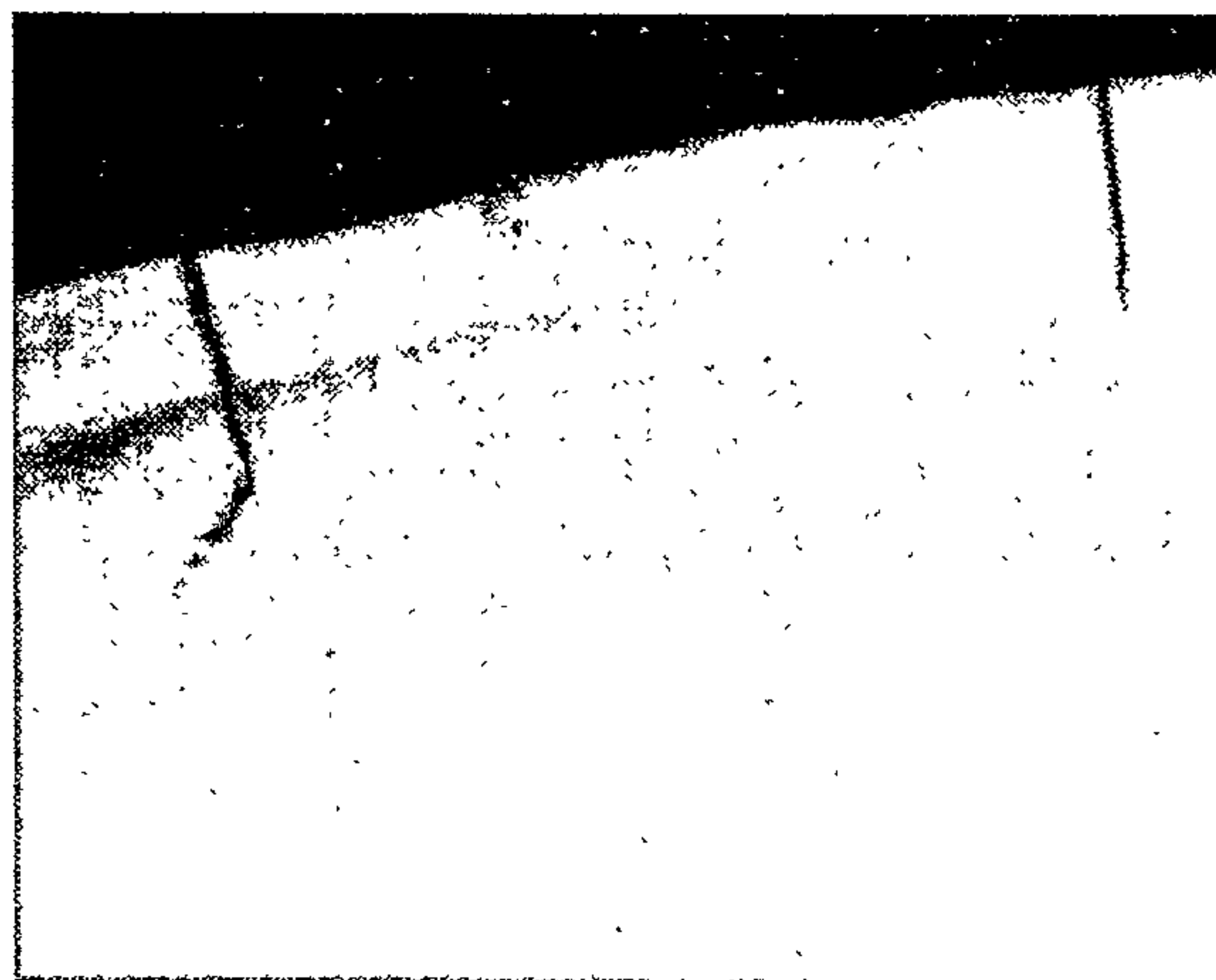


Figure 2.8: Microradiograph of AEFC (140µm wide) taken from the cervical third of a human premolar root. The acellular cementum shows faint lamination with some variation in the degree of mineralization of the laminae. The thin, radiopaque line delineates the CDJ, and the thin, radiolucent line adjacent to the CDJ represents dentin that is less mineralised than the bulk of the underlying dentin. There is no granular layer of Tomes'. The 3 lines perpendicular to the cementum surface are artefacts. (*Magnification: x90.* Source: Soni *et al.*, 1962).

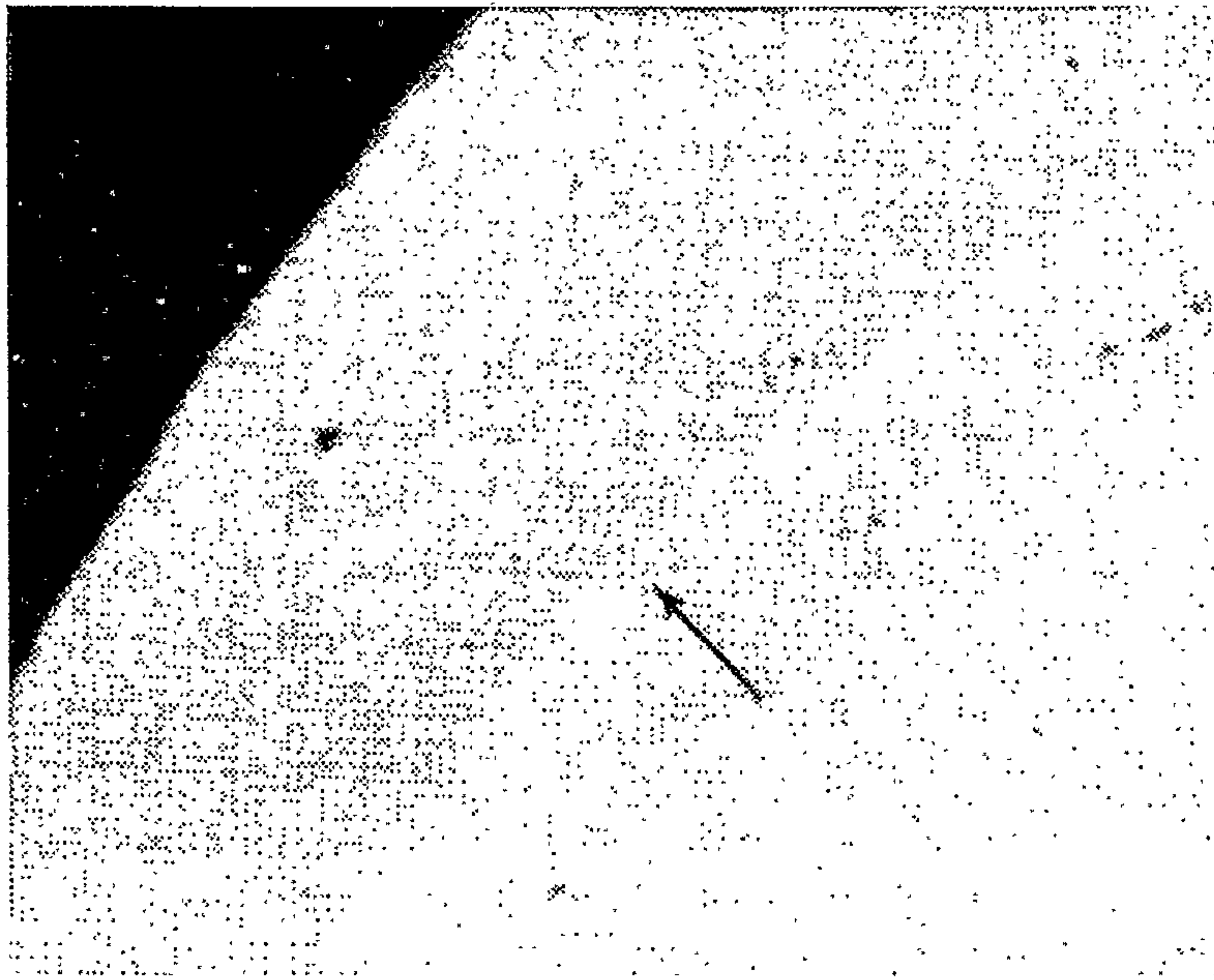


Figure 2.9: Microradiograph of CMSC (610µm wide) taken from the mid-root region of a human premolar root. The CIFIC is peripheral to the AEFC, shown by the arrow. A direct comparison of radio-density between AEFC and CIFIC can be made. The AEFC is much more radiopaque, and therefore, more mineralised, than the CIFIC. The lacunae in CIFIC are distributed as several small dark spots, irregular in shape, position and number. Both types of cementum show a laminated pattern which reflects the rhythmic formation of calcified tissues. The laminae of AEFC are less distinct and thinner than CIFIC. The granular layer of 'Tomes' is visible in the peripheral root dentin. (*Magnification: x90. Source: Soni et al., 1962*).

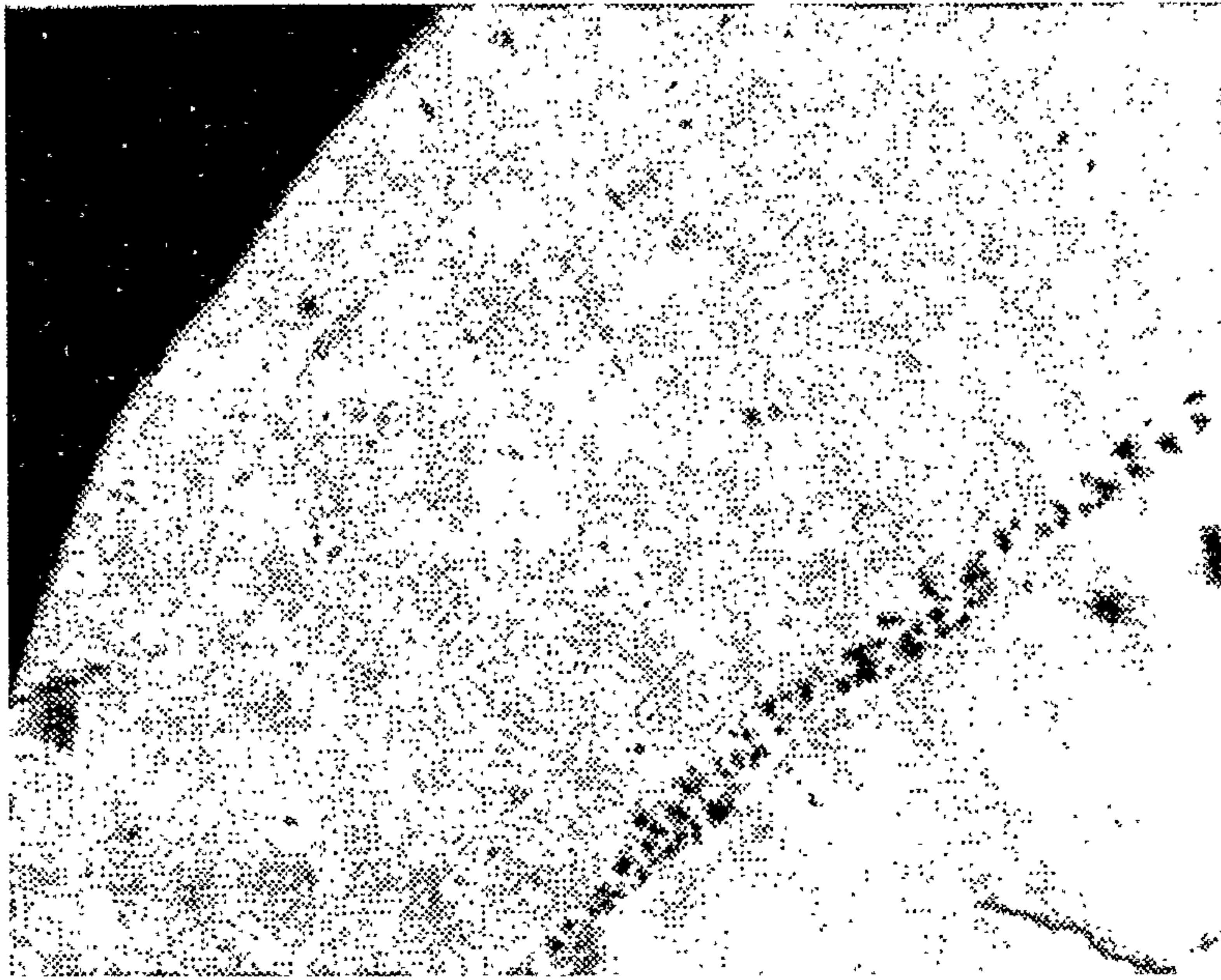


Figure 2.10: Microradiograph of CMFC (560-712 μ m wide) taken from the apical region of a cuspid tooth. The innermost cementum lamina showing numerous, irregular spaces is IC. The CDJ appears on the dentin side of the IC as a darker radiolucent line. Alternating bands of high and low X-ray absorption are clearly visible. The dark, radiolucent bands tend to be irregular, thin and interrupted and run at right angles to the root surface. The light bands appear to be wider with lamellae running parallel to the root surface. The dark, radiolucent bands represent incompletely mineralised extrinsic fibres of the PDL, whereas the light bands represent the more completely mineralised intrinsic fibres of cementum. (*Magnification: x90. Source: Soni et al., 1962*).

The most common elements in cementum include calcium (Ca) and phosphorus (P), with trace amounts of fluoride (F), magnesium (Mg), carbonate (CO₃), citrate, sodium (Na), copper (Cu), zinc (Zn), sulfur (S), selenium (Se), chlorine (Cl) and iron (Fe) (Schroeder, 1986).

There are very few quantitative studies in the literature on the mineral composition of human cementum (Selvig and Selvig, 1962; Selvig and Zander, 1962; Neiders *et al.*, 1972; Nakata *et al.*, 1972; Stepnick *et al.*, 1975; Hals and Selvig, 1977; Totdal & Hals, 1985; Hennequin and Douillard, 1995). These studies have used either chemical analysis (Selvig and Selvig, 1962; Selvig and Zander, 1962; Nakata *et al.*, 1972; Stepnick *et al.*, 1975) or EPMA (Neiders *et al.*, 1972; Hals and Selvig, 1977; Totdal & Hals, 1985; Hennequin and Douillard, 1995) to gain quantitative data on the mineral composition of cementum and are summarized in Tables II-c & II-d.

2.2.4.2.1 Ca and P Content

Very little quantitative data exists in the literature regarding the composition and distribution profiles of Ca and P in normal human cementum (Table II-c). Existing studies are limited by small sample sizes, non-homogeneous tooth samples, and different preparation techniques. Furthermore, in the majority of studies, no distinction in Ca and P composition has been made between the root surface (buccal vs lingual vs mesial vs distal), root position (cervical vs middle vs apical) or position from the outer surface of cementum toward the CDJ.

Existing analyses of the mineral composition in cementum show no significant differences in the Ca and P concentration between cervical and mid-root cementum (Neiders *et al.*, 1972), between cervical and apical cementum (Nakata *et al.*, 1972), or between cervical, middle and apical cementum (Selvig and Selvig, 1962), despite the fact that microradiographs show that cervical AEFC is more highly mineralised than apical CMSC or CIFIC (Soni *et al.*, 1962). No change in Ca or P concentrations have been demonstrated with age or fluoride exposure (Nakata *et al.*, 1972), however, Selvig and Selvig (1962) did find a higher combined Ca + Mg and P content in cervical cementum from teeth greater than 50 years old that had been exposed to the oral cavity, suggesting an uptake of minerals from the oral environment over time. Tötdal and Hals, (1985) demonstrated an increasing concentration of Ca and P from the outer surface of cementum to the CDJ, however, Hals and Selvig, (1977) reported little variation in the Ca and P profiles in cervical cementum from the outer surface to the CDJ. Tohda *et al.*, (1996) also demonstrated little variation in the Ca profiles in cervical cementum. No comparison of Ca and P concentrations has been made in the literature between the buccal, lingual, mesial or distal root surfaces.

Mean Ca concentrations in human cementum have been found to vary from 24.0% - 29.24% dry wt (Selvig and Selvig, 1962; Neiders *et al.*, 1972; Tötdal and Hals, 1985; Hennequin and Douillard, 1995) or 35.6% - 42.4% ash (Nakata *et al.*, 1972). Mean P concentrations in human cementum have been found to vary from 11.6% - 13.49% dry wt (Selvig and Selvig, 1962; Neiders *et al.*, 1972; Tötdal and Hals, 1985; Hennequin and Douillard, 1995) or 16.6% - 20.0% ash (Nakata *et al.*, 1972).

2.2.4.2.1.1 EPMA Studies

Neiders *et al.*, (1972) used EPMA to determine the Ca and P concentrations of human premolar cementum at the cervical and mid-root regions from a sample of 5 adolescent upper and lower premolar teeth. Examination under the SEM showed that the cementum in these specimens was acellular, ranging from 10 to 20µm thick. The mean Ca concentration at the cervical and mid-root region was found to be 25.62% (range 24.7% - 26.9%) and 26.04% (range 24.5% - 27.8%), respectively. The Ca composition of the cementum in the cervical and mid-root regions showed statistically significant differences in only one tooth, with a higher Ca composition in the mid-root region. The mean P concentration at the cervical and mid-root region was found to be 12.92% (range 11.2% - 14.0%) and 13.48% (range 12.6% - 14.2%), respectively. P composition in the cervical and mid-root regions showed statistically significant differences in 2 teeth, with a lower P composition in the mid-root region. This study appears to be the most comprehensive in the literature with regard to the mineral composition of human premolar cementum when considering composition in percentage dry weight, however, it has many limitations including a small sample size, a lack of distinction between the root surface or position from the outer to the inner surface of cementum, and lack of analysis of the Ca and P concentrations for apical cementum.

Tötdal and Hals (1985) used EPMA to examine the Ca and P concentrations of human cementum from 2 adult maxillary incisors and 1 maxillary premolar from an 8-year-old child. An upward sloping Ca and P profile was demonstrated from the outer surface of

the cementum to the CDJ in the adult incisors, suggesting an increasing concentration of Ca and P from the outer surface of cementum to the CDJ. This however, was not demonstrated in the child's premolar. The mean Ca concentration was found to be 24.0% wt (range 19.4% – 28.1% wt). The mean P concentration was found to be 11.6% wt (range 8.4% – 14.0% wt). This study is also quite limited due to the small sample size, lack of distinction between root surface (buccal vs lingual vs mesial vs distal) and root position (cervical vs middle vs apical), and no quantitative values were given comparing the outer to the inner surface of cementum.

Hennequin and Douillard (1995) used EPMA to determine the Ca and P content of human molar cementum at the junction between the cervical and middle third of the root. The sample consisted of 25 extracted mandibular third molar teeth. The mean Ca concentration was found to be $29.24 \pm 0.57\%$ wt and the mean P concentration was found to be $13.49 \pm 0.31\%$ wt. The Ca/P ratio was 2.17. This is the first study that gives Ca and P concentrations in cementum derived from a large sample of human teeth.

2.2.4.2.1.2 Chemical Analysis

Selvig and Selvig (1962) examined the combined Ca + Mg and P concentrations of human cementum in a sample of 20 teeth extracted from individuals in one of 3 groups, i) less than 20 years, ii) 31-40 years, and iii) greater than 50 years. Samples of cementum were obtained by dissecting out the tissue with a scalpel blade under a dissecting microscope. The combined Ca + Mg content was determined by chemical analysis

according to the method of Ericsson (1955). The P content was determined colorimetrically by a modification of the ammonium molybdate method. Values were reported as a percentage of the dry weight. They found the combined Ca + Mg content at the cervical, middle and apical parts of the root to be 26.0% wt, 26.5% wt, and 26.2% wt, respectively. The P concentrations at the cervical, middle and apical parts of the root were 12.3% wt, 12.3% wt, and 12.0% wt, respectively. There was no difference in the combined Ca + Mg and P concentrations from cervical to middle to apical cementum. There was no change in combined Ca + Mg and P content with age, except for the over 50 years group which demonstrated a higher combined Ca + Mg and P content in the cervical cementum, suggesting an uptake of minerals over time from the surrounding fluids as most of these samples had been exposed to the oral cavity due to gingival recession.

Nakata *et al.*, (1972) examined the Ca and P concentration of cementum in 602 human teeth obtained from individuals living in either a low fluoridated (0.22ppm or less), optimally fluoridated (0.80-1.2ppm) or highly fluoridated (3.0-5.6ppm) area. The teeth were obtained from individuals divided into 3 age groups, i) under 20 years, ii) 20-40 years, and, iii) over 40 years. Ca concentrations were determined on ashed samples by Atomic Absorption Spectroscopy (AAS) (Perkin-Elmer atomic absorption spectrophotometer, model 290B). P concentrations were determined on ashed samples using the King modification (Lindberg and Ernster, 1956) of the Fiske and Subbarow method (Fiske and Subbarow, 1925). Ca and P concentrations were given as a percentage of the ash weight (%ash). Percentage of dry weight was calculated based on the ash

content of cementum, which ranged from 30.3% - 64.2%, and is also given in Table II-c. The mean Ca concentration of cervical and apical cementum was found to be $39.5 \pm 1.0\%$ ash and $40.3 \pm 0.7\%$ ash, respectively. The mean P concentration of cervical and apical cementum was found to be $17.7 \pm 0.3\%$ ash and $18.0 \pm 0.3\%$ ash, respectively. No significant difference in Ca and P concentration was found between cervical and apical cementum, or with increasing age and fluoride exposure.

Author	Sample Size	Type of Teeth	Method	F in H ₂ O	Age of Patient (yrs)	Mean Ca Content		Mean P Content	
						% wt	% ash	% wt	% ash
Selvig and Selvig, 1962	20	Not specified	Chemical analysis	Not specified	<20 31-40 >50	(Ca+Mg) Cervical: 26.0 Mid-root: 26.5 Apical: 26.2		Cervical: 12.3 Mid-root: 12.3 Apical: 12.0	
Neiders <i>et al.</i> , 1972	5	Mx & Md premolars	EPMA	Not specified	11-15	Cervical: 25.62 Midroot: 26.04		Cervical: 12.92 Midroot: 13.48	
Nakata <i>et al.</i> , 1972	602	Various	Ca by AAS P using the King modification of the Fiske & Subbarow method (1925)	0.22 or less	<20	Cervical: 11.2	Cervical: 36.8	Cervical: 5.2	Cervical: 17.2
					20-40	24.6	40.7	10.3	17.1
					>40	23.5	38.9	10.7	17.7
					<20	Apical: 21.1	Apical: 38.2	Apical: 9.7	Apical: 17.6
					20-40	25.5	40.4	11.2	17.8
					>40	25.4	39.6	11.2	17.5
				0.8-1.2	<20	Cervical: 19.2	Cervical: 37.8	Cervical: 8.6	Cervical: 16.9
					20-40	24.2	41.1	9.9	16.8
					>40	23.2	38.0	10.4	17.1
					<20	Apical: 22.4	Apical: 39.7	Apical: 9.7	Apical: 17.2
					20-40	25.8	42.4	10.1	16.6
					>40	24.1	38.0	10.7	16.9
				3.0-5.6	<20	Cervical: 17.2	Cervical: 35.6	Cervical: 8.2	Cervical: 17.0
					20-40	22.4	37.5	10.5	17.5
					>40	23.3	40.8	11.4	20.0
					<20	Apical: 19.8	Apical: 36.0	Apical: 9.7	Apical: 17.6
					20-40	26.1	41.7	12.3	19.7
					>40	24.6	39.9	11.8	19.2
Hals and Selvig, 1977	Not specified	Not specified	EPMA	Low F area	31-40	Not specified		Not specified	
Totdal and Hals, 1985	3	2 Mx incisors, 1 premolar	EPMA	Not specified	1 Adult, 1 8yr old	24.0		11.6	
Hennequin and Douillard, 1995	25	Md third molars	EPMA	Not specified	Not specified	Midroot: 29.24±0.57		Midroot: 13.49±0.31	

Table II-c: Summary of the Ca and P concentrations in human cementum expressed in both percentage dry weight (%wt) and percentage of ash weight (% ash).

2.2.4.2.2 F Content

Cementum has been reported to have the highest F content of all the calcified tissues, up to 5 times as much as enamel, and 3 times as much as alveolar bone. Concentrations up to 0.9% (9000ppm) of the ash weight have been reported, while some authors have found considerably lower values (Brudevold *et al.*, 1960; Yoon *et al.*, 1960; Singer and Armstrong, 1962; Yardeni *et al.*, 1963; Gedalia *et al.*, 1965; Zipkin, 1970; Stepnick *et al.*, 1975). There could be several reasons why cementum has a higher F content than all other calcified tissues. The crystallinity of the mineral component in cementum is lower than in other hard tissues, which means that cementum is more permeable and has a greater capacity for adsorption of fluoride over time. Cementum is also exposed to the circulating tissue fluids in the periodontal ligament from which F can be absorbed (Nakagaki *et al.*, 1985; Sugihara *et al.*, 1991). Table II-d summarises the F composition in human cementum found by existing studies in the literature.

F concentrations are lower in deciduous teeth compared with permanent teeth (Kato *et al.*, 1991). Kato *et al.*, (1991) found that the mean F concentration of cementum from deciduous canines was 150-450ppm, as opposed to 200-1000ppm in permanent incisors (Nakagaki *et al.*, 1985) and 200-3000ppm in mandibular permanent premolars (Nakagaki *et al.*, 1987).

There is a general decrease in fluoride content from the cervical to apical cementum, with the mean fluoride content of cervical PAEFC being greater than that of apical CMSC and CIFIC (Brudevold *et al.*, 1960; Stepnick *et al.*, 1975; Nakagaki *et al.*, 1988).

Fluoride concentration in cementum shows an increase with age (Yoon *et al.*, 1960; Nakata *et al.*, 1972; Nakagaki *et al.*, 1985,1987; Weatherell and Robinson, 1988; Sugihara *et al.*, 1991; Kato *et al.*, 1997; Tsuboi *et al.*, 2000) and varies with the nutritional fluoride supply to the individual. The fluoride content increases with the duration of exposure to the oral environment and with increasing fluoride concentrations in the drinking water (Nakata *et al.*, 1972; Stepnick *et al.*, 1975; Kato *et al.*, 1997).

Fluoride concentrations in cementum demonstrate a distribution gradient from the outer root surface inwards with a higher fluoride content on the outer root surface compared with the fluoride concentration at the CDJ suggesting an uptake over time from the surrounding fluids (Hals and Selvig, 1977; Nakagaki *et al.*, 1985,1987; Murakami *et al.*, 1987; Kato *et al.*, 1991; Tohda *et al.*, 1996). This uptake of ions from the surroundings has also been thought to explain why root cementum exposed to the oral environment was more mineralised than non-exposed surfaces (Selvig and Zander, 1962; Selvig, 1965; Hals and Selvig, 1977).

2.2.4.2.2.1 EPMA Studies

Hals and Selvig (1977) examined the fluoride concentration of cementum in freshly extracted teeth from individuals aged 31-40 years, who were living in a low F area. The fluoride concentration was found to vary from one specimen to another, with a higher concentration in the outer cementum (0.5-0.6%wt) compared with the cementum at the CDJ (0.15%wt).

Tötdal and Hals (1985) examined the F concentration of cementum in 2 maxillary incisors obtained from adults and a premolar obtained from an 8-year-old child and found the F concentration to be an average of 0.37%wt, with a range of 0.16-0.7%wt.

2.2.4.2.2.2 F Ion Electrode Studies

Nakata *et al.*, (1972) and Stepnick *et al.*, (1975) examined the fluoride content of cementum in 602 extracted human teeth obtained from individuals living in either a low fluoridated (0.22ppm or less), optimally fluoridated (0.80-1.2ppm) or highly fluoridated (3.0-5.6ppm) area. The teeth were obtained from individuals divided into 3 age groups, 1) under 20 years, 2) 20-40 years, and, 3) over 40 years. Fluoride composition was determined on ashed samples according to McCann (1968) with the Orion specific fluoride ion electrode and meter, Model 407 (Orion Research Company, Inc., Cambridge, Mass.) after the cementum was removed with a Bard-Parker blade and chisel under a dissecting microscope. The fluoride content was reported as a percentage of the ash

weight (%ash) and is demonstrated in Table II-d. The ash weight was found to be 45-65% of the dry weight. The percentage ash value can be converted to ppm by moving the decimal point 4 places to the right. The results demonstrated a general increase in F content with age and amount of fluoride in the drinking water. There was a higher fluoride content in cervical cementum compared with apical cementum. The under 20 years age group represented an anomalous category as seen by a high concentration of fluoride in the cervical and apical cementum of the low fluoride area, suggesting a contribution from other sources such as topical fluoride treatments, toothpaste and fluoride supplementation.

Nakagaki *et al.*, (1985,1987,1988), Murakami *et al.*, (1987), Sugihara *et al.*, (1991), Kato *et al.*, (1991), and Kato *et al.*, (1997) have performed extensive studies on the F composition and distribution in human enamel and cementum.

Nakagaki *et al.*, (1985) examined the F composition of cementum from 20 permanent lower incisors obtained from individuals aged 10-60 years who lived in an area where the F concentration of drinking water was 0.1ppm or less. 300 μ m bucco-lingual sections were cut from the teeth and ground flat. 30 μ m layers of cementum were removed from these sections by abrasive micro-sampling using a 15 μ m-grade silicon carbide Imperial Lapping Film (3M, USA). Samples were recovered from the abrasive film with 3 μ L of 1M HClO₄. This acid solution was then transferred from the film by suction into a 0.25mL polythene capsule. The film was then washed 3 times with 4 μ L of acetate buffer (pH5.2) and this was also transferred to the capsule. F was determined from 2-3 μ L

volumes with the fluoride ion electrode (94-09, Orion Research, MA, USA) described by Hallsworth et al., (1976). The concentration of F in the original samples was calculated from the F:P ratios. The results were expressed as ppm on a dry weight basis, with the assumption that the P concentration was about 18.5% of dry weight in enamel (Nakagaki et al., 1985) and 12.2% of dry weight in cementum. The mean F concentration varied from 200-1000ppm.

Nakagaki *et al.*, (1987) examined the F composition of both enamel and cementum from 20 mandibular premolars obtained from individuals of variable age and lived in an area where the F concentration of drinking water was 0.1ppm or less. The methodology was the same as for Nakagaki *et al.*, (1985). F concentrations in enamel varied from 80-350ppm. The highest values were reported in the outermost region, with an exponential decrease in concentration toward the middle third, and an increase across the final 50µm before the DEJ. Unlike cementum, F concentration in enamel did not appear to increase with age. F concentrations in cementum varied from 200-3000ppm. There was an increase in F concentration with age as well as a distribution gradient from the outer surface inward.

Murakami *et al.*, (1987) examined the distribution of F across human cementum on 59 teeth taken post-mortem from 5 subjects aged 30, 43, 54, 66 and 70 years. The methodology was the same as for Nakagaki *et al.*, (1985). Mean F concentrations were found to range from 825 to 3364ppm, with a maximum F concentration recorded at 5532ppm.

Nakagaki *et al.*, (1988) examined 31 teeth (30 permanent canines and 1 mandibular first molar) taken post-mortem from 10 subjects aged from 40-66 years. The methodology was the same as for Nakagaki *et al.*, (1985). Mean F concentrations were found to range from 100-2100ppm.

Sugihara *et al.*, (1991) examined the F composition of cementum from 10 lower incisors obtained from individuals aged 32-72 years who lived in an area where the F concentration of drinking water was 0.1ppm or less. The methodology was the same as for Nakagaki *et al.*, (1987). An average F concentration of 1509ppm and 1372ppm was reported at the cervical and apical cementum, respectively. A maximum F concentration of 2140ppm and 2035ppm were reported at the cervical and apical cementum, respectively. As previously reported, (Nakagaki *et al.*, 1985,1987,1988; Murakami *et al.*, 1987), F concentrations increased with age.

Kato *et al.*, (1991) examined the F composition of cementum from 20 deciduous canines, obtained from children aged 6-9 years who lived in an area where the F concentration of drinking water was 0.1ppm or less. The methodology was the same as for Nakagaki *et al.*, (1987). The mean F concentration varied from 150-450ppm.

Kato *et al.*, (1997) examined the F composition of cementum from 28 permanent anterior teeth obtained from individuals aged 30 to 60 years who lived in either 1) a low fluoridated area (0.1ppm) or 2) an optimally fluoridated area (1.0-1.3ppm). The

methodology was the same as for Nakagaki *et al.*, (1987). F concentrations reported are shown in Table II-d.

Author	Sample Size	Type of Teeth	Method	F in H ₂ O	Age (yrs)	F Concentration		
						ppm	% ash	% wt
Nakata <i>et al.</i> , 1972 Stepnick <i>et al.</i> , 1972	602	Various	F ion electrode (McCann, 1968)	0.22 or less	<20	Cervical: 7200	Cervical: 0.720	Cervical: 0.22
					20-40	3040	0.304	0.18
					>40	3310	0.331	0.20
					<20	Apical: 4390	Apical: 0.439	Apical: 0.24
					20-40	2340	0.234	0.15
					>40	3140	0.314	0.20
				0.8-1.2	<20	Cervical: 3890	Cervical: 0.389	Cervical: 0.20
					20-40	3630	0.363	0.21
					>40	4250	0.425	0.20
					<20	Apical: 2730	Apical: 0.273	Apical: 0.15
					20-40	3010	0.301	0.18
					>40	4220	0.422	0.27
				3.0-5.6	<20	Cervical: 6110	Cervical: 0.611	Cervical: 0.30
					20-40	5570	0.557	0.33
					>40	7740	0.774	0.44
					<20	Apical: 4450	Apical: 0.445	Apical: 0.24
					20-40	4620	0.462	0.29
					>40	6030	0.603	0.37
Nakagaki <i>et al.</i> , 1985	20	Md permanent incisors	F ion electrode (Hallsworth et al., 1976)	0.1 or less	10-60	200-1000 (dry wt)		0.02-0.1
Nakagaki <i>et al.</i> , 1987	20	Md permanent premolars	F ion electrode (Hallsworth et al., 1976)	0.1 or less	Variable age	200-3000 (dry wt)		0.02-0.3
Murakami <i>et al.</i> , 1987	59	Various	F ion electrode (Hallsworth et al., 1976)	Not specified	30, 43, 54, 66 & 70	Mean: 825-3364 Max: 5532		Mean: 0.083-0.336 Max: 0.553
Nakagaki <i>et al.</i> , 1988	31	Permanent canines 1 md 1 st molar	F ion electrode (Hallsworth et al., 1976)	Not specified	40-66	100-2100		0.01-0.21
Sugihara <i>et al.</i> , 1991	10	Md permanent incisors	F ion electrode (Hallsworth et al., 1976)	0.1 or less	32-72	Cervical: 1509 av 2140 mx (dry wt) Apical: 1372 av 2035 mx (dry wt)		Cervical: 0.151 av 0.214mx (dry wt) Apical: 0.137 av 0.204mx
Kato <i>et al.</i> , 1991	20	Deciduous canines	F ion electrode (Hallsworth et al., 1976)	0.1 or less	6-9	150-450 (dry wt)		0.015-0.045

Kato <i>et al.</i> , 1997	28	Permanent anterior teeth	F ion electrode (Hallsworth et al., 1976)	0.1	30-60	Cervical: 1000-6000 Middle: 1000-4500 Apical: 1000-7900 (dry wt)		Cervical: 0.1-0.6 Middle: 0.1-0.45 Apical: 0.1-0.79
				1.0-1.3	30-60	Cervical: 3000- >9000 Middle: 2500-7900 Apical: 3000-8000 (dry wt)		Cervical: 0.3->0.9 Middle: 0.25-0.79 Apical: 0.3-0.8
Hals and Selvig, 1977	Not specified	Variable	EPMA	Low-F area	31-40	Outer surface: 5000-6000 CDJ: 1500		Outer surface: 0.5-0.6 CDJ: 0.15
Tötdal and Hals, 1985	3	2 mx incisors 1 premolar	EPMA	Not specified	Adult 8 yr child	3700 (1600- 7000)		0.37 (0.16-0.7)

Table II-d: Summary of F composition in human cementum given in ppm, % ash, and % wt.

2.2.4.2.3 Other Elements

2.2.4.2.3.1 Magnesium (Mg) Content

Cementum contains 0.5-0.9% wt Mg (Nakata *et al.*, 1972; Hals and Selvig, 1977; Neiders *et al.*, 1972). The Mg ion occupies the place of an equal number of Ca ions in the hydroxyapatite crystal lattice. The Mg content in cementum is about half that in dentin (Neiders *et al.*, 1972; Hals and Selvig, 1977). The significance of this low Mg content remains obscure, but the finding is in harmony with the notion that the composition of cementum is more similar to bone tissue than to dentin (Neiders *et al.*, 1972).

Nakata *et al.*, (1972) examined the Mg concentrations of cementum in 602 teeth obtained from individuals in 3 age groups, 1) under 20 years, 2) 20-40 years, and, 3) over 40 years who were living in either a low fluoridated (0.22ppm or less), optimally fluoridated (0.80-1.2ppm) or highly fluoridated (3.0-5.6ppm) area. Mg concentrations was determined on ashed samples of cementum with a Perkin-Elmer atomic absorption spectrophotometer model 290B and found to range from $0.67 \pm 0.03\%$ ash to $1.12 \pm 0.08\%$ ash.

Neiders *et al.*, (1972) used EPMA to determine Mg concentrations in cementum obtained from maxillary and mandibular premolars and found the Mg concentration in cementum to range from $0.46 \pm 0.02\%$ wt to $0.68 \pm 0.03\%$ wt.

The Mg concentration has been found to increase in both cervical and apical cementum as the age and fluoride exposure increases (Nakata *et al.*, 1972). The concentration of Mg appears to be lower at the surface than in the deeper layers of cementum. Hals and Selvig (1977) used EPMA to examine the Mg profiles in cementum and found that Mg concentrations ascended gradually from approximately 0.5% at the surface of cementum to approximately 0.9% at the CDJ.

2.2.4.2.3.2 Citrate Content

The mean citrate content of cementum has been reported to be $1.52 \pm 0.10\%$ on an ash weight basis (Stepnick *et al.*, 1975) and $0.86 \pm 0.06\%$ (Stepnick *et al.*, 1975) and 0.70-

0.80% Brudevold *et al.*, (1960) on a dry weight basis. An inverse fluoride-citrate relationship has been demonstrated in human bone (Zipkin *et al.*, 1960), deciduous enamel (Gedalia and Leopold-Calmanovitch, 1968), and permanent enamel (Nikifruk and Grainger, 1965), however, such a relationship has not been found to exist in cementum (Stepnick *et al.*, 1975).

2.2.4.2.3.3 Carbonate Content

The mean carbonate content of cementum has been reported to be 2.79% on a dry weight basis (Stepnick *et al.*, 1975). No inverse F-carbonate relationship has been found (Stepnick *et al.*, 1975).

2.2.4.2.3.4 Sulfur, Sodium and Other Trace Elements

Using EPMA, Hals and Selvig (1977) found the sulfur concentrations in cementum to range from 0.1-0.3% weight and sodium (Na) concentrations to be approximately 0.3%.

A number of trace elements may also be present in concentrations detectable by electron probe microanalysis, in particular Cu and Zn (Brudevold *et al.*, 1960, Barton and Van Swol, 1986), however their distribution and significance have not been studied in any detail.

2.2.4.3 Surface Chemistry of Hydroxyapatite

2.2.4.3.1 Crystal Structure of Hydroxyapatite

Hydroxapatite, $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ has an hexagonal crystal lattice symbolised by space group symmetry P63/m; that is, it represents a primitive hexagonal lattice with a 6-fold screw axis along the c -axis which has two mirror planes ($z=1/4$ and $3/4$) perpendicular to the c -axis (Young and Brown, 1982). The unit cell dimensions are $a = b = 9.418\text{\AA}$, $c = 6.880\text{\AA}$, $\alpha = \beta = 90^\circ$, $\gamma = 120^\circ$ (Young and Brown, 1982). The essential crystallographic symmetry of hydroxyapatite is easier to visualize in terms of the simpler but isostructural fluoroapatite lattice (Figure 13). The Ca ions occupy two crystallographic non-equivalent sites, four at position (I) and six at (II). The Ca(I) ions are arranged in columns at $1/3, 2/3, z$ and $2/3, 1/3, z$ ($z \sim 0$ and $1/2$). The six Ca(II) ions and the six PO_4 groups lie on the mirror planes at $z = 1/4$ and $3/4$ and occupy positions corresponding to two sets of triangles, rotated by about 60° with respect to each other. Whereas in fluorapatite F^- occupies the centre of the Ca(II) triangles on the mirror planes, in hydroxapatite the hydroxyl groups are located along the six-fold axis, but the O atoms are about $0.4\text{\AA}$ out of the plane of the Ca(II) triangles and the H about $1.0\text{\AA}$ further away.

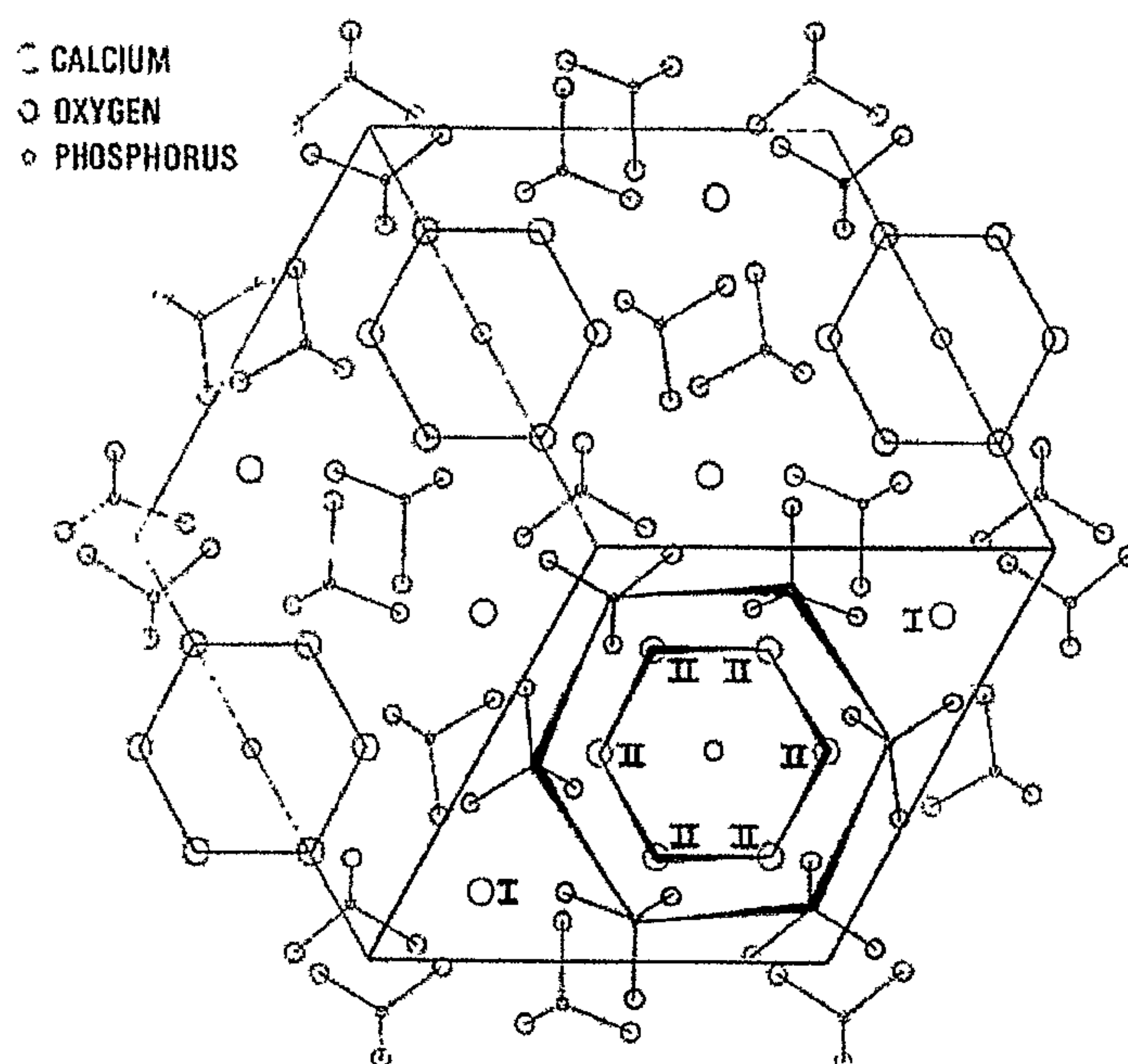


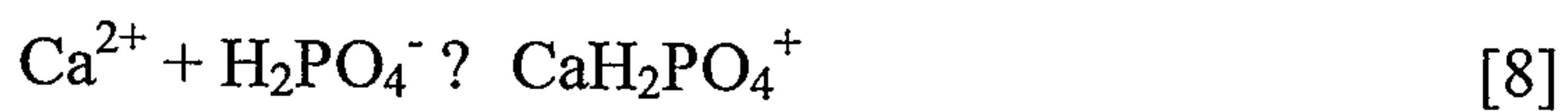
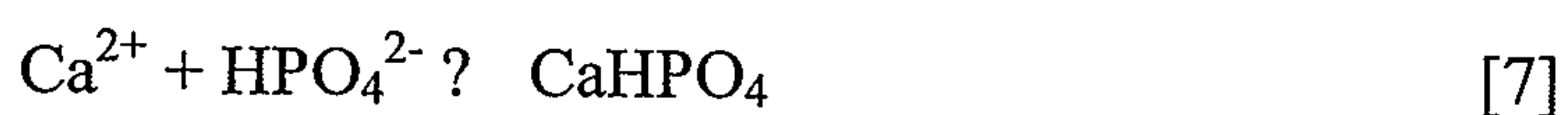
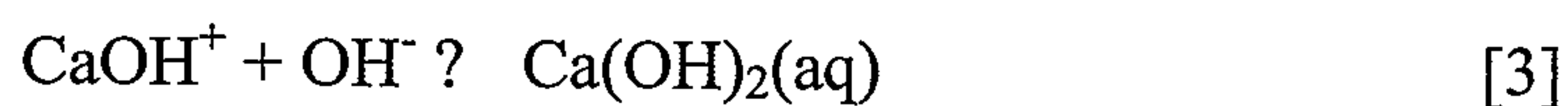
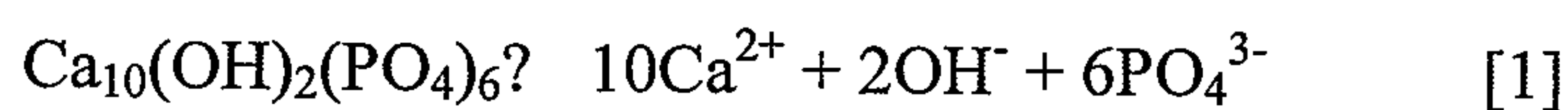
Figure 2.11: Crystal structure of fluorapatite

(Source: Brown and Chow, 1976).

2.2.4.3.2 Electrochemical and Surface Charge Characteristics of Hydroxyapatite

For an ionic solid such as hydroxyapatite, the electrochemical nature and charge characteristics of surfaces very much determine the related properties of adsorption, diffusion and kinetics of dissolution (Misra, 1984). One of the most important parameters that govern the electrical and physicochemical behaviour of an ionic surface is the pH of the solution (Somasundaran, 1968; Neiders *et al.*, 1970; Bell *et al.*, 1972).

A very important electrochemical property of any ionic surface in aqueous solution is its point of zero charge (PZC). It may be regarded as the pH at which the net charge at the surface is zero; at a higher pH the net surface charge is negative and at a lower pH the net surface charge is positive. The charge on the hydroxyapatite surface is determined by the adsorption of charged aqueous species, which develop as a consequence of the various dissolution and hydrolytic reactions that take place when the solid is suspended in aqueous solution (Somasundaran, 1968; Bell *et al.*, 1973). These reactions may be represented as:



Surface species such as Ca^+ and PO_4^{2-} would undergo similar hydrolytic reactions as above and the extent of such hydrolysis for each species depends upon the solution pH, which in turn essentially determines the surface charge. An alternative mechanism would be the hydrolysis of the ions in the bulk crystal, followed by their adsorption at the

interface. Thermodynamically, both mechanisms are indistinguishable and yield the same final result (Misra, 1984).

The hydroxyapatite surface acquires a net negative charge when it is in contact with a solution having a pH above the point of zero charge, since the equilibrium shifts to the left for the reactions [1], [4], [5] and [6], and to the right for the reactions [2] and [3]. When hydroxyapatite is in contact with acidic solutions, it acquires a net positive charge, since equilibrium shifts to the right for the reactions [1], [4], [5] and [6], and to the left for the reactions [2] and [3] (Misra, 1984).

Various electrochemical and surface charge studies (Waters, 1971; Bell et al., 1973; Somasundaran, 1968) have found the point of zero charge (PZC) for apatitic materials to be at a pH of 8.5. In aqueous solutions under non-reactive conditions, at a pH less than 8.5, anions will adsorb on hydroxyapatite whereas cations will be released. At a pH greater than 8.5, cations will adsorb on hydroxyapatite, whereas anions will be released.

2.2.4.3.3 Solubility of Hydroxyapatite

The solubility of a material will increase as its specific surface increases (i.e. the size of the crystallites decreases). The size of crystallites in cementum is smaller than the other calcified dental tissues (enamel and dentin), and therefore cementum has a greater capacity for adsorption of fluoride and other elements over time, but also more readily decalcifies in the presence of acidic conditions.

The interaction of F^- with hydroxyapatite is of immense significance. In general, this interaction may transform the surface of hydroxyapatite to that of fluorapatite or may cause precipitation of CaF_2 or fluorapatite ($Ca_{10}(PO_4)_6F_2$) (Spinelli *et al.*, 1971). The phase rule defines the basic characteristics of the fluorapatite system. This is a quaternary system and may be represented by four components: $Ca(OH)_2$, H_3PO_4 , HF and H_2O . There is, therefore an extra degree of freedom in the fluorapatite system as compared to that of hydroxyapatite for the same number of phases present, or for the same degree of freedom there is one more phase present in the fluorapatite system. The presence of F^- on tooth mineral may render it less soluble and accelerate mineralization processes (Moreno *et al.*, 1977).

2.2.4.3.4 Dissolution of Hydroxyapatite

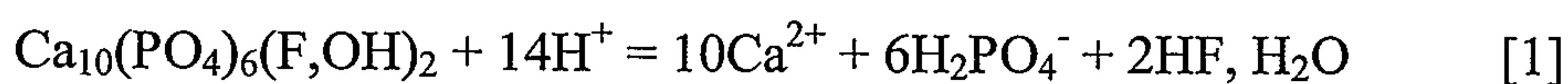
The surface processes of apatite dissolution are not completely understood. Different models for apatite dissolution have been proposed including diffusion-controlled and kinetic (surface)-controlled models; self-inhibited Ca-rich layer formation and similar permselective membrane models; polynuclear mechanisms; congruent/incongruent (or stoichiometric/nonstoichiometric) mechanisms; etch pit formation; two-site mechanisms; ion exchange mechanisms; and hydrogen catalytic mechanisms (Dorozhkin, 1997). Diffusion-controlled and kinetic-controlled mechanisms as well as models of permselective membrane and self-inhibition Ca-rich layer formation are mainly devoted to the transport of chemical reagents to the apatite surface being dissolved and products of chemical interaction backward. Polynuclear, etch pit formation and two-site

mechanisms are devoted to the dissolution of apatite as if it were an ordinary solid. Polynuclear mechanisms are based on dissolution nuclei formation on the crystal surface, whereas etch pit formation and two-site mechanisms are based on defects in crystal structure. Ion exchange mechanisms are based on the sorption of protons and acidic anions from solution on the surface of the apatite that is being dissolved and the removal of Ca and phosphate ions to solution instead. Hydrogen catalytic mechanisms are based on sorption of protons on the phosphate groups of apatite. After being sorbed, protons catalyze dissolution.

Dorozhkin (1997) suggest that only congruent/incongruent (or stoichiometric/nonstoichiometric), ion exchange and hydrogen catalytic mechanisms can be considered in attempts to describe the surface processes occurring during dissolution. Of these three possible dissolution mechanisms, the congruent/incongruent (or stoichiometric/nonstoichiometric) mechanism appears to be most accepted. Mika *et al.*, (1976) investigated the role of surface reactions in the dissolution of stoichiometric hydroxyapatite at pH values ranging from 4.90-9.94. They found that during the dissolution of hydroxyapatite a local nonstoichiometry always appeared on the surface of hydroxyapatite (moreover, it depended on pH), while in the bulk solution nonstoichiometry appeared only at the very beginning of dissolution and was transformed into a stoichiometric ratio when dissolution progressed. Dorozhkin (1997) investigated the surface reactions of fluorapatite dissolution in acidic solutions (phosphoric acid) by scanning electron microscopy, Auger electron spectroscopy and infrared reflection spectroscopy and found fluorapatite to dissolve incongruently (nonstoichiometrically)

with the following sequence of ionic detachment from the surface of apatite: fluorine, followed by calcium and lastly phosphate. Furthermore, he suggested that the small differences in structure between fluorapatite and hydroxyapatite did not affect the surface mechanism and that dissolution for both fluorapatite and hydroxyapatite could be considered synonymous.

Two chemical reactions are widely used for the description of fluorapatite and hydroxyapatite dissolution:

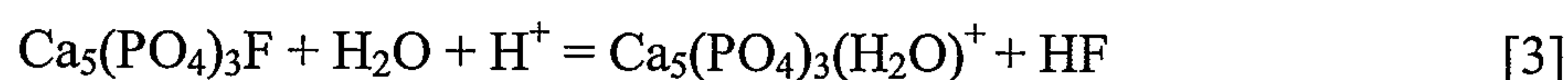


The first equation describes chemical transformation of apatite into acidic calcium phosphates, while the second describes the dissolution process as a simple dissociation and reports nothing about final products of chemical transformation.

Suspension of fluorapatite in an acidic medium most probably results in the transformation of apatite into acidic calcium phosphates (equation [1]), however, the formation of octacalcium phosphate cannot be ruled out (Dorozhkin, 1997). There is a structural relationship between hexagonal hydroxyapatite and triclinic octacalcium phosphate ($\text{Ca}_8\text{H}_2(\text{PO}_4)_6 \cdot 5\text{H}_2\text{O}$). The portion of structure adjacent to hydroxyapatite, the “apatitic” layer of the octacalcium phosphate, is almost identical in structure to hydroxyapatite, however, the “hydrated” layer of octacalcium phosphate differs entirely

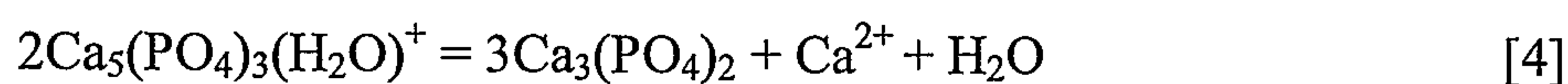
in its composition and structure from that of hydroxyapatite (Brown, 1966). The structural relationship between these two salts suggests that hydroxyapatite may possibly expose a 100 face of octacalcium phosphate in aqueous solutions (Brown, 1966). The octacalcium phosphate structure introduces a transition zone from apatite to the aqueous phase through the hydrated layer that could reasonably be expected to have a lower interfacial energy per se than the ionic apatitic layer. The hydrated layer, because of its hydrogen bonding, is likely to be more compatible with the aqueous phase than the apatitic layer.

Fluorine for fluorapatite and hydroxyl for hydroxyapatite most probably dissolves first (Moreno *et al.*, 1977; Wong *et al.*, 1987; Pearce *et al.*, 1995; Dorozhkin, 1997). Dissolution starts with replacement of fluorine for water and has been represented by the following equation [3] (Dorozhkin, 1997):



A proton, most likely H_3O^+ , present within an acidic medium, is thought to adsorb onto the surface of fluorapatite and result in a positive surface charge formation (Somasundaran, 1968; Bell, 1973; Doss, 1976). This proton has been thought to catalyse the removal of fluorine and incorporation of water into apatite (Christoffersen *et al.*, 1996a,b). Dorozhkin (1997), however, suggested that the positive surface charge of apatite is acquired by the replacement of fluorine anions with neutral water molecules as shown in equation [3].

The positive charge attained by the apatite surface in an acidic medium is removed by dissolution of one of the nearest calcium cations and may be represented by the following equation [4] (Dorozhkin, 1997):



Later, protons from the bulk solution replace other calcium cations around the nearest phosphate groups according to equation [5] and as a result, a very thin surface layer of acidic calcium phosphates is formed (Dorozhkin, 1997).



Finally, when all or almost all of the nearest calcium cations have been replaced with protons, phosphate anions (H_2PO_4^- , $\text{CaH}_2\text{PO}_4^+$, or H_3PO_4 ; it is not yet clear) detach from the surface according to the following surface reactions [6] and [7] (Dorozhkin, 1997):



Therefore, the dissolution at the surface of apatite appears to follow a sequence of ionic detachment of fluorine first, followed by calcium and lastly phosphate (Dorozhkin, 1997).

2.2.4.4 Methods for Determining the Mineral Composition of Cementum

Techniques employed to determine the mineral composition of human cementum have included measurements of specific gravity, X-ray densitometry (Amprino and Camanni, 1956; Röckert, 1958; Soni *et al.*, 1962; Dreyfuss and Frank, 1964), microhardness (Rautiola and Craig, 1961), microradiography (Rockert, 1958, Soni *et al.*, 1962, Hals and Selvig, 1977), chemical analysis (Selvig and Selvig, 1962; Selvig and Zander, 1962, Nakata *et al.*, 1972, Stepnick *et al.*, 1975), scanning electron microscopy in combination with an energy dispersive X-ray detector (EDX) (Barton and Swol, 1986; Cohen *et al.*, 1992) and electron probe microanalysis (EPMA) (Neiders *et al.*, 1972; Hals and Selvig, 1977; Totdal and Hals, 1985; Hennequin and Douillard, 1995). Of these techniques, microradiography, chemical analysis, SEM in combination with EDX and EPMA have been most widely used in the literature.

2.2.4.4.1 Microradiography

Microradiography involves the production of an X-ray photograph (microradiograph) of a specimen on a slide. A ground section of cementum is made and then placed in contact with a photographic emulsion on a glass slide and exposed to a beam of X-rays. The photographic emulsion is then developed and viewed with a microscope.

Microradiography is useful for examining the radiodensity of a tissue and comparing the degree of mineralisation within a tissue. As in a standard X-ray, more highly mineralised areas appear radiopaque, less mineralised areas appear radiolucent. Standards of known mass can be added to the slide or to a companion slide treated in the same manner in order to provide semi-quantitative information on the amount of mineral in different parts of the ground section. The advantage of microradiography is that it does not require the separation of cementum from other tissues, but it is limited because it usually can only yield semi-quantitative data.

2.2.4.4.2 Chemical Analysis

Although this method can yield quantitative data, one of the major problems with chemical analysis of cementum is that it is difficult to obtain large enough samples that are free of dentin and connective tissue (Neiders *et al.*, 1972). Chemical analysis may be performed on ashed samples in which case quantitative data for elements is given on an ash basis. The ash content of cementum has been found to be 48-65% of the dry weight (Nakata *et al.*, 1972). Alternatively, data may be reported in percent weight (%wt).

Chemical analysis of Ca concentrations in cementum has involved the use of atomic absorption spectroscopy (AAS) (Nakata *et al.*, 1972) as well as the method of Ericsson (1955) (Selvig and Selvig, 1962).

Chemical analysis of P concentrations in cementum has involved the use of the King modification (Lindberg and Ernster, 1956) of the Fiske and Subbarow method (Fiske and Subbarow, 1925) (Nakata *et al.*, 1972) and well as colorimetrically by a modification of the ammonium molybdate method (Selvig and Selvig, 1962).

Chemical analysis of F concentrations in cementum involves measurement with a fluoride ion electrode (McCann, 1968; Hallsworth *et al.*, 1976) after a sample of cementum has been removed from the tooth root. Removal of cementum prior to examination with the fluoride ion electrode has been done with abrasive micro-sampling (Weatherell *et al.*, 1985; Nakagaki *et al.*, 1985,1987; Murakami *et al.*, 1987; Kato *et al.*, 1991; Sugihara *et al.*, 1991; Kato *et al.*, 1997, Tsuboi *et al.*, 2000) and a Bard-Parker blade and chisel under a dissecting microscope (Nakata *et al.*, 1972; Stepnick *et al.*, 1975).

Abrasive micro-sampling is a technique developed by Weatherell *et al.*, (1985) which employs abrasion to remove the surface layer from the tissue under investigation. The sample is collected as a powder. The abrasive is usually in the form of paper or film, impregnated with an abrasive. A Mikrokator is used to measure the thickness of the layer to be removed and its accuracy has been found to be in the order of $\pm 1\mu\text{m}$ (Weatherell *et al.*, 1985). The main disadvantage of this technique is recovery of the sample, where some of the abraded sample might be lost due to adherence to the specimen or abraded surface. For this reason, the technique is not ideal for determining total amounts of any component or for determining concentration on a volume basis, rather it is useful for

determining relative concentrations of two or more components e.g. F/P ratios. The advantage of this method is that the procedure is not influenced by specimen porosity or the presence of acid-insoluble organic components. Weatherell *et al.*, (1985) suggest that the thickness of the sample layers removed can be determined with great accuracy and reliability and conclude that this technique is suitable for investigating thin histological layers such as cementum.

2.2.4.4.3 Electron Probe Microanalysis (EPMA)

EPMA is a fully quantitative method that allows for the non-destructive analysis of μm -sized volumes at the surface of materials. It is the most suitable technique for examining elemental composition within localized small areas of mineralised tissue such as cementum (http://www.cameca.fr/html/epma_technique.html).

Unlike chemical analysis, EPMA does not require separation of cementum from dentin (Neiders *et al.*, 1972), and furthermore, the composition of a number of elements can be determined at any one time (Andersen, 1967). It is the most precise and accurate microanalysis technique available with sensitivity at the level of ppm and routine quantification to 1% reproducibility. It is reported to be the most precise and accurate microanalysis technique available (http://www.cameca.fr/html/epma_technique.html).

The accuracy of EPMA is dependent on the following factors (Ngo *et al.*, 1997):

1. There must be a suitable standard of known composition, and it should be homogeneous at a microscopic level. Accurate analysis can be performed with simple standards consisting of a pure element.
2. The specimen must have a flat, highly polished surface placed at a known angle to the incident beam and the spectrometers.
3. The specimen must be homogenous on the micro-scale.
4. The specimen must be stable under electron bombardment.
5. The specimen must be stable under vacuum.

The high degree of accuracy obtained with EPMA comes from the use of wavelength dispersive spectroscopy (WDS). The WDS detectors are significantly more sensitive than standard scanning electron microscopy/energy dispersive spectroscopy (SEM/EDS) systems and allow very high precision chemical analysis to be performed (http://srv.emunit.unsw.edu.au/Facilities2000_files/Equipment/_sx50.htm).

With EDS, the X-ray quantum energy is measured by the charge deposited in a lithium-drifted silicon detector at liquid nitrogen temperature. It has the advantage that the whole spectrum is registered simultaneously and that a relatively high proportion of the generated X-rays can be recorded, if the detector is positioned close to the specimen. The disadvantage of EDS is that it has relatively poor spectral resolution, so that often the

peaks of different X-ray lines overlap. The peak to background ratio is low, so that the detection of elements with low concentration is impaired (Höhling & Krefting, 1984).

With WDS, one X-ray wavelength is separated from all others by diffraction from a crystal of known lattice spacing. This provides very fine separation of closely spaced spectral lines, enabling clear recognition of all the overlapping lines due to different elements. Its spectral resolution is good. The peak to background ratio is high, and therefore elements with a relatively low concentration can be detected (Höhling & Krefting, 1984). This is particularly required for F, where concentrations are at the ppm level.

An electron microprobe consists of an electron gun, electron column and a variable number of wavelength dispersive spectrometers (Figure 2.11,2.12). EPMA uses a beam of focused electrons to excite X-rays from a small area of a flat, polished sample. Low-energy thermionic electrons are produced from a tungsten filament and accelerated by a positively biased anode plate to 10-30 thousand electron volts (keV). The anode plate has a hole in its center and the electrons pass through it and are collimated and focused by a series of magnetic lenses and apertures. The electron beam is used to bombard the sample and produce analytical X-rays from it (<http://jan.ucc.nau.edu/~wittke/Microprobe/ProbeIntro.html>). Characteristic X-rays that are generated by the elements in the sample are diffracted by a suitable analysing crystal (LiF, PET, PCO, PC1, PC2, PC3), detected, and then measured in counts per second by the gas flow proportional detectors. The composition of the unknown is determined by

comparison with X-ray intensities from standards with known compositions (http://srv.emunit.unsw.edu.au/Facilities2000_files/Equipment/_sx50.htm).

When analysing calcified tissues, the electron microprobe is operated in the backscattered electron (BSE) mode. BSE detectors function well at electron energies greater than 10keV, and the SEM is usually operated at 20 or 30kV in this mode. BSE carry information about the density of the superficial layers of the specimen. To abstract the density-dependent (atomic number) contrast, one must have very flat sample surfaces. Combined with carbon coating and BSE collection over a wide solid angle averaged at normal incidence to the surface, very low density differences can be detected and imaged (Boyde, 1981; Boyde and Jones, 1983a,b).

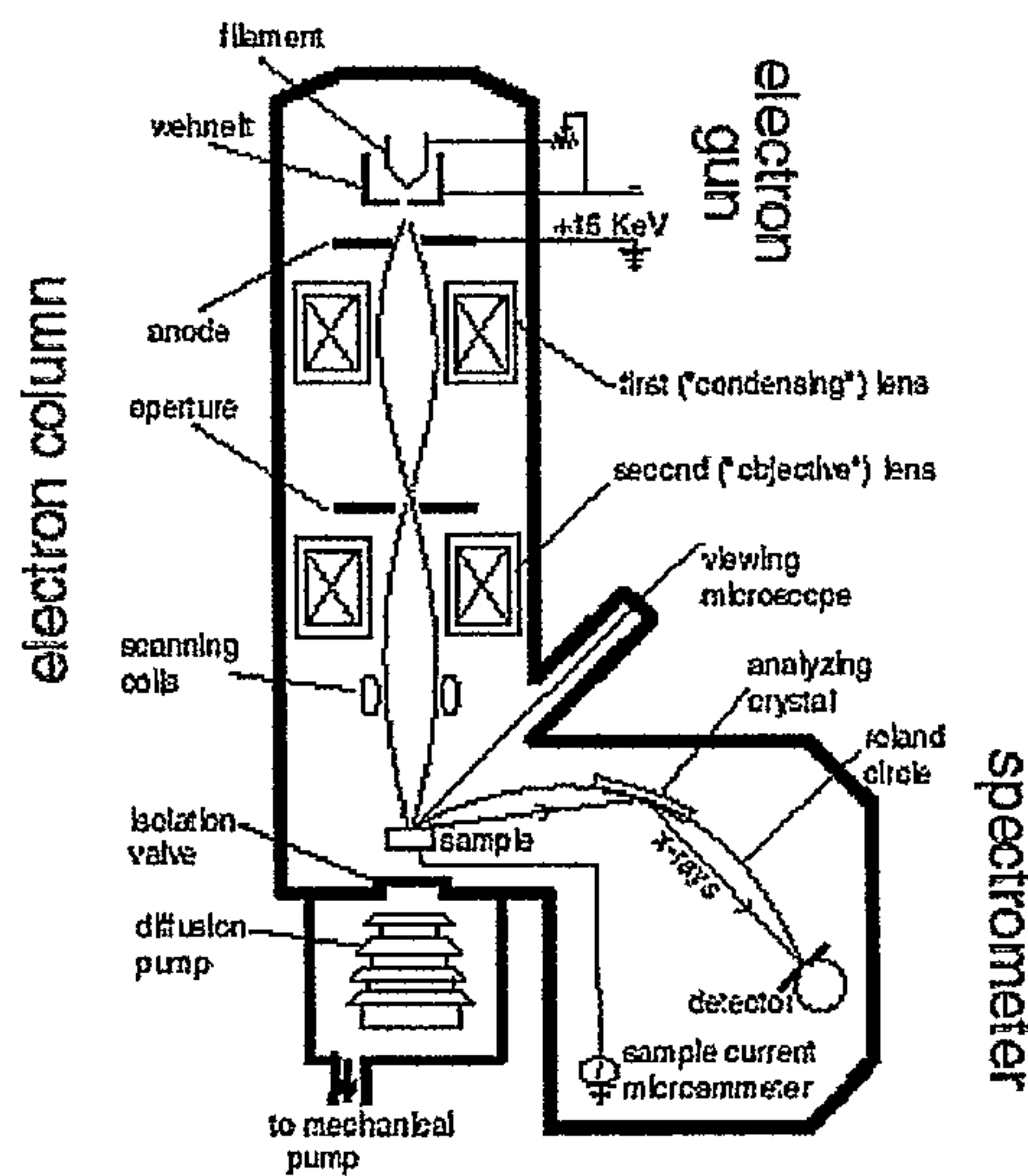


Figure 2.12: Schematic diagram of an electron microprobe showing the electron column and one wavelength-dispersive spectrometer (most microprobes have three or more situated radially around the column and sample chamber). *Source:* <http://jan.ucc.nau.edu/~wittke/Microprobe/ProbeIntro.html>.

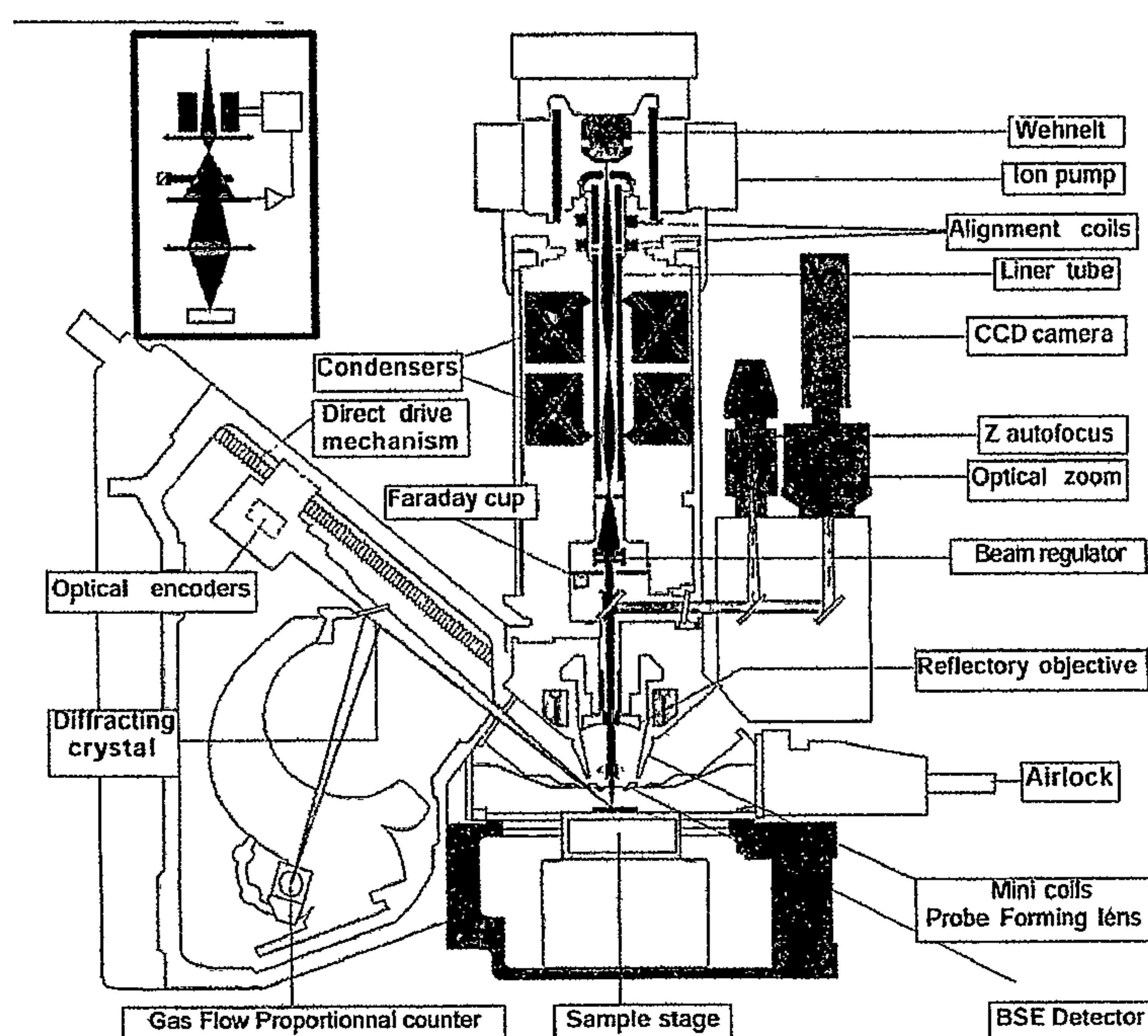


Figure 2.13: Illustration of the Cameca SX50 electron microprobe (Cameca, France).

Source: http://www.cameca.fr/html/epma_technique.html

2.2.4.4.3.1 Quantification

The 2 most common methods used for quantitation in EPMA include the calculation of ZAF-correction and the use of peak to background (P/B) ratios. The quantitative analysis of bulk specimens can be performed less accurately with theoretically derived ZAF-correction programmes, or more accurately using the P/B ratio (Stantham and Pawley, 1978; Small *et al.*, 1979).

Theoretically derived ZAF-correction programmes have certain problems with biological specimens. For computation of the ZAF-correction factors the elemental composition of

the specimen and the standard must be known. For the unknown it is therefore necessary to make initial estimates of all elemental concentrations (Boeckstein, 1980). In a ZAF-procedure corrections are applied for:

1. Loss of kinetic energy of beam electrons (stopping power:S).
2. Partial backscattering of beam electrons.
3. Absorption of primary generated X-rays.
4. Generation and subsequent partial absorption of secondary X-rays (X-ray fluorescence).

The peak-background (P/B) ratio takes into account the background in the same energy range as the characteristic peak, and assumes that the absorption of the energy generated is the same for the characteristic and continuum radiation in the volume irradiated. The advantages of this method are that it is independent of the specimen thickness or the take-off angle since the absorption of both radiations, having the same energy, is identical. It is also independent of variations in beam current intensities and specimen surface effects, and is suitable for quantitative analysis of rough surfaces in scanning electron microscopy (Boeckstein *et al.*, 1984; Armstrong, 1991).

2.2.4.4.3.2 Standards

Quantification of biological tissues in an analytical electron microscope depends on the choice of suitable standards (Hall, 1971). One of the problems with quantitative studies is

the preparation of adequate standards for mineralised tissues. Problems arise because the organic matrix is present in different proportions in hard tissues, ranging from less than 1% in the enamel to 20-35% in dentine (Avery, 1987).

The basic characteristics required for a compound to be used as a standard were defined by Anderson (1967) and include:

1. The material must have a well-defined chemical composition.
2. It must be homogeneous at the spatial resolution used during the analysis, and,
3. It must resemble the specimen to assure similar interactions with the electron beam.

Standards may be classified into 2 types depending on the resemblance to the specimen in chemical composition:

1. *Ideal standards* must have the same matrix and composition as the specimen. The choice of ideal standards implies that the composition of the specimen has already been established by other analytical techniques. ZAF corrections are not necessary.
2. *Non-ideal standards* require mathematical corrections accounting for differences in absorption between specimen and standard. ZAF corrections are necessary.

Calibration of the X-ray detector is achieved by using a standard containing the element of interest in a known concentration. The value obtained should not be statistically different from the one estimated by the calibration curve. The measured signal (i.e. P/B ratio) for the element of interest must be plotted as a function of the concentration of the element. The usual procedure is to analyze a number of standards that contain this element at different concentrations and to demonstrate a linear relationship between the measured signal and the concentration of the element (Lopez-Escamez and Campos, 1994).

Previous EPMA studies on cementum have used various apatites for Ca, P and F determination. Neiders *et al.*, (1972) used a fluorapatite, $\text{Ca}_{10}(\text{PO}_4)_3\text{F}_2$ with a Ca composition of 39.7% and P composition of 18.4% to determine Ca and P concentrations. Hals and Selvig, (1977) used an apatite to determine Ca, P and F compositions but did not state its' composition. Hennequin and Douillard, (1995) used a synthetic apatite made up of 39.02% Ca and 18.3% P to determine Ca and P concentrations.

2.2.4.4.3.3 Operating Conditions

The operating conditions of the probe will depend on the sample being analyzed. The choice of optimum analytical conditions is complicated in materials with low thermal conductivity because the sample heats up during electron bombardment, and light element ions such as fluoride may be volatilised from the sample during analysis. This

results in an incorrect measurement, indicating concentrations lower than those initially present in the specimen (Chu *et al.*, 1989).

The rise in temperature of a specimen under the electron beam is directly proportional to the accelerating voltage, specimen current, and reciprocal beam radius. Increasing the beam diameter while sacrificing spatial resolution can minimize volatilization of fluoride. Alternatively, it is possible to operate at low accelerating voltages and retain a relatively small beam diameter.

In trace analysis of fluoride (less than 10^4 ppm), count rates are usually low, and peak-to-background ratios are generally poor. To obtain reliable results, it is important to measure and subtract the background accurately. The background can include contributions from sources such as the x-ray tube continuum scattered by the specimen, diffraction peaks resulting from the crystallite structure of the specimen, interference of fluorescence from other elements in the specimen and the x-ray spectrometer itself (Jenkins *et al.*, 1981). However, careful collimation, the proper choice of diffraction crystal, and the use of pulse height discrimination can effectively minimize these sources of background radiation. Although lower accelerating voltages result in reduced x-ray intensities, background radiation declines more rapidly, resulting in improved peak-to-background ratios.

Operating conditions for cementum analysis have varied. Neiders *et al.*, (1972) examined cementum with the probe at 10kV and 0.01 μ A. Hals and Selvig, (1977) examined

cementum with the probe at 11, 15 & 23kV and 0.2-0.67 μA and Hennequin and Douillard, (1995) examined cementum with the probe at 15kV and 0.011 μA .

2.2.4.4.3.4 Specimen Preparation

One of the problems with quantitative studies is the appropriate preparation of specimens. Preparation of specimens requires a number of steps. In each of these steps elements can be lost or redistributed. Samples for EPMA must be dehydrated to make it suitable for insertion into the vacuum of the electron probe. The specimen must be flat with ideally parallel surfaces. In the case of teeth, resin embedding is often required to obtain a well-prepared specimen. The sample must be well polished using a minimum of 1 μm abrasives, mounted to be physically compatible with the specimen stage and rendered electrically and thermally conductive (Boyde, 1984). Table II-e gives a summary of the existing literature on various specimen preparation procedures employed for EPMA analysis of cementum.

2.2.4.4.3.4.1 Fixation

Chemical fixation of a sample is important if the aim is to examine the morphological features of the cells or the distribution of the less stable polysaccharides of the matrix ground substance (Boyde, 1984). The concern with unfixed tissue is that it will decay and this may somehow affect the mineral composition of the tissue, however, there is no evidence to suggest that post-mortem autolytic changes in the surrounding cells will be

associated with significant changes to the superficial mineral component in cementum (Boyde, 1984).

Fixation should generally be avoided as it has been shown that certain fixatives may alter the mineral composition of calcified tissues (Boyde, 1984). Formaldehyde, glutaraldehyde, osmium tetroxide, osmium tetroxide/boric acid/borate, thiocarbohydrazide and osmium tetroxide, and cetylpyridinium chloride have been used in the fixation of calcified tissues (Boyde, 1984). Formaldehyde decomposes to formic acid, which cause partial dissolution of the mineral component (Boyde, 1984). It is unknown whether glutaraldehyde, osmium tetroxide, osmium tetroxide/boric acid/borate, thiocarbohydrazide and osmium tetroxide, and cetylpyridinium chloride have any effects on the mineral composition of cementum. Phosphate buffers are often used as the vehicle in chemical fixation of calcified tissues and can precipitate apatite or other calcium phosphates (Boyde, 1984).

Various forms of fixation have been used in some of the existing EPMA studies on cementum. Hals and Selvig, (1977) fixed their teeth in neutral formalin, whereas, Hennequin and Douillard, (1995) fixed their teeth in benzalkonium chloride (1/3000). In these studies, the mineral composition may have been affected by such fixation.

2.2.4.4.3.4.2 *Dehydration*

Dehydration of the sample is required to make the specimen suitable for use in the vacuum chamber of the SEM. The effect of dehydration on calcified tissues is structural shrinkage. Dehydration, however, is the only technique that does not risk sample contamination, loss of soluble substances, displacements of cell constituents, or chemical alteration of reactive groups (Andersen, 1967). Dehydration of calcified tissues may be accomplished by either evaporative drying (air-drying), critical point drying or freeze drying, after the specimen has been rapidly frozen.

Evaporative drying or “air-drying” – is acceptable for examining cementum where the interest is to be focused on dense mineral. Due to the greater surface free energy of water, air-drying from water causes more shrinkage than drying from a volatile, low surface tension solvent. For this reason, substitution of water with ethanol, acetone, ether, xylene, toluene, chloroform or best of all 1,1,2-trichlorotrifluoroethane (Freon 113, Arcton 113, Arklone) prior to drying has been recommended (Boyde, 1984). Boyde (1984) recommends that if maintenance of structural integrity is paramount, in order to reduce the consequence of shrinkage, air-drying be done in an environment that is saturated with the vapour of the solvent employed. Air-dried specimens can be protected from rehydration with subsequent degradation by keeping them in a vacuum dessicator, preferably in the dark.

Differences in drying technique exist between the few existing EPMA studies on cementum. Neiders *et al.*, (1972) dehydrated their teeth in 100% ethanol for 7 days followed by drying at 95⁰C for 1 week. Hals and Selvig, (1977) used alcohol to dehydrate their teeth. Tötdal and Hals, (1985) dried their teeth at 50⁰C for 48 hours, whereas Hennequin and Douillard, (1995) dried their teeth at 35⁰C for 30 minutes. Extreme temperature, however, for a prolonged period of time may cause thermal damage to the specimen with a subsequent loss in the mineral content of the specimen (Boyde and Switsur, 1962). Those studies employing high temperatures to dry specimens, therefore, may have resulted in changes to the mineral content of cementum.

2.2.4.4.3.4.3 Resin Embedding

EPMA requires that the specimen have an ultraflat, highly polished surface. This can most readily be achieved by resin embedding. The disadvantage with resin embedding is that it may introduce some of the undesirable consequences of specimen contamination and displacement of cell constituents. Resin-embedded material will reveal only density-dependent information using BSE imaging. Large areas of calcification are more easily retained and sectioned from specimens embedded in low viscosity resin mixtures such as Epon and Spurr resin mixtures rather than Araldite mixtures.

All existing EPMA studies on cementum have embedded samples in resin. Neiders *et al.*, (1972) used acrylic resin. Hals and Selvig, (1977) used polyester or epoxy resin. Tötdal

and Hals, (1985) used Acrofix. Hennequin and Douillard, (1995) used a fast-setting resin, Mexaprex-Presi.

2.2.4.4.3.4.4 *Sectioning*

Sawing with a constant speed, constant torque, diamond saw is recommended for the cutting of flat surfaces on large samples such as teeth (Boyde, 1984). Sawing should be carried out under copious irrigation with distilled water to prevent excessive heat production and subsequent loss in the mineral content of the specimen (Boyde and Switsur, 1962). Sectioning can be done before or after embedding, however, sectioning after embedding eliminates the possibility of tooth fracture.

The thickness of tissue sections is important from thermal and microscopic examination considerations as well as from the point of view of quantitative analysis. The heat generated in a sample is directly related to the current in the beam and the accelerating potential, and inversely related to the diameter of the probe. Heavily mineralised tissues such as teeth need not be restricted to thin sections since this tissue can withstand the heat developed by the probe much better than soft tissue. A minimum thickness is required if quantitative determinations of weight concentrations are sought. The maximum depth of X-ray production for a particular element in a specimen at some accelerating potential defines the minimum thickness of the structure.

2.2.4.4.3.4.5 *Polishing*

A highly polished, flat surface is required for EPMA. Polishing is achieved with abrasives such as silicon carbide papers, sandpapers, disks, diamond pastes and polishing powders. As for sectioning, polishing should be performed under copious irrigation with water to prevent excessive heat production and subsequent loss in the mineral content of the specimen (Boyde and Switsur, 1962).

Various polishing protocols have been employed in the existing EPMA studies on cementum. Neiders *et al.*, (1972) used 600 grit silicon carbide paper followed by 0.25µm-diamond paste to polish their resin embedded specimens. Tötdal and Hals, (1985) used sand paper followed by diamond paste in a DP-U metallographic grinding/polishing apparatus (Struers, Denmark), whereas Hennequin and Douillard, (1995) polished their resin embedded specimens with abrasive disks (Presi P1000, P600, P400 on a Multipol-2 polisher), followed by polishing powders (Escil FD1B with Oxide of Alumin - 7.5µm, 3.25µm and 1.25µm) under irrigation with distilled water.

2.2.4.4.3.4.6 *Mounting*

Various adhesives are available to mount specimens for EPMA.

1. Low Vapour Pressure Polymer Adhesives

Glues used for mounting the dry SEM specimen should have a viscosity that they do not wet and swamp the sample. They should have a low vapour pressure when set. For permanent mounts, Boyde (1984) recommends the use of rapid-setting epoxy or polyurethane glues. Conductive cements containing metal or carbon particles are also available.

2. Solvent Evaporative Glues

These include silver-dag and carbon-dag or conductive carbon cement. The latter is recommended as it outgases for much longer than glues that set by a polymerisation process (Boyde, 1984).

3. Thermosetting Glues

Very low vapour pressure adhesives melting in the 50-60°C range are useful adhesives from which a specimen can be removed or on which it can be reoriented by remelting the adhesive. Examples include “tempcemfix” and Apiezon wax (vacuum wax) (Boyde, 1984).

4. *Vacuum Putty*

Useful when dealing with very large samples requiring large specimen stubs which would be too expensive if used for only one sample. Samples can be demounted, remounted and reoriented at will (Boyde, 1984).

5. *Adhesive Tape*

Double-sided adhesive carbon tape offers the advantage of being able to easily remove the specimen if needed as well as improving conductivity to the specimen (Boyde, 1984).

2.2.4.4.3.4.7 *Conductive Coatings*

Dried specimens are not electrically conductive and calcified tissues such as cementum are especially poor conductors. Non-conductive samples will create an unequal charge build-up in the subsurface zone of the sample causing astigmatic electrical fields that distort and deflect the scanning beam, inducing various forms of image aberration. Furthermore, periodic variations in brightness occur usually in the form of lines across the image. For this reason, the specimen must be rendered conductive to facilitate the removal of electrons from the sample's surface and prevent the build-up of an electrical charge. The correct thickness for any conductive coating is that which allows the specimen to be examined in the required operating mode without significant problems.

For BSE studies, too thick a coating may obscure the specimen contrast. For high-resolution work, details may be blurred by the application of too thick or too grainy a coating. Carbon, Duron antistatic spray, or an easily sputtered or evaporated metal such as gold, aluminium, or silver have been used to render a specimen conductive (Boyde, 1984).

i) Carbon

Carbon is commonly used as a coating as its electrical conductivity properties are adequate and it does not affect the analysis of the specimen. 100-200Å of evaporated carbon provides sufficient conduction of biological tissues, however, it is not the layer thickness that is of critical importance to conductivity but rather the continuity of the layer. Another advantage of carbon is that it does not oxidise and lose its conductive properties with time, as do most other metals. Carbon is applied by striking an arc between electrodes, or passing a heavy current through a carbon textile fibre bundle. It is invaluable for coating samples that are to be analysed with either X-rays or BSE, and therefore is the coating of choice for EPMA (Boyde, 1984).

ii) Gold, Gold-Palladium and Silver

These metals may be applied by either (Boyde, 1984):

1. Sputter coating (striking a DC discharge between the specimen holding area and a target composed of the pure metal in a noble gas atmosphere at reduced pressure).
2. Evaporative coating (by thermal evaporation from a tungsten filament or molybdenum boat at $<10^{-4}$ Torr).
3. Ion-beam evaporation, or,
4. Electron-beam evaporation.

Gold coatings give a rich SE yield and therefore fine detail. 5nm of gold or gold-palladium alloy is usually sufficient to provide adequate conduction of biological tissues. Silver coatings give a lower SE yield and can be used to enhance the BSE. Aluminium can be used to coat samples destined for microanalysis. Owing to its tendency to oxidise easily, it is difficult to obtain continuous satisfactory coatings on porous samples such as cementum. It is applied by evaporation and cannot be effectively sputtered (Boyde, 1984).

iii) Duron

Duron contains a long-chain fatty acid antistatic agent in a propellant/solvent, packaged as an aerosol spray. It can be applied directly, and is suitable for porous dried samples such as tooth specimens. Thinner and more controlled coating of Duron can be obtained by making a 5% solution in Freon 113. The specimen is dried by evaporation after dipping in this solution (Boyde, 1984).

All EPMA studies on cementum have employed carbon coating for conductivity (Neiders *et al.*, 1972; Hals and Selvig, 1977; Tötdal and Hals, 1985; Hennequin and Douillard, 1995). The thickness of the coating has varied from 200Å (Hennequin and Douillard, 1995) to 200-400Å (Neiders *et al.*, 1972).

Study	Fixation	Sectioning	Drying	Embedding	Polishing	Coating
Neiders <i>et al.</i> , 1972	-	1. Transverse sections	2. 100% ethanol for 7 days; 95 ⁰ C for 1 week	3. acrylic resin	4. 600 grit silicon carbide paper; 0.25µm diamond paste	5. 200-400Å carbon
Hals and Selvig, 1977	1. neutral formalin	4. 30-80µm ground sections	2. alcohol	3. polyester or epoxy resin	Not mentioned	5. carbon
Tötdal and Hals, 1985	-	1. transverse sections	3. 50 ⁰ C for 48 hours	4. Acrofix	2. sandpaper; diamond paste	5. carbon
Hennequin and Douillard, 1995	1. benzalkonium chloride (1/3000)	2. transverse sections	5. 35 ⁰ C for 30 minutes	3. fast-set resin	4. abrasive disks (P100, P600, P400); polishing powders (7.5µm, 3.25µm, 1.25µm); distilled water	6. 200Å carbon

Table II-e: Summary of specimen preparation from existing EPMA studies on cementum.

2.2.4.4.3.5 Limitations of EPMA and Bulk Biological Specimens

A “bulk” specimen may be defined as a specimen thick enough to decrease the kinetic energy of the beam electrons to the level of the critical ionisation energy of a given shell (K, L or M) for the element under consideration (Boekestein *et al.*, 1980). Problems associated with biological bulk specimens of teeth include:

1. *Charging*

Charging can be described as a surplus of negative charge in the specimen and results in poor spatial resolution. In general, biological specimens are poor conductors of electricity. Methods used to prevent or minimize charging include:

1. The application of conducting layers on the specimen surface. Carbon or aluminium is commonly used as conducting materials.
2. Decreasing the beam current.
3. Decreasing the accelerating voltage.

2. *Loss of Mass*

Loss of mass occurs when molecules and/or fragments of molecules disappear from the specimen into the vacuum of the probe instrument. Mass loss can lead to an altered elemental composition in the analysed volume and to a modification of surface topography. Mass loss depends on the amount of organic matrix in the specimen.

Edie and Glick (1980) observed that irradiation effects can influence the absolute quantification of Ca and P in mineralised tissue and correction factors are necessary for a reliable estimate of Ca/P ratios. The effect of the electron beam on the specimen was to remove a major portion of the specimen leaving the heavy mineral (a form of hydroxyapatite) in apparently higher concentration (Edie and Glick, 1980). About 10^{11} electrons per area analysed are necessary to obtain a significant spectrum. This necessary electron dose also depends on the thickness of the specimen, but radiation damage is unavoidable in most EPMA determinations (Von Zglinicki, 1993). Therefore, standards matching the radiation sensitivity of the biological specimen should be analysed with the same range of radiation doses.

The choice of crystalline standards for the quantitative analysis of calcified structures will reduce the electron beam irradiation effects (mass loss or contamination) and produce reliable calibration curves.

Methods used to prevent or minimize mass loss include:

1. The application of a metal coating to improve the thermal conductivity of the specimen.
2. Lowering the specimen temperature before and during the analysis.
3. Embedding freeze-dried material in epoxy resin or keeping the specimen in the frozen hydrated state.
4. Lower the beam current density.

3. *Contamination*

Contamination occurs when molecules and fragments of molecules are deposited on the specimen. These deposits originate either from compounds present in the vacuum of the instrument or from the specimen itself and its surface coating. The effects of contamination include (Boekstein et al., 1980):

1. The appearance of additional peaks in the spectrum.
2. After a certain time interval the analysed volume contains matter of a different elemental composition.
3. A change in the surface topography.

4. *Surface Topography*

Only becomes a problem for quantification if the specimens have been prepared without a flat surface e.g. freeze fracturing. It is possible to minimize the effect of a non-flat surface on quantification by choosing the appropriate analytical conditions or using P/B ratios instead of net peak intensities.

5. *Local Density*

In a wet or frozen-hydrated biological specimen local density variations generally will be small. In freeze-dried specimens, however, differences can be larger.

6. *Poorly Known Matrix Composition*

In biological specimens the mass fractions of the light matrix elements H, C, N and O usually are relatively large. When carrying out a ZAF-correction the influence of these elements on quantitation is important. Accurate knowledge of the mass fractions of the matrix elements is then required. However, with EPMA these light elements are difficult to analyze, and with other techniques only approximate overall information can be obtained, for instance as mass fraction ratios.

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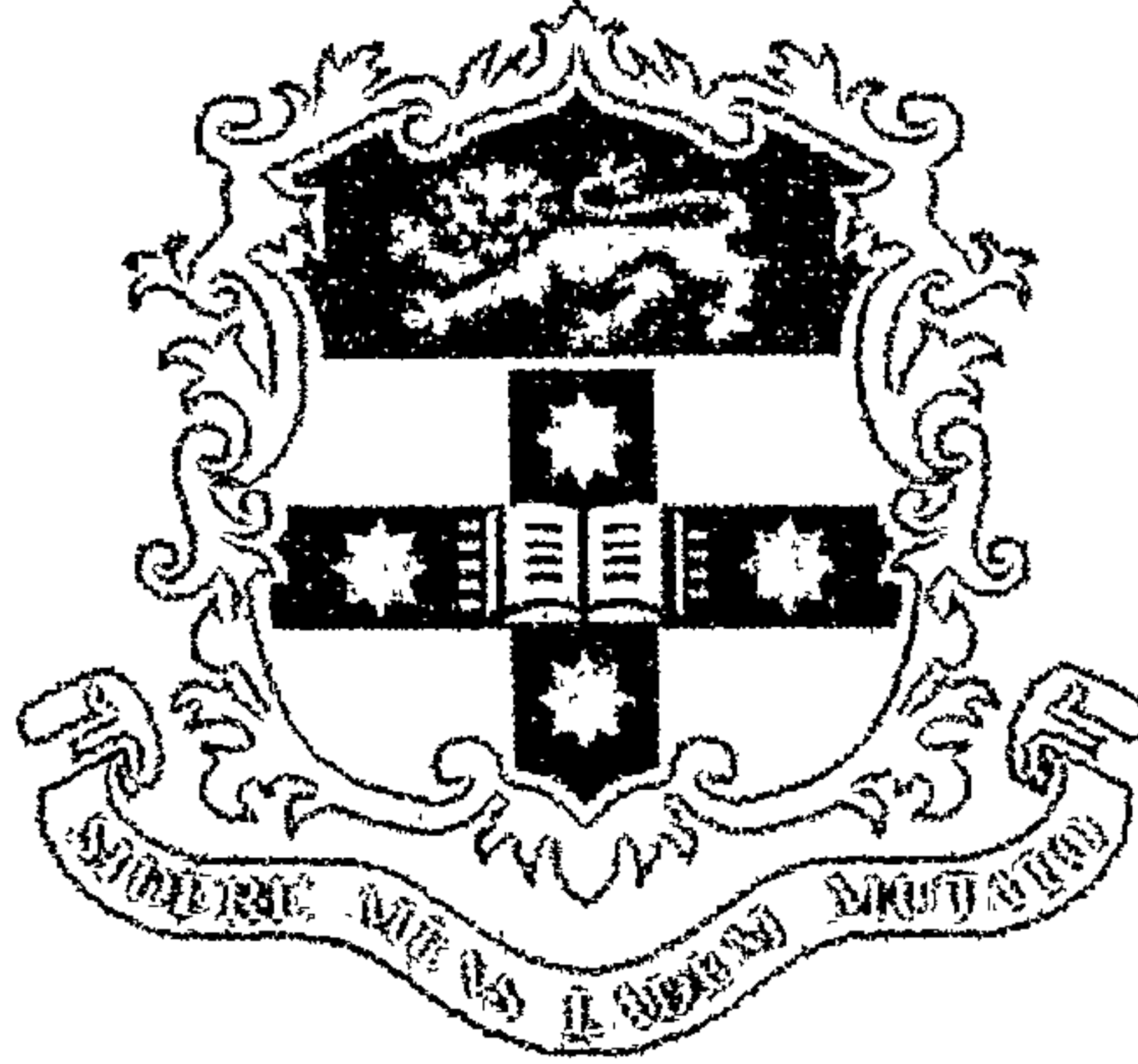
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4. Manuscript



A comparative quantitative analysis of the mineral composition of human premolar cementum after the application of orthodontic forces – an EPMA study.

This manuscript is to be submitted to the American Journal of Orthodontics and Dentofacial Orthopedics. For the pupose of this thesis the manuscript is extended and will be shortened when submitted for publication.

Teriko Rex, BDS (Hons)

Postgraduate Student, Discipline of Orthodontics,

Faculty of Dentistry, University of Sydney.

M. Ali Darendeliler, BDS, PhD, Dip Orth, Certif Orth, Priv Doc (TR), Priv Doc (Ge)

Professor and Chair, Discipline of Orthodontics, (ASO (NSW Branch) Inc.),

Faculty of Dentistry, University of Sydney.

Om Prakash Kharbanda BDS, MDS, MOrthRCS(Edin), FICD

Senior Lecturer, Discipline of Orthodontics,

Faculty of Dentistry, University of Sydney.

Peter Petocz, PhD

Department of Mathematical Sciences,

University of Technology, Sydney.

Address for Correspondence:

M.Ali Darendeliler

Discipline of Orthodontics

Faculty of Dentistry

The University of Sydney

Level 2, 2 Chalmers St,

SURRY HILLS NSW 2010 Australia

Phone +61 2 9351 8314

Fax +61 2 9351 8336

E-mail: adarendel@dentistry.usyd.edu.au

4.1 Abstract

There have been some suggestions in the literature that the mineral content of cementum may influence resistance or susceptibility to root resorption. Less mineralised cementum has been reported to be more susceptible to root resorption. The mineral composition of cementum after the application of orthodontic forces is to date unexplored and may reveal important information regarding the mechanism of root resorption. The aims and objectives of this study were twofold: (1) to evaluate the calcium (Ca), phosphorus (P) and fluorine (F) content in orthodontically untreated human first premolar cementum at various root positions, and, (2) to perform a comparative quantitative analysis of the Ca, P and F content in intact cementum between human first premolars subjected to 25g and 225g of orthodontic force and those premolars subjected to no orthodontic force (controls). Thirty-six upper and lower first premolar teeth (eighteen experimental, eighteen control) were extracted from sixteen individuals (10M, 6F), mean age 13.9 years (range 11.7–16.1 years) who were randomly assigned to one of two groups, (1) light force (25g), and (2) heavy force (225g). The light force group consisted of nine experimental and nine control first premolar teeth in which 25g of buccally directed force was applied to one of the upper and/or lower first premolars, while the contralateral premolar served as the control. The heavy force group consisted of nine experimental and nine control first premolar teeth in which 225g of buccally directed force was applied to one of the upper and/or lower first premolars while the contralateral premolar served as the control. The experimental and control premolar teeth were extracted 28-29 days after initial force application, and prepared for electron probe microanalysis (EPMA). The Ca, P and F concentrations were measured on the buccal and the lingual surface of the cementum at

the midpoint of the cervical, middle and apical third of the root. At each measurement at the cervical, middle and apical third, 15 points were measured. Results showed that in untreated human first premolar cementum there was a very highly significant inter-individual variation in the Ca, P and F concentrations ($p=0.000$, 0.005 & 0.000 , respectively). There was no significant difference in the Ca, P and F concentrations of cementum between the buccal and lingual surface, except for a significantly higher F content at the cervical region on the buccal surface ($p=0.000$). There was a decreasing gradient in Ca, P and F concentrations from the cervical to apical third of the root which was very highly significant from the cervical to middle third ($p=0.000$) and middle to apical third ($p=0.000$), except for F where there was no significant difference from the cervical to middle third on the lingual surface ($p=0.966$). There was a significant increasing gradient in Ca and P concentrations from the outer to inner third of cementum at the cervical ($p<0.01$) and middle ($p<0.01$) third of the root, with more variable trends at the apical third. For F, there was a significant decreasing gradient from the outer to inner third of cementum at the cervical ($p<0.01$), middle ($p<0.01$) and apical ($p<0.01$) third of the root. With the application of both light (25g) and heavy (225g) orthodontic forces, this study found that there was an overall decrease in the Ca, P and F concentration in cementum. This was only significant for Ca and P concentrations in the heavy force group ($p=0.000$ & 0.004 , respectively). In the heavy force group, there was a significant decrease in Ca at the cervical ($p<0.01$), middle ($p<0.01$) and apical ($p<0.01$) third of the root on the buccal surface, and the middle third of the root on the lingual surface ($p<0.01$). In the same group, there was a significant decrease in P at the cervical ($p<0.01$) and middle ($p<0.01$) third on the lingual surface, and a significant increase in P

at the middle third on the buccal surface ($p < 0.01$). In conclusion, the results of this study show that in untreated human first premolar teeth there is a large inter-individual variation in the Ca, P and F concentrations in human first premolar cementum. There is no difference in the Ca, P and F concentrations of cementum between the buccal and lingual surface except for a higher F content at the cervical region on the buccal surface. There is a decreasing gradient in Ca, P and F concentrations from the cervical to apical third of the root. There is an increasing gradient in Ca and P concentrations from the outer to inner third of cementum at the cervical and middle third of the root and there is a decreasing gradient in F concentrations from the outer to inner third of cementum at the cervical, middle and apical third of the root. With orthodontic force application there is a decrease in the Ca and P concentrations in cementum that is more pronounced with heavier forces. Although there is a trend toward a decreasing F content in cementum with the application of orthodontic forces, a definitive conclusion could not be made due to the large interindividual variation in F content. If less mineralised cementum is more susceptible to resorption as various authors claim, then it is hypothesised that this process of demineralisation that occurs concurrently with orthodontic force application may explain why orthodontically treated teeth are prone to the resorptive process.

Keywords: root resorption, orthodontic force, cementum, mineral composition, calcium, phosphorus, fluoride, fluorine, electron probe microanalysis (EPMA)

4.2 Introduction

Root resorption is an undesirable complication associated with orthodontic treatment. Although various risk factors have been identified with this pathological process, the exact etiology and underlying mechanism is unknown. Of all the calcified tissues, cementum is most similar to bone and has been described as a bone-like structure¹. Bone and cementum, however, behave differently to the application of orthodontic forces. Unlike bone, which undergoes resorption and apposition of a continual remodelling process, cementum is not normally resorbed. The exact mechanism by which the resorption process is inhibited is as yet unclear, however, several theories exist to explain the resistance of cementum to resorption.

Andreasen² related cementum's resistance to resorption to the innermost cellular layer of the PDL (cementoblasts, fibroblasts, osteoblasts, endothelial and perivascular cells) and discluded the peripheral part of the PDL (Sharpey's fibres, cementum, precementum and epithelial rests of Mallassez). Jones and Boyde³, however, did not rule out the Sharpey's fibres, precementum, predentin and elements of the organic matrix as participating in resistance to resorption. It has been reported that various uncalcified mineralised tissues in response to orthodontic force are more resistant to resorption. This has been demonstrated in precementum⁴, osteoid⁵, and predentin^{6,7}.

Another theory suggests that the mineral content of cementum may play a role in cementum's resistance to root resorption. Certain authors have reported a decreased susceptibility to root resorption where cementum is more mineralized^{8,9,10}. From histological studies on 261 permanent teeth from untreated individuals, Henry and Weinmann⁸ found that the cervically positioned, more mineralised, acellular cementum was more resistant to root resorption than the apically positioned, less mineralised, cellular cementum. Reitan⁹ reported that the density and hardness of cementum may influence its resistance to root resorption, where the harder the cementum, the greater the resistance to root resorption. This has been extrapolated from the retarded resorption seen in deciduous teeth during tooth eruption where the hardness of the deciduous tooth substance may retard the resorption process¹¹. Since hardness has been found to be positively correlated to mineral content¹², it can be extrapolated that cementum with a higher mineral content may also be more resistant to root resorption. Alatli *et al.*¹⁰ found in rats, that roots lacking acellular cementum were readily resorbed and concluded that acellular cementum might confer some protective mechanism against root resorption. Fluoride, in particular, has been associated with a reduced risk of both bone^{13,14} and root resorption^{15,16,17,18,19}. The mechanism whereby fluoride inhibits root resorption is unknown but may be similar to its action on other mineralized tissues such as enamel and bone. In bone, four mechanisms of action have been proposed: (1) promotion of osteoblastic activity or inhibition of osteoclastic activity^{15,20,21,22}; (2) degradation of bone collagen, thus protecting bone from the action of osteoclasts²³; (3) an increase in crystallite size^{24,25} which is more resistant to dissolution and subsequently resorption²⁶;

and (4) transformation of the surface of hydroxyapatite to that of fluorapatite²⁷ which has been reported to be more resistant to resorptive processes²⁸.

Cementum is a non-uniform, mineralised connective tissue²⁹. On a wet weight basis, human cementum contains 65% inorganic material, 23% organic material and 12% water³⁰. The organic component comprises Type I and Type III collagen and noncollagenous proteins³¹. The mineral component is hydroxyapatite $[\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2]$, with small amounts of amorphous calcium phosphates³¹. The hydroxyapatite in cementum is not chemically pure but contains other elements that have been taken up from the tissue fluid during initial crystallization. Other elements include carbonate (CO_3), citrate, fluoride (F), magnesium (Mg), sulfur (S), sodium (Na), iron (Fe), copper (Cu), zinc (Zn), tin (Sn) and silver (Ag)³². The amount of these ions initially incorporated into the mineral phase reflects their concentration in the fluid environment during mineralization. Over time, the concentration may change by additional uptake or substitution by other ions³¹. The crystallinity of the mineral component in cementum is lower than in other hard tissues³³, which means that cementum has a greater capacity for adsorption of fluoride and other elements over time.

Microradiographic, chemical and electron probe microanalysis (EPMA) studies have demonstrated that cementum is less calcified than dentin^{34,35,36,37}. There is a rhythmic mineralisation pattern to cementum formation^{29,38}. This incremental pattern of mineralisation creates alternating bands of high and low mineral content, seen as lamellae within the cementum²⁹. The dentino-cementum junction (DCJ) commonly shows a zone

of high mineral content delineated by zones of low mineral content on the dentine side and sometimes on the cementum side as well^{29,35,36,39,40,41,42,43,44}. The exact location of this hypermineralized zone has not been determined. Boyde and Jones⁴⁵ believe that it is a part of cementum. Other investigators designate it as the CDJ^{29,35} or as a part of dentin³⁶.

Differences in mineral composition exist from one individual to another, from tooth to tooth in the same individual⁴⁶ and between the various cementum types²⁹. Microradiographs of cementum have shown that cervically located acellular extrinsic fibre cementum (AEFC) is more radiodense and, therefore, more mineralised than the apically positioned cellular intrinsic fibre cementum (CIFC), and variably located cellular mixed fibre cementum (CMFC)²⁹. The difference can be explained by the presence of uncalcified spaces, such as lacunae in CIFC and by an uncalcified core of extrinsic Sharpey's fibres in the CMFC⁴⁷. In addition, the matrix of AEFC tends to be more completely mineralised because its formation is a slower process that allows longer direct contact of tissue fluids²⁹.

There are very few quantitative studies in the literature on the mineral composition of human cementum. These studies have used either chemical analysis^{34,35,48,49} or EPMA^{36,37,50,51} to gain quantitative data on the mineral composition of cementum. Existing quantitative studies are limited by small samples sizes^{36,50}, non-homogeneous tooth samples^{48,50}, different ages of individuals from which the teeth are obtained, different preparation techniques, lack of distinction between the root position examined (buccal vs

lingual vs mesial vs distal; cervical vs middle vs apical; outer vs middle vs inner surface) and lack of information regarding the individual's F exposure.

Mean Ca concentrations in human cementum have been found to vary from 24.0% - 29.24% dry wt^{34,36,50,51} or 35.6% - 42.4% ash⁴⁸. Mean P concentrations in human cementum have been found to vary from 11.6% - 13.49% dry wt^{34,36,50,51} or 16.6% - 20.0% ash⁴⁸. Existing studies show no significant differences in the Ca and P concentration between cervical and mid-root cementum³⁶, between cervical and apical cementum⁴⁸, or between cervical, middle and apical cementum³⁴, despite the fact that microradiographic studies demonstrate that cervical AEFC is more highly mineralised than apical CMSC or CIFC²⁹. No change in Ca or P concentrations have been demonstrated with age or fluoride exposure⁴⁸ except for Selvig and Selvig³⁴ who found a higher combined Ca and Mg and P content in cervical cementum from teeth greater than 50 years old that had been exposed to the oral cavity, suggesting an uptake of minerals from the oral environment over time. Tötdal and Hals⁵⁰ demonstrated an increasing concentration of Ca and P from the outer surface of cementum to the CDJ, however, Hals and Selvig³⁷ reported little variation in the Ca and P profiles in cervical cementum from the outer surface to the CDJ. Tohda *et al.*,³⁸ also demonstrated little variation in the Ca profiles in cervical cementum. No comparison of Ca and P concentrations has been made in the literature between the buccal, lingual, mesial or distal root surfaces.

Cementum has been reported to have the highest F content of all the calcified tissues, up to 5 times as much as enamel, and 3 times as much as alveolar bone. There could be

several reasons why cementum has a higher F content than all other calcified tissues. The crystallinity of the mineral component in cementum is lower than in other hard tissues, which means that cementum is more permeable and has a greater capacity for adsorption of F over time. Cementum is also exposed to the circulating tissue fluids in the periodontal ligament from which F can be absorbed^{52,53}.

F concentrations in cementum show an increase with age^{48,52,53,54,55,56,57,58}, increasing F concentrations in the drinking water and with greater duration of exposure to the oral environment^{48,49,57}. There is a general decrease in F content from the cervical to apical cementum, with the mean F content of cervical AEFC being greater than that of apical CMSC and CIFC^{49,59,60}. F concentrations in cementum demonstrate a decreasing concentration gradient from the outer root surface to the CDJ suggesting an uptake over time from the surrounding fluids^{37,38,52,55,58,61,62}. This uptake of ions from the surroundings has also been thought to explain why root cementum exposed to the oral environment was more mineralised than non-exposed surfaces^{33,35,37}.

In an optimally fluoridated area (1.0-1.3ppm), concentrations at the cervical, middle and apical third of permanent anterior teeth have been reported to range from 0.3->0.9%wt, 0.25-0.79%wt, and 0.3-0.8%wt, respectively⁵⁷. Nakata *et al.*,⁴⁸ and Stepnick *et al.*,⁴⁹, however, reported lower F concentrations at the cervical and apical third in a large sample of teeth obtained from individuals living in an optimally fluoridated community (0.8-1.2ppm). In a low fluoridated area (0.1ppm or less), lower F concentrations have been found in permanent teeth with a range varying from 0.02-0.79%wt^{52,53,55,57}. Only

two EPMA studies exist that have examined the F concentration in cementum quantitatively^{37,50}. Hals and Selvig³⁷ found the fluoride concentration to be higher in the outer cementum (0.5-0.6%wt) compared with the cementum at the CDJ (0.15%wt) in a sample of teeth obtained from individuals living in a low F area. Tötdal and Hals⁵⁰, found the F concentration of cementum to be an average of 0.37%wt, with a range of 0.16-0.7%wt. They did not state what level of fluoridation there was.

Various techniques have been employed to determine the mineral composition of cementum, however, electron probe microanalysis (EPMA) and chemical analysis are the only techniques that can yield fully quantitative data. One of the major problems with chemical analysis of cementum is that it is difficult to obtain large enough samples that are free of dentin and connective tissue³⁶. EPMA is a technique that does not require the separation of cementum from dentin. It is a fully quantitative method for the non-destructive analysis of μm -sized volumes at the surface of materials, with sensitivity at the level of ppm. EPMA is the most suitable technique for examining elemental composition within localized small areas of mineralised tissue such as cementum. Furthermore, unlike chemical analysis, the composition of a number of elements can be determined at any one time⁴³. It has been reported to be the most precise and accurate microanalysis technique available with routine quantification to 1% reproducibility.

To the author's knowledge, the mineral composition of cementum after the application of orthodontic forces is to date unexplored and may reveal important information regarding the mechanism of root resorption. In the present study, it was hypothesized that the

application of orthodontic force may cause a demineralization of cementum, and that the magnitude of this demineralization may vary according to the magnitude of applied orthodontic force. The aims and objectives of this study were twofold: (1) to evaluate the Ca, P and F concentrations in orthodontically untreated human first premolar cementum on the buccal and lingual surface at the cervical, middle and apical third from the outer to middle to inner third of cementum using EPMA, and, (2) to perform a comparative quantitative analysis of the Ca, P and F concentrations in intact cementum between human first premolars subjected to 25g and 225g of orthodontic force and those premolars subjected to no orthodontic force (controls) using EPMA.

4.3 Materials and Method

4.3.1 *Clinical Procedure*

36 upper and lower first premolar teeth (eighteen experimental, eighteen control) were extracted from 16 individuals (10M, 6F), mean age 13.9yrs (range 11.7yrs – 16.1yrs) based on the following selection criteria:

1. Bilateral upper and/or lower premolar teeth to be extracted as part of the individual's orthodontic treatment plan.
2. Apexification complete.
3. No previous dental treatment.
4. No previous trauma.
5. No previous orthodontic treatment.
6. No past and present signs and symptoms of bruxism.
7. No significant medical history that may have affected dental development.
8. No abnormality concerning the anatomy of the craniofacial and dentoalveolar complexes.
9. Knowledge of the individual's residence from birth until the extraction of the premolar teeth.
10. Knowledge of the individual's past history of fluoride consumption.

The majority of individuals had lived in Sydney, Australia since birth where the water is optimally fluoridated at 1.0ppm (n=10). These individuals had a standard history of fluoridated toothpaste and occasional professional applications. One individual lived in Singapore from birth until 5 years old and Sydney thereafter. The other five individuals were born outside of Australia in areas where the level of water fluoridation was unknown.

Periapical radiographs were taken with a long cone paralleling technique of both the experimental and control premolar teeth to assess root formation, periodontal status and the presence or absence of caries.

These sixteen individuals were assigned to one of two groups, 1) light force (25g), and 2) heavy force (225g). The light force group consisted of nine experimental and nine control first premolar teeth extracted from eight individuals (4M, 4F), mean age 14.8yrs, (range 13.5 – 16.1yrs) who had 25g of buccally directed force applied to one of the upper and/or lower first premolars, while the contralateral premolar served as the control. The heavy force group consisted of nine experimental and nine control first premolar teeth extracted from nine individuals (7M, 2F), mean age 13.8yrs, (range 11.7yrs – 15.8yrs) who had 225g of buccally directed force applied to one of the upper and/or lower first premolars, while the contralateral premolar served as the control.

In the light force group, a 25g buccally directed force was applied to the experimental premolar by a 0.016" TMA[®] (Ormco, CA) spring (Fig. 1a,c). In the heavy force group, a

225g buccally directed force was applied by a 0.017" x 0.025" TMA[®] (Ormco, CA) spring. These springs were used as a sectional archwire and engaged in 0.022" SPEED brackets (Strite Industries, Canada) bonded to the first permanent molar and experimental premolar tooth. The control side had SPEED brackets bonded to the first permanent molar and control premolar tooth but no spring was attached (Fig. 1b,c). Force magnitude was measured to the nearest gram with a strain gauge (Dentaurum, Germany). Glass ionomer cement (Transbond, 3M Unitek[™], USA) was bonded onto the occlusal surfaces of the lower first molar teeth to minimize occlusal trauma to the premolar teeth during the experimental period⁶³.

The experimental and control first premolar teeth were extracted 28-29 days after initial force application. There was no re-activation during this period and one operator performed the experimental procedure. Extractions were performed by 1 of 2 oral surgeons who were instructed to avoid any forceps contact on the cervical cementum. Immediately after extraction, the teeth were stored in 5mL of sterilized deionised water (Milli Q[®]) where they were subjected to ultrasonication for 10 minutes to remove remnants of the periodontal ligament. The teeth were then disinfected in 70% alcohol for 30 minutes and then stored in 5mL of Milli Q[®] at ambient room temperature (23°C ±1°C)⁶⁴.

4.3.2 Specimen Preparation

Half to two thirds of the tooth crowns were removed with a high-speed diamond bur and Milli Q[®] as a coolant [Fig. 2a(i)]. The teeth were then air-dried for 7 days, embedded in epoxy resin [Procure 812 (ProSciTech, Qld, Australia), Nadic Methyl Anhydride (NMA) (ProSciTech, Qld, Australia) and Benzyldimethylamine (BDMA) (Probing and Structure, Qld, Australia) in a ratio of 2.7:2.3:1, respectively], and cured in the oven at 60⁰C for 24 hours. The teeth were then sectioned bucco-lingually down the long axis of the tooth through the apex with a diamond blade (Leco, MI, USA) mounted on an Accutom (Struers, Denmark) [Fig. 2a(ii)]. Sectioning was performed under irrigation with distilled water. The sections were handpolished on a DP-U2 polishing machine (Struers, Denmark) with increasingly finer abrasives. Polishing was performed on a standard wheel with P400 grit sandpaper (Leco, MI, USA), followed by P1200 grit sandpaper (Leco, MI, USA) under irrigation with distilled water. Following this, the specimens were then polished on an 8" diameter, 203mm PAN W PSA polishing disc (Leco, MI, USA) with 6µm water based polycrystalline diamond suspension (Allied High Tech Products Inc., CA, USA) followed by 1µm water based polycrystalline diamond suspension (Allied High Tech Products Inc., CA, USA) [Fig. 2a(iii)]. A section was sufficiently polished when there were few visible scratches when assessed under the light microscope. Following this, a second section was made 0.5cm from the first cut to create a 0.5cm thick section with flat parallel surfaces [Fig.2a(iv)]. The polished specimen was then mounted on a metal stub with double-sided sticky carbon paper. Carbon dag was added to the specimen at non critical points to increase conductivity. The specimen was

then carbon coated (evaporated) in a vacuum at 10^{-4} Torr with a 300Å layer [Fig. 2a(v)]. The specimens were stored in separate airtight containers according to the heavy and light force groups (Fig. 2b).

4.3.3 Electron Microprobe

An electron microprobe consists of an electron gun, electron column and a variable number of wavelength dispersive spectrometers. EPMA uses a beam of focused electrons to excite X-rays from a small area of a flat, polished sample. Low-energy thermionic electrons are produced from a tungsten filament and accelerated by a positively biased anode plate to 10-30 thousand electron volts (keV). The anode plate has a hole in its center and the electrons pass through it and are collimated and focused by a series of magnetic lenses and apertures. The electron beam is used to bombard the sample and produce analytical X-rays from it. Characteristic X-rays that are generated by the elements in the sample are diffracted by a suitable analysing crystal (LiF, PET, PCO, PC1, PC2, PC3), detected, and then measured in counts per second by the gas flow proportional detectors. The composition of the unknown is determined by comparison with X-ray intensities from materials with known compositions (standards).

A Cameca SX50 Microprobe (Cameca, France) (Fig. 3) was used for determination of the Ca, P and F concentrations in cementum. The Cameca SX50 Microprobe is fitted with four wavelength dispersive spectrometers and one energy dispersive spectrometer. The electron probe was operated at 15kV and 20nA using three wavelength dispersive

spectrometers. PET analysing crystals were used for Ca and P determination. A PCØ crystal was used for F determination.

4.3.4 EPMA Standards

Durango apatite, $\text{Ca}_5(\text{PO}_4)_3\text{OH}$, (Astimex Scientific Ltd.) with a Ca, P and F composition of $38.55 \pm 0.23\%$ wt, $17.63 \pm 0.17\%$ wt, and $3.65 \pm 0.21\%$ wt, respectively, was the standard used to determine the Ca and P concentrations in cementum. Fluorite, CaF_2 , (Astimex Scientific Ltd.) with a Ca and F composition of 51.33% wt and 48.67% wt, respectively, was used to determine F concentrations.

4.3.5 Points of Analysis

The Ca, P and F concentrations were measured in non-resorbed, intact cementum on the buccal and lingual surface at the midpoint of the cervical, middle and apical third of the root (Fig. 4). Any resorption craters were avoided. At each measurement at the cervical, middle and apical third, 15 points were measured, consisting of 5 lines of 3 points each; each line extending from the outermost aspect of the cementum to the dentino-cemental junction (DCJ) (Fig. 5). The hypermineralised zone was clearly visible as a radiopaque line separating the cementum from dentin and in this study was designated as the CDJ.

The innermost point was taken just before the cemental edge of the hypermineralised zone, therefore, measurements did not extend into the hypermineralised zone. A total of

90 points were analysed per tooth, making a total of 3240 measurement points in the 36 teeth.

4.3.6 Statistical Analysis

SPSS (version 10.0) software program was used for statistical analysis. A univariate analysis of variance (UNIANOVA) was employed to investigate the Ca, P and F concentrations in cementum. Two models were created, one for control teeth only, and one for control and experimental teeth. Since a statistically significant difference was found for P concentrations between the light and heavy force controls, the control teeth could not be considered together. Instead the sample was subdivided into 4 groups, i) light force control group, ii) light force experimental group, iii) heavy force control group, and iv) heavy force experimental group.

The UNIANOVA model for control teeth only was constructed to allow for differences within subjects, position (buccal and lingual surface at the cervical, middle, and apical third), the interaction between subject and position, and differences between the outer, middle and inner aspect of cementum within various positions. For Ca and P, no significant difference was found between the buccal and lingual surface, and therefore, values at the cervical, middle and apical third on both the buccal and lingual surface were considered together.

The UNIANOVA model for control and experimental teeth was constructed to allow for differences within subjects, position (buccal and lingual surface at the cervical, middle and apical third), interaction between subject and position, differences between the outer, middle and inner aspect of cementum within various positions, group (light force control group, light force group, heavy force control group and heavy force group) and the interaction between group and root position.

Pairwise comparisons were used to determine statistical significance between the 4 groups. A Bonferroni adjustment was made to allow for multiple comparisons. Further statistical significance was required within the 4 groups at various root positions that could not be provided by the model. At this level, to allow for multiple comparisons, statistical significance was at the $p < 0.01$ level (rather than $p < 0.05$).

4.4 Results

4.4.1 Control Teeth

4.4.1.1 Calcium Concentration

The mean Ca concentrations for cementum on the buccal and lingual surface at the cervical, middle and apical third, from the outer to middle to inner third in control teeth are given in Table I. The UNIANOVA model constructed for the control data only showed that in control teeth, Ca concentrations were significantly different between subjects ($p=0.00$), between various positions on the root (buccal and lingual surface at the cervical, middle and apical third) ($p=0.00$), between various positions on the root within each subject ($p=0.00$), and between the outer, middle and inner third of cementum within various root positions ($p=0.00$).

Subject Variability - There was a very highly significant ($p=0.00$) inter-individual variation in mean Ca concentration with a range of 27.17%wt – 30.40%wt.

Buccal Vs Lingual Surface - Mean Ca concentrations and pairwise comparisons between the buccal and lingual surface at the cervical, middle and apical third are given in Table II. There was a trend toward higher mean Ca values on the buccal surface compared with the lingual surface, however, pairwise comparisons demonstrated no significant difference between the buccal and lingual surface at the cervical ($p=0.24$), middle ($p=1.00$) or apical third ($p=1.00$).

Cervical Vs Middle Vs Apical Third – Mean Ca concentrations and pairwise comparisons at the cervical, middle and apical third are given in Table III. The mean Ca concentration at the cervical, middle and apical third was 29.87%wt, 28.76%wt and 27.06%wt, respectively, demonstrating a decreasing gradient from the cervical to apical third that was very highly significant from the cervical to middle ($p=0.00$), cervical to apical ($p=0.00$) and middle to apical third ($p=0.00$).

Outer Vs Middle Vs Inner Third - Mean Ca concentrations and pairwise comparisons at the outer, middle and inner third at the cervical, middle and apical third are given in Table IV. There was an increasing gradient in Ca concentration from the outer aspect of cementum toward the CDJ at the cervical and middle third of the root which was significant between the outer to middle ($p<0.01$), middle to inner ($p<0.01$) and outer to inner third ($p<0.01$). The apical third showed lower mean Ca concentrations at the middle third (26.88%wt) compared with the outer (27.11%wt) and inner third (27.19%wt), however, this was not significantly different.

4.4.1.2 *Phosphorus Concentration*

The mean P concentrations for cementum on the buccal and lingual surface at the cervical, middle and apical third, and outer, middle and inner third in control teeth are given in Table I.

The UNIANOVA model constructed for the control data only showed that in control teeth P concentrations were significantly different between subjects ($p=0.01$), between various positions on the root (buccal and lingual surface at the cervical, middle and apical third) ($p=0.00$), between various positions on the root within each subject ($p=0.00$), and between the outer, middle and inner third of cementum within various root positions ($p=0.00$).

Subject Variability - There was less inter-individual variability in mean P concentration between subjects compared with Ca and F ($p=0.00$), however variability was still highly significant ($p=0.01$) with a range of 12.43%wt – 14.15%wt.

Buccal Vs Lingual Surface - Mean P concentrations and pairwise comparisons on the buccal and lingual surface at the cervical, middle and apical third are given in Table II. Pairwise comparisons revealed no significant difference in mean P concentrations between the buccal and lingual surface at the cervical ($p=1.00$), middle ($p=1.00$), or apical regions ($p=1.00$).

Cervical Vs Middle Vs Apical Third - Mean P concentrations and pairwise comparisons at the cervical, middle and apical third are given in Table III. The mean P concentration at the cervical, middle and apical third was 13.71%wt, 13.21%wt and 12.32%wt, respectively, demonstrating a decreasing gradient from the cervical to apical third that was very highly significant from the cervical to middle ($p=0.00$), cervical to apical ($p=0.00$) and middle to apical third ($p=0.00$).

Outer Vs Middle Vs Inner Third - Mean P concentrations and pairwise comparisons at the outer, middle and inner third at the cervical, middle and apical third are given in Table IV. There was an increasing gradient in P concentration from the outer aspect of cementum toward the CDJ at the cervical and middle third of the root which was significant between the outer to middle ($p<0.01$) and outer to inner third ($p<0.01$) at the cervical region and from the outer to inner third ($p<0.01$) and middle to inner third ($p<0.01$) at the midroot region. There was no significant difference from the middle to inner third at the cervical region, or from the outer to middle third at the midroot region. The apical third showed lower mean P concentrations at the middle third (12.21%wt) compared with the outer (12.42%wt) and inner third (12.32%wt), however, this was not significantly different.

4.4.1.3 *F Concentration*

The mean F concentrations for cementum on the buccal and lingual surface at the cervical, middle and apical third, and outer, middle and inner third in control teeth are given in Table I. The UNIANOVA model constructed for the control data only showed that in control teeth, F concentrations were significantly different between subjects ($p=0.00$), between various positions on the root (buccal and lingual surface at the cervical, middle and apical third) ($p=0.00$), between various positions on the root within each subject ($p=0.00$), and between the outer, middle and inner third of cementum within various root positions ($p=0.00$).

Subject Variability - Subject variability was greatest for F with a very high significance level ($p=0.00$) and range of 0.37%wt – 1.49%wt.

Buccal Vs Lingual Surface - Mean F concentrations and pairwise comparisons on the buccal and lingual surface at the cervical, middle and apical third are given in Table II. There was a trend toward higher F concentrations on the buccal surface compared with the lingual surface that was very highly significant at the cervical region (1.13%wt Vs 0.96%wt) ($p=0.00$), but not significant at the middle ($p=1.00$) or apical third ($p=1.00$).

Cervical Vs Middle Vs Apical Third - Mean F concentrations and pairwise comparisons on the buccal and lingual surface at the cervical, middle and apical third are given in Table III. The mean F concentration on the buccal surface at the cervical, middle and apical third was 1.13%wt, 0.91%wt and 0.62%wt, respectively. The mean F concentration on the lingual surface at the cervical, middle and apical third was 0.96%wt, 0.91%wt and 0.57%wt, respectively. Both the buccal and lingual surface demonstrate a decreasing gradient from the cervical to apical third which was very highly significant from the cervical to middle ($p=0.00$), cervical to apical ($p=0.00$), and middle to apical third ($p=0.00$) on the buccal surface, and from the cervical to apical ($p=0.00$) and middle to apical third ($p=0.00$) on the lingual surface. There was no significant difference from the cervical to middle third on the lingual surface ($p=0.97$).

Outer Vs Middle Vs Inner Third - Mean F concentrations and pairwise comparisons at the outer, middle and inner third at the cervical, middle and apical third are given in Table IV. There was a decreasing gradient from the outer aspect of cementum toward the CDJ both on the buccal and lingual surface at the cervical, middle and apical third of the root. This was significant between the outer to inner third at the cervical region ($p<0.01$), but not significant between the outer to middle third or middle to inner third. At the midroot and apical region, there was a significant difference from the outer to middle ($p<0.01$), middle to inner ($p<0.01$), and outer to inner third ($p<0.01$).

4.4.2 Experimental Vs Control Teeth

4.4.2.1 Light Force Control Group Vs Heavy Force Control Group

Mean Ca, P and F concentrations and pairwise comparisons between the light force and heavy force controls by group and position are given in Table V, VI (Ca), VII (P) and VIII (F), respectively.

Ca - There was an insignificantly lower mean Ca concentration in the light force control group (28.79%wt) compared with the heavy force control group (28.91%wt) ($p=1.00$).

P - There was a very highly significant increase in mean P concentration in the heavy force controls (13.31%wt) compared with the light force controls (13.14%wt) ($p=0.001$).

F - There was an insignificant lower mean F concentration in the heavy force controls (0.895%wt) compared with the light force controls (0.897%wt) ($p=1.00$).

4.4.2.2 *Light Force Group Vs Light Force Control Group*

Mean Ca, P and F concentrations and pairwise comparisons between the light force group and light force controls by group and position are given in Table V, VI (Ca), VII (P) and VIII (F) respectively.

Ca – There was an overall insignificant lower mean Ca concentration in the light force group (28.44%wt) compared with the light force controls (28.79%wt) ($p=0.57$). When taking into consideration the interaction between group and root position, there was a significantly lower mean Ca concentration in the light force group at the apical region on the buccal surface (26.33%wt) compared with controls (28.02%wt) ($p<0.01$).

P – There was an overall insignificant lower mean P concentration in the light force group (13.04%wt) compared with the light force controls (13.14%wt) ($p=1.00$). When taking into consideration the interaction between group and root position, there was a significantly lower mean P concentration in the light force group at the cervical third on the lingual surface (13.48%wt) compared with controls (14.02%wt) ($p<0.01$).

F - There was an overall insignificant lower mean F concentration in the light force group (0.83%wt) compared with the light force controls (0.90%wt) ($p=0.74$).

When taking into consideration the interaction between group and root position, there was a significantly higher mean F concentration in the light force group at the apical region of the buccal surface (0.74%wt) compared with controls (0.51%wt) ($p<0.01$).

4.4.2.3 *Heavy Force Group Vs Heavy Force Control Group*

Mean Ca, P and F concentrations and pairwise comparisons between the heavy force group and heavy force controls by group and position are given in Table V, VI (Ca), VII (P) and VIII (F), respectively.

Ca - There was an overall very highly significant lower mean Ca concentration in the heavy force group (27.69%wt) compared with the heavy force controls (28.91%wt) ($p=0.00$). When taking into consideration the interaction between group and root position, there was a significantly lower mean Ca concentration in the heavy force group compared with controls at the cervical (28.87%wt Vs 30.75%wt) ($p<0.01$), middle (28.35%wt Vs 30.32%wt) ($p<0.01$) and apical (26.95%wt Vs 28.59%wt) ($p<0.01$) third on the buccal surface, as well as the middle third on the lingual surface (27.07%wt Vs 28.16%wt) ($p<0.01$).

P – There was an overall highly significant lower mean P concentration in the heavy force group (12.96%wt) compared with the heavy force controls (13.31%wt) ($p=0.004$).

When taking into consideration the interaction between group and root position, there was a significantly lower mean P concentration in the heavy force group compared with

controls at the cervical (12.28%wt Vs 13.96%wt) ($p<0.01$) and middle (12.29%wt Vs 13.42%wt) ($p<0.01$) third on the lingual surface, and a significantly higher mean P concentration in the heavy force group compared with controls at the the middle third on the buccal surface (13.92%wt Vs 13.37%wt) ($p<0.01$).

F - There was an overall insignificant lower mean F concentration in the heavy force group (0.859%wt) compared with the heavy force controls (0.895%wt) ($p=1.00$). When taking into consideration the interaction between group and root position, there was a significantly lower mean F concentration in the heavy force group compared with controls at the cervical (0.71%wt Vs 1.41%wt) ($p<0.01$) and middle (0.79%wt Vs 1.26%wt) ($p<0.01$) third of the buccal surface. There was also a significantly higher mean F concentration in the heavy force group compared with controls at the apical third on the buccal surface (0.87%wt Vs 0.38%wt) ($p<0.01$) and the cervical third of the lingual surface (1.16%wt Vs 0.88%wt) ($p<0.01$).

4.4.2.4 *Heavy Force Group Vs Light Force Group*

Mean Ca, P and F concentrations and pairwise comparisons between the heavy force group and light force group by group and position are given in Table V, VI (Ca), VII (P) and VIII (F) respectively.

Ca – There was an overall very highly significant lower mean Ca concentration in the heavy force group (27.69%wt) compared with the light force group (28.44%wt) ($p=0.00$).

When taking into consideration the interaction between group and root position, there was a significantly lower mean Ca concentration in the heavy force group compared with the light force group at the cervical (27.81%wt Vs 30.17%wt) ($p<0.01$) and middle (27.07%wt Vs 29.00%wt) ($p<0.01$) third on the lingual surface.

P – There was an overall insignificant lower mean P concentration in the heavy force group (12.96%wt) compared with the light force group (13.04%wt) ($p=0.44$). When taking into consideration the interaction between group and root position, there was a significantly lower mean P concentration in the heavy force group compared with the light force group at the middle (12.29%wt Vs 13.20%wt) ($p<0.01$) and cervical (12.28%wt Vs 13.48%wt) ($p<0.01$) third on the lingual surface and a significantly higher mean P concentration at the middle third on the buccal surface (13.92%wt Vs 13.33%wt) ($p<0.01$).

F – There was an overall insignificant higher mean F concentration in the heavy force group (0.86%wt) compared with the light force group (0.83%wt) ($p=0.81$). When taking into consideration the interaction between group and root position, there was a significantly lower mean F concentration in the heavy force group compared with the light force group at the cervical third on the buccal surface (0.71%wt Vs 1.10%wt) ($p<0.01$) and a significantly higher mean F concentration at the cervical third on the lingual surface (1.16%wt Vs 0.93%wt) ($p<0.01$).

4.5 Discussion

There have been some suggestions in the literature that the mineral content of cementum may influence resistance or susceptibility to root resorption. Certain authors have reported a decreased susceptibility to root resorption where cementum is more mineralized^{8,9,10}. Fluoride, in particular, has been associated with a reduced risk of root resorption^{15,16,17,18,19}. There are few quantitative studies in the literature examining the mineral composition of cementum in untreated human teeth. Existing studies are limited by small sample sizes, different types of teeth examined, large ranges in the age of the individuals from which the teeth were extracted, limited investigation at various root positions, lack of fluoride history, differences in specimen preparation, and differences in methodological technique. The literature is also devoid of any studies examining the mineral composition of cementum after the application of orthodontic forces. The purpose of this study, therefore, was to investigate the mineral content (Ca, P and F) of cementum in both untreated (control) and orthodontically treated human first premolars after the application of light (25g) and heavy (225g) forces.

The present study chose maxillary and mandibular first premolars, as they are frequently required for extraction as part of an individual's orthodontic treatment plan. Limitation was given to first premolars to eliminate any possible differences between different types of teeth and to try and ensure similar calcification and eruption times. A 4-week experimental period was chosen for ethical reasons and clinical practicality. Although Lundgren *et al.*,⁶⁵ found a force decay rate of 20%-24% 1-3 days after the application of a 50g force with a 0.018" Sentalloy Heavy sectional archwire extending from the first

permanent molar to the experimental premolar, reactivation of springs during the 4-week experimental period was not performed in the present study to simulate a typical clinical situation. A buccal tipping force was chosen because clinically it is simple to do, and the majority of previous clinical studies examining root resorption on extracted teeth after the application of orthodontic forces had also employed this type of force^{65,66,67,68,69,70,71}. Comparison with these studies would therefore, be more applicable. It may be argued that a buccally directed tooth movement would limit the application of the results to a true clinical situation, since movement of premolars is most commonly mesio-distally directed, however, displacement in a buccal direction in this region is not uncommon, and this model imitates the common tipping of maxillary incisors in a labiolingual direction⁶⁵. Furthermore, the application of a mesial-distal force would be impossible without extraction of adjacent teeth. Self-ligating SPEED brackets (Strite Industries, Canada) were chosen to ensure standard ligation via the spring clip. TMA[®] (Ormco, CA) was used for the springs because of its unique properties of high springback and formability, and low stiffness⁷². The play of 10^0 between a 0.016" and 0.017" x 0.025" wire in an 0.022" slot was thought to be sufficient to allow buccal tipping as the crown would have to move 1.8-2.2mm before torque could take effect, assuming the bracket was bonded at the centre of the clinical crown and the centre of rotation of the tooth was one third of the average 22mm tooth length. The experimental teeth were expected to move approximately 1mm in the 4-week experimental period, and therefore, bodily movement was not expected. Occlusal stops were bonded on the lower molars to minimize trauma to the premolars during the experimental period. Orthodontic force measurements were performed with a mechanical strain gauge in which the validity and precision of the force measurements

have been found to be high with standard deviation values of 1.0cN and 0.4cN, respectively⁶⁵.

The present study required quantitative investigation of three elements (Ca, P and F) on intact cementum. EPMA was chosen as it is a fully quantitative method that allows for the non-destructive analysis of μm -sized volumes at the surface of materials and is the most suitable technique for examining elemental composition within localized small areas of mineralised tissue. The technique does not require separation of cementum from dentin³⁶, and the composition of a number of elements can be determined at any one time⁴³. It has been reported to be the most precise and accurate microanalysis technique available with sensitivity at the level of ppm and routine quantification to 1% reproducibility. The level of accuracy comes from the use of Wavelength Dispersive Spectroscopy (WDS). The WDS detectors are significantly more sensitive than standard Scanning Electron Microscopy/Energy Dispersive Spectroscopy (SEM/EDS) systems. With WDS, one X-ray wavelength is separated from all others by diffraction from a crystal of known lattice spacing. This provides very fine separation of closely spaced spectral lines, enabling clear recognition of all the overlapping lines due to different elements. Its spectral resolution is good. The peak to background ratio is high, and therefore elements with a relatively low concentration can be detected⁷³. This is particularly required for F, where concentrations are at the ppm level.

Quantification of biological tissues in an analytical electron microscope depends on the choice of suitable standards⁷⁴. The basic characteristics required for a compound to be used as a standard were defined by Anderson⁴³ and include (1) the material must have a well defined chemical composition, (2) it must be homogeneous at the spatial resolution used during the analysis, and (3) it must resemble the specimen to assure similar interactions with the electron beam. Previous EPMA studies on cementum have used various apatites for Ca & P determination. Neiders *et al.*,³⁶ used a fluorapatite $\text{Ca}_{10}(\text{PO}_4)\text{F}_2$ with a Ca composition of 39.7% and P composition of 18.4%. Hennequin and Douillard⁵¹ used a synthetic apatite made up of 39.02% Ca and 18.3% P. The apatite standard used in the present study for Ca and P was similar to those standards used in other EPMA studies on cementum^{36,51}. The fluorite standard was not ideal; it would have been better to obtain a hydroxapatite standard with varying concentrations of fluoride. The choice of standard for F in the present study should not affect results reflecting a comparison between groups; however, quantitative values for F may not be as accurate and could be considered semi-quantitative.

The operating conditions of the probe will depend on the sample being analyzed. Operating conditions for cementum analysis have varied. Neiders *et al.*³⁶ examined cementum with the probe at 10kV and 0.01 μA . Hals and Selvig³⁷ examined cementum with the probe at 11, 15 & 23kV and 0.2-0.67 μA and Hennequin and Douillard⁵¹ examined cementum with the probe at 15kV and 0.011 μA . The present study operated the probe at relatively similar conditions of 15kV and 20nA.

One of the problems with quantitative studies is the appropriate preparation of specimens. Samples for EPMA must be dehydrated to make it suitable for insertion into the vacuum of the electron probe. The specimen must be flat with parallel surfaces. In the case of teeth, resin embedding is often required to obtain a well-prepared specimen. The sample must be well polished using a minimum of 1µm abrasives, mounted to be physically compatible with the specimen stage and rendered electrically and thermally conductive⁷⁵. The sample preparation in this study followed these guidelines.

1. Controls

To the authors' knowledge, this is the first study to report, from a large sample of teeth, quantitative values for the Ca, P and F concentration in human first premolar cementum at various root positions (buccal and lingual surface at the cervical, middle and apical third from the outer to middle to inner third of cementum).

It is difficult to compare the mean Ca, P and F concentrations for control teeth in the present study with values reported in the literature due to statistically significant inter-individual variation in teeth as demonstrated by the UNIANOVA model ($p=0.000$), differences in the type of teeth investigated, differences in the age of the individuals from which the teeth were extracted, differences in the root position examined, differences in the amount of F exposure, differences in specimen preparation, and differences in methodological technique using either EPMA^{36,37,50,51} or chemical analysis^{34,48,52,53,55,57,60,61,62}. Reported values from EPMA and chemical studies are not

comparable. EPMA studies tend to give quantitative data in percentage dry weight (%wt), whereas studies by chemical analysis often report data for elements on an ash basis (%ash); it is difficult to compare the two. When comparing F composition across studies, the age of the subject and amount of F exposure is important as F concentration in cementum increases with age^{48,52,53,54,55,56,59,60}, and with F exposure^{48,49,57}. F exposure is not only a factor of the level of fluoridation in the water, but is also dependent on an individual's exposure to topical F applications from toothpaste, mouthrinses and professional applications, as well as systemic doses from the diet and F supplementation.

Only one study exists that has looked at a similar sample to the present study, however, differences still exist regarding the sample size and the specimen preparation technique³⁶. Compared with this study, Neiders *et al.*,³⁶ reported lower mean Ca values at the cervical (25.62%wt Vs 29.87%wt) and midroot (26.04%wt Vs 28.76%wt) region in adolescent (11-15 years) maxillary and mandibular premolars, and lower P values at the cervical (12.92%wt Vs 13.71%wt) but higher P values at the middle third (13.48%wt Vs 13.21%wt). Differences may be due to subject variability within a small sample size (n=5), differences in operating conditions, or differences in specimen preparation. Lower kV/amp conditions were used to operate the probe, and samples were dried at 95⁰C for 1 week. Extreme temperature for a prolonged period of time may cause thermal damage to the specimen with a subsequent loss in the mineral content of the specimen⁷⁶. The reported mean Ca and P values in the present study at the midroot region in maxillary and mandibular first premolars (28.76%wt and 13.21%wt, respectively), however, were comparable to those reported by Hennequin and Douillard⁵¹ in mandibular third molars at

the midroot region (29.24%wt and 13.49%wt, respectively). The latter study had a much larger sample size (n=25) and was similar to the present study in that it did not use high temperatures for a prolonged period of time during the specimen preparation.

In the present study the reported mean F concentrations from the outer to inner third of cementum at the cervical (1.11-0.97%wt), middle (1.10-0.73%wt) and apical third (0.99-0.30%wt) were higher than previously reported values obtained by EPMA^{37,50}. Hals and Selvig³⁷ reported a mean F concentration of 0.5-0.6%wt to 0.15%wt from the outer surface of cementum to the CDJ, in a variable sample of teeth taken from 31-40 year-old individuals living in a low F area. Tötdal and Hals⁵⁰ reported a mean F concentration of 0.37%wt (range 0.16-0.7%wt) in a sample of 3 teeth (2 incisors and 1 premolar) taken from an adult and child, respectively, however, did not mention what level of water fluoridation their samples had been taken from. A limitation to the present study was that not all subjects had been exposed to the same level of water fluoridation. The majority of subjects in the present study had been living in an optimally fluoridated community of 1.0ppm, however, five individuals had spent some time of their lives living in areas where the level of water fluoridation was unknown. These individuals may have had very high levels of fluoride in their drinking water. The difference in the F results of the present study compared with existing studies may be due to differences in the level of water fluoridation. Comparable values to the present study, however, have been reported in a chemical analysis on permanent anterior teeth from individuals aged from 30-60 years living in an optimally fluoridated area (1.0-1.3ppm), where F values ranged from 0.3-0.9%wt cervically, 0.25-0.79%wt midroot and 0.3-0.8%wt apically⁵⁷. However, the

age group in the present study was younger (11.7-16.1 years) and, therefore, lower F concentrations should be expected since F concentrations increase with age. The higher F readings may also have been a result of the chosen standard (fluorite) or may just reflect differences in the subject's exposure to other F avenues e.g. toothpaste, mouthrinses, F supplementation and professional topical applications.

The present study found there to be a very highly significant inter-individual variation in the mean Ca, P and F concentrations in untreated human first premolar cementum ($p=0.000$, 0.005 & 0.000 , respectively). The range of mean Ca, P and F concentrations between subjects varied from 27.17%wt – 30.40%wt, 12.43%wt-14.15%wt, and 0.37%wt – 1.49%wt, respectively. This large subject variability in the Ca and P content of cementum is in agreement with Cohen *et al.*,⁴⁶ who using SEM/EDX, demonstrated large variations from root to root in different individuals. Variability in F concentration between individuals was expected, since subjects would have been exposed to different levels of F throughout their lifetime, and F concentrations in cementum are directly related to the amount of ingested F^{48,49,57}.

No studies exist in the literature comparing the Ca, P and F composition of cementum at the buccal and lingual surface. Fig. 6(a,b,c) show a trend toward similar values in the Ca, P and F contents at the buccal and lingual surface, respectively. The present study found no significant difference in the mean Ca, P or F concentration between the buccal and lingual surface, except for at the cervical third, where there was a significant ($p=0.000$) higher mean F concentration on the buccal surface compared with the lingual surface

(1.13%wt Vs 0.96%wt). This is difficult to explain but may be a result of greater fluoride delivery at the gingival sulcus with toothbrushing. Gingival recession and root exposure, however, were not evident in this adolescent group.

In the present study, a decreasing gradient in Ca, P and F concentration was seen from the cervical to apical third (Fig. 6a,b,c). These changes from the cervical to middle, cervical to apical, and middle to apical third were very highly significant ($p=0.000$), except for F, where there was no significant difference between the cervical and middle third on the lingual surface ($p=0.966$). These results confirm what has been demonstrated on microradiographs of cementum, where the cervically located acellular cementum is more radiodense, and therefore, more mineralised, than the apically positioned CIFIC, CMFC and cellular mixed stratified cementum (CMSC)²⁹. The difference can be explained by the presence of uncalcified spaces, such as lacunae in SCIFIC, an uncalcified core of extrinsic Sharpey's fibres in the CMFC⁴⁷ and alternating layers of AEFC and CIFIC in CMSC⁷⁷. In addition, the matrix of AEFC tends to be more completely mineralised because its formation is a slow process that allows longer direct contact of tissue fluids²⁹. The results for Ca and P in the present study, however, conflict with those of Neiders *et al.*,³⁶ who found no significant differences between cervical and mid-root cementum; Nakata *et al.*,⁴⁸ who found no significant differences in Ca and P concentration between cervical and apical cementum, and Selvig and Selvig³⁴, who found no significant difference between cervical, middle and apical cementum. The latter two studies, however, were carried out by chemical analysis, where difficulty may have been encountered in obtaining pure cementum samples. The former study was limited by a

small sample size (n=5) where there may have been too few data to demonstrate any statistical significance. For F, the results of this study confirm those of others; that there is a decrease in F content from the cervical to apical cementum^{49,59,60}.

A trend toward an increasing Ca and P content from the outer edge of the cementum to the CDJ was observed (Fig. 6a,b). A statistically significant increase in Ca and P concentrations was seen from the outer to the inner third of cementum at the cervical and middle third of the root ($p < 0.01$), but not at the apical region, where mean Ca and P values were lower at the middle third compared with the outer and inner third. Most of the apical cementum was composed of the mixed stratified type, where the AEFC was often seen at the outer and inner third, and the CIFC at the middle third. This may explain why the mean Ca and P values at the middle third are lower than the mean values at the outer or inner third, since CIFC is less mineralised than AEFC. These findings for Ca and P profiles from the outer to inner third are in agreement with Tötdal and Hals⁵⁰ who also demonstrated an increasing concentration of Ca and P from the outer surface of cementum to the CDJ, however, are in disagreement with the studies by Hals and Selvig³⁷ and Tohda *et al.*,³⁸ who reported little variation in the Ca and P profiles in cervical cementum from the outer surface to the CDJ. These latter studies, however, were based on trends seen on linescans and not on quantitative data. The results of this study may be a function of a large amount of data showing up very small differences as statistically significant, or may be due to an edge-effect, where on the outer surface of cementum there may not be full penetration of the electron beam due to slight curvature in the specimen and as a result, readings at the outer third may have been lower. There was a

trend toward decreasing F concentrations from the outer edge of cementum to the CDJ (Fig. 6c). This was statistically significant ($p<0.01$) from the outer to inner third of cementum at the cervical, middle and apical third of the root. This concentration gradient for F from the outer surface of cementum to the CDJ is in agreement with numerous other studies^{37,38,52,55,58,61,62}.

2. Control and Experimental Teeth

To the authors' knowledge, there is no available data regarding the changes in the mineral composition of cementum after the application of orthodontic forces. This study found that with the application of both light (25g) and heavy (225g) orthodontic force there was a trend toward decreasing Ca, P and F concentrations in cementum, which for Ca and P, occurred to a greater extent in the heavy force group.

Figs. 7a, 8a and 9a demonstrate the trend in the Ca, P and F concentrations, respectively, between the four groups. Overall, the Ca and P content in cementum decreased in both the light and heavy force groups compared with controls, but occurred to a greater extent in the heavy force group (Fig. 7a,b). The decrease in Ca and P content was very highly significant for the heavy force group only when compared with controls ($p=0.00$ and $p=0.004$, respectively). The difference in Ca content between the light and heavy force groups was also statistically significant ($p=0.00$). F content also demonstrated a similar trend with lower mean F concentrations in both the light and heavy force groups compared with controls, however, the decrease in F was greater in the light force group

compared with the heavy force group (Fig. 7c). Although these F changes were statistically insignificant, this may have been due to a masking effect induced by the large inter-individual variation in F content seen in control teeth.

It is not known what causes this decrease in mineral content in cementum with orthodontic force application and why there is a greater demineralisation with heavier forces. Furthermore, it is difficult to explain the results of the present study particularly with respect to root position since no obvious trends in relation to periodontal ligament compression are apparent. Root resorption occurring in connection with orthodontic tooth movement is associated with local over-compression of the periodontal membrane with development of a sterile coagulation necrosis (a hyalinized zone)^{78,79,80,81,82}. Studies in mice and rats have confirmed that orthodontically induced root resorption is part of the hyaline zone elimination process^{83,84,85,86,87,88}. Root resorption at the hyalinized zone occurs in two stages: initially at the circumference of the necrotic hyalinized zone followed several days later by resorption on the root surface situated beneath the main, central part of the necrotic zone^{83,84}. At the latter stage, repair in the periphery of the resorption lacunae is already taking place^{87,88}. If the extent of demineralisation were related to periodontal ligament compression, then with the application of a buccal tipping force, one would expect the greatest changes at the cervical and apical third of the buccal and lingual surface, respectively. This was not the finding of the present study.

Figs. 7b, 8b and 9b demonstrate the trend in the Ca, P and F concentrations, respectively, between the four groups on the buccal and lingual surface at the cervical, middle and

apical third of the root. At the cervical third on the buccal surface, Ca and F decreased in both the heavy and light force groups, whereas P increased in the heavy force group and decreased in the light force group. These changes, however, were only significant for Ca and F in the heavy force group ($p < 0.01$). Similar trends in Ca, P and F were evident at the middle and apical third of the buccal surface in both the light and heavy force groups. At the middle third on the buccal surface Ca and F decreased while P increased. This was significant for Ca, P and F in the heavy force group only ($p < 0.01$). At the apical third on the buccal surface Ca and P decreased while F increased. This was significant for Ca and F in both the heavy and light force groups ($p < 0.01$). At the cervical third on the lingual surface P decreased both in the light and heavy force groups. Ca, however, decreased in the heavy force group and increased in the light force group. Likewise F increased in the heavy force group but decreased in the light force group. Changes were only significant for P and F in the heavy force group ($p < 0.01$). At the middle third on the lingual surface Ca and P decreased in both the heavy and light force groups, whereas F increased in the heavy force group and decreased in the light force group. These changes were only significant for Ca and P in the heavy force group ($p < 0.01$). At the apical third on the lingual surface, F decreased in both the heavy and light force groups, whereas Ca decreased in the heavy force group but increased in the light force group. Likewise, P decreased in the heavy force group but increased in the light force group. None of these changes, however, were statistically significant. Operator error in producing a pure buccal tipping force may possibly explain the results we obtained at various root positions. Lundgren *et al.*,⁶⁵ discussed the difficulty in producing a pure buccal tipping force. They measured tooth displacement on dental casts after the application of a 50g

buccally directed horizontal force to maxillary first or second premolars and found the movement pattern of the test teeth to be a combination of horizontal and vertical displacements, including tipping. This alone, however, seems unlikely to explain the results of this study. Obviously there are other unknown mechanisms occurring that are difficult to explain.

The exact mechanism of root resorption is not yet fully understood. Resorption of the calcified dental tissues occurs when the root resorbing cell or odontoclast obtains access to the mineralised tissue through a breach in the formative cell layer covering the tissue^{3,89}, if the mineral and matrix surfaces coincide³, or when the precementum is mechanically damaged or scraped off⁸⁹. The denuded root areas attract hard tissue resorbing cells to colonize the damaged areas of the root⁸⁹. In bone, the dissolution of hydroxyapatite occurs by targeted secretion of HCl through the ruffled border of the osteoclast into the resorption lacuna^{90,91}. This is an extracellular space between the ruffled border membrane and the bone matrix, and is sealed from the extracellular fluid by the sealing zone⁹². The low pH in the resorption lacuna is achieved by the action of ATP-consuming vacuolar proton pumps both at the ruffled border membrane and in intracellular vacuoles⁹³. These acidic extracellular compartments lie beneath the resorbing cells⁹⁴. After solubilization of the mineral phase, several proteolytic enzymes such as matrix metalloproteinases (MMPs) and lysosomal cysteine proteinases degrade the organic bone matrix. Degradation products are removed from the resorption lacuna through a transcytotic vesicular pathway from the ruffled border to the functional secretory domain, where they are liberated into the extracellular space^{95,96}. Activation of

osteoclasts appears to be mediated by osteoblasts. Activation of osteoblasts by binding of a bone resorption hormone such as PGE₂ to the osteoblast results in rounding of the osteoblast to expose the underlying osteoid, release of matrix metalloproteinases to dissolve the osteoid and production of a soluble mediator that recruits and activates osteoclasts^{97,98,99}. Once the osteoid is removed and the mineralised matrix is exposed, the osteoclasts can resorb the bone. Root resorption is produced by odontoclasts that are similar to osteoclasts in structure and function¹⁰⁰. In rats and mice, the first cells to be involved in the initial stage of root resorption at the periphery of the necrotic zone have been shown to be mono-nucleated, TRAP (tartrate resistant acid phosphatase) negative (non-clast) cells resembling macrophages and/or fibroblasts^{83,84}. In the later stage of root resorption beneath the main hyalinized zone, both multi-nucleated, TRAP positive, giant cells without a ruffled border and mono-nucleated, TRAP positive, macrophage-like cells appear to be responsible for removal of the necrotic tissue and resorption of the surface part of the root cementum^{85,86}. It is assumed that these multi-nucleated giant cells without a ruffled border are derived from the mono-nucleated phagocytic system^{85,86}. It is conceivable that the demineralization seen in cementum in the present study might be similar to the mechanism of demineralization seen in bone resorption, because root resorption is produced by odontoclasts that are similar to osteoclasts in structure and function¹⁰⁰.

Local tissue pH changes may also possibly explain the decrease in mineral content of cementum seen in the present study. Metabolic acidosis has been shown to induce bone calcium efflux and bone resorption initially by *physicochemical mineral dissolution* and

subsequently by cell-mediated mechanisms involving *inhibition of osteoblasts* and *stimulation of osteoclasts*^{101,102}. Orthodontic tooth movement is characterised by a continual remodelling process of bone resorption and apposition. The fundamental component behind both the bone and root resorption process is a local inflammatory reaction¹⁰³. It is well recognized that in the presence of inflammation the pH of tissue fluid drops¹⁰⁴. The magnitude of this fall in pH is generally small. Punnia-Moorthy¹⁰⁴ demonstrated about a 0.5 pH unit drop in rats using the air pouch granuloma inflammatory model. Andersson *et al.*,¹⁰⁵ demonstrated a reduction in pH in the periarticular tissue of arthritic joints in rats of the order of 0.2 – 1.2 pH unit. *Physicochemical mineral dissolution* of cementum in response to a fall in local tissue pH may possibly explain the decrease in Ca, P and F content seen in cementum in the present study. Both the properties of adsorption and kinetics of mineral dissolution are determined by the electrochemical nature and charge characteristics of the hydroxyapatite surface²⁶. The charge on the hydroxyapatite surface is determined by the adsorption of charged aqueous species, which develop as a consequence of the various dissolution and hydrolytic reactions that take place when the solid is suspended in aqueous solution¹⁰⁶. The extent of hydrolysis for species such as calcium and phosphate ions depends upon the solution pH, which in turn essentially determines the surface charge. The solution pH, therefore, is one of the most important parameters that govern the electrical and physicochemical behaviour of an ionic surface such as hydroxyapatite^{106,107}. The point of zero charge (PZC) may be regarded as the pH at which the net charge at the hydroxyapatite surface is zero; at a higher pH the hydroxyapatite surface acquires a net negative charge and at a lower pH the net surface charge is positive²⁶. Various

electrochemical and surface charge studies have found the PZC for apatitic materials to be at a pH of 8.5^{26,108}. In the current study, it was assumed that tissue pH was slightly acidic due to the inflammatory nature of orthodontic tooth movement. In this state, tissue pH would be less than 8.5. The surface processes of apatite dissolution are not completely understood. Different models for apatite dissolution have been proposed including diffusion-controlled and kinetic (surface)-controlled models; self-inhibited Ca-rich layer formation and similar permselective membrane models; polynuclear mechanisms; congruent/incongruent (or stoichiometric/nonstoichiometric) mechanisms; etch pit formation; two-site mechanisms; ion exchange mechanisms; and hydrogen catalytic mechanisms¹⁰⁹. Dorozhkin¹⁰⁹ suggest that only congruent/incongruent, ion exchange and hydrogen catalytic mechanisms can be considered in attempts to describe the surface processes occurring during dissolution. Of these three possible dissolution mechanisms, the congruent/incongruent mechanism appears to be most accepted^{106,109,110}. Suspension of fluorapatite/hydroxyapatite in an acidic medium most probably results in the transformation of apatite into acidic calcium phosphates, however, the formation of octacalcium phosphate cannot be ruled out¹⁰⁹. Fluorine for fluorapatite and hydroxyl for hydroxyapatite most probably dissolves first^{109,110,111,112}. Dissolution starts with replacement of fluorine for water¹⁰⁹. A proton, most likely H_3O^+ , present within an acidic medium, is thought to adsorb onto the surface of fluorapatite and result in a positive surface charge formation¹¹³. This proton has been thought to catalyse the removal of fluorine and incorporation of water into apatite^{114,115}. Dorozhkin¹⁰⁹, however, suggested that the positive surface charge of apatite might be acquired by the replacement of fluorine anions with neutral water molecules. The positive charge attained by the apatite

surface in an acidic medium is removed by dissolution of one of the nearest calcium cations¹⁰⁹. Later, protons from the bulk solution replace other calcium cations around the nearest phosphate groups and as a result, a very thin surface layer of acidic calcium phosphates is formed¹⁰⁹. Finally, when all or almost all of the nearest calcium cations have been replaced with protons, phosphate anions (H_2PO_4^- , $\text{CaH}_2\text{PO}_4^+$, or H_3PO_4 ; it is not yet clear) detach from the surface. Therefore, the dissolution at the surface of apatite appears to follow a sequence of ionic detachment of fluorine first, followed by calcium and lastly phosphate¹⁰⁹. Based on this model of apatite dissolution, the greatest decreases in mineral content should have been expected for F and Ca, and to lesser extent for P. Certainly in the present study, decreases in the Ca content after the application of orthodontic forces appeared of a greater magnitude than decreases in the P content (0.35% Vs 0.1%, respectively in the light force group and 1.22% Vs 0.35%, respectively in the heavy force group), however, decreases in F content were of a much smaller magnitude (0.07% in the light force group and 0.04% in the heavy force group). This however, is not really comparable as F concentrations in cementum are of a much smaller magnitude than Ca or P. Although the decreases in fluoride were not statistically significant for both the heavy and light force groups, statistical significance may have been overridden by the large inter-individual variation in F content. Although it seems likely that physicochemical mineral dissolution in response to lowered tissue pH may play a role in the demineralisation of cementum seen in the present study, definitive conclusions cannot be made without further investigations.

Lowering of tissue pH has also been shown to cause a cell-mediated response involving inhibition of osteoblasts and *stimulation of osteoclasts*^{101,103}. Arnett and Dempster¹¹⁶ were the first to demonstrate the stimulatory action of extracellular protons on rat osteoclasts cultured in media buffered nonphysiologically by showing progressively increasing resorption on cortical bone or dentine wafers as the pH was reduced from 7.4 to 6.8. In neonatal rat and chick osteoclasts, lowering of extracellular pH to the level of 6.3-7.3 has been shown to produce a consistently higher level of bone resorption over 24-72 hours¹¹⁷. This was mainly due to a higher proportion of active osteoclasts at a lower pH and to a lesser extent deeper resorption sites. Carano *et al.*,¹¹⁸ demonstrated a 50% increase in bone resorption by lowering extracellular pH from 7.3 to 6.7 in avian osteoclasts. Subsequent work, however, has demonstrated that rat osteoclasts cultured in media buffered physiologically with $\text{HCO}_3^-/\text{CO}_2^-$ may be sensitive to pH changes within a more limited range¹¹⁹. Arnett and Spowage¹²⁰ investigated the effect of small shifts in extracellular pH on the resorption activity of rat osteoclasts cultured in $\text{HCO}_3^-/\text{CO}_2^-$ buffered medium and found that little or no bone resorption occurred when ambient pH was above 7.30; at pH 7.00, osteoclasts exhibited near-maximal activity. The average number of resorption pits increased sixfold with a pH difference of as little as 0.10 unit; between pH 7.25 and pH 7.15 suggesting that only very small fluctuations in ambient hydrogen ion concentration is required to "switch on" or "switch off" rat osteoclasts. Meghji *et al.*,¹²¹ investigated the pH dependence of bone resorption in mouse calvarial osteoclasts and found that Ca^{2+} release was minimal above pH 7.2 but was stimulated strongly by the addition of small amounts of H^+ to culture medium (HCO_3^- acidosis). A fall in pH from 7.12 to 7.03 resulted in a 3.8 fold increase in Ca^{2+} release. CO_2 acidosis

was a less effective stimulator of Ca^{2+} release than HCO_3^- acidosis over a similar pH range. The Ca^{2+} release stimulated by HCO_3^- acidosis was almost entirely the result of osteoclast activity. HCO_3^- acidosis stimulated resorption by activating mature osteoclasts already present in calvarial bones, rather than by inducing formation of new osteoclasts. It is conceivable that a lowering of tissue pH associated with orthodontic tooth movement may have a similar stimulatory effect on odontoclasts to induce odontoclastic resorption of cementum. Stimulation of odontoclastic activity by pH changes induced by orthodontic tooth movement could possibly explain the demineralization of cementum observed in the present study.

The decrease in the mineral content of cementum seen in the present study may also possibly have a systemic contribution. Bone significantly contributes to the maintenance of calcium and phosphate homeostasis¹²². In bone, the application of mechanical strain to osteoblasts has been shown to activate stretch-activated Ca channels thereby producing a large increase in intracellular Ca^{123} . This mobilisation of Ca from the extracellular to intracellular fluid is hypothesised to induce a state of hypocalcaemia. Normal physiology demands precise control of serum Ca and P levels, and in response to Ca deprivation, parathyroid hormone (PTH) is secreted, which in turn acts to decrease serum P levels. In the presence of PTH, bone is sacrificed by: (1) a rapid flux of Ca from bone fluid to the extra-cellular fluid (seconds), (P does not appear to be mobilized with Ca in this process), and (2) a short-term (minutes-days) response of osteoclasts and osteoblasts to increase bone resorption and decrease bone formation, creating a transfer of Ca and P from bone into the extracellular fluid^{122,124}. This movement of Ca and P from the bone into the

extracellular fluid restores plasma Ca and P levels. Orthodontic tooth movement in hypocalcaemic rats^{125,126} and hypocalcaemic and hypophosphataemic dogs¹²⁷ has been shown to cause an increased rate of bone resorption, decreased bone density and more rapid tooth movement. However, differences of opinion exist regarding the incidence of root resorption in a hypocalcaemic state. Engström *et al.*,¹²⁶ observed an increase in the occurrence and severity of root resorptions in orthodontically treated hypocalcemic rats. Goldie and King¹²⁵, however, in a study on orthodontically treated, hypocalcemic and lactating rats did not support these findings. Assuming that orthodontic treatment does induce a state of hypocalcaemia, it is possible that cementum may also participate in Ca and P homeostasis, in which case it would be expected that Ca and P levels in cementum would decrease as Ca and P is mobilised from cementum to the extra-cellular fluid.

The results of the present study demonstrated a trend of decreasing Ca, P and F concentrations in cementum after the application of orthodontic forces. This trend was more pronounced with heavier forces and was only statistically significant for Ca and P in the heavy force group. Although these decreases in Ca and P were statistically significant, the changes appear to be very small. Whether this is clinically significant is unknown. It does appear, however, that at the biologic level very small changes in the microenvironment can produce quite dramatic chemical and cellular responses. Inflammation and associated pH changes are an example of this. Although the decrease in F content seen with orthodontic force application was not statistically significant, statistical significance may have been masked by the overall large inter-individual variation present in F concentrations in untreated teeth. The variable fluoride history of

the present sample of teeth is a limitation of this study. It is not known exactly why this demineralization occurs in cementum with orthodontic force application. Various hypotheses have been proposed in this discussion. It is possible that odontoblasts behave in a similar manner to osteoclastic dissolution of hydroxyapatite in bone. Local tissue pH changes induced by the inflammatory nature of orthodontic tooth movement may also possibly explain the demineralization of cementum seen in the present study. Local tissue pH changes in bone induce Ca efflux and bone resorption initially by physicochemical mineral dissolution and subsequently by cell-mediated mechanisms involving stimulation of osteoclasts^{101,102}. Of all the calcified tissues, cementum is most similar to bone and it is conceivable that a fall in tissue pH may also induce a similar action on cementum and odontoblasts. A systemic contribution from an orthodontically induced hypocalcaemia has also been hypothesised as a possible explanation for the demineralization of cementum seen in the present study. PTH released in response to reduced serum Ca levels has been shown to increase the severity of root resorption¹²⁶. It is possible that if orthodontic tooth movement does induce a hypocalcaemia via stretch-activated Ca channels, and PTH release has a similar effect on cementum to that of bone, then this mechanism of action may also possibly explain the decrease in mineral content observed in the present study. If orthodontic treatment does induce a state of hypocalcaemia with a subsequent demineralization of cementum, then perhaps Ca and P supplementation during orthodontic treatment may reduce susceptibility to root resorption. Finally, if less mineralised cementum is more susceptible to resorption as some authors claim, then this process of demineralisation that occurs concurrently with orthodontic force application may explain why orthodontically treated teeth are prone to the resorptive process.

Further research is required into understanding the relationship between orthodontic force application and alterations in the mineral composition of cementum. The limitation of the present study was that the sample teeth collected were from individuals of a different fluoride background and as a result no definitive conclusions could be drawn with respect to fluoride changes in cementum after the application of orthodontic forces. More definitive conclusions could be obtained by using a sample of teeth collected from individuals with a similar fluoride history. Future avenues of research could entail investigation into the mode of action of odontoblastic dissolution of hydroxyapatite as well as the effect of pH changes on cementum and odontoblasts. An animal model investigating blood Ca and P levels before, during and after orthodontic treatment as well as the effects of Ca and P supplementation on the amount of root resorption could also be a possible area of future research. More recent studies have examined the changes in the hardness and elasticity of cementum⁶³ as well as the volume of root resorption¹²⁷ in the same sample of teeth. Future research will entail a correlation study between the physical properties of cementum (hardness and elasticity), the mineral content of cementum and the volume of root resorption.

4.6 Conclusions

In untreated human first premolar teeth:

1. There is a large inter-individual variation in the Ca, P and F concentrations in human first premolar cementum.
2. There is no difference in the Ca, P and F concentrations of cementum between the buccal and lingual surface except for a higher F content at the cervical region on the buccal surface.
3. There is a decreasing gradient in Ca, P and F concentrations from the cervical to apical third of the root.
4. There is an increasing gradient in Ca and P concentrations from the outer to inner third of cementum at the cervical and middle third of the root.
5. There is a decreasing gradient in F concentrations from the outer to inner third of cementum at the cervical, middle and apical third of the root.

In orthodontically treated human first premolar teeth:

1. The application of orthodontic forces causes a decrease in the Ca and P content in cementum that is more pronounced with heavier forces.
2. Although there is a trend toward a decreasing F content in cementum with the application of orthodontic forces, definitive conclusions could not be made due to the large interindividual variation in F content.

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Table VIII - Pairwise comparisons of the mean F concentrations across the 4 groups (light force control group, light force group, heavy force control group, and heavy force group) on the buccal and lingual surface at the cervical, middle and apical third.

Root Position	OMI	Ca%wt		P%wt		F%wt	
		Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
BC	O	28.89	.18	13.26	.08	1.13	.03
	M	30.05	.18	13.76	.08	1.14	.03
	I	31.20	.18	14.07	.08	1.12	.03
BM	O	28.06	.18	12.96	.08	1.10	.03
	M	28.69	.18	13.15	.08	.91	.03
	I	29.14	.18	13.36	.08	.73	.03
BA	O	27.09	.18	12.34	.08	1.00	.03
	M	26.82	.18	12.22	.08	.52	.03
	I	27.57	.18	12.47	.08	.33	.03
LC	O	28.93	.18	13.49	.08	1.08	.03
	M	29.71	.18	13.75	.08	.97	.03
	I	30.43	.18	13.93	.08	.83	.03
LM	O	28.26	.18	13.08	.08	1.10	.03
	M	28.84	.18	13.18	.08	.91	.03
	I	29.60	.18	13.53	.08	.73	.03
LA	O	27.14	.18	12.50	.08	.98	.03
	M	26.93	.18	12.19	.08	.45	.03
	I	26.82	.18	12.17	.08	.27	.03

Table I: Mean Ca, P and F concentrations (%wt) in untreated human premolar cementum on the buccal and lingual surface, at the cervical, middle and apical third and the outer, middle and inner third.

- BC – buccal cervical
- BM – buccal middle
- BA – buccal apical
- LC – lingual cervical
- LM -lingual middle
- LA – lingual apical
- O – outer third of cementum
- M – middle third of cementum
- I – inner third of cementum
- Std. Error – standard error

Element	Position Comparison						Mean Difference (1-2)	SE	Sig. ^a
	Position 1	Mean	SE	Position 2	Mean	SE			
Ca	BC	30.05	.11	LC	29.69	.11	.36	.15	.24
	BM	28.63	.11	LM	28.90	.11	-.27	.15	1.00
	BA	27.16	.11	LA	26.96	.11	.20	.15	1.00
P	BC	13.70	.05	LC	13.72	.05	-.02	.07	1.00
	BM	13.16	.05	LM	13.27	.05	-.11	.07	1.00
	BA	12.35	.05	LA	12.28	.05	.06	.07	1.00
F	BC	1.13	.02	LC	.96	.02	.17*	.03	.00
	BM	.91	.02	LM	.91	.02	.002	.03	1.00
	BA	.62	.02	LA	.57	.02	.05	.03	1.00

Table II: Buccal Vs Lingual Surface (Control). Pairwise comparisons of the mean Ca, P and F concentrations on the buccal and lingual surface at the cervical, middle and apical third of cementum.

Based on estimated marginal means

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Bonferroni.

BC – buccal cervical

BM – buccal middle

BA – buccal apical

LC – lingual cervical

LM -lingual middle

LA – lingual apical

SE – standard error

Element	Position Comparison						Mean Difference (1-2)	SE	Sig. ^a
	Position 1	Mean	SE	Position 2	Mean	SE			
Ca	C	29.87	.08	M	28.76	.08	1.10*	.12	.00
	M	28.76	.08	A	27.06	.08	1.70*	.12	.00
	C	29.87	.08	A	27.06	.08	2.81*	.12	.00
P	C	13.71	.04	M	13.21	.04	0.50*	.06	.00
	M	13.21	.04	A	12.32	.04	0.90*	.06	.00
	C	13.71	.04	A	12.32	.04	1.39*	.06	.00
F	BC	1.13	.02	BM	.91	.02	0.22*	.03	.00
	BM	.91	.02	BA	.62	.02	0.30*	.03	.00
	BC	1.13	.02	BA	.62	.02	0.52*	.03	.00
	LC	.96	.02	LM	.91	.02	.05	.03	.97
	LM	.91	.02	LA	.57	.02	0.34*	.03	.00
	LC	.96	.02	LA	.57	.02	0.39*	.03	.00

Table III: Cervical Vs Middle Vs Apical Third (Control). Pairwise comparisons of the mean Ca, P and F concentrations on the buccal and lingual surface at the cervical, middle and apical third of cementum.

Based on estimated marginal means.

* The mean difference is significant at the .05 level.

a Adjustment for multiple comparisons: Bonferroni.

C – cervical third

M – middle third

A – apical third

BC – buccal cervical

BM – buccal middle

BA – buccal apical

LC – lingual cervical

LM -lingual middle

LA – lingual apical

SE – standard error

Element	CMA	Position 1			Position 2			Mean Diff (1-2)	SED	Sig. p<0.01
		OMI	Mean	SE	OMI	Mean	SE			
Ca	cervical	O	28.91	.14	M	29.88	.14	-1.97	.50	*
		M	29.88	.14	I	30.81	.14	-0.94	.50	*
		I	30.81	.14	O	28.91	.14	1.90	.50	*
	middle	O	28.16	.14	M	28.76	.14	-0.61	.50	*
		M	28.76	.14	I	29.37	.14	-0.61	.50	*
		I	29.37	.14	O	28.16	.14	1.22	.50	*
	apical	O	27.11	.14	M	26.88	.14	0.24	.50	NS
		M	26.88	.14	I	27.19	.14	-0.32	.50	NS
		I	27.19	.14	O	27.11	.14	0.08	.50	NS
P	cervical	O	13.37	.07	M	13.76	.07	-0.39	.25	*
		M	13.76	.07	I	14.00	.07	-0.24	.25	NS
		I	14.00	.07	O	13.37	.07	0.63	.25	*
	middle	O	13.02	.07	M	13.17	.07	-0.15	.25	NS
		M	13.17	.07	I	13.45	.07	-0.28	.25	*
		I	13.45	.07	O	13.02	.07	0.43	.25	*
	apical	O	12.42	.07	M	12.21	.07	0.21	.25	NS
		M	12.21	.07	I	12.32	.07	-0.11	.25	NS
		I	12.32	.07	O	12.42	.07	-0.10	.25	NS
F	cervical	O	1.11	.03	M	1.06	.03	0.05	.11	NS
		M	1.06	.03	I	.97	.03	0.08	.11	NS
		I	.97	.03	O	1.11	.03	-0.13	.11	*
	middle	O	1.10	.03	M	.91	.03	0.19	.11	*
		M	.91	.03	I	.73	.03	0.88	.11	*
		I	.73	.03	O	1.10	.03	-0.37	.11	*
	apical	O	.99	.03	M	.48	.03	0.25	.11	*
		M	.48	.03	I	.30	.03	0.20	.11	*
		I	.30	.03	O	.99	.03	-0.69	.11	*

Table IV: Outer Vs Middle Vs Inner Third (Control). Pairwise comparisons of mean Ca, P and F concentrations at the cervical, middle and apical third, at the outer, middle and inner third of cementum.

CMA – cervical, middle, apical third

OMI – outer, middle, inner third

Mean diff (1-2) – mean difference between CMA/OMI 1 and CMA/OMI 2

SE – standard error ; SED – standard error of the difference

Sig. p<0.01 - significant at the 0.01 level, to allow for multiple comparisons.

* - p<0.01; NS – not significant

Element	Group Comparison						Mean Difference (1-2)	SE	Sig. ^a
	Group 1	Mean	SE	Group 2	Mean	SE			
Ca	LC	28.79	.13	HC	28.91	.13	-0.12	.09	1.00
	LC	28.79	.13	LE	28.44	.11	0.35	.21	0.57
	HC	28.91	.13	HE	27.69	.11	1.22*	.21	.00
	LE	28.44	.11	HE	27.69	.11	0.75*	.09	.00
P	LC	13.14	.06	HC	13.31	.06	-0.17*	.05	.00
	LC	13.14	.06	LE	13.04	.06	.10	.10	1.00
	HC	13.31	.06	HE	12.96	.06	0.35*	.10	.00
	LE	13.04	.06	HE	12.96	.06	.082	.05	.44
F	LC	.90	.03	HC	.90	.03	.003	.02	1.00
	LC	.90	.03	LE	.83	.02	.07	.04	.74
	HC	.90	.03	HE	.86	.02	.036	.04	1.00
	LE	.83	.02	HE	.86	.02	-.03	.02	.81

Table V: Pairwise comparisons of the mean Ca, P and F concentrations across the 4 groups (light force control group, light force group, heavy force control group, and heavy force group).

Based on estimated marginal means

^a. Adjustment for multiple comparisons: Bonferroni

* The mean difference is significant at the .05 level.

SE – standard error

LC – light control group

HC – heavy control group

LE – light force (experimental) group

HE – heavy force (experimental) group

Group/Position 1				Group/Position 2				Mean Diff (1-2)	SED	Sig. p<0.01
Group	Position	Mean	SE	Group	Position	Mean	SE			
LC	BC	30.46	.30	HC	BC	30.75	.30	-0.29	1.08	NS
	BM	29.04	.30		BM	30.32	.30	-1.28	1.08	*
	BA	28.02	.30		BA	28.59	.30	-0.57	1.08	NS
	LC	29.29	.30		LC	28.36	.30	0.94	1.08	NS
	LM	29.01	.30		LM	28.16	.30	0.86	1.08	NS
	LA	26.91	.30		LA	27.30	.30	-0.38	1.08	NS
LC	BC	30.46	.30	LE	BC	29.69	.27	-0.77	1.04	NS
	BM	29.04	.30		BM	28.24	.27	-0.80	1.04	NS
	BA	28.02	.30		BA	26.33	.27	-1.69	1.04	*
	LC	29.29	.30		LC	30.17	.27	0.88	1.04	NS
	LM	29.01	.30		LM	29.00	.27	-0.01	1.04	NS
	LA	26.91	.30		LA	27.20	.27	0.28	1.04	NS
HC	BC	30.75	.30	HE	BC	28.87	.27	1.88	1.04	*
	BM	30.32	.30		BM	28.35	.27	1.97	1.04	*
	BA	28.59	.30		BA	26.95	.27	1.64	1.04	*
	LC	28.36	.30		LC	27.81	.27	0.55	1.04	NS
	LM	28.16	.30		LM	27.07	.27	1.09	1.04	*
	LA	27.30	.30		LA	27.11	.27	0.19	1.04	NS
LE	BC	29.69	.27	HE	BC	28.87	.27	-0.82	.99	NS
	BM	28.24	.27		BM	28.35	.27	0.11	.99	NS
	BA	26.33	.27		BA	26.95	.27	0.62	.99	NS
	LC	30.17	.27		LC	27.81	.27	-2.36	.99	*
	LM	29.00	.27		LM	27.07	.27	-1.93	.99	*
	LA	27.20	.27		LA	27.11	.27	-0.09	.99	NS

Table VI: Pairwise comparisons of the mean Ca concentrations across the 4 groups (light force control group, light force group, heavy force control group, and heavy force group) on the buccal and lingual surface at the cervical, middle and apical third.

Mean Diff (1-2) – mean difference between group/position1 and group/position 2

NS – not significant

SE – standard error; SED – standard error of the difference

Sig. p<0.01 – statistically significant at p<0.01

BC – buccal cervical; BM – buccal middle; BA – buccal apical

LC – lingual cervical; LM – lingual middle; LA – lingual apical

LC – light control group; HC – heavy control group

LE – light force (experimental) group; HE – heavy force (experimental) group

Group/Position 1				Group/Position 2				Mean Diff (1-2)	SED	Sig. p<0.01
Group	Position	Mean	SE	Group	Position	Mean	SE			
LC	BC	13.82	.14	HC	BC	13.59	.14	0.23	.53	NS
	BM	12.94	.14		BM	13.38	.14	-0.43	.53	NS
	BA	12.50	.14		BA	12.71	.14	-0.22	.53	NS
	LC	14.02	.14		LC	13.96	.14	0.06	.53	NS
	LM	13.35	.14		LM	13.42	.14	-0.07	.53	NS
	LA	12.20	.14		LA	12.79	.14	-0.59	.53	*
LC	BC	13.82	.14	LE	BC	13.61	.13	-0.21	.50	NS
	BM	12.94	.14		BM	13.33	.13	0.39	.50	NS
	BA	12.50	.14		BA	12.19	.13	-0.31	.50	NS
	LC	14.02	.14		LC	13.48	.13	-0.54	.50	*
	LM	13.35	.14		LM	13.20	.13	-0.16	.50	NS
	LA	12.20	.14		LA	12.42	.13	0.22	.50	NS
HC	BC	13.59	.14	HE	BC	13.99	.13	-0.40	.50	NS
	BM	13.38	.14		BM	13.92	.13	-0.54	.50	*
	BA	12.71	.14		BA	12.66	.13	0.05	.50	NS
	LC	13.96	.14		LC	12.28	.13	1.68	.50	*
	LM	13.42	.14		LM	12.29	.13	1.14	.50	*
	LA	12.79	.14		LA	12.60	.13	0.19	.50	NS
LE	BC	13.61	.13	HE	BC	13.99	.13	0.38	.48	NS
	BM	13.33	.13		BM	13.92	.13	0.59	.48	*
	BA	12.19	.13		BA	12.66	.13	0.47	.48	NS
	LC	13.48	.13		LC	12.28	.13	-1.20	.48	*
	LM	13.20	.13		LM	12.29	.13	-0.91	.48	*
	LA	12.42	.13		LA	12.60	.13	0.18	.48	NS

Table VII: Pairwise comparisons of the mean P concentrations across the 4 groups (light force control group, light force group, heavy force control group, and heavy force group) on the buccal and lingual surface at the cervical, middle and apical third.

Mean Diff (1-2) – mean difference between group/position1 and group/position 2

NS – not significant

SE – standard error; SED – standard error of the difference

Sig. p<0.01 – statistically significant at p<0.01

BC – buccal cervical; BM – buccal middle; BA – buccal apical

LC – lingual cervical; LM – lingual middle; LA – lingual apical

LC – light control group; HC – heavy control group

LE – light force (experimental) group; HE – heavy force (experimental) group

Group/Position 1				Group/Position 2				Mean		Sig.
Group	Position	Mean	SE	Group	Position	Mean	SE	Diff (1-2)	SED	p<0.01
LC	BC	1.15	.06	HC	BC	1.41	.062	-0.26	.23	*
	BM	.99	.06		BM	1.26	.062	-0.28	.23	*
	BA	.51	.06		BA	.38	.062	0.13	.23	NS
	LC	1.05	.06		LC	.88	.062	0.17	.23	NS
	LM	1.03	.06		LM	.81	.062	0.22	.23	NS
	LA	.66	.06		LA	.64	.062	0.02	.23	NS
LC	BC	1.15	.062	LE	BC	1.10	.056	-0.05	.22	NS
	BM	.99	.062		BM	.85	.056	-0.14	.22	NS
	BA	.51	.062		BA	.74	.056	0.23	.22	*
	LC	1.05	.062		LC	.93	.056	-0.12	.22	NS
	LM	1.03	.062		LM	.86	.056	-0.18	.22	NS
	LA	.66	.062		LA	.51	.056	-0.15	.22	NS
HC	BC	1.41	.06	HE	BC	.71	.056	0.70	.22	*
	BM	1.26	.06		BM	.79	.056	0.47	.22	*
	BA	.38	.06		BA	.87	.056	-0.50	.22	*
	LC	.88	.06		LC	1.16	.056	-0.28	.22	*
	LM	.81	.06		LM	1.00	.056	-0.19	.22	NS
	LA	.64	.06		LA	.64	.056	0.01	.22	NS
LE	BC	1.10	.056	HE	BC	.71	.056	-0.40	.20	*
	BM	.85	.056		BM	.79	.056	-0.054	.20	NS
	BA	.74	.056		BA	.87	.056	0.13	.20	NS
	LC	.93	.056		LC	1.16	.056	0.23	.20	*
	LM	.86	.056		LM	1.00	.056	0.14	.20	NS
	LA	.51	.056		LA	.64	.056	0.13	.20	NS

Table VIII: Pairwise comparisons of the mean F concentrations across the 4 groups (light force control group, light force group, heavy force control group, and heavy force group) on the buccal and lingual surface at the cervical, middle and apical third.

Mean Diff (1-2) – mean difference between group/position1 and group/position 2

NS – not significant

SE – standard error; SED – standard error of the difference

Sig. p<0.01 – statistically significant at p<0.01

BC – buccal cervical; BM – buccal middle; BA – buccal apical

LC – lingual cervical; LM – lingual middle; LA – lingual apical

LC – light control group; HC – heavy control group

LE – light force (experimental) group; HE – heavy force (experimental) group

4.10 List of Figures

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Fig. 2b: Completed specimens: heavy (L) and light (R) force samples.

Fig. 3: The Cameca Microprobe.

Fig. 4: Points of analysis on the buccal and lingual surface.

Fig. 5: Points of analysis at the cervical, middle and apical third of cementum.

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Fig. 6b: Control Teeth - Mean P concentrations (%wt) on the buccal and lingual surface at the cervical, middle and apical third of the root from the outer to middle to inner third of cementum.

Fig. 6c: Control Teeth - Mean F concentrations (%wt) on the buccal and lingual surface at the cervical, middle and apical third of the root from the outer to middle to inner third of cementum.

Fig. 7a: Estimated marginal means for Ca concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Fig. 7b: Estimated marginal means for Ca concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.

Fig. 8a: Estimated marginal means for P concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Fig. 8b: Estimated marginal means for P concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.

Fig. 9a: Estimated marginal means for F concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Fig. 9b: Estimated marginal means for F concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.



a



b



c

Fig. 1: Intra-oral view of the experimental side (a), control side (b) and occlusal view (c) of the light force group with a 0.016" TMA[®] spring. Note the posterior openbite due to disocclusion with GIC stops on the occlusal surfaces of the lower 1st molars.

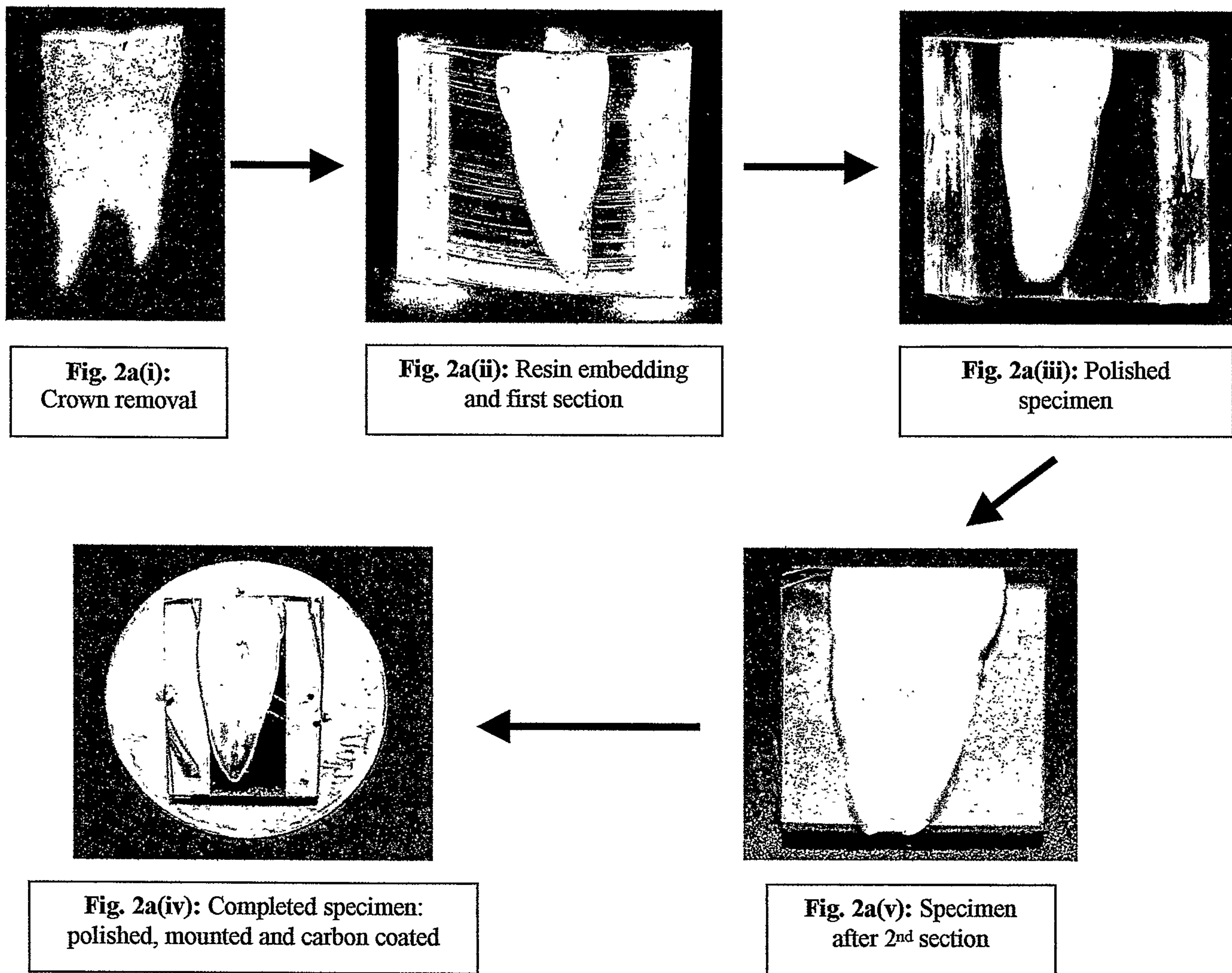


Fig. 2a: Specimen preparation for EPMA.

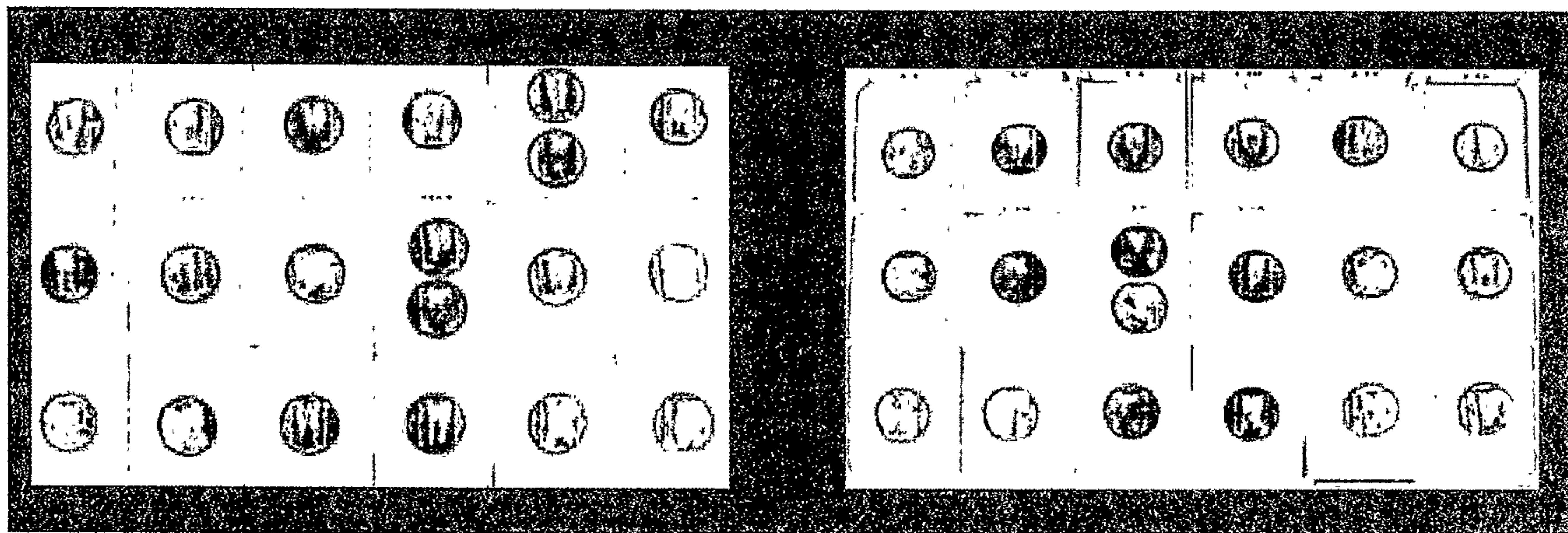


Fig. 2b: Completed specimens: heavy (L) and light (R) force samples.

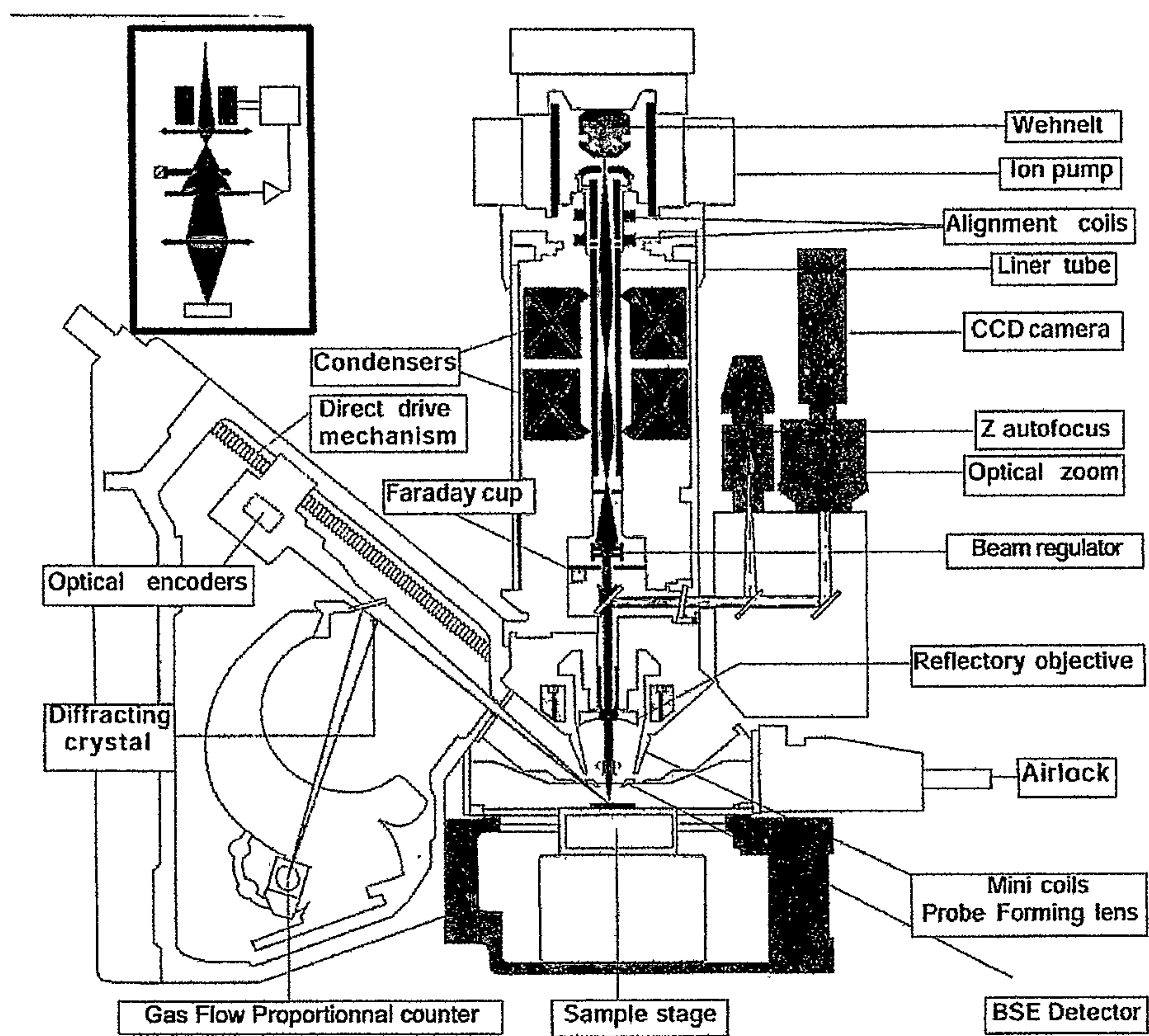


Figure 3: The Cameca Microprobe (http://www.cameca.fr/html/epma_technique.html).

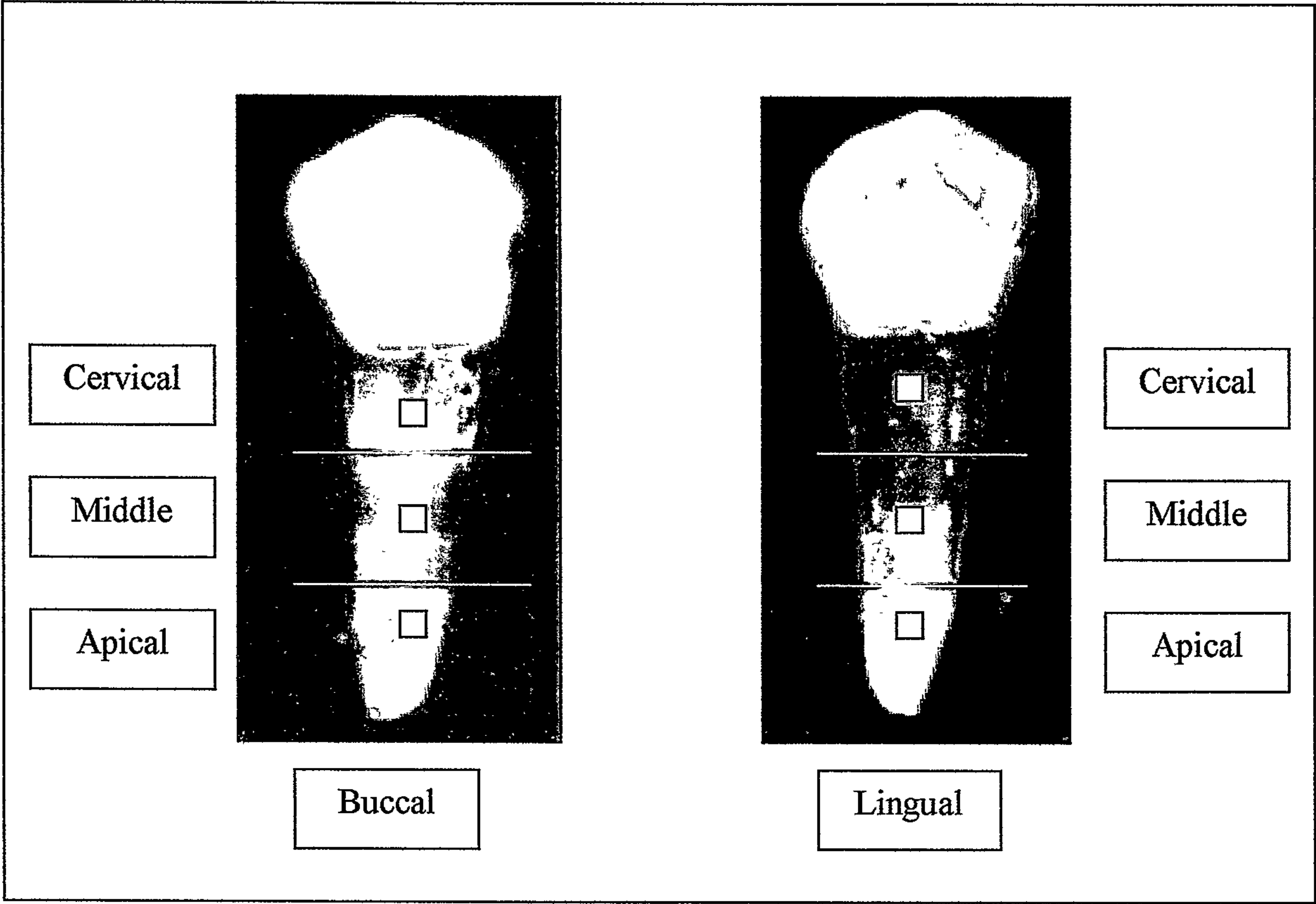


Fig. 4: Points of analysis on the buccal and lingual surface.

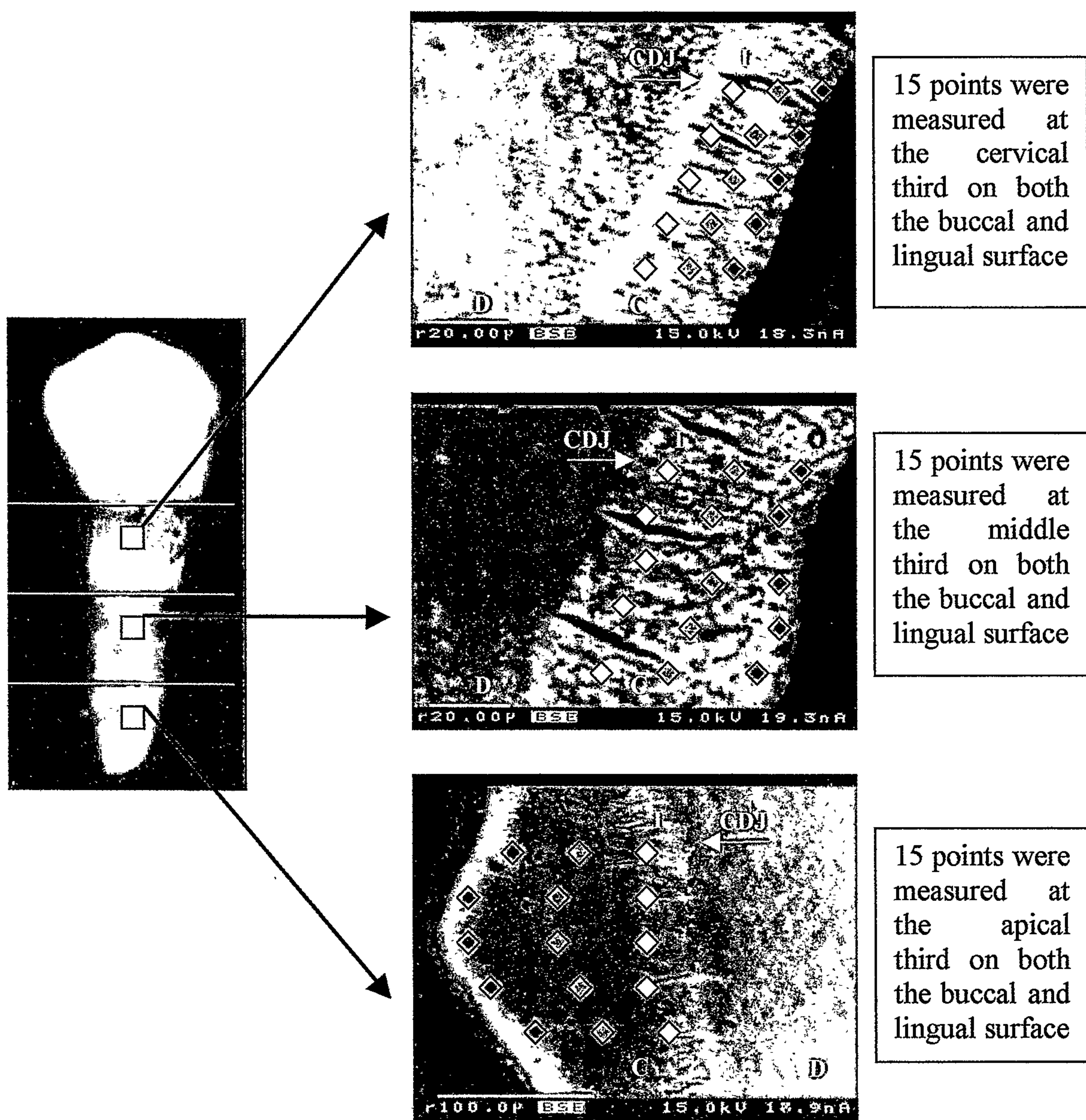


Fig. 5: Points of analysis at the cervical, middle and apical third of cementum.

D – dentin

C – cementum

CDJ – cemento-dentinal junction (hypermineralized zone)

O – points of analysis at the outer third of cementum

M – points of analysis at the middle third of cementum

I - points of analysis at the inner third of cementum

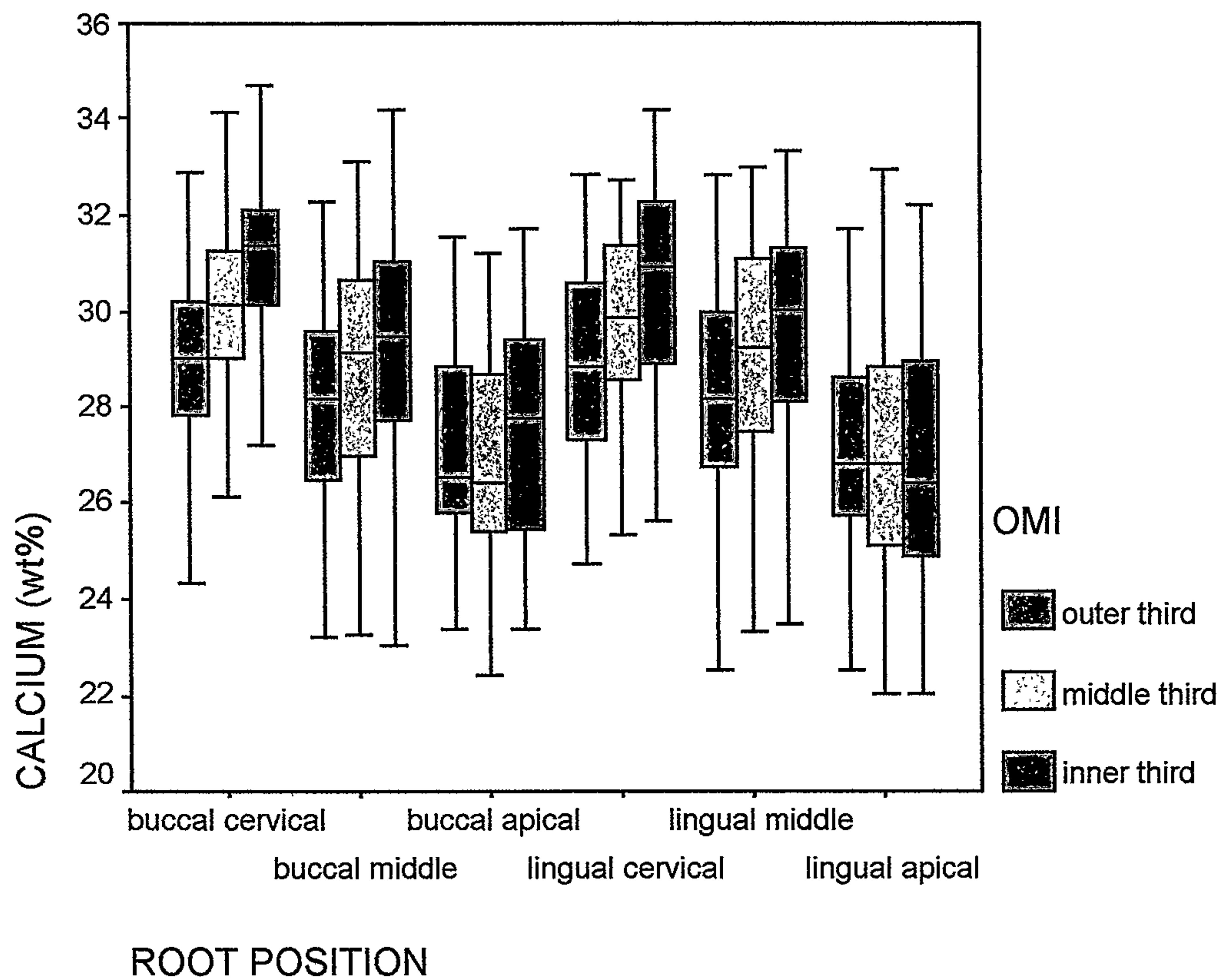


Fig. 6a: Control Teeth - Mean Ca concentrations (%wt) on the buccal and lingual surface at the cervical, middle and apical third of the root from the outer to middle to inner third of cementum.

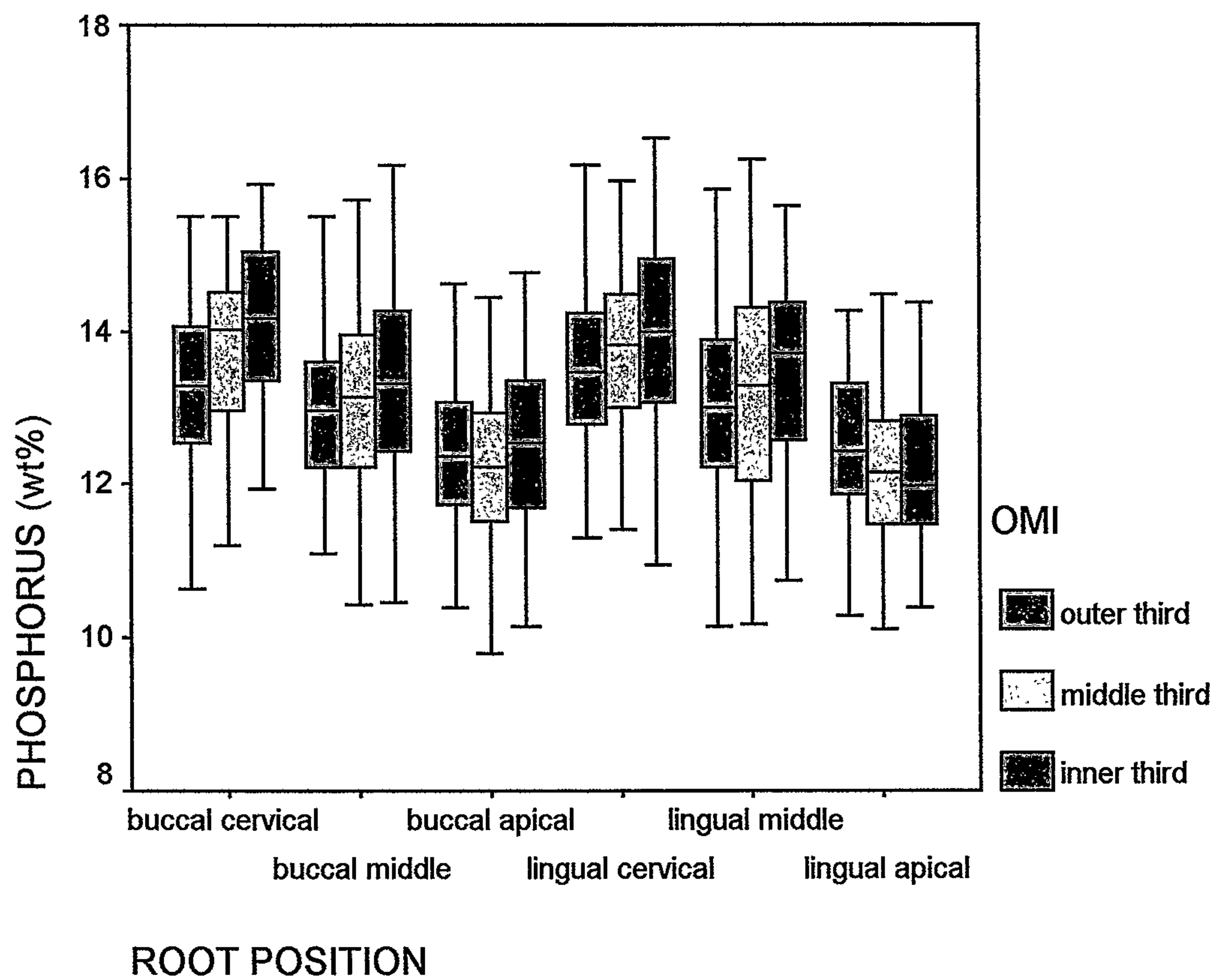


Fig. 6b: Control Teeth - Mean P concentrations (%wt) on the buccal and lingual surface at the cervical, middle and apical third of the root from the outer to middle to inner third of cementum.

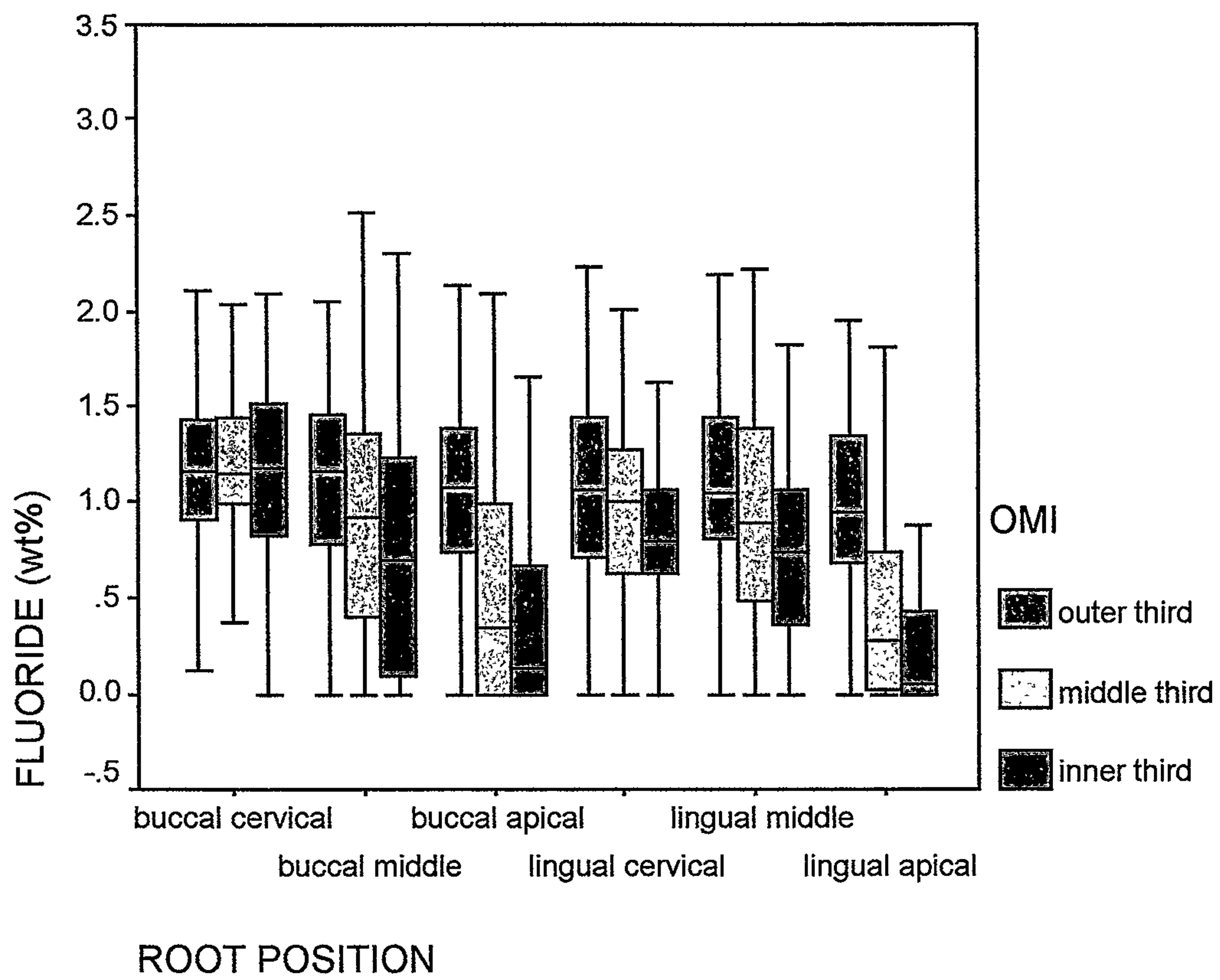


Fig. 6c: Control Teeth - Mean F concentrations (%wt) on the buccal and lingual surface at the cervical, middle and apical third of the root from the outer to middle to inner third of cementum.

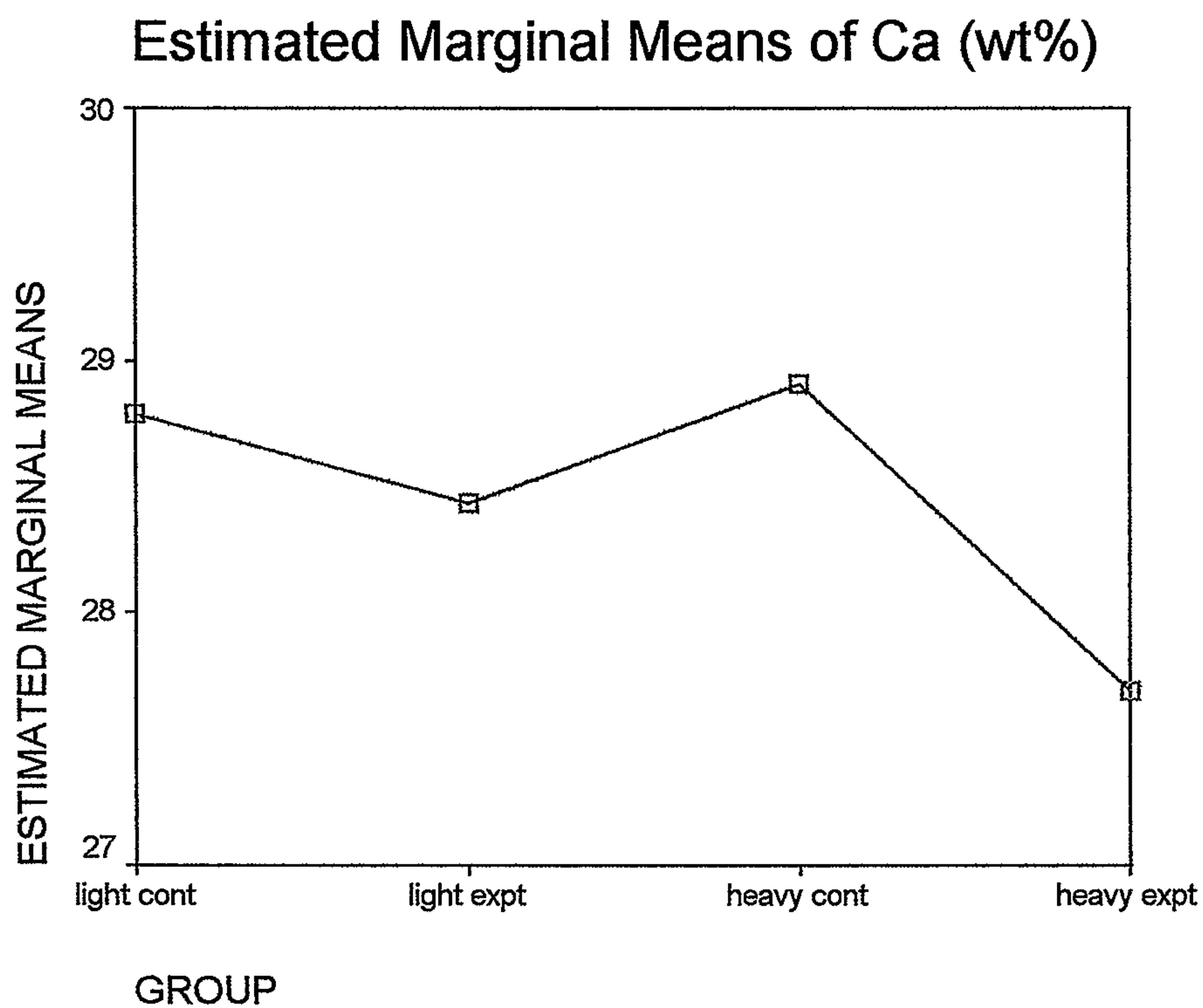


Fig. 7a: Estimated marginal means for Ca concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

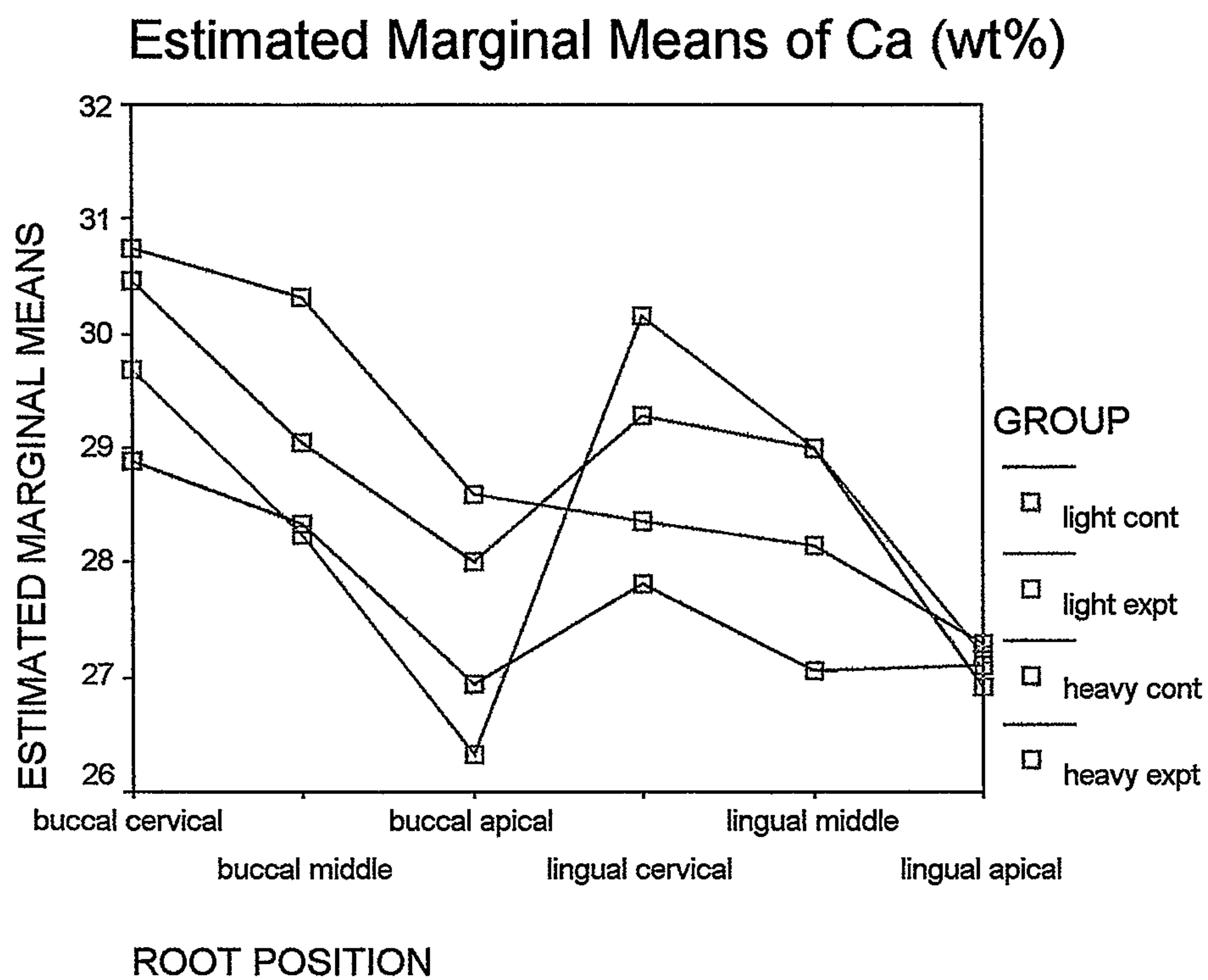


Fig. 7b: Estimated marginal means for Ca concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

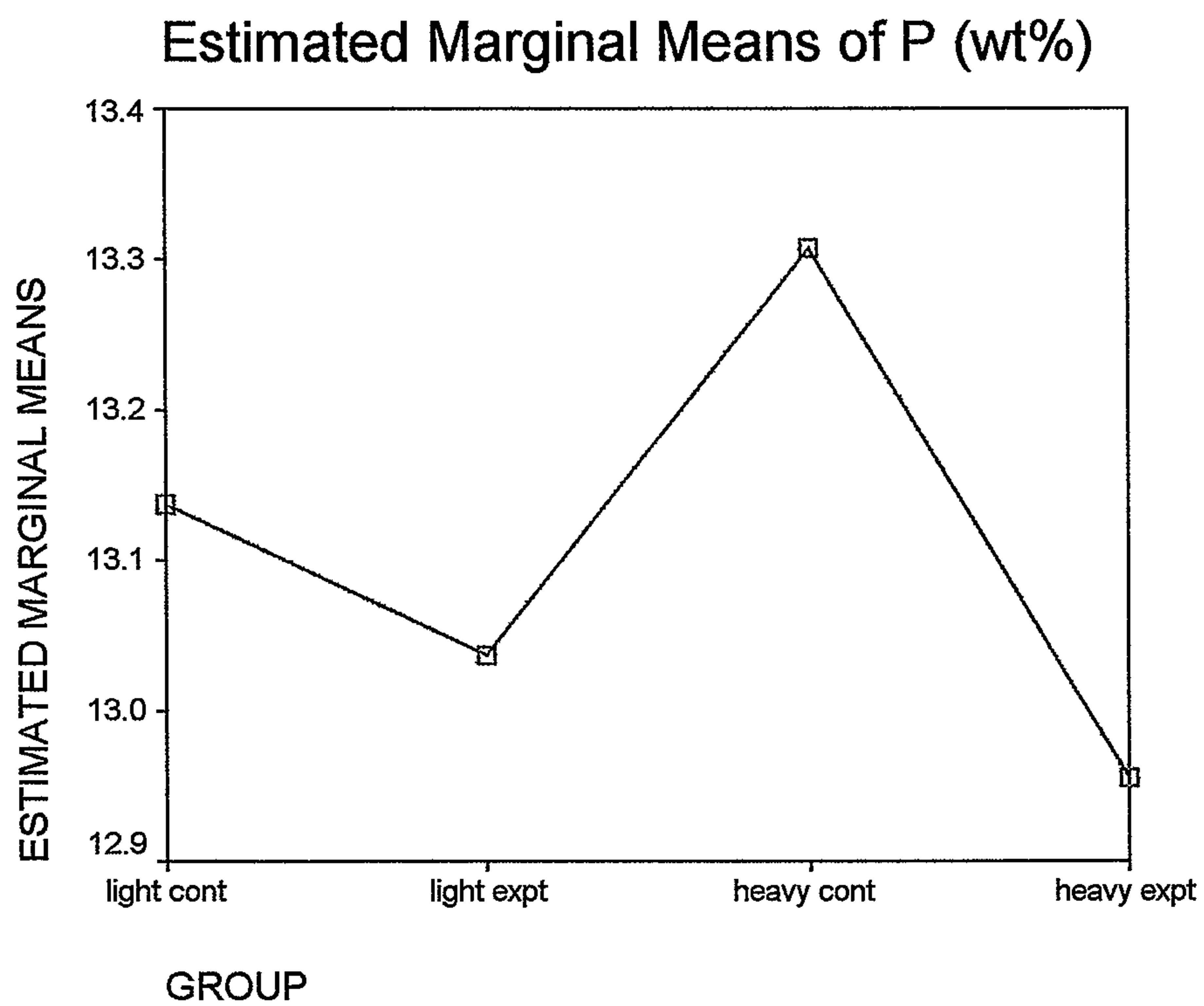


Fig. 8a: Estimated marginal means for P concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

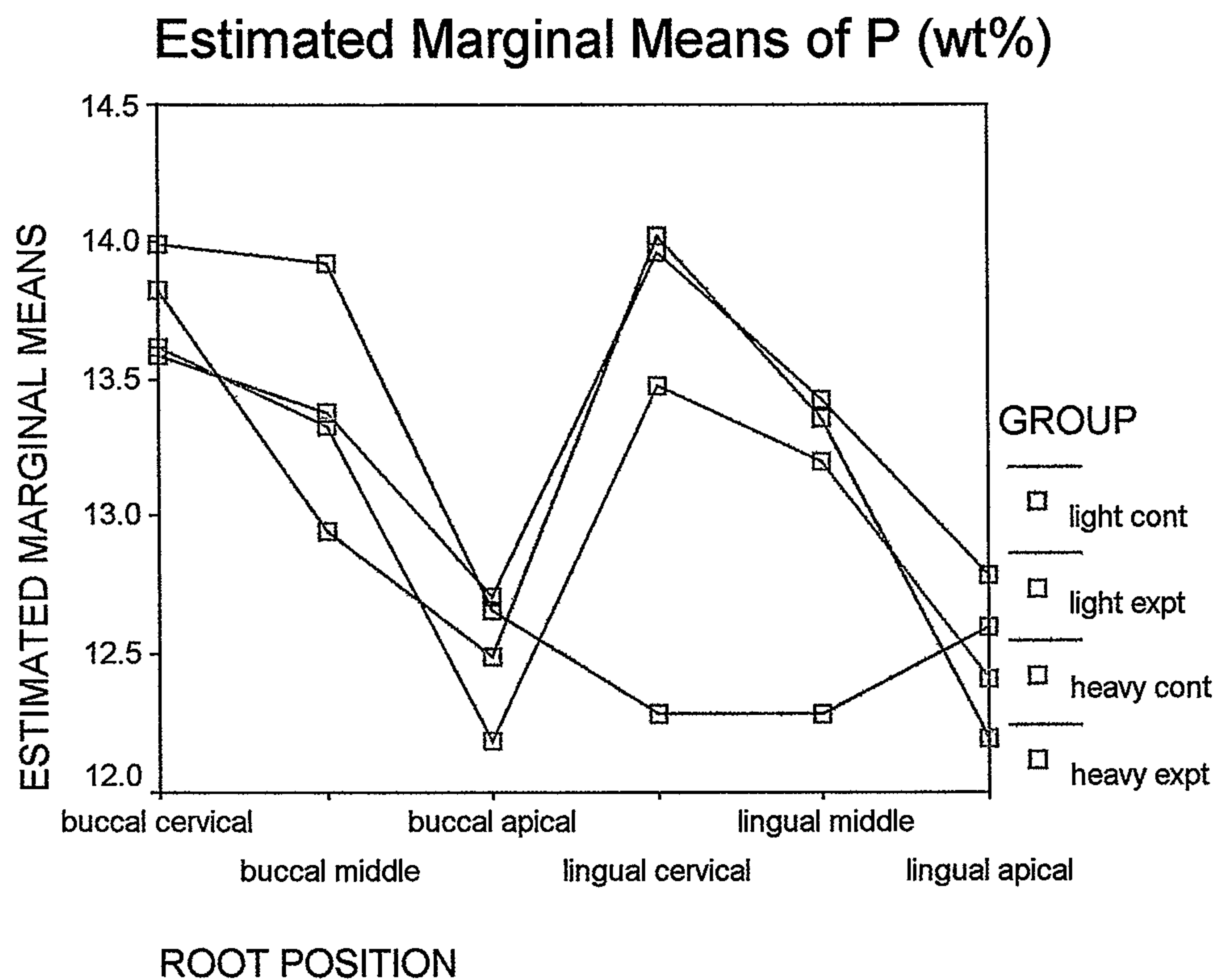


Fig. 8b: Estimated marginal means for P concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

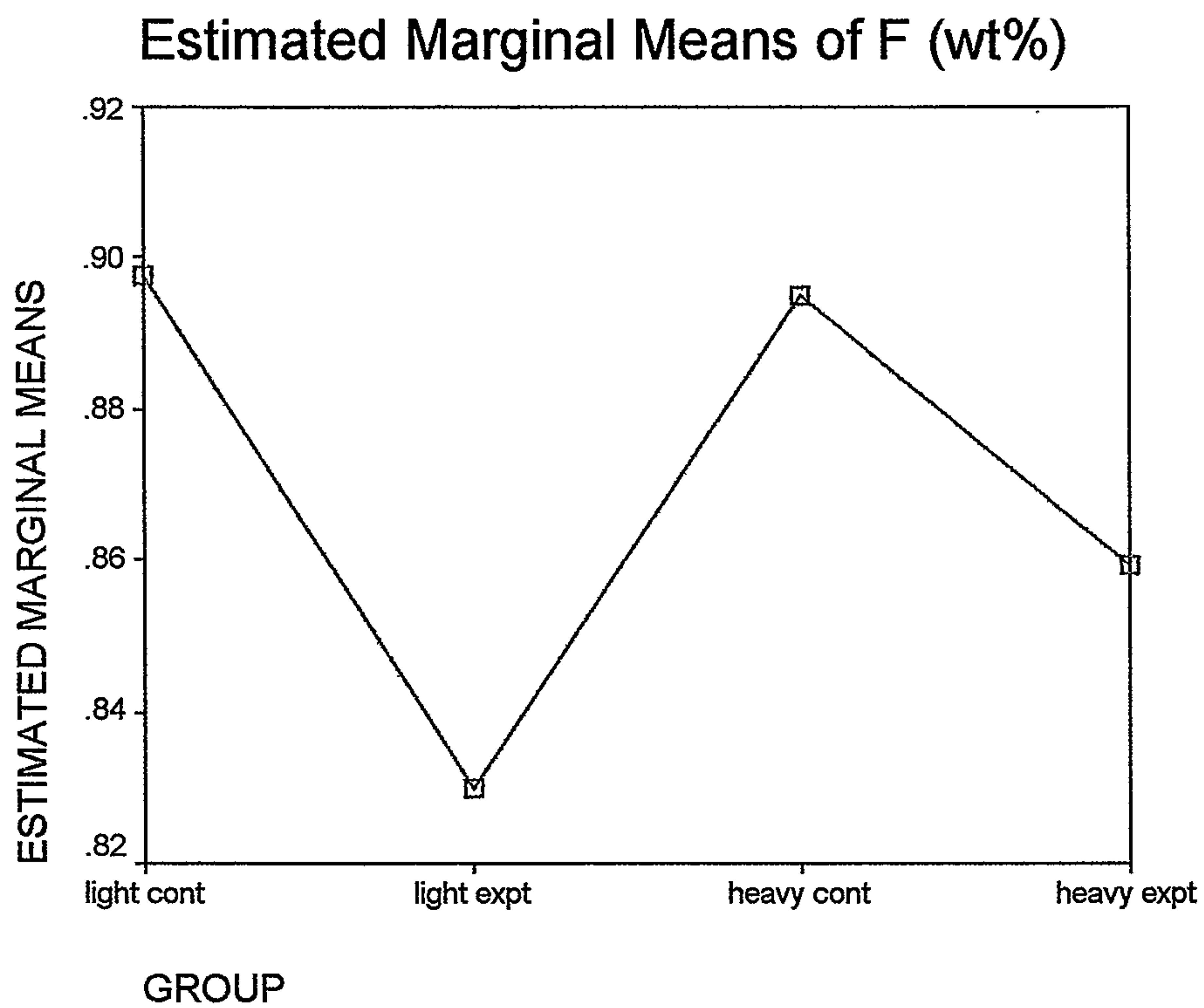


Fig. 9a: Estimated marginal means for F concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

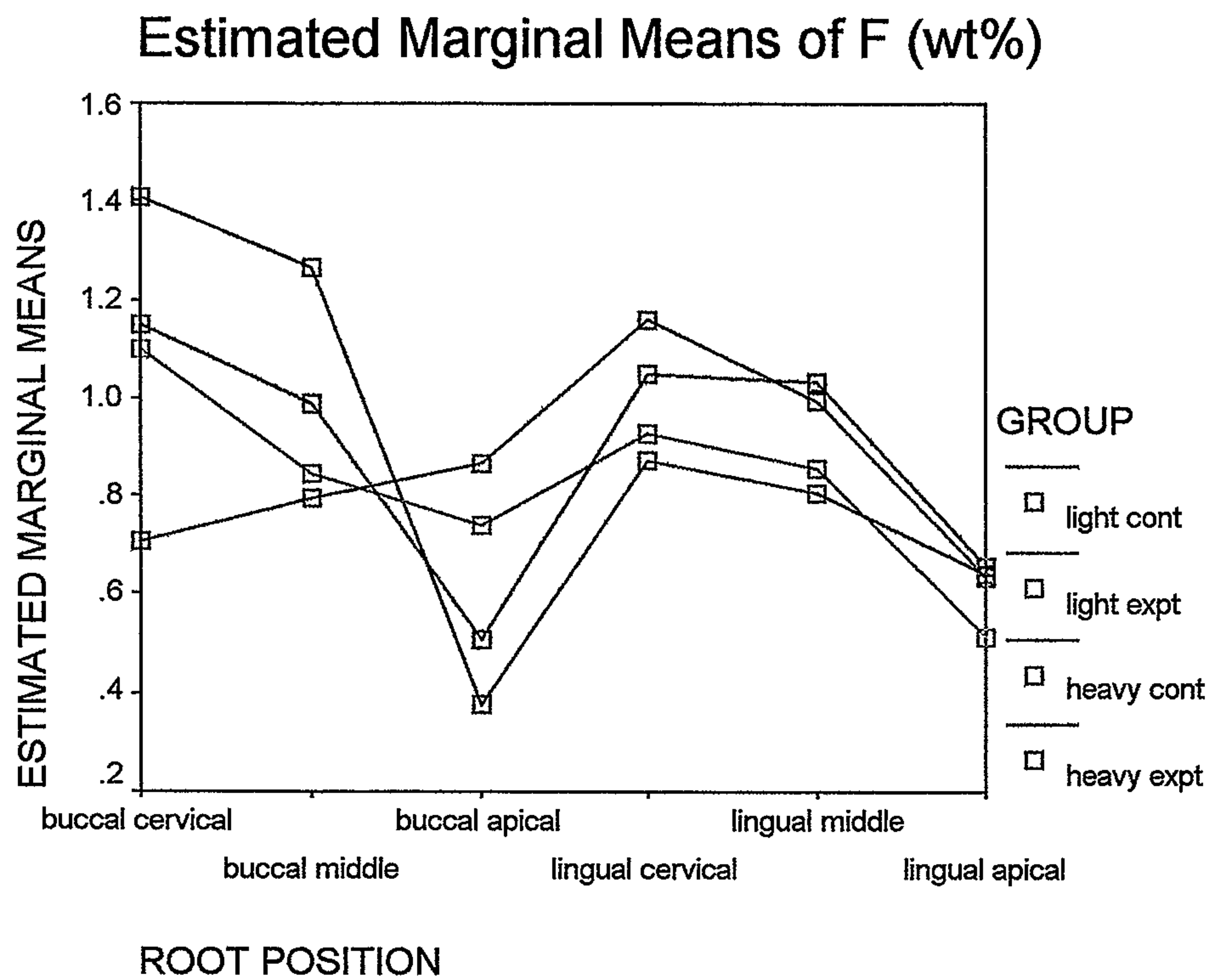


Fig. 9b: Estimated marginal means for F concentrations (%wt) in the light control, light experimental, heavy control and heavy experimental groups on the buccal and lingual surface at the cervical, middle and apical third of the root.

Light cont – light force control group

Light expt – light force group

Heavy cont – heavy force control group

Heavy expt – heavy force group

5. Future Directions

Further research is required into understanding the relationship between orthodontic force application and alterations in the mineral composition of cementum. The limitation of the present study was that the sample teeth collected were from individuals of a different fluoride background and as a result no definitive conclusions could be drawn with respect to fluoride changes in cementum after the application of orthodontic forces. More definitive conclusions could be obtained by using a sample of teeth collected from individuals with a similar fluoride history. Future avenues of research could entail investigation into the mode of action of odontoblastic dissolution of hydroxyapatite as well as the effect of pH changes on cementum and odontoblasts. An animal model investigating blood Ca and P levels before, during and after orthodontic treatment as well as the effects of Ca and P supplementation on the amount of root resorption could also be a possible area of future research. More recent studies have examined the changes in the hardness and elasticity of cementum (Srivicharnkul et al., 2002) as well as the volume of root resorption (Chan et al., 2002) in the same sample of teeth. Future research will entail a correlation study between the physical properties of cementum (hardness and elasticity), the mineral content of cementum and the volume of root resorption.

6. Appendices

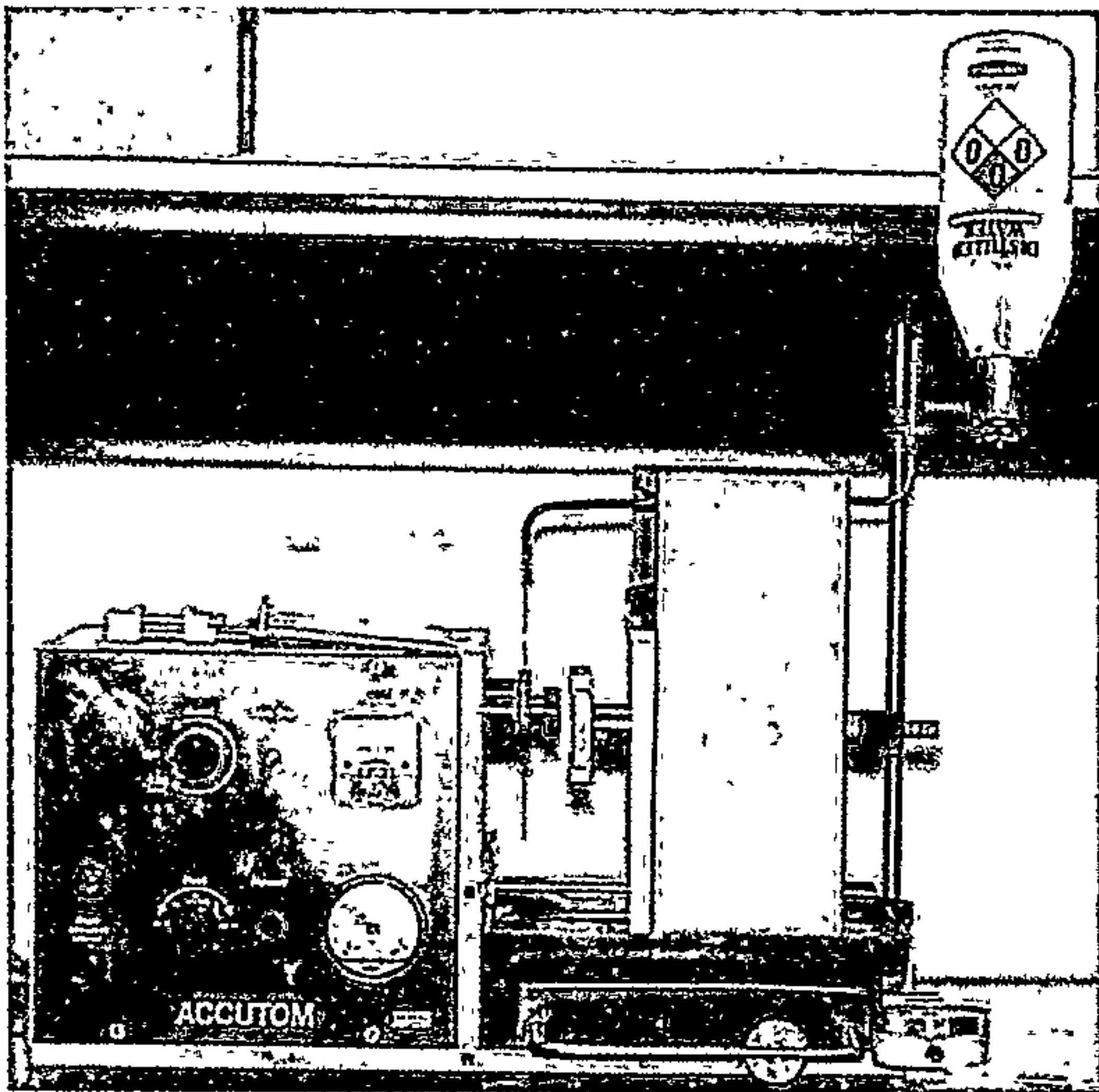


Figure 6.1: Accutom with diamond blade (Struers, Denmark) used for sectioning specimens.



Figure 6.2: DP-U2 polishing machine (Struers, Denmark) used for polishing specimens.

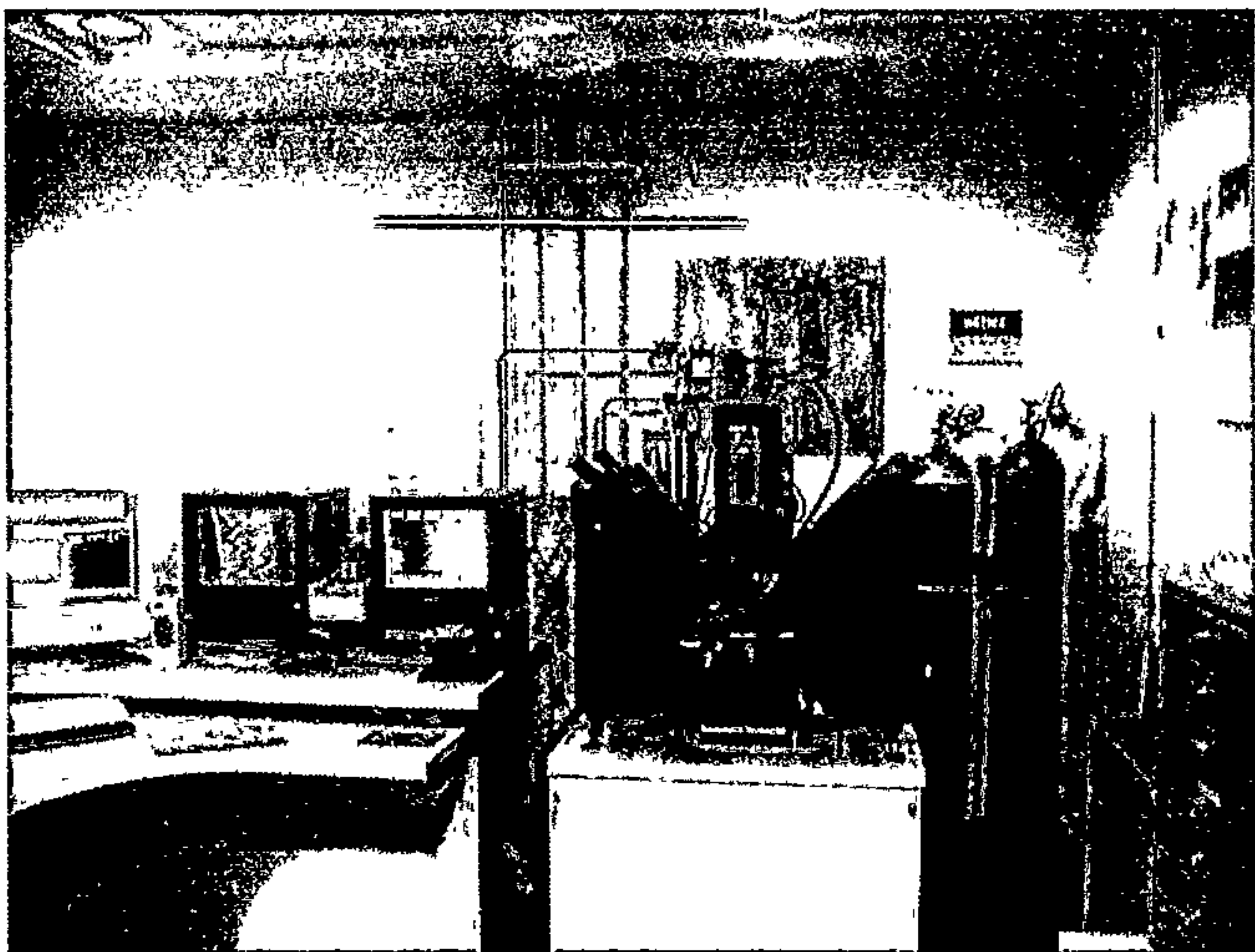
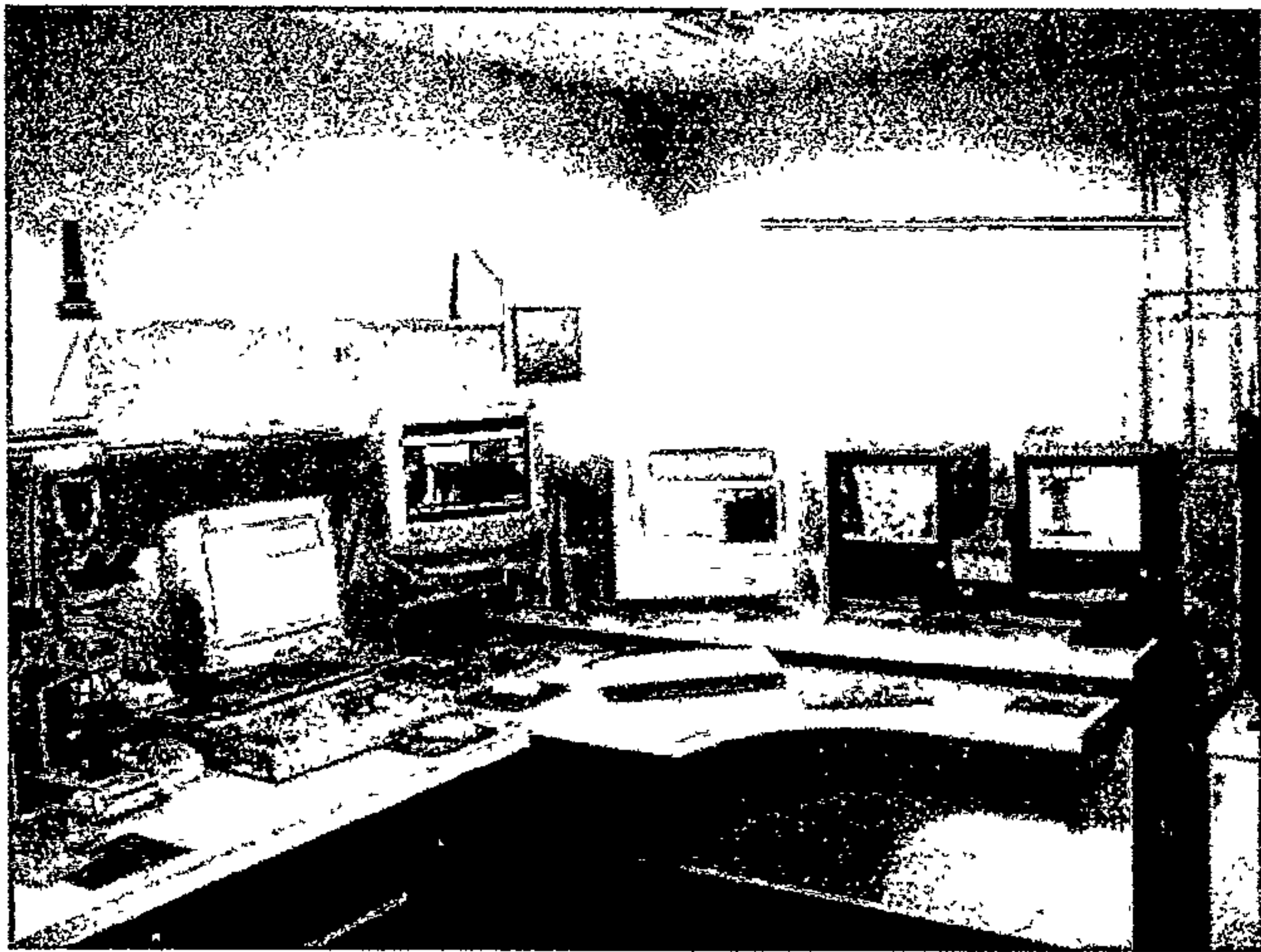


Figure 6.3: Cameca SX50 Microprobe (UNSW).

Element	Ca	P	F	O	Na	Mg	Si	S	Cl	Mn	Sum 99.86
Wt% av	38.55	17.63	3.65	38.64	0.04	0.00	0.15	0.11	0.35	0.03	
Wt% sd	0.23	0.17	0.21	0.19	0.02	0.00	0.05	0.06	0.02	0.01	
Element	Fe	As	Sr	Y	Ba	La	Ce	Pr	Nd	Sm	
Wt% av	0.01	0.01	0.28	0.03	0.00	0.08	0.18	0.00	0.10	0.02	
Wt% sd	0.01	0.00	0.01	0.01	0.00	0.01	0.04	0.01	0.03	0.02	

Table VI-a: Composition of Durango Apatite, Ca₅(PO₄)₃OH (Astimex Scientific Ltd.).

Element	F	Ca	Sum
Wt%	48.67	51.33	100.0

Table VI-b: Composition of Fluorite, CaF₂ (Astimex Scientific Ltd.).

6.1 Sample Information

6.1.1 Light Force (25g) Vs Control (0g)

Sample	Name	Sex	Age	DOB	Duration (weeks)	Exp (E-25g)/ Control (C-0g) Tooth	Tooth Number
L7	Adib, S	M	13.5	22/12/86	4.1	E	14
L8	Adib, S	M	13.5	22/12/86	4.1	C	24
L9	Valdivia, G	F	15.8	31/08/84	4.0	E	14
L10	Valdivia, G	F	15.8	31/08/84	4.0	C	24
L11	Ye, ZH	F	13.6	10/10/86	4.1	E	44
L12	Ye, ZH	F	13.6	10/10/86	4.1	C	34
L13	Astudillo, T	F	13.8	17/10/86	4.0	E	14
L14	Astudillo, T	F	13.8	17/10/86	4.0	C	24
L15	Canagasunda, R	M	16.1	25/08/84	4.0	C	34
L16	Canagasunda, R	M	16.1	25/08/84	4.0	E	44
L17	Canagasunda, R	M	16.1	25/08/84	4.0	E	14
L18	Canagasunda, R	M	16.1	25/08/84	4.0	C	24
L19	Heng, SB	M	15.8	22/07/85	4.0	C	34
L20	Heng, SB	M	15.8	22/07/85	4.0	E	44
L21	Yay, I	F	15.3	31/01/86	4.0	C	14
L22	Yay, I	F	15.3	31/01/86	4.0	E	24
L23	Agius, J	M	14.8	29/08/86	4.0	E	14
L24	Agius, J	M	14.8	29/08/86	4.0	C	24

6.1.2 Heavy Force (225g) Vs Control (0g)

Sample	Name	Sex	Age	DOB	Duration (weeks)	Exp (E-25g)/ Control (C-0g) Tooth	Tooth Number
H5	Shen, D	M	15.6	05/10/84	4.0	E	14
H6	Shen, D	M	15.6	05/10/84	4.0	C	24
H7	Berrio, V	F	12.6	19/11/87	4.0	E	14
H8	Berrio, V	F	12.6	19/11/87	4.0	C	24
H9	Johnson, N	M	15.7	17/09/84	4.0	E	14
H10	Johnson, N	M	15.7	17/09/84	4.0	C	24
H11	Hamka, A	M	13	22/08/87	4.0	E	14
H12	Hamka, A	M	13	22/08/87	4.0	C	24
H13	Guo, J	M	13.2	23/06/87	4.0	C	34
H14	Guo, J	M	13.2	23/06/87	4.0	E	44
H15	Chien, C	M	11.7	22/02/89	4.0	E	14
H16	Chien, C	M	11.7	22/02/89	4.0	C	24
H17	Adams, K	F	15.1	11/10/85	4.1	E	14
H18	Adams, K	F	15.1	11/10/85	4.1	C	24
H19	Assal, M	M	13.5	19/10/87	4.0	C	14
H20	Assal, M	M	13.5	19/10/87	4.0	E	24
H21	Heng, SB	M	15.8	22/07/85	4.0	E	14
H22	Heng, SB	M	15.8	22/07/85	4.0	C	24

6.2 Patient Fluoride History

6.2.1 Light Force (25g) Vs Control (0g)

Sample	Name	Sex	Age	DOB	Ethnicity	Birthplace	Place of Residence Since Birth		F in H ₂ O (ppm)
							Age (yrs)	Suburb/Postcode	
L7 L8	Adib, S	M	13.5	22/12/86	Lebanese	Sydney, Australia	0–13.5	Daceyville, NSW 2032	1.0
L9 L10	Valdivia, G	F	15.8	31/08/84	Chilean	Chile	0–2	Chile	
							2-15.8	Harris Park, NSW 2150	1.0
L11 L12	Ye, Z	F	13.6	10/10/86	Chinese	China	0–10	Canton, China	Unknown
							10-13.6	Campsie, NSW 2194	1.0
L13 L14	Astudillo, T	F	13.8	17/10/86	Chilean	Sydney, Australia	0–13	Liverpool, NSW 2170	1.0
							13-13.8	Mt. Pritchard, NSW 2170	1.0
L15 L16 L17 L18	Canagasunda, R	M	16.1	25/08/84	Sri Lankan	Sri Lanka	0–14	Sri Lanka	Unknown
							14–16	Auburn, NSW 2144	1.0
							16-16.1	Pendle Hill, NSW 2145	1.0
L19 L20	Heng, SB	M	15.8	22/07/85	Chinese	Singapore	0-5	Singapore	0.6
							6-15.8	Beverly Hills, NSW 2209	1.0
L21 L22	Yay, I	F	15.3	31/01/86	Turkish	Sydney, Australia	0–15.3	Smithfield, NSW 2164	1.0
L23 L24	Agius, J	M	14.8	29/08/86	Chinese	Sydney, Australia	0-14.8	Pendle Hill, NSW 2145	1.0

6.2.2 Heavy Force (225g) Vs Control (0g)

Sample	Name	Sex	Age	DOB	Ethnicity	Birthplace	Place of Residence Since Birth		F in H ₂ O (ppm)
							Age (yrs)	Suburb/Postcode	
H5 H6	Shen, D	M	15.6	05/10/84	Chinese	Shiang Hai, China	0 - 12	Shiang Hai, China	Unknown
							12 - 13	Campsie, NSW 2194	1.0
							13 - 14	Rockdale, NSW 2216	1.0
							14 - 15	Earlwood, NSW 2206	1.0
H7 H8	Berio, V	F	12.6	19/11/87	Spanish	Sydney, Australia	0 - 12.6	Wolloomooloo, NSW 2011	1.0
H9 H10	Johnson, N	M	15.7	17/09/84	Australian	Sydney, Australia	0 - 15.7	Wollongong, NSW 2500	1.0
H11 H12	Hamka, A	M	13.0	22/08/87	Lebanese	Sydney, Australia	0 - 7	Brighton Le Sands, NSW 2216	1.0
							8 - 13	Kogarah, NSW 2217	1.0
H13 H14	Guo, J	M	13.2	23/06/87	Chinese	China	0 - 6	Shutung Lew, China	Unknown
							7 - 13.2	Belmore, NSW 2192	1.0
H15 H16	Chien, C	M	11.7	22/02/89	Chinese	Sydney, Australia	0 - 11.7	Haberfield, NSW 2045	1.0
H17 H18	Adams, K	F	15.1	11/10/85	Australian	Sydney, Australia	0 – 15.1	Surry Hills, NSW 2010.	1.0
H19 H20	Assal, M	M	13.5	19/10/87	Egyptian	Sydney, Australia	0 – 13.5	Punchbowl, NSW, 2196	1.0
H21 H22	Heng, SB	M	15.8	22/07/85	Chinese	Singapore	0 – 5	Singapore	0.6
							6 – 15.8	Beverly Hills, NSW 2209	1.0

6.3 Result Tables

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I7be1_1	1	-8403	32698	0	15.898	36.4037	20.5013	1142.401	4864.982	21.2013	29.9045	33.3034
I7be1_2	2	-8545	32698	0	15.7868	36.3148	22.9016	1137.166	4856.850	20.2012	32.0049	35.1038
I7be1_3	3	-8688	32698	0	15.2943	35.4303	18.9011	1101.729	4738.825	21.8014	31.0049	37.8044
I7be2_1	4	-8439	32646	0	15.7923	36.329	21.5014	1136.864	4859.629	21.6014	31.3047	35.9039
I7be2_2	5	-8569	32646	0	15.8951	36.0771	22.1015	1139.884	4826.898	22.4015	26.5034	36.004
I7be2_3	6	-8699	32646	0	15.7977	36.0605	19.8012	1136.964	4818.048	23.2016	31.6048	34.2036
I7be3_1	7	-8428	32559	0	15.6622	36.549	20.7013	1128.608	4883.513	20.2012	32.8054	31.403
I7be3_2	8	-8552	32559	0	15.792	36.5677	22.0015	1134.246	4887.219	19.2011	29.8045	35.0038
I7be3_3	9	-8677	32559	0	15.7434	35.8909	19.5011	1128.105	4792.013	20.0012	26.6034	31.8031
I7bc1_1	1	-9236	28656	0.1627	13.3439	27.3722	23.8017	953.5198	3600.781	8.8002	26.7035	25.602
I7bc1_2	2	-9238	28656	0.4498	14.1638	29.7708	48.207	1013.371	3941.051	20.0012	28.704	32.3032
I7bc1_3	3	-9240	28655	0.4815	14.5111	30.6947	47.6068	1036.110	4063.028	18.001	28.0038	31.703
I7bc2_1	4	-9236	28649	0.1523	13.8192	27.9397	22.6015	986.9134	3677.938	8.0002	27.1034	28.0024
I7bc2_2	5	-9238	28650	0.3695	13.8758	29.6144	43.9058	991.1383	3909.726	19.6012	28.4041	30.9029
I7bc2_3	6	-9241	28650	0.3059	14.8314	31.0387	37.7043	1057.947	4100.017	16.2008	27.7038	28.1025
I7bc3_1	7	-9237	28642	0.8203	14.4744	29.1146	66.2132	1029.268	3840.033	20.4012	27.7036	30.5028
I7bc3_2	8	-9241	28642	0.5426	14.5414	30.253	47.7068	1037.418	3990.814	15.2007	30.0045	29.3027
I7bc3_3	9	-9245	28641	0.5742	14.3824	30.1596	64.5125	1026.350	3981.905	30.6028	30.2041	32.6032
I7bc4_1	10	-9240	28634	0.4262	14.0775	28.8402	45.0061	1002.908	3795.327	17.801	27.8036	27.3024
I7bc4_2	11	-9243	28634	0.5601	14.2197	29.2152	53.6086	1011.057	3847.196	20.2012	26.9035	28.6025
I7bc4_3	12	-9247	28634	0.8711	13.4761	28.2503	78.3184	956.6376	3715.355	30.6028	26.7037	27.1023
I7bc5_1	13	-9243	28621	0.1803	13.6824	28.4083	30.9029	976.2509	3737.031	15.2007	28.0036	30.4029
I7bc5_2	14	-9247	28621	0.4186	14.0346	29.3663	40.905	1000.292	3871.141	14.2006	27.6037	29.6027
I7bc5_3	15	-9251	28621	0.5947	14.3577	30.023	55.1091	1023.231	3961.323	20.2012	28.4039	28.4025
I7bm1_1	1	-10184	24771	0.6928	13.866	28.011	55.8093	985.5051	3697.770	16.0008	24.003	29.0026
I7bm1_2	2	-10188	24771	0.6772	13.9318	28.4201	56.0094	990.1324	3755.336	17.0009	23.4026	29.2026
I7bm1_3	3	-10192	24771	0.4816	13.954	29.0113	51.3079	996.47	3832.462	21.6014	27.4037	28.0024
I7bm2_1	4	-10183	24767	0.7437	13.7706	27.9058	62.6118	981.2803	3687.649	20.4012	25.7031	28.8026
I7bm2_2	5	-10187	24769	0.7611	13.8041	28.0251	67.8138	982.4873	3702.779	24.8018	24.6029	27.5024
I7bm2_3	6	-10192	24771	0.4545	13.0163	28.656	48.207	926.5684	3786.939	20.2012	22.8024	28.4025
I7bm3_1	7	-10184	24757	0.6307	13.4618	27.9885	64.7126	960.1578	3701.859	28.0024	24.903	29.0027
I7bm3_2	8	-10188	24757	0.6832	13.0169	28.1081	64.2124	926.7695	3717.399	25.4019	22.9024	27.0022
I7bm3_3	9	-10193	24757	0.5036	14.0789	28.8712	50.1075	1003.914	3820.492	19.2011	24.2029	27.4024
I7bm4_1	10	-10184	24750	0.859	13.1884	28.1058	70.4149	938.2335	3721.592	23.2016	22.5024	27.7023
I7bm4_2	11	-10189	24750	0.5713	12.0795	27.3729	52.8084	861.7219	3617.538	19.6012	22.9025	25.802
I7bm4_3	12	-10194	24750	0.6362	12.8209	27.098	54.0088	916.2114	3581.267	17.2009	26.103	28.9026
I7bm5_1	13	-10187	24737	0.5072	13.0714	27.503	49.8074	929.8868	3628.983	19.0011	22.6022	27.0022
I7bm5_2	14	-10192	24737	0.7212	13.1901	28.2157	60.4109	938.334	3728.033	19.8012	23.8027	28.3024
I7bm5_3	15	-10197	24737	0.5203	13.8647	29.0669	57.61	985.7062	3837.373	26.2021	24.0027	28.6025
I7ba1_1	1	-11296	20551	0.5379	12.3469	24.6989	59.5106	879.5145	3247.840	26.8022	23.0026	24.0017
I7ba1_2	2	-11301	20551	0.5878	14.2213	30.6528	58.4102	1014.176	4058.520	24.0017	26.3035	29.3026
I7ba1_3	3	-11307	20551	0.3576	14.0053	29.7745	51.2079	996.0676	3931.530	27.4023	23.2027	27.2022
I7ba2_1	4	-11310	20518	0.8007	12.0132	26.4764	63.5121	855.49	3490.981	19.4011	23.8029	26.002
I7ba2_2	5	-11314	20518	0.5109	13.0464	29.1879	52.9084	931.0936	3855.279	22.4015	26.1034	28.1024
I7ba2_3	6	-11318	20517	0.2672	13.6562	29.5248	41.5052	972.5292	3899.797	22.0015	23.9026	30.4028
I7ba3_1	7	-11321	20496	0.6876	12.4295	27.124	67.9138	882.3293	3573.299	29.0025	21.0021	22.4015
I7ba3_2	8	-11327	20494	0.6753	12.5282	27.3815	65.713	892.1816	3611.816	27.4023	24.3028	28.0024
I7ba3_3	9	-11334	20492	0.2295	12.7326	28.747	40.3049	906.5588	3794.201	22.8016	21.8023	26.8022
I7ba4_1	10	-11331	20473	0.5242	13.3388	28.2689	58.4102	951.7095	3738.565	26.8022	25.003	31.3031
I7ba4_2	11	-11335	20473	0.537	14.588	30.5997	61.3113	1040.236	4056.164	29.0025	25.4033	31.203
I7ba4_3	12	-11340	20473	0.3396	12.8418	28.0526	42.0053	917.0158	3706.255	19.2011	24.6029	30.3029
I7ba5_1	13	-11352	20432	0.8207	13.6091	28.7869	72.1156	973.3339	3810.671	26.6021	28.1037	27.5024
I7ba5_2	14	-11357	20432	0.5586	13.7074	29.9131	59.4106	981.9844	3965.316	26.4021	28.304	29.3027
I7ba5_3	15	-11363	20432	0.0618	13.0419	28.1054	34.3035	930.6913	3705.131	24.2018	22.8024	24.0018
I7le1_1	1	-18050	32950	0	16.7128	35.9429	22.0015	1195.472	4782.959	23.6017	30.5047	37.6043
I7le1_2	2	-17937	32950	0	16.1059	35.4704	20.1012	1152.470	4711.362	17.801	30.404	31.2029
I7le1_3	3	-17825	32950	0	16.241	34.8317	20.7013	1160.022	4626.021	18.001	27.9035	32.1032
I7le2_1	4	-18095	32912	0	16.1389	35.8043	20.7013	1155.894	4764.954	21.0013	30.9047	36.104
I7le2_2	5	-17980	32912	0	16.6318	35.6237	18.501	1186.105	4733.579	18.8011	26.3032	30.1027
I7le2_3	6	-17865	32912	0	15.8972	34.8577	19.2011	1136.662	4634.964	22.0015	27.7035	32.6033
I7le3_1	7	-18080	32851	0	16.7174	35.5938	21.5014	1193.054	4733.476	19.8012	27.2037	34.2037
I7le3_2	8	-17998	32851	0	16.308	35.536	21.4014	1169.388	4729.464	16.2008	31.9054	35.6039

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I7le3_3	9	-17917	32851	0	16.4064	35.1426	19.3011	1172.409	4673.930	21.8014	28.0037	34.7038
I7lc1_1	1	-18088	30154	1.7424	12.3715	27.685	127.3486	875.8956	3668.023	39.2046	21.5022	26.3022
I7lc1_2	2	-18083	30154	1.0088	13.0457	27.2986	85.0217	925.4623	3603.437	30.6028	22.1023	25.8021
I7lc1_3	3	-18078	30153	0.5009	12.9119	28.0544	43.9058	921.4401	3701.961	13.6006	25.1029	25.602
I7lc2_1	4	-18091	30140	1.7738	10.4402	26.1639	138.3574	739.6376	3471.174	50.4076	19.5018	28.1024
I7lc2_2	5	-18085	30140	0.782	13.5067	28.8161	67.0135	963.2757	3813.637	23.4016	25.103	26.8022
I7lc2_3	6	-18079	30140	0.5151	12.8884	27.1722	47.6068	915.1053	3582.289	16.4008	20.6021	25.8021
I7lc3_1	7	-18093	30130	1.7668	12.3337	27.5848	135.1548	874.2871	3658.620	45.8063	22.2024	28.4025
I7lc3_2	8	-18086	30130	0.6916	11.9948	26.5826	57.81	852.2736	3509.464	18.8011	20.2019	26.2021
I7lc3_3	9	-18079	30130	0.2357	13.127	28.6552	38.8045	934.412	3785.303	20.8013	22.0023	30.703
I7lc4_1	10	-18094	30119	1.6468	11.7745	27.3674	134.7545	833.9814	3629.596	51.608	20.2019	27.3024
I7lc4_2	11	-18087	30118	0.5275	13.0012	28.3722	50.3076	924.7584	3745.519	18.8011	22.2026	25.6021
I7lc4_3	12	-18080	30117	0.2665	13.3643	28.7756	37.3042	953.4193	3799.111	17.801	24.903	29.8027
I7lc5_1	13	-18095	30110	1.2516	13.1745	28.3495	97.2284	935.3171	3746.337	31.803	24.903	28.5025
I7lc5_2	14	-18088	30109	0.5086	13.1206	29.2269	48.8071	930.2891	3857.326	18.401	21.0022	28.8026
I7lc5_3	15	-18081	30108	0.2841	13.2501	28.8913	34.2035	943.5634	3807.909	14.0006	24.503	28.2025
I7lm1_1	1	-18214	24625	1.144	13.6788	29.0703	88.0232	971.121	3846.172	27.4023	23.5028	26.3021
I7lm1_2	2	-18208	24625	0.6322	12.9253	27.9546	59.2105	917.5186	3690.818	22.8016	21.6022	30.1028
I7lm1_3	3	-18202	24625	0.4045	12.8704	28.8012	44.2059	914.2004	3803.408	18.601	20.8022	28.3026
I7lm2_1	4	-18214	24610	1.1524	13.3792	28.8014	97.6286	947.1838	3811.796	36.8041	21.1023	30.0027
I7lm2_2	5	-18208	24610	0.893	14.6808	30.7964	68.9142	1042.953	4080.343	20.0012	24.3029	30.403
I7lm2_3	6	-18202	24610	0.5094	12.9399	29.0722	42.2053	916.312	3837.987	11.8004	18.8018	26.5021
I7lm3_1	7	-18214	24603	0.9387	13.8297	28.7969	80.2193	987.5169	3813.535	29.0025	28.2038	31.7031
I7lm3_2	8	-18207	24603	0.9881	14.852	31.4608	79.519	1056.739	4171.868	26.2021	26.3033	29.8027
I7lm3_3	9	-18201	24603	0.5489	14.1199	30.2779	62.8118	1007.838	4001.567	30.2027	28.0039	28.1024
I7lm4_1	10	-18211	24587	0.8656	12.5619	27.1674	84.8216	891.7794	3577.181	37.6042	24.003	27.3023
I7lm4_2	11	-18203	24588	0.6955	13.7625	29.4997	67.2135	979.9726	3896.113	27.8023	26.3033	28.8025
I7lm4_3	12	-18195	24588	0.3178	13.601	29.8564	34.9037	965.8907	3942.996	13.2005	22.7024	33.5034
I7lm5_1	13	-18206	24559	0.8203	13.8133	28.9322	71.0151	975.0438	3814.660	25.602	19.3018	27.2023
I7lm5_2	14	-18198	24559	0.7917	14.8601	30.4333	76.9177	1058.450	4015.394	32.6032	29.004	24.7018
I7lm5_3	15	-18190	24559	0.3349	13.7557	29.7144	46.8066	978.8661	3916.584	24.2018	24.903	26.4022
I7la1_1	1	-17039	20956	0.7607	13.4588	29.7666	62.4117	956.3359	3938.594	20.2012	22.7026	27.7023
I7la1_2	2	-17027	20956	0.2866	14.187	30.7568	42.0053	1017.496	4069.790	21.6014	30.5046	28.0024
I7la1_3	3	-17015	20956	0.1848	13.7667	29.8174	34.1035	981.9844	3937.468	18.401	24.8029	27.3022
I7la2_1	4	-17033	20945	0.6801	14.3711	30.9142	61.9115	1023.030	4094.791	23.2016	25.4034	30.8029
I7la2_2	5	-17025	20945	0.2468	12.7511	30.0023	35.4038	906.3578	3958.661	17.4009	22.0022	27.4023
I7la2_3	6	-17017	20945	0.1521	12.7343	27.3889	25.602	907.866	3601.496	11.4004	25.1031	29.1026
I7la3_1	7	-17024	20926	0.6664	12.4813	27.262	49.4073	883.5357	3584.332	11.6004	21.1022	25.8021
I7la3_2	8	-17014	20926	0.0691	13.4764	29.4958	30.5028	957.8445	3882.296	20.2012	24.0026	31.003
I7la3_3	9	-17005	20926	0.1316	13.1011	29.3617	26.4021	931.3953	3862.238	13.4005	24.5029	30.0028
I7la4_1	10	-17016	20907	0.4642	13.4721	29.2733	45.9063	959.4537	3855.791	17.4009	26.8036	27.7024
I7la4_2	11	-17007	20907	0.276	13.7432	29.9734	37.2042	976.955	3948.934	17.4009	24.6028	28.1025
I7la4_3	12	-16998	20907	0.1413	13.5079	29.5709	27.8023	960.4595	3893.451	14.2006	23.7028	27.1023
I7la5_1	13	-17004	20880	0.667	14.131	30.8347	55.9094	1004.618	4074.298	18.001	25.3029	27.2023
I7la5_2	14	-16995	20880	0.1991	14.5885	31.2432	36.8041	1043.355	4126.048	20.4012	30.3047	29.3026
I7la5_3	15	-16987	20880	0.1807	13.7433	30.1682	35.8038	979.5703	3979.55	20.4012	25.9033	29.4026

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
18be1_1	1	18370	5232	0	15.9969	34.5914	29.0025	1139.079	4567.644	22.8016	30.0043	28.8025
18be1_2	2	18346	5242	0	16.1028	34.6621	19.9012	1146.228	4581.517	20.6013	29.7044	33.0033
18be1_3	3	18321	5251	0	15.7488	34.827	22.9016	1124.782	4605.052	20.2012	33.1054	33.6034
18be2_1	4	18361	5203	0	16.4809	35.1137	27.1022	1176.236	4645.348	26.6021	33.1054	34.8037
18be2_2	5	18339	5219	0	16.4479	34.7041	22.2015	1171.905	4584.292	23.0016	31.7049	32.5032
18be2_3	6	18316	5235	0	15.836	34.2255	20.6013	1126.494	4520.792	24.2018	29.304	34.5036
18be3_1	7	18352	5172	0	16.4376	35.2785	27.5023	1172.409	4665.499	25.4019	32.3051	32.2032
18be3_2	8	18332	5194	0	16.1069	34.5638	22.4015	1147.738	4565.486	22.8016	31.5051	32.8034
18be3_3	9	18311	5216	0	15.6216	34.0995	21.5014	1110.688	4499.630	21.4014	29.1043	32.8033
18bc1_1	1	18150	2099	0.9943	14.1132	27.463	78.3184	1000.494	3601.598	24.2018	29.3042	27.9024
18bc1_2	2	18148	2099	0.985	14.3183	29.103	76.8177	1012.365	3825.71	23.6017	26.0035	28.3024
18bc1_3	3	18145	2099	1.4931	15.3689	32.0536	110.8368	1086.630	4234.210	34.0035	27.5036	28.3024
18bc2_1	4	18149	2096	1.3884	14.4842	27.9558	109.0357	1027.155	3678.858	36.0039	29.4043	27.5024
18bc2_2	5	18147	2096	1.3276	15.4436	31.3618	107.0344	1093.978	4141.422	37.6042	28.704	30.0027
18bc2_3	6	18144	2096	1.4533	15.1091	32.3354	109.4359	1068.816	4282.009	34.8036	27.1037	35.3038
18bc3_1	7	18149	2092	1.2335	14.4602	28.3465	99.0294	1022.225	3734.168	33.6034	26.0032	33.2033
18bc3_2	8	18147	2092	1.2885	15.2855	30.7072	98.5291	1084.315	4051.963	30.8028	30.1043	30.2027
18bc3_3	9	18145	2092	1.3064	15.4015	31.6816	102.1313	1090.858	4187.349	33.8034	27.3035	28.1025
18bc4_1	10	18148	2089	1.337	14.4097	28.9705	107.1344	1019.307	3825.607	37.0041	24.8028	31.0029
18bc4_2	11	18147	2089	1.1404	15.3652	31.2274	92.0254	1088.140	4125.638	31.403	27.2035	32.4032
18bc4_3	12	18144	2089	1.5151	15.311	32.7832	106.3339	1085.121	4337.619	28.8025	29.4041	29.1027
18bc5_1	13	18149	2085	1.2336	14.4143	27.9108	92.6257	1021.621	3674.156	27.0022	28.2041	30.4028
18bc5_2	14	18147	2085	0.9802	15.5061	30.9589	82.4204	1098.608	4083.622	29.2026	27.8041	31.103
18bc5_3	15	18144	2085	1.4892	15.4044	32.3389	116.8409	1092.166	4278.931	40.2048	29.4043	29.7028
18bm1_1	1	16858	-2663	1.0952	12.3966	24.2538	77.7181	874.4882	3174.752	18.8011	22.7024	27.0023
18bm1_2	2	16796	-2663	0.2016	13.1379	27.8818	36.304	930.5908	3653.919	19.8012	22.9024	27.2022
18bm1_3	3	16734	-2663	0	10.9425	22.6087	21.4014	774.194	2942.650	20.6013	18.9017	23.6017
18bm2_1	4	16830	-2706	1.1733	12.2133	25.6606	81.0197	860.7168	3369.01	19.2011	20.3021	25.8021
18bm2_2	5	16771	-2706	0.1412	11.5435	23.6765	33.5034	819.1078	3081.322	19.6012	23.2026	21.3014
18bm2_3	6	16711	-2706	0	10.4522	22.4174	19.9012	743.2536	2912.833	13.6006	22.8025	21.9015
18bm3_1	7	16814	-2745	1.1362	12.0248	23.746	83.0207	852.3741	3110.660	22.2015	25.4032	25.3019
18bm3_2	8	16760	-2745	0.2655	11.1051	23.6196	43.0055	789.1639	3083.359	23.6017	23.4026	25.8021
18bm3_3	9	16705	-2745	0	11.4533	24.0521	20.7013	813.9828	3134.806	16.0008	23.0026	23.2017
18bm4_1	10	16776	-2805	0.6948	12.0348	23.2699	57.2098	851.4695	3043.537	17.0009	22.3025	27.0022
18bm4_2	11	16720	-2805	0.0618	10.7899	23.7516	30.5028	765.5542	3099.454	20.6013	20.6022	25.202
18bm4_3	12	16664	-2805	0	12.1788	24.964	17.7009	862.5261	3260.075	12.4005	20.9021	26.7022
18bm5_1	13	16753	-2850	1.1145	13.4352	27.85	89.424	950.7038	3663.935	30.2027	25.0028	29.0025
18bm5_2	14	16704	-2850	0.4897	11.8589	24.8693	43.1056	840.4136	3257.934	13.2005	22.0024	27.4023
18bm5_3	15	16654	-2850	0	11.1419	23.0184	19.8012	792.0777	3002.3	17.801	21.7024	24.2018
18ba1_1	1	14848	-6762	1.1514	10.3844	24.5057	90.5246	730.0956	3218.376	31.2029	16.5013	25.2021
18ba1_2	2	14795	-6762	0.9244	11.5684	24.1721	71.7154	815.7917	3163.847	21.6014	19.8017	22.2015
18ba1_3	3	14742	-6762	0.5717	11.4271	24.3653	51.508	810.2648	3189.733	18.001	22.4023	24.7019
18ba2_1	4	14809	-6811	1.033	12.4145	25.045	86.0222	877.8055	3282.305	30.4028	23.2027	23.3017
18ba2_2	5	14746	-6811	0.9919	12.2117	26.2308	74.8168	863.9333	3447.796	21.8014	22.6023	27.2023
18ba2_3	6	14682	-6811	0.1229	12.0241	25.4417	36.1039	854.5853	3332.792	23.2016	23.0027	27.8024
18ba3_1	7	14792	-6839	0.9607	13.2557	26.039	80.0192	939.038	3424.626	27.4023	24.003	28.5024
18ba3_2	8	14731	-6839	0.9499	11.2964	23.7972	80.1193	800.2164	3123.700	28.8025	21.7023	25.402
18ba3_3	9	14670	-6839	0.2034	11.9357	24.4683	38.2044	847.6501	3203.086	21.4014	21.8023	24.7019
18ba4_1	10	14753	-6887	1.1136	12.6789	25.7751	91.0248	898.2139	3391.050	31.603	24.0029	28.0024
18ba4_2	11	14706	-6887	1.1301	13.0885	27.0929	97.0282	928.3785	3570.336	37.0041	24.9029	27.5024
18ba4_3	12	14659	-6887	0.4843	12.9652	27.772	47.3067	920.2335	3654.736	17.801	23.0025	27.3023
18ba5_1	13	14716	-6928	1.0804	12.3124	23.9064	82.0202	872.0756	3139.493	23.6017	23.3027	26.7021
18ba5_2	14	14683	-6928	1.0346	13.3628	27.712	82.3203	948.6924	3653.408	26.8022	25.6031	28.0024
18ba5_3	15	14649	-6928	0.7651	14.7513	31.1832	71.3153	1051.104	4128.098	28.6025	28.704	31.9031
18le1_1	1	9088	5511	0	16.7899	35.1868	2.9	1195.270	4655.937	3.4	30.4045	35.5039
18le1_2	2	9117	5511	0	16.203	34.3369	20.9013	1152.672	4541.545	20.4012	28.0038	33.3034
18le1_3	3	9146	5511	0	16.0595	34.4393	21.8014	1146.429	4552.950	22.2015	32.4049	32.8033
18le2_1	4	9097	5468	0	16.6089	35.1882	3	1184.594	4660.872	3	30.7045	33.1033
18le2_2	5	9125	5468	0	16.3705	34.654	23.3016	1168.683	4586.655	20.6013	32.205	34.8036
18le2_3	6	9153	5468	0	15.9073	34.283	17.801	1133.038	4535.175	20.6013	28.604	31.9031
18le3_1	7	9108	5419	0	16.3966	35.1588	3.5	1170.395	4662.414	2.2	30.3045	33.9035
18le3_2	8	9127	5419	0	16.3348	35.1431	19.9012	1166.367	4656.348	22.8016	31.2047	32.3033
18le3_3	9	9145	5419	0	15.5105	33.0605	23.7017	1107.869	4375.490	20.2012	29.8044	33.6034
18lc1_1	1	8940	2543	0.7278	12.6983	26.3995	55.8093	895.7004	3466.580	14.8007	19.502	27.1023
18lc1_2	2	8949	2543	1.074	12.8852	28.2972	80.8196	912.6922	3727.829	24.2018	24.3027	27.2023
18lc1_3	3	8957	2543	1.3415	12.5248	26.4736	91.0248	884.8427	3486.591	21.4014	22.4022	27.9024
18lc2_1	4	8934	2528	0	12.6411	26.244	2.1	896.2031	3436.976	1	21.0021	25.9021
18lc2_2	5	8945	2528	1.5654	13.389	28.9132	106.9343	945.9771	3820.799	27.0022	23.0026	27.8024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
18lc2_3	6	8956	2528	0.9963	12.9427	28.5352	71.6154	914.8037	3764.847	18.601	21.2022	29.1026
18lc3_1	7	8937	2465	0.6342	12.1224	24.7232	52.6083	857.2993	3242.232	15.8007	21.202	29.2027
18lc3_2	8	8944	2465	1.2802	12.6427	26.8437	89.0238	888.9645	3529.786	22.4015	18.9018	25.402
18lc3_3	9	8951	2465	1.1008	12.8559	27.3776	83.621	907.2627	3602.109	25.4019	21.2021	26.0022
18lc4_1	10	8937	2450	0.6998	12.1674	26.2123	51.608	861.6215	3444.428	12.2004	21.5022	26.4021
18lc4_2	11	8945	2450	1.2686	12.3444	27.0927	80.9196	872.9803	3569.928	15.2007	22.7026	27.8024
18lc4_3	12	8952	2450	1.0377	12.0925	26.7067	76.8177	851.6705	3510.791	22.0015	19.1019	26.8022
18lc5_1	13	8936	2400	0.322	14.0559	30.0869	35.0037	999.1862	3965.214	13.0005	25.7031	29.7027
18lc5_2	14	8942	2400	1.0163	14.3661	30.6619	84.4214	1019.206	4048.992	30.2027	27.8036	33.0034
18lc5_3	15	8947	2400	1.1946	14.3971	31.2452	89.7241	1018.905	4126.458	27.4023	26.3033	30.8029
18lm1_1	1	9947	-2687	0	12.2371	26.3471	3.8	867.7531	3449.328	3.8	21.2023	25.802
18lm1_2	2	9958	-2687	1.1445	13.1392	28.6561	87.0227	930.8925	3778.245	27.0022	24.503	26.5022
18lm1_3	3	9968	-2687	0.7775	12.7188	26.9714	67.7138	899.5209	3542.042	24.6018	22.4022	26.4021
18lm2_1	4	9951	-2703	0.3604	11.5307	23.5223	32.9032	816.2941	3079.591	8.8002	19.4017	25.9021
18lm2_2	5	9963	-2703	1.1783	11.553	24.2913	87.0227	815.9927	3191.772	25.0019	20.7021	26.3021
18lm2_3	6	9974	-2703	0.7818	12.9253	28.1326	66.5133	915.1053	3703.802	23.4016	22.5024	27.3023
18lm3_1	7	9958	-2731	0.4009	13.514	28.2221	41.8052	961.3647	3711.061	16.0008	26.8035	29.7027
18lm3_2	8	9968	-2731	1.6959	13.1533	28.2212	129.0499	928.0768	3723.330	43.0055	23.5027	28.4024
18lm3_3	9	9977	-2731	0.4872	11.7908	28.1439	51.508	835.1874	3693.170	22.8016	22.4025	24.9019
18lm4_1	10	9964	-2746	0.6153	12.8	26.7122	50.5077	903.2409	3503.337	14.8007	20.402	26.6022
18lm4_2	11	9974	-2746	1.1305	13.2814	29.4741	81.4199	934.5126	3881.170	22.4015	20.3019	28.1024
18lm4_3	12	9983	-2746	0.9218	14.3172	30.2611	85.622	1013.874	3986.718	35.8038	26.6036	30.5028
18lm5_1	13	9965	-2754	0.1251	11.5901	23.9096	21.1013	818.6054	3114.429	8.0002	19.9018	24.4018
18lm5_2	14	9976	-2755	1.3824	14.022	30.2666	110.3365	990.6354	3992.965	39.2046	25.5033	30.3029
18lm5_3	15	9986	-2756	0.7755	14.1244	30.2414	66.7133	1001.198	3984.875	23.8017	26.4034	30.8029
18la1_1	1	11999	-6223	1.2207	12.4492	25.8651	95.3273	877.6045	3398.601	31.2029	20.602	25.2019
18la1_2	2	12009	-6217	0.9812	11.7789	24.9164	78.2184	832.8759	3265.785	25.602	22.7025	25.302
18la1_3	3	12019	-6211	1.2504	13.5254	28.0121	103.4321	955.7324	3693.476	37.8043	22.9024	28.8027
18la2_1	4	12008	-6232	1.0874	12.402	26.3834	89.8242	881.0225	3466.988	32.2031	26.3033	23.2016
18la2_2	5	12022	-6228	1.1858	11.7488	25.1036	85.9221	829.9614	3295.665	23.8017	21.7025	24.2018
18la2_3	6	12035	-6224	1.2963	14.2828	30.1562	97.7286	1011.661	3986.615	30.2027	26.1034	32.4032
18la3_1	7	12034	-6252	1.3741	11.9304	24.5594	96.7281	843.4287	3229.896	25.2019	22.5024	26.8022
18la3_2	8	12053	-6251	1.3515	11.4929	24.7243	97.6286	808.1546	3247.840	27.8023	17.9016	23.5017
18la3_3	9	12072	-6251	0.8642	14.0285	29.3191	91.225	998.5826	3869.401	43.8058	28.0035	28.1024
18la4_1	10	12057	-6274	1.4875	12.1117	24.6888	107.8349	853.3792	3246.922	30.8028	20.202	25.502
18la4_2	11	12074	-6272	1.4359	14.1255	30.1094	113.2385	1001.198	3982.519	39.2046	26.1035	28.9026
18la4_3	12	12090	-6271	0.8409	11.8989	25.2638	65.1127	838.6045	3317.185	19.0011	18.3015	26.8022
18la5_1	13	12078	-6302	1.617	14.2819	29.4434	125.8475	1011.862	3890.176	42.8055	27.1037	27.9024
18la5_2	14	12082	-6302	1.697	13.3949	28.5887	135.6552	947.5861	3782.132	49.2073	23.3027	26.3021
18la5_3	15	12086	-6302	1.4289	14.0771	30.3999	127.2486	998.0796	4029.836	53.6086	24.8029	30.4028

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
19be1_1	1	-18180	4834	0	16.8688	35.7405	22.3015	1210.681	4751.581	16.2008	34.7055	34.4036
19be1_2	2	-18050	4834	0	16.7642	35.7157	21.9014	1197.789	4748.495	19.2011	29.2041	34.7037
19be1_3	3	-17920	4834	0	16.5394	35.6542	21.3014	1184.998	4738.002	21.4014	32.305	32.6033
19be2_1	4	-18200	4744	0	16.6223	35.4333	23.0016	1190.134	4709.717	20.6013	31.6048	35.0037
19be2_2	5	-18073	4744	0	16.2681	35.5425	18.8011	1164.756	4720.311	20.2012	31.8052	32.6033
19be2_3	6	-17946	4744	0	16.255	35.7105	21.0013	1163.95	4749.009	19.8012	31.905	38.0045
19be3_1	7	-18178	4685	0	16.8317	35.6554	23.6017	1205.947	4743.557	21.6014	32.0055	35.8039
19be3_2	8	-18053	4685	0	16.6555	35.9055	21.4014	1190.94	4770.407	18.401	30.6045	32.6033
19be3_3	9	-17929	4685	0	16.5195	35.5801	21.9014	1182.984	4728.231	19.6012	31.705	33.1033
19bc1_1	1	-17598	1608	1.2956	12.5838	28.8222	107.1344	890.0704	3817.832	40.4049	20.5021	32.0031
19bc1_2	2	-17595	1608	0.8985	14.276	31.189	81.3198	1015.685	4131.686	32.6032	25.9033	29.3026
19bc1_3	3	-17593	1608	0.5802	13.9689	30.501	60.9111	995.967	4035.573	27.0022	26.8035	31.003
19bc2_1	4	-17597	1603	1.3625	13.5449	30.4279	107.9349	964.8849	4035.88	37.8043	28.004	31.303
19bc2_2	5	-17593	1603	0.7588	14.3045	31.5754	70.3148	1018.603	4187.247	28.2024	26.3035	33.5035
19bc2_3	6	-17589	1603	0.3972	14.6371	31.616	51.1078	1042.752	4185.196	25.602	26.4033	32.8032
19bc3_1	7	-17597	1592	1.0874	12.7904	29.3102	89.0238	905.855	3879.635	32.0031	21.1021	30.0028
19bc3_2	8	-17593	1592	0.5514	13.9049	30.9771	55.2091	991.9431	4100.53	22.8016	27.1035	31.003
19bc3_3	9	-17590	1592	0.4218	14.9038	31.9832	55.5092	1063.885	4236.877	28.8025	28.3041	31.9032
19bc4_1	10	-17595	1577	1.1934	13.5592	29.6776	93.7263	961.4653	3926.719	31.2029	23.2025	26.9022
19bc4_2	11	-17590	1577	0.6744	13.0835	29.478	64.6125	932.1997	3898.672	26.6021	25.1029	29.8028
19bc4_3	12	-17586	1577	0.3374	14.23	31.0209	47.3067	1014.579	4111.291	24.6018	25.2031	34.7037
19bc5_1	13	-17593	1557	1.1978	12.6963	29.1986	89.7241	898.3144	3859.782	27.6023	20.502	23.9019
19bc5_2	14	-17590	1557	0.7858	13.9858	30.45	82.5204	993.8544	4032.5	39.0046	23.7027	30.4029
19bc5_3	15	-17588	1557	0.8952	14.6088	31.7667	82.4204	1042.953	4212.265	33.8034	29.7044	31.0029
19bm1_1	1	-16215	-2667	0.0964	14.5045	31.0223	22.1015	1034.803	4102.067	10.4003	26.3036	32.7033
19bm1_2	2	-16212	-2666	0.835	14.5145	31.6005	80.4194	1035.708	4190.22	34.6036	28.4038	30.3028
19bm1_3	3	-16209	-2666	0.9027	15.0223	31.6056	81.3198	1071.634	4191.45	32.0031	29.4044	32.8033
19bm2_1	4	-16212	-2672	1.23	13.8582	29.8116	108.8355	988.0199	3942.996	44.4059	29.4042	26.9022
19bm2_2	5	-16208	-2671	1.0037	14.4802	30.9457	83.9211	1030.677	4101.76	30.0027	27.0037	31.8032
19bm2_3	6	-16205	-2671	0.9748	14.6388	31.5838	81.4199	1044.664	4189.4	29.0025	29.604	32.4033
19bm3_1	7	-16197	-2684	1.3707	14.8795	31.8723	112.3378	1059.557	4228.673	41.2051	29.4047	30.0028
19bm3_2	8	-16195	-2683	1.0565	14.8815	32.034	93.9265	1062.375	4251.236	37.6042	30.5047	31.7031
19bm3_3	9	-16193	-2683	0.8333	15.3444	31.5145	79.1188	1095.992	4174.124	32.8032	30.9047	29.2026
19bm4_1	10	-16191	-2692	1.2318	14.509	30.3071	109.1357	1034.4	4015.702	44.2059	29.6046	30.8029
19bm4_2	11	-16189	-2690	0.9869	15.0917	32.2662	89.7241	1078.78	4282.625	36.604	31.3048	30.1028
19bm4_3	12	-16187	-2689	0.8189	14.8888	32.2791	77.1178	1062.375	4286.318	32.0031	28.6038	33.7034
19bm5_1	13	-16185	-2701	1.0205	15.0833	32.3797	84.2213	1078.377	4297.911	29.6026	32.105	31.5031
19bm5_2	14	-16181	-2699	1.0366	15.2882	32.4523	94.927	1090.254	4303.759	39.4047	30.2042	29.6027
19bm5_3	15	-16178	-2697	0.7944	14.3618	30.5902	73.5162	1025.244	4049.607	29.4026	29.2042	30.7029
19ba1_1	1	-14483	-5063	0.6638	12.0256	26.1522	54.3088	858.8069	3438.814	16.6008	27.2038	24.0018
19ba1_2	2	-14438	-5063	0	12.0574	25.0462	24.9019	857.0982	3280.878	18.001	21.1022	24.2018
19ba1_3	3	-14394	-5063	0	12.9178	28.2931	17.5009	922.9484	3722.717	14.8007	26.4032	27.1022
19ba2_1	4	-14457	-5086	0.1638	11.2841	23.0578	29.2026	806.5468	3014.416	14.2006	25.403	22.3015
19ba2_2	5	-14419	-5086	0.127	12.4868	27.4544	18.701	884.8427	3612.736	5.8001	19.0017	29.0025
19ba2_3	6	-14381	-5086	0	11.6839	23.8861	18.9011	831.1674	3125.637	19.4011	21.4022	24.8019
19ba3_1	7	-14443	-5122	0.0799	13.8278	29.6382	29.5026	992.2449	3908.703	18.601	32.5052	31.403
19ba3_2	8	-14410	-5122	0	11.5518	23.8735	22.1015	822.7256	3121.459	15.8007	22.6024	23.8017
19ba3_3	9	-14377	-5122	0	12.329	26.8897	17.4009	880.0172	3526.927	14.6006	25.7032	24.9019

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
19ba4_1	10	-14439	-5148	0.6583	11.0069	25.1281	49.8074	778.4136	3302.702	12.8005	18.0016	25.0019
19ba4_2	11	-14409	-5148	0	14.0015	29.6844	19.3011	1002.707	3913.514	14.2006	30.0043	29.1027
19ba4_3	12	-14379	-5148	0	11.8975	24.6577	18.501	849.4592	3227.246	17.0009	25.103	24.4018
19ba5_1	13	-14425	-5199	0.7977	11.7313	25.0391	64.9126	831.8708	3290.464	20.8013	21.9024	25.702
19ba5_2	14	-14399	-5199	0.1108	12.5111	26.2759	27.6023	887.9591	3446.062	15.2007	21.8022	27.4023
19ba5_3	15	-14374	-5199	0	13.8273	29.5913	17.901	986.3098	3893.759	16.8008	27.3034	27.8024
19le1_1	1	-10494	4746	0	16.4447	35.8884	20.7013	1173.316	4752.404	19.8012	31.5049	30.1028
19le1_2	2	-10619	4746	0	16.4568	35.5384	20.5013	1176.84	4708.895	20.6013	34.2056	35.0038
19le1_3	3	-10745	4746	0	15.982	35.0607	20.3012	1136.461	4645.04	27.4023	26.7034	34.5037
19le2_1	4	-10457	4616	0	16.496	35.8656	19.6012	1180.365	4759.399	21.8014	33.2054	33.1034
19le2_2	5	-10572	4616	0	16.6774	35.676	20.2012	1189.933	4735.122	19.0011	30.0044	35.2038
19le2_3	6	-10687	4616	0	16.2221	35.1632	21.1013	1156.599	4662.826	20.8013	28.8043	33.6035
19le3_1	7	-10470	4544	0	16.3806	35.826	20.4012	1167.575	4752.198	21.8014	29.7042	36.104
19le3_2	8	-10558	4544	0	16.4573	36.0477	19.4011	1170.395	4778.844	19.4011	27.1035	32.1032
19le3_3	9	-10647	4544	0	16.3371	35.7123	19.9012	1167.575	4733.065	25.802	32.2051	30.3028
19lc1_1	1	-10247	1982	0.5712	13.4815	28.3711	51.2079	952.3129	3719.343	17.6009	22.8026	25.8021
19lc1_2	2	-10249	1982	0.5668	15.1352	31.6776	47.5068	1074.251	4177.302	14.0006	27.7037	31.7031
19lc1_3	3	-10252	1982	0.4092	14.7925	31.7502	43.8058	1051.809	4184.889	17.801	28.704	30.9029
19lc2_1	4	-10251	1979	0.4201	15.0812	31.5022	44.606	1069.923	4130.456	18.001	30.9049	27.2023
19lc2_2	5	-10247	1978	0.5782	14.1411	29.3045	53.3085	1005.524	3852.312	19.2011	28.904	29.0026
19lc2_3	6	-10250	1977	0.6832	14.545	30.4992	62.1116	1032.891	4017.443	23.2016	27.7036	28.7025
19lc3_1	7	-10243	1949	0.5595	13.3494	28.8545	49.1072	947.4855	3793.69	16.2008	25.2032	27.0023
19lc3_2	8	-10245	1949	0.4835	14.0567	28.8857	48.8071	998.2808	3798.907	19.0011	26.3033	29.7027
19lc3_3	9	-10248	1949	0.2946	14.4988	30.3737	35.5038	1032.488	3999.007	14.6006	28.7042	30.0028
19lc4_1	10	-10241	1945	0.5277	13.3106	27.9347	55.3092	946.3793	3671.397	23.6017	25.9031	26.2021
19lc4_2	11	-10245	1943	0.3997	14.0882	30.5126	43.3056	1001.902	4016.931	17.801	27.7037	29.3026
19lc4_3	12	-10249	1941	0.275	14.872	31.9449	34.8036	1055.23	4203.96	15.0007	26.6033	27.2022
19lc5_1	13	-10244	1919	0.4544	14.1669	30.219	47.5068	1000.796	3973.406	19.4011	22.8025	31.203
19lc5_2	14	-10247	1919	0.3821	14.9801	31.8221	44.806	1065.092	4189.4	20.0012	29.8042	30.3028
19lc5_3	15	-10251	1919	0.2326	15.0184	31.9776	37.3042	1066.2	4208.266	19.4011	27.7036	29.8028
19lm1_1	1	-10117	-2062	0.5819	12.0807	26.5158	48.5071	852.8766	3470.562	14.8007	21.6021	27.6023
19lm1_2	2	-10139	-2062	0.066	11.2003	24.0363	22.6015	792.982	3128.489	12.4005	21.8023	25.8021
19lm1_3	3	-10161	-2062	0.117	12.0513	26.4438	22.2015	852.173	3452.492	9.8003	21.8022	27.1023
19lm2_1	4	-10117	-2087	0.6451	12.9586	27.1524	47.4067	911.4856	3554.401	10.4003	20.2019	29.5026
19lm2_2	5	-10145	-2087	0	11.3384	24.2276	18.9011	801.7236	3148.664	16.2008	21.1022	23.0016
19lm2_3	6	-10173	-2087	0.0193	11.8814	25.6195	20.7013	839.8105	3337.281	12.6005	21.0021	23.8017
19lm3_1	7	-10122	-2117	0.5959	11.827	25.7653	50.0075	836.3934	3371.663	15.6007	22.9025	29.2026
19lm3_2	8	-10147	-2117	0	10.9826	24.3364	19.4011	777.4089	3167.924	14.0006	20.702	24.3018
19lm3_3	9	-10173	-2117	0	11.5714	25.3606	17.2009	819.2084	3303.722	12.0004	21.9023	25.0019
19lm4_1	10	-10123	-2132	0.5355	11.7755	25.3971	49.7074	830.4639	3315.962	18.001	20.4019	23.7018
19lm4_2	11	-10148	-2132	0	11.3257	24.0902	20.3012	801.7236	3133.074	14.8007	21.2022	22.6016
19lm4_3	12	-10174	-2132	0	11.6615	24.8471	17.3009	823.7306	3236.013	13.4005	19.8019	24.5018
19lm5_1	13	-10133	-2162	0.6433	11.8473	25.4684	57.3099	837.2979	3328.916	20.6013	22.6025	25.802
19lm5_2	14	-10155	-2162	0.0622	11.2382	24.764	22.9016	793.9868	3227.755	13.0005	19.3017	24.6019
19lm5_3	15	-10177	-2162	0	12.1416	25.1462	18.301	858.2039	3280.266	15.6007	20.0019	25.702
19la1_1	1	-10758	-5262	0.4367	15.0638	31.1189	52.1081	1071.735	4097.251	24.6018	30.5044	30.6028
19la1_2	2	-10835	-5262	0	11.0875	23.2698	21.2013	786.1497	3029.384	20.4012	21.6022	24.6019
19la1_3	3	-10913	-5262	0	13.858	30.1018	19.5011	983.3926	3951.392	14.0006	25.1031	27.8024
19la2_1	4	-10784	-5327	0.5125	14.8994	31.6051	51.8081	1056.84	4165.819	21.0013	27.3035	31.7031

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
19la2_2	5	-10862	-5327	0	11.3033	23.9166	21.9014	799.4126	3117.078	16.6008	19.8018	26.002
19la2_3	6	-10941	-5327	0	13.1794	28.0723	15.3007	933.2053	3675.077	11.8004	22.5024	26.3021
19la3_1	7	-10802	-5389	0.5908	15.7976	32.7768	58.0101	1122.769	4322.433	23.4016	31.0046	30.1027
19la3_2	8	-10883	-5389	0	11.3385	24.757	21.7014	805.2405	3229.081	16.0008	23.1025	25.5021
19la3_3	9	-10965	-5389	0	11.7722	24.3909	16.9009	833.9814	3179.44	17.0009	21.7023	25.202
19la4_1	10	-10812	-5426	0.4288	15.17	30.7322	58.3102	1077.069	4042.641	31.0029	27.9038	26.9022
19la4_2	11	-10906	-5426	0	12.5845	25.8357	17.5009	892.9859	3381.867	13.8006	23.1028	30.9029
19la4_3	12	-11000	-5426	0	12.2419	26.7539	15.4007	870.3667	3501.805	11.6004	24.3028	26.9022
19la5_1	13	-10861	-5534	0.6229	15.5476	33.1595	62.1116	1105.152	4382.47	26.2021	29.3041	30.4028
19la5_2	14	-10942	-5534	0	12.3462	25.4671	21.2013	874.8903	3326.366	16.0008	22.1024	26.5022
19la5_3	15	-11024	-5534	0	12.8842	28.4041	17.6009	911.9883	3723.739	13.8006	21.4023	28.0024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l10be1_1	1	-18873	31547	0.0153	16.5936	35.7929	25.902	1173.214	4718.768	18.001	27.4039	35.8039
l10be1_2	2	-18830	31543	0	16.4574	35.5164	21.5014	1166.367	4682.670	21.2013	28.904	33.1033
l10be1_3	3	-18787	31538	0	15.7953	34.1485	23.7017	1119.245	4492.851	22.6015	28.8039	33.0033
l10be2_1	4	-18864	31485	0	16.3633	35.6395	25.2019	1162.339	4695.422	21.8014	32.605	33.6034
l10be2_2	5	-18824	31485	0	16.292	35.0387	19.8012	1157.102	4611.219	19.0011	32.4051	31.9031
l10be2_3	6	-18785	31485	0	15.6497	33.7431	18.201	1109.178	4433.083	18.201	29.5044	30.9029
l10be3_1	7	-18850	31430	0	15.211	33.6107	20.1012	1075.861	4413.780	13.6006	27.9037	33.9037
l10be3_2	8	-18820	31430	0	16.1379	35.1287	19.8012	1136.058	4615.331	19.6012	24.4028	32.9034
l10be3_3	9	-18791	31430	0	16.112	34.9897	18.701	1137.971	4594.671	17.801	28.704	33.6034
l10bc1_1	1	-18570	27954	1.3379	14.0685	29.4379	109.2358	987.6175	3849.447	40.2048	26.5034	30.4028
l10bc1_2	2	-18567	27954	1.7385	14.0497	30.1705	129.2501	985.8068	3952.313	41.8052	26.6034	27.9024
l10bc1_3	3	-18564	27954	1.6737	13.6586	30.5404	125.0469	959.152	4005.152	41.2051	26.2034	28.5025
l10bc2_1	4	-18569	27949	0.9108	11.0847	26.2305	80.7195	776.5047	3421.564	32.8032	19.3019	28.5025
l10bc2_2	5	-18565	27949	1.8017	14.0611	30.6821	133.0531	986.3098	4027.276	42.8055	25.4031	28.8026
l10bc2_3	6	-18561	27949	1.7175	14.9651	31.8679	129.15	1050.600	4191.245	42.4054	26.0034	32.0031
l10bc3_1	7	-18564	27924	1.0568	10.9538	24.9614	83.4209	767.9653	3254.467	28.4024	20.1018	27.6023
l10bc3_2	8	-18563	27924	1.444	11.2285	24.2172	116.6408	788.5611	3158.038	43.0055	23.2026	26.7021
l10bc3_3	9	-18561	27924	1.4476	12.3641	27.2245	106.9343	863.3303	3560.632	33.4033	19.4018	30.0028
l10bc4_1	10	-18560	27898	0.9606	13.2355	29.0461	79.8191	928.5796	3799.623	28.8025	22.5026	30.6029
l10bc4_2	11	-18559	27899	1.3114	12.2594	26.1633	110.0363	859.5106	3415.236	42.4054	22.2023	26.8022
l10bc4_3	12	-18557	27899	1.6897	12.9376	28.751	126.7482	909.5753	3771.495	42.0053	26.0034	31.603
l10bc5_1	13	-18560	27877	1.0183	10.6342	23.8238	72.0156	741.1442	3097.926	18.601	15.401	22.9016
l10bc5_2	14	-18556	27877	1.4504	13.5692	30.563	111.6374	951.7095	4010.683	38.2044	23.3024	29.2027
l10bc5_3	15	-18552	27877	1.4855	14.1718	31.6467	101.4309	995.7658	4156.490	26.2021	25.0029	26.3021
l10bm1_1	1	-18217	25309	1.9245	11.7347	26.4634	117.9417	820.6153	3459.944	22.6015	22.1024	26.8022
l10bm1_2	2	-18208	25309	0.8753	11.8878	25.1672	72.0156	833.6799	3277.308	24.6018	21.2022	28.4025
l10bm1_3	3	-18199	25309	0.5436	11.9029	25.1203	62.5117	838.0015	3270.476	30.4028	22.9026	30.3028
l10bm2_1	4	-18210	25270	1.4105	11.7537	25.6761	96.3278	818.9069	3352.073	24.4018	16.9014	26.9022
l10bm2_2	5	-18202	25270	1.3819	12.7843	29.0412	96.9282	896.6052	3807.5	26.8022	22.6026	31.5031
l10bm2_3	6	-18195	25270	0.8111	13.2945	28.864	66.6133	936.4233	3773.642	22.4015	25.3029	29.2027
l10bm3_1	7	-18199	25242	1.6591	12.1194	27.4392	104.5328	847.5496	3587.805	21.6014	21.5021	27.2023
l10bm3_2	8	-18192	25242	0.9233	12.8513	29.334	66.8134	901.029	3831.336	18.001	22.7026	29.1027
l10bm3_3	9	-18186	25242	0.6872	14.4697	31.127	69.1143	1018.905	4065.384	30.6028	28.0039	27.9024
l10bm4_1	10	-18196	25231	1.3572	12.0834	27.5044	94.3267	842.0217	3584.843	25.602	19.2018	26.1021
l10bm4_2	11	-18190	25231	1.2392	13.8466	30.7548	94.827	970.9199	4023.383	31.2029	25.5032	31.0029
l10bm4_3	12	-18185	25231	0.8774	14.093	31.0667	78.7186	988.0199	4054.627	31.803	25.8033	30.8029
l10bm5_1	13	-18187	25213	1.4573	13.7957	30.083	99.3296	965.2873	3932.246	25.4019	24.703	30.2028
l10bm5_2	14	-18180	25213	0.8496	14.269	31.2255	79.9192	1000.292	4075.220	34.2035	25.8032	30.5028
l10bm5_3	15	-18174	25213	0.7974	13.9797	30.6156	63.5121	980.0732	3993.989	20.2012	25.5033	31.9031
l10ba1_1	1	-17336	22648	2.1099	11.0185	25.0994	145.6636	769.4722	3279.45	41.8052	20.7021	23.9017
l10ba1_2	2	-17330	22648	0.8963	11.8877	25.0879	87.0227	834.9864	3264.154	38.6045	22.6024	25.602
l10ba1_3	3	-17324	22648	0.7814	11.4107	24.8313	75.8172	800.7189	3228.265	33.0033	20.502	23.0017
l10ba2_1	4	-17328	22632	1.4849	12.3728	27.1857	115.3399	864.2349	3554.707	40.0048	19.4018	27.1023
l10ba2_2	5	-17321	22632	1.2381	12.3056	26.6043	86.2223	861.0183	3471.991	22.2015	20.6022	27.0022
l10ba2_3	6	-17314	22632	0.7909	11.6242	25.1454	70.9151	813.6814	3273.739	27.6023	18.7017	26.7022
l10ba3_1	7	-17318	22606	1.8617	12.121	25.9471	131.5519	848.9567	3390.233	38.2044	23.0025	24.6019
l10ba3_2	8	-17313	22606	1.2026	11.7327	25.2797	97.6286	823.8311	3298.521	35.2037	22.7025	28.8025
l10ba3_3	9	-17309	22606	0.8421	11.2442	24.0209	73.8163	789.6663	3127.164	28.0024	20.9021	27.5024
l10ba4_1	10	-17313	22588	1.4497	12.3551	27.2834	100.03	866.2453	3568.804	26.4021	22.5024	28.4025
l10ba4_2	11	-17307	22588	1.3815	13.4172	30.0747	104.933	943.4628	3948.627	34.6036	25.0029	31.9031
l10ba4_3	12	-17301	22588	0.7332	13.4254	29.2662	68.214	946.8821	3828.779	27.6023	25.9034	29.2026
l10ba5_1	13	-17300	22553	1.6375	11.744	24.2602	121.3442	820.2133	3164.459	38.0043	20.002	26.4021
l10ba5_2	14	-17294	22553	1.4243	11.3522	24.4008	106.534	795.1925	3176.586	33.8034	21.6023	22.8017
l10ba5_3	15	-17288	22553	0.7725	11.6208	24.6249	77.418	816.5956	3199.416	34.8036	22.7024	25.402
l10le1_1	1	-10092	32006	0	16.5935	35.9447	23.7017	1173.819	4729.258	20.8013	30.1045	36.204
l10le1_2	2	-10372	32006	0	16.3682	35.9498	20.7013	1157.706	4723.499	21.6014	30.3045	32.0033
l10le1_3	3	-10653	32006	0	15.8422	35.4675	20.0012	1120.957	4652.853	21.4014	31.4047	31.9032
l10le2_1	4	-10118	31916	0	16.6848	36.3036	22.7015	1181.170	4771.744	19.8012	32.8051	36.7042
l10le2_2	5	-10390	31916	0	16.3609	36.0468	19.1011	1157.606	4738.516	24.4018	30.7048	33.7036
l10le2_3	6	-10662	31916	0	16.0473	35.2165	18.601	1135.656	4623.759	21.8014	30.7046	32.6033
l10le3_1	7	-10168	31847	0	16.5106	35.8764	24.1017	1168.884	4708.071	21.2013	32.7056	31.5031
l10le3_2	8	-10417	31847	0	16.3945	36.241	20.3012	1158.814	4760.427	23.4016	30.7048	33.8036
l10le3_3	9	-10667	31847	0	16.3052	35.7711	20.9013	1153.175	4693.879	23.6017	31.9048	34.0035
l10lc1_1	1	-10814	27695	0.6429	14.2896	30.1741	53.1085	1005.021	3947.296	16.4008	24.6031	31.0031
l10lc1_2	2	-10816	27695	0.604	15.6781	32.2689	53.4086	1104.85	4237.492	18.201	25.8033	32.5032
l10lc1_3	3	-10818	27695	0.7364	15.5767	32.5971	61.4113	1102.232	4282.624	20.2012	30.1042	29.1026
l10lc2_1	4	-10816	27667	0.7577	14.463	30.1883	61.0112	1017.597	3957.432	18.8011	23.5028	30.1028
l10lc2_2	5	-10818	27667	0.4908	14.7956	31.8221	49.0072	1046.475	4174.431	19.4011	28.6038	30.703

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I10lc2_3	6	-10820	27667	0.9091	15.0131	31.9693	76.6176	1059.456	4198.73	27.6023	27.8037	30.3028
I10lc3_1	7	-10815	27658	0.6543	14.5121	30.75	49.0072	1021.219	4026.763	11.8004	25.3031	32.6033
I10lc3_2	8	-10817	27658	0.595	15.031	32.0482	57.4099	1058.752	4197.704	23.0016	26.9037	30.7029
I10lc3_3	9	-10820	27658	0.7704	13.9945	29.9815	67.0135	987.014	3919.041	24.6018	28.5042	30.9029
I10lc4_1	10	-10816	27641	0.6123	13.5121	28.8848	59.1105	950.4021	3763.824	24.0017	25.9034	28.8025
I10lc4_2	11	-10817	27641	0.5077	13.8656	29.6069	55.9094	974.5409	3858.963	25.602	25.603	30.3028
I10lc4_3	12	-10819	27641	0.8523	14.0187	29.807	81.8201	986.6116	3892.735	35.6038	27.7037	31.203
I10lc5_1	13	-10816	27628	0.6283	13.2643	27.3269	51.3079	927.6746	3546.23	15.2007	22.0023	25.402
I10lc5_2	14	-10818	27628	0.5632	14.4828	30.3266	52.6083	1015.886	3953.337	19.6012	24.803	29.6027
I10lc5_3	15	-10821	27628	0.7608	15.3716	32.4093	61.0112	1076.163	4233.800	19.0011	24.9032	31.203
I10lm1_1	1	-11087	25378	0.5518	11.2402	23.0545	48.7071	788.4606	2992.526	16.0008	19.5016	26.7022
I10lm1_2	2	-11112	25378	0.8255	10.3052	23.3286	71.4153	722.8642	3029.078	27.0022	19.6018	23.4017
I10lm1_3	3	-11137	25378	0.3395	11.8609	25.5514	46.6065	832.8759	3323.918	24.0017	19.5017	27.0023
I10lm2_1	4	-11095	25340	0.9091	11.8923	26.1509	66.8134	835.3884	3409.113	18.201	22.1022	26.4021
I10lm2_2	5	-11117	25340	0.6818	11.0184	23.6717	64.7126	776.6052	3072.257	26.4021	23.7026	23.9018
I10lm2_3	6	-11140	25340	0.3549	13.2963	27.7599	42.1053	936.0211	3611.407	18.601	24.8028	26.8022
I10lm3_1	7	-11102	25304	0.997	11.958	23.5209	77.8182	837.2979	3050.564	24.0017	21.6024	23.1016
I10lm3_2	8	-11126	25304	0.749	12.3382	24.7859	71.0151	866.8484	3216.541	29.0025	24.2028	25.602
I10lm3_3	9	-11151	25304	0.4403	11.4792	23.52	47.9069	802.2261	3043.334	20.4012	18.3016	25.0019
I10lm4_1	10	-11109	25279	0.8007	11.9842	25.7319	63.7122	839.107	3339.627	20.0012	21.7021	24.7019
I10lm4_2	11	-11134	25279	0.7148	10.7394	24.1018	60.7111	754.8054	3123.802	21.4014	23.4026	26.8022
I10lm4_3	12	-11159	25279	0.1725	11.2673	24.3399	28.7025	793.1829	3147.339	13.8006	23.2026	25.002
I10lm5_1	13	-11110	25235	0.6394	10.7491	22.5577	56.6096	750.1845	2913.342	20.2012	18.1016	22.1015
I10lm5_2	14	-11134	25235	0.9356	12.8105	26.5282	61.5113	894.5945	3446.776	11.2004	21.0021	26.8023
I10lm5_3	15	-11158	25235	0.4067	12.502	25.8326	44.906	877.705	3350.543	19.0011	23.2027	27.7023
I10la1_1	1	-12080	21235	0.6944	10.7692	22.5607	53.2085	755.3076	2917.412	14.2006	21.7022	23.6017
I10la1_2	2	-12094	21235	0.8446	14.119	30.1151	61.2112	990.4341	3931.223	15.4007	25.0029	30.3028
I10la1_3	3	-12109	21235	0.3737	11.3734	23.748	46.3064	799.2116	3072.970	22.0015	22.3025	25.102
I10la2_1	4	-12088	21221	0.5484	12.2496	25.6957	42.7055	859.41	3333.404	10.4003	22.4025	25.102
I10la2_2	5	-12098	21221	0.884	11.4473	23.9158	74.2165	802.2261	3103.223	26.4021	22.4024	28.4024
I10la2_3	6	-12109	21221	0.4338	13.3651	29.0175	44.606	941.5521	3778.143	17.801	26.6035	27.3023
I10la3_1	7	-12094	21209	0.9709	12.2623	25.4532	69.0143	858.1033	3309.842	17.0009	20.9021	25.502
I10la3_2	8	-12101	21208	0.7322	13.3628	28.2335	59.2105	939.3397	3685.503	18.401	23.8027	29.0026
I10la3_3	9	-12109	21207	0.6351	11.6022	24.4577	59.5106	816.5956	3173.732	23.2016	23.1026	22.1016
I10la4_1	10	-12105	21177	1.0377	12.5871	26.1167	87.8231	883.5357	3404.724	32.6032	22.7024	26.2021
I10la4_2	11	-12112	21177	0.4949	11.6352	24.7327	47.4067	819.6104	3216.032	17.6009	22.9025	27.9024
I10la4_3	12	-12119	21177	0.6053	11.9189	24.8338	55.6093	836.4939	3222.964	20.6013	21.8024	25.2019
I10la5_1	13	-12109	21159	1.1569	12.8168	26.9149	77.7181	896.7057	3504.766	17.2009	22.0024	25.202
I10la5_2	14	-12116	21159	0.8885	12.2598	25.5623	77.3179	859.6111	3322.184	29.2026	22.7025	25.9021
I10la5_3	15	-12124	21159	0.8691	11.9196	24.8352	72.0156	834.5844	3226.328	24.8018	21.2021	26.8022

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l1lbe1_1	1	16842	6337	0	16.6288	35.0701	22.7015	1174.524	4602.380	24.0017	29.0041	31.603
l1lbe1_2	2	16755	6337	0	16.3892	35.3331	20.0012	1160.022	4644.628	21.4014	31.2049	37.7044
l1lbe1_3	3	16668	6337	0	15.9402	34.9496	22.3015	1127.702	4583.161	19.6012	30.8045	30.8029
l1lbe2_1	4	16814	6269	0	15.9642	34.944	22.0015	1129.011	4579.667	23.0016	31.0048	30.4029
l1lbe2_2	5	16731	6269	0	16.0642	35.5162	22.4015	1136.260	4665.910	23.0016	30.1043	33.7035
l1lbe2_3	6	16648	6269	0	15.6247	34.6954	21.0013	1104.346	4551.511	25.4019	28.9041	31.4031
l1lbe3_1	7	16800	6184	0	16.1033	35.1938	20.9013	1141.596	4617.284	20.2012	33.3056	31.6031
l1lbe3_2	8	16714	6184	0	15.8606	34.9859	23.8017	1121.158	4591.280	23.2016	29.8043	33.9037
l1lbe3_3	9	16627	6184	0	16.0001	34.8797	21.1013	1126.796	4581.106	22.2015	24.6029	33.7035
l1lbc1_1	1	16208	3165	0.6249	13.5012	27.5819	50.4076	944.8708	3584.843	14.4006	22.0023	25.802
l1lbc1_2	2	16207	3165	0.3682	14.2793	28.2713	40.4049	1005.121	3670.783	16.0008	28.4035	26.8023
l1lbc1_3	3	16206	3165	0.2319	15.4208	29.8108	30.7028	1083.913	3879.021	12.4005	27.4036	30.7029
l1lbc2_1	4	16207	3158	0.1641	14.5874	30.4994	25.1019	1026.954	3970.538	10.4003	27.9037	29.6027
l1lbc2_2	5	16206	3158	0	15.1411	30.3944	14.3006	1064.186	3952.210	9.0002	26.7034	29.8028
l1lbc2_3	6	16204	3158	0.3861	15.44	31.9313	39.1046	1085.624	4166.024	14.2006	28.6041	31.703
l1lbc3_1	7	16206	3147	0.1158	14.2321	30.3434	25.802	1000.091	3950.470	13.4005	25.5033	30.9029
l1lbc3_2	8	16204	3147	0.2535	14.2716	29.1963	35.5038	1004.920	3793.895	16.6008	28.704	29.0026
l1lbc3_3	9	16202	3147	0.2901	15.6239	32.0784	39.8048	1101.528	4195.961	19.2011	29.2043	34.5036
l1lbc4_1	10	16208	3137	0.229	14.3585	30.3194	32.0031	1010.956	3949.856	14.4006	27.5038	30.2028
l1lbc4_2	11	16205	3137	0.3232	15.3829	31.5671	33.1033	1084.819	4117.746	11.0004	30.5046	29.2026
l1lbc4_3	12	16201	3137	0.7717	15.1506	32.1377	69.3144	1064.991	4208.983	26.8022	26.1034	29.1026
l1lbc5_1	13	16205	3100	0.1377	13.3896	27.1526	26.102	944.0662	3526.212	12.4005	26.3034	26.9023
l1lbc5_2	14	16202	3100	0.4129	13.9379	28.707	41.8052	980.1738	3735.907	15.6007	25.7031	26.9022
l1lbc5_3	15	16199	3100	0.465	14.6391	31.3908	53.5086	1029.469	4100.120	25.2019	25.703	26.8022
l1lbm1_1	1	15596	-781	0.6327	12.3983	24.5259	55.6093	868.9594	3174.446	19.0011	23.2025	23.8017
l1lbm1_2	2	15594	-781	0.5688	12.8025	25.4857	58.0101	899.4203	3302.498	24.4018	25.4032	25.3019
l1lbm1_3	3	15591	-781	0.2714	12.4389	25.4685	36.9041	871.2714	3297.705	17.2009	21.7024	27.7024
l1lbm2_1	4	15599	-786	0.2434	12.1378	24.1862	34.2035	851.0674	3124.413	15.6007	21.9024	23.3016
l1lbm2_2	5	15595	-786	0.6415	12.8454	25.7945	58.5103	899.923	3347.380	21.6014	22.7025	26.5022
l1lbm2_3	6	15591	-786	0.0075	13.8973	28.519	17.0009	976.955	3711.061	9.2003	23.4026	30.403
l1lbm3_1	7	15587	-833	0.2404	12.8354	25.2344	30.8028	904.4474	3271.802	12.2004	25.2029	25.402
l1lbm3_2	8	15586	-831	0.6465	13.1931	25.3964	57.2098	926.9707	3296.889	19.6012	24.0029	22.8016
l1lbm3_3	9	15585	-830	0.6758	13.6832	26.2098	59.2105	959.7554	3408.705	20.2012	23.3026	27.8023
l1lbm4_1	10	15579	-882	0.157	12.3815	24.5951	24.9019	873.9855	3186.981	10.2003	25.9034	26.4021
l1lbm4_2	11	15575	-881	0.4346	12.6552	25.7428	43.7057	886.2501	3343.810	16.4008	20.1021	27.0022
l1lbm4_3	12	15570	-880	0.43	12.8929	25.9023	43.8058	910.0779	3364.418	16.6008	27.0035	24.9019
l1lbm5_1	13	15568	-918	0.3122	11.4885	23.2326	35.5038	809.7624	3007.594	13.8006	23.7028	23.8017
l1lbm5_2	14	15566	-918	0.1621	12.5068	25.0196	29.3026	879.7156	3246.616	14.4006	22.5026	27.9024
l1lbm5_3	15	15563	-918	0.1078	13.5517	27.7129	25.502	957.1405	3603.539	13.2005	27.5036	27.8023
l1lba1_1	1	14674	-4320	0.898	13.2967	29.8396	74.8168	932.9036	3891.916	27.2022	25.6031	29.5027
l1lba1_2	2	14643	-4320	0.0386	12.2689	26.791	22.0015	857.6008	3467.295	13.2005	18.8018	23.9018
l1lba1_3	3	14611	-4320	0.0047	12.7921	27.6723	22.0015	898.2139	3587.397	14.6006	23.1024	27.0022
l1lba2_1	4	14661	-4352	0.7266	12.7713	29.2114	65.2128	897.9122	3807.397	25.602	26.4032	31.0029
l1lba2_2	5	14635	-4352	0.0025	11.0191	22.4433	30.0027	771.6824	2891.059	22.4015	19.3018	24.3018
l1lba2_3	6	14608	-4352	0.0777	12.6043	28.2552	22.0015	880.5198	3666.593	11.6004	19.0018	28.9026
l1lba3_1	7	14650	-4400	1.1173	13.0806	28.7432	88.1233	914.9043	3744.700	30.2027	23.9025	28.9026
l1lba3_2	8	14620	-4400	0.1329	12.2121	27.2045	26.7021	853.5802	3524.475	13.8006	19.4019	26.3022
l1lba3_3	9	14590	-4400	0	13.1917	29.0148	20.3012	927.0712	3767.915	18.001	24.2028	27.9024
l1lba4_1	10	14637	-4433	0.6912	13.4181	29.2051	52.5083	939.7419	3809.443	14.0006	22.1024	29.4028
l1lba4_2	11	14615	-4433	0.1014	11.0977	23.3326	38.2044	780.3224	3009.223	26.4021	22.4025	22.2015
l1lba4_3	12	14592	-4433	0	12.8057	29.5161	23.3016	901.029	3836.759	16.4008	23.9028	25.2019
l1lba5_1	13	14619	-4469	0.6525	12.4898	28.873	55.4092	875.2924	3764.745	19.2011	21.7022	28.7025
l1lba5_2	14	14597	-4469	0.202	11.2712	23.9341	36.304	792.781	3092.119	20.0012	23.2026	24.2018
l1lba5_3	15	14575	-4469	0	11.1949	25.1653	19.0011	787.054	3253.447	12.2004	22.3023	26.4021
l1lle1_1	1	10205	6846	0	16.3228	35.1235	27.8023	1153.679	4600.427	25.802	31.8047	31.5031
l1lle1_2	2	10229	6846	0	16.1112	34.9726	23.9017	1136.360	4577.920	21.6014	29.8045	31.8031
l1lle1_3	3	10252	6846	0	15.5033	33.8047	27.8023	1093.777	4425.587	22.6015	28.5038	33.8034
l1lle2_1	4	10210	6799	0	16.5235	35.0523	31.9031	1166.971	4590.252	28.4024	31.7049	33.5034
l1lle2_2	5	10228	6799	0	16.0913	34.8084	23.7017	1136.763	4555.313	22.4015	31.6052	31.6031
l1lle2_3	6	10245	6799	0	15.8241	34.1489	23.4016	1115.319	4463.272	24.0017	28.8039	29.3026
l1lle3_1	7	10216	6749	0.1806	16.4886	35.1828	35.8038	1166.165	4622.218	20.4012	31.6051	36.1041
l1lle3_2	8	10231	6749	0	16.0763	34.9372	25.2019	1136.058	4575.351	19.6012	30.8047	29.4026
l1lle3_3	9	10245	6749	0	15.8004	34.0061	24.9019	1115.42	4453.414	24.8018	28.904	32.1031
l1lle1_1	1	10177	5738	0.8827	12.2087	27.0591	71.8155	851.972	3507.523	24.8018	22.1022	26.9022
l1lle1_2	2	10180	5738	1.0885	12.26	27.4278	83.1207	853.4797	3557.465	26.8022	21.102	27.0022
l1lle1_3	3	10183	5738	0.9545	10.9482	25.8189	67.0135	761.2345	3342.483	17.4009	18.6017	25.902
l1lle2_1	4	10178	5711	1.1856	11.892	26.8443	90.9248	829.7604	3486.897	30.2027	22.2024	29.0026
l1lle2_2	5	10181	5711	1.0338	11.5202	26.8218	89.2239	804.8386	3478.831	35.8038	22.3023	25.1019

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l11lc2_3	6	10183	5711	0.7219	11.6427	27.0116	73.8163	811.4706	3501.090	34.6036	19.9019	28.0024
l11lc3_1	7	10177	5685	1.1248	11.4038	27.4893	94.6269	800.116	3571.664	37.4042	25.3031	25.502
l11lc3_2	8	10181	5685	0.9881	11.8118	27.6436	89.524	826.8459	3589.951	38.2044	23.6027	25.602
l11lc3_3	9	10185	5685	0.4066	11.2799	25.661	50.1075	790.3696	3317.899	25.0019	22.5025	26.7022
l11lc4_1	10	10173	5656	1.4376	11.5572	26.4018	120.6436	806.2454	3422.483	48.6071	23.7026	25.302
l11lc4_2	11	10177	5656	0.8429	11.4011	26.947	76.5176	794.2882	3492.105	32.0031	20.502	29.2026
l11lc4_3	12	10180	5656	1.0394	11.0575	26.9182	87.7231	771.1801	3488.327	34.6036	21.5023	26.1021
l11lc5_1	13	10172	5639	0.8754	12.1229	28.0405	71.0151	844.7354	3633.275	24.8018	21.4021	25.1019
l11lc5_2	14	10175	5639	1.1352	12.274	28.3296	88.6236	855.49	3674.259	30.6028	23.4025	28.2024
l11lc5_3	15	10178	5639	1.0625	11.8696	27.2131	90.0243	826.7454	3528.254	35.2037	21.5023	27.9023
l11lm1_1	1	9980	209	1.5667	11.247	27.5253	117.4414	783.9393	3592.607	40.0048	18.8016	24.9019
l11lm1_2	2	9983	212	1.327	12.6059	29.1346	101.5309	882.6309	3811.796	34.2035	21.2023	25.4019
l11lm1_3	3	9989	212	0.373	12.8448	29.8354	47.2067	907.1621	3895.191	23.6017	26.1032	26.5021
l11lm2_1	4	9980	204	1.6041	11.9447	27.6439	124.5465	835.4889	3609.159	44.606	22.5025	26.7021
l11lm2_2	5	9982	202	1.4771	11.6178	27.4595	118.7423	811.5712	3591.994	44.806	19.1019	27.8024
l11lm2_3	6	9984	202	1.0528	13.8321	30.901	93.126	972.9315	4050.939	38.0043	25.0032	28.6025
l11lm3_1	7	9981	190	1.3544	11.5046	26.5782	105.5334	804.6376	3471.072	37.0041	20.2019	28.4025
l11lm3_2	8	9984	189	1.7224	12.6231	29.3332	125.8475	887.8586	3850.572	40.2048	25.5032	28.9026
l11lm3_3	9	9987	189	1.1646	13.6413	30.9181	94.3267	961.063	4056.983	34.2035	26.7035	30.7029
l11lm4_1	10	9983	185	1.3855	11.1571	27.0299	112.8382	779.8201	3534.484	43.4057	18.5016	26.4021
l11lm4_2	11	9986	172	1.4038	12.0431	28.5601	113.9389	846.1425	3737.236	43.4057	23.903	26.4021
l11lm4_3	12	9988	183	0.9705	13.871	31.2987	91.4251	978.0614	4104.834	40.2048	27.1034	29.5028
l11lm5_1	13	9983	170	1.4342	11.9559	27.0002	112.638	840.6146	3530.399	40.0048	24.0027	25.7021
l11lm5_2	14	9985	168	1.4267	10.1998	25.3448	113.5387	715.3318	3308.108	42.6054	20.7021	25.302
l11lm5_3	15	9987	168	1.8035	12.5325	29.4482	140.3591	880.6204	3863.772	51.2079	25.6031	29.3026
l11la1_1	1	10742	-4428	1.2512	12.7674	27.4372	82.4204	897.0074	3579.428	17.801	25.9034	28.6025
l11la1_2	2	10801	-4428	0	10.4936	22.7695	24.6018	738.7336	2938.884	19.4011	20.5021	21.9015
l11la1_3	3	10860	-4428	0	13.2388	30.1707	18.101	936.1216	3938.389	12.4005	26.5034	29.8027
l11la2_1	4	10765	-4463	0.6892	12.2154	26.4187	58.8104	861.8224	3443.203	20.2012	25.403	27.8024
l11la2_2	5	10817	-4463	0	10.238	22.6179	23.3016	724.6721	2924.535	18.601	23.0024	23.0017
l11la2_3	6	10868	-4463	0	10.5301	23.9648	25.4019	743.8563	3104.751	18.8011	21.9023	24.6019
l11la3_1	7	10805	-4530	0.3157	10.9213	23.8432	42.6054	769.1708	3097.417	21.2013	20.9021	27.8024
l11la3_2	8	10849	-4530	0.0192	10.3031	22.8582	23.1016	727.2834	2957.815	15.2007	20.802	22.7016
l11la3_3	9	10892	-4530	0.06	10.9124	24.2809	23.5017	771.1801	3149.173	13.8006	22.6024	24.8019
l11la4_1	10	10822	-4577	0.4808	11.4374	25.1677	48.1069	808.2551	3274.147	19.2011	24.7031	26.2021
l11la4_2	11	10871	-4577	0.0467	10.1216	22.0382	29.4026	713.4236	2847.112	20.2012	20.0018	21.6014
l11la4_3	12	10919	-4577	0	10.4045	22.0318	27.5023	733.1088	2847.417	22.0015	20.0019	23.6017
l11la5_1	13	10830	-4608	0.7225	11.2886	24.3146	64.2124	796.0968	3162.420	24.0017	23.8027	25.1019
l11la5_2	14	10878	-4608	0	10.3456	22.2402	22.9016	731.3009	2874.984	19.4011	22.6025	25.0019
l11la5_3	15	10925	-4608	0.0488	12.4683	26.7422	22.2015	879.8161	3475.973	12.8005	24.1028	27.5023

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
112be1_1	1	9760	30514	0	16.2436	34.6781	25.2019	1148.141	4533.942	20.0012	34.1059	35.0038
112be1_2	2	9823	30514	0	15.8541	34.5191	20.7013	1114.514	4506.924	23.2016	28.1036	31.7031
112be1_3	3	9886	30514	0	15.5779	33.9683	17.7009	1096.595	4438.422	22.6015	28.3043	33.4035
112be2_1	4	9780	30465	0	15.9051	35.0044	20.6013	1120.352	4577.303	20.0012	29.8044	33.7035
112be2_2	5	9834	30465	0	16.2104	34.3326	22.8016	1142.905	4480.834	19.8012	31.2046	28.9026
112be2_3	6	9887	30465	0	15.3197	33.5517	20.1012	1081.397	4380.725	19.6012	31.6049	34.4037
112be3_1	7	9785	30425	0	16.1951	34.878	21.0013	1139.985	4558.704	22.6015	29.3042	32.5033
112be3_2	8	9837	30425	0	16.2133	34.6055	20.4012	1141.596	4523.771	25.4019	29.1042	32.4033
112be3_3	9	9889	30425	0	16.0203	34.0479	19.4011	1128.004	4443.453	22.0015	30.1047	32.4032
112bc1_1	1	10170	29169	1.446	13.22	27.7428	115.44	924.2557	3610.079	41.6052	24.8028	26.002
112bc1_2	2	10174	29169	1.1676	13.8645	28.7114	94.6269	970.4169	3736.929	33.6034	25.9032	28.8026
112bc1_3	3	10178	29169	0.798	10.8415	25.8637	74.1165	755.5085	3354.216	31.603	17.8015	25.0019
112bc2_1	4	10170	29163	1.152	12.7616	27.9058	92.9259	895.2982	3633.172	33.2033	25.5032	26.0021
112bc2_2	5	10174	29162	0.9742	14.1786	30.4252	88.3234	994.6592	3969.924	36.604	26.5034	29.7027
112bc2_3	6	10177	29161	0.9337	13.8109	30.0056	77.518	970.7187	3911.466	27.8023	27.9037	27.8023
112bc3_1	7	10170	29151	1.0298	12.4103	26.7634	94.0265	869.3615	3480.567	39.8048	23.6028	27.4023
112bc3_2	8	10174	29151	1.2584	13.1736	28.0287	98.9294	922.9484	3647.071	34.0035	26.0034	26.6021
112bc3_3	9	10178	29151	1.0195	13.4608	27.7352	89.424	942.4572	3605.174	35.2037	25.0029	27.2023
112bc4_1	10	10171	29139	1.3224	11.6792	24.8159	109.636	813.5809	3217.765	41.8052	20.7019	25.0019
112bc4_2	11	10177	29139	1.2987	13.2083	28.3293	98.6292	922.8479	3684.583	32.0031	24.5028	27.1022
112bc4_3	12	10182	29139	1.1399	13.1949	29.1079	91.325	922.9484	3787.553	32.4031	25.3033	29.2026
112bc5_1	13	10180	29103	1.242	13.5058	28.3031	105.6335	942.256	3675.076	41.4051	24.2029	26.0021
112bc5_2	14	10185	29103	1.2545	13.9192	29.5479	97.2284	975.0438	3841.977	32.6032	28.8042	28.3025
112bc5_3	15	10189	29103	1.5029	13.7571	29.5326	111.4372	963.8792	3845.354	35.4038	29.1041	28.8026
112bm1_1	1	11217	23888	1.1053	11.6652	25.3992	86.9227	810.7673	3295.563	29.4026	17.6015	25.9021
112bm1_2	2	11221	23888	1.0826	13.3678	28.0957	91.9253	934.8143	3656.780	35.0037	23.9027	29.6026
112bm1_3	3	11224	23888	0.9002	11.3441	26.44	77.0178	793.0825	3436.466	29.6026	20.702	28.1024
112bm2_1	4	11219	23881	1.3675	12.6603	26.9038	100.6304	887.1548	3501.294	30.6028	25.7033	27.7024
112bm2_2	5	11223	23881	1.1614	12.2354	26.4235	94.0265	851.972	3429.525	33.8034	19.6019	23.5017
112bm2_3	6	11227	23881	0.8428	11.7292	25.3449	78.5185	820.0123	3281.183	33.0033	21.6023	22.0015
112bm3_1	7	11222	23871	1.2418	12.0882	26.6604	87.0227	841.1171	3461.271	23.4016	19.9019	25.9021
112bm3_2	8	11226	23871	0.9563	11.8778	26.5409	77.518	827.7504	3440.243	27.2022	20.5021	25.6021
112bm3_3	9	11229	23871	1.0182	12.2261	27.1796	84.4214	853.5802	3526.109	31.2029	22.5025	26.0021
112bm4_1	10	11229	23842	1.2161	13.5356	27.7659	93.9265	937.9318	3603.335	30.6028	17.4014	24.7019
112bm4_2	11	11233	23843	1.2662	12.7633	27.705	100.3302	891.9805	3599.861	35.4038	24.7031	27.5023
112bm4_3	12	11236	23843	1.4007	11.8569	26.5958	110.3365	825.841	3454.432	39.6047	21.0022	25.402
112bm5_1	13	11263	23729	1.0856	12.5819	26.9238	86.7226	876.1971	3489.552	30.0027	21.402	25.202
112bm5_2	14	11266	23729	1.1176	12.9811	27.6445	88.3234	907.866	3589.134	30.0027	24.7029	25.1019
112bm5_3	15	11269	23729	1.6085	12.4018	27.1547	119.743	863.2297	3534.280	39.0046	21.1021	27.5025
112ba1_1	1	12287	20841	1.4136	13.1089	26.4999	102.4315	913.7982	3445.040	29.6026	22.2024	27.6023
112ba1_2	2	12299	20841	0.9717	11.6814	24.7814	76.6176	812.4755	3206.348	25.0019	18.3016	22.2015
112ba1_3	3	12311	20841	0.3069	9.958	22.2405	43.9058	698.0588	2859.929	23.2016	20.6021	19.8013
112ba2_1	4	12294	20833	1.1463	11.7545	25.2269	92.7258	819.7108	3270.782	33.2033	21.4022	27.1022
112ba2_2	5	12307	20833	0.4662	11.2387	23.5822	49.2073	784.1403	3040.177	20.8013	19.602	23.8018
112ba2_3	6	12320	20833	0.2451	11.1008	23.3493	40.905	778.715	3007.797	22.6015	22.9025	24.902
112ba3_1	7	12302	20812	0.9641	12.1488	25.4133	91.5251	845.4389	3281.999	40.2048	20.702	21.3014
112ba3_2	8	12314	20813	0.4825	11.3158	24.153	47.0066	790.3696	3115.856	18.001	20.9022	25.402
112ba3_3	9	12325	20814	0.2203	10.8273	23.0019	30.3028	757.2162	2960.868	13.2005	20.502	25.402
112ba4_1	10	12310	20795	1.097	11.4443	25.1842	94.3267	796.8001	3263.134	37.4042	20.0018	26.8022
112ba4_2	11	12321	20795	0.5624	11.4599	24.9569	56.7096	799.0107	3223.983	24.2018	19.4018	24.5019
112ba4_3	12	12331	20795	0.3852	10.0613	22.287	39.3046	702.9794	2870.813	15.0007	18.7018	23.6017
112ba5_1	13	12323	20761	1.1917	11.4192	24.4712	97.2284	797.6039	3167.210	35.6038	22.6025	22.9016
112ba5_2	14	12335	20761	0.5026	11.1659	23.6994	50.4076	779.7196	3060.443	20.4012	19.5019	24.9019
112ba5_3	15	12346	20761	0.2254	10.4739	23.9249	34.1035	732.3053	3084.989	17.2009	19.0017	24.1018
112le1_1	1	15915	32765	0	16.0887	35.2423	22.3015	1136.461	4610.088	22.2015	33.7056	36.5042
112le1_2	2	15732	32765	0	16.3581	35.359	20.4012	1150.356	4624.788	22.0015	28.3041	33.1035
112le1_3	3	15548	32765	0	16.3015	34.3664	19.3011	1146.832	4485.867	19.2011	28.804	29.4027
112le2_1	4	15888	32697	0	16.5306	35.4857	18.301	1165.057	4642.572	23.2016	31.0047	33.7035
112le2_2	5	15720	32697	0	16.3515	35.1346	17.7009	1153.175	4594.980	20.4012	31.6046	33.9036
112le2_3	6	15552	32697	0	16.3387	34.5372	20.4012	1147.537	4513.806	20.6013	26.9036	34.1036
112le3_1	7	15885	32560	0	16.6639	35.4777	22.4015	1175.732	4640.002	19.4011	32.4053	32.3032
112le3_2	8	15724	32560	0	16.3556	35.0177	22.6015	1149.349	4579.050	23.0016	27.5036	33.9038
112le3_3	9	15562	32560	0	16.1429	34.2564	20.1012	1132.635	4472.926	23.8017	26.2033	33.6035
112lc1_1	1	15900	28962	0.1915	13.3651	26.7616	21.8014	938.6357	3460.965	5.6001	26.4035	28.1024
112lc1_2	2	15899	28962	0.4455	13.6063	27.547	41.8052	952.7152	3569.723	14.0006	23.7027	25.6021
112lc1_3	3	15895	28962	0.5433	12.8639	26.6468	46.3064	903.0399	3454.738	14.2006	25.7031	28.9026
112lc2_1	4	15903	28954	0.2839	13.1311	26.0622	31.503	921.0379	3368.193	11.0004	24.9031	25.402
112lc2_2	5	15899	28954	0.5555	14.4888	28.8448	48.8071	1014.075	3746.848	15.8007	24.8029	30.403

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
112lc2_3	6	15894	28954	0.4741	13.9987	28.7796	42.2053	982.7891	3738.667	13.2005	26.6036	29.5027
112lc3_1	7	15903	28948	0.4452	13.7328	27.7566	39.2046	964.0803	3597.920	11.4004	26.3034	25.9021
112lc3_2	8	15899	28948	0.5474	13.8472	28.3044	42.4054	970.9199	3676.405	10.0003	26.0034	31.8031
112lc3_3	9	15895	28948	0.4528	14.8248	29.0728	42.6054	1038.223	3773.847	14.2006	24.8031	26.4022
112lc4_1	10	15905	28925	0.4071	14.6196	28.9621	35.8038	1028.664	3760.347	9.6003	29.8042	30.0027
112lc4_2	11	15903	28925	0.3939	14.3976	28.8942	43.5057	1011.158	3753.495	18.001	27.1036	30.3028
112lc4_3	12	15901	28925	0.3643	14.5647	29.7039	38.6045	1020.313	3857.735	14.6006	25.5031	30.2028
112lc5_1	13	15905	28917	0.2784	14.6013	28.8186	30.7028	1025.243	3736.724	10.4003	27.2035	27.1023
112lc5_2	14	15904	28917	0.4271	13.6973	28.3007	38.4044	962.6722	3675.894	11.6004	27.2034	31.203
112lc5_3	15	15903	28916	0.4865	14.4918	29.1663	45.7063	1012.264	3786.939	16.0008	23.5029	32.0032
112lm1_1	1	16023	25756	0.5097	13.4014	26.9703	43.4057	943.1611	3492.717	12.6005	28.604	24.7019
112lm1_2	2	16023	25756	0.3544	13.2913	26.5201	38.1044	930.5908	3431.771	14.4006	23.6027	27.3023
112lm1_3	3	16021	25755	0.1811	13.8717	28.0187	23.1016	974.1385	3631.435	7.4002	25.3031	25.8021
112lm2_1	4	16026	25734	0.4367	13.1578	26.2036	41.9053	921.239	3389.009	14.4006	23.8028	25.602
112lm2_2	5	16027	25740	0.5558	11.5875	23.556	48.6071	809.8629	3040.584	15.8007	20.9023	23.9017
112lm2_3	6	16023	25740	0.3309	14.5359	28.7383	34.9037	1021.520	3727.624	12.2004	28.2039	28.1025
112lm3_1	7	16032	25725	0.4282	11.4128	23.6094	44.4059	801.7236	3046.287	17.6009	24.3029	23.9017
112lm3_2	8	16029	25725	0.5269	11.9383	24.2015	52.9084	834.8859	3125.738	21.4014	21.6023	24.3018
112lm3_3	9	16026	25725	0.2392	14.1114	28.26	34.8036	993.0497	3664.241	16.4008	28.8037	29.5027
112lm4_1	10	16036	25707	0.8002	11.4862	24.0921	67.0135	801.1208	3116.772	23.2016	19.902	25.902
112lm4_2	11	16033	25706	0.5652	11.3147	22.7889	50.7077	789.3649	2938.986	17.4009	19.3017	23.3017
112lm4_3	12	16029	25705	0.3027	13.2208	26.0955	33.8034	924.1551	3371.662	12.4005	21.9021	24.3019
112lm5_1	13	16033	25696	0.3851	11.3117	23.1079	46.5065	788.4606	2975.017	21.6014	18.3017	20.9014
112lm5_2	14	16031	25694	0.5047	13.2652	26.481	56.8097	928.4791	3424.728	26.2021	24.303	25.402
112lm5_3	15	16027	25694	0.3434	14.0553	28.422	35.5038	989.6294	3683.152	12.4005	30.1042	27.3023
112la1_1	1	15937	22415	0.2271	11.1955	23.145	28.6025	785.2455	2980.412	11.0004	22.5024	23.3016
112la1_2	2	15891	22423	0.6589	12.6754	25.4223	50.5077	884.541	3290.463	12.8005	20.8021	26.2021
112la1_3	3	15847	22423	1.1165	11.9137	24.9821	78.0183	831.1674	3239.581	19.6012	21.9023	29.1026
112la2_1	4	15916	22388	0.5938	14.1292	28.5754	49.9075	990.5347	3717.093	15.2007	24.303	28.4025
112la2_2	5	15879	22388	0.6674	11.9598	24.3975	57.71	834.9864	3155.695	19.8012	21.1021	28.2025
112la2_3	6	15826	22388	0.6834	12.7789	26.5804	58.7103	894.1923	3441.366	20.2012	23.2025	22.6015
112la3_1	7	15899	22329	0.0991	10.7963	21.8633	20.7013	757.9194	2809.990	8.8002	21.9023	21.7014
112la3_2	8	15845	22329	0.7558	11.3096	23.6541	60.2109	788.4606	3056.369	18.401	18.9016	22.3015
112la3_3	9	15821	22330	0.8739	13.1339	29.2436	63.9123	916.5131	3812.205	17.2009	19.4018	27.1023
112la4_1	10	15872	22270	0.291	11.7341	23.4697	42.2053	821.7207	3030.707	21.4014	20.102	22.7016
112la4_2	11	15823	22266	0.7904	12.2279	25.8956	60.1108	852.9771	3358.501	16.8008	20.0018	27.3023
112la4_3	12	15779	22269	0.5859	11.8258	24.6332	57.2098	823.5296	3187.389	23.2016	17.7016	26.2021
112la5_1	13	15835	22187	0.4165	14.6136	29.9034	41.4051	1027.960	3890.074	15.0007	28.904	31.203
112la5_2	14	15780	22187	0.7937	12.0016	26.2	72.8159	836.9964	3400.438	29.6026	18.7016	24.802
112la5_3	15	15729	22187	0.8862	11.6979	24.7698	75.5171	818.5049	3209.304	27.8023	22.5024	26.1021

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l13be1_1	1	-8191	4553	0	16.7928	35.2488	18.501	1183.487	4605.258	20.0012	31.8052	31.2031
l13be1_2	2	-8408	4553	0	16.166	35.6501	19.2011	1136.360	4664.368	21.6014	28.2041	35.2038
l13be1_3	3	-8230	4487	0	16.277	35.7205	20.4012	1149.651	4672.388	22.2015	33.2057	31.3031
l13be2_1	4	-8390	4487	0	16.2851	35.1549	21.9014	1147.335	4600.427	21.8014	29.8042	34.2035
l13be2_2	5	-8308	4358	0	16.4274	35.5746	18.201	1159.318	4651.208	18.601	33.0055	32.5033
l13be2_3	6	-8479	4367	0	16.2632	35.4919	23.1016	1142.401	4640.516	25.4019	27.5034	33.0034
l13be3_1	1	-8447	4172	0	16.4941	35.7173	19.9012	1163.245	4673.313	21.8014	31.7049	32.8033
l13be3_2	2	-8522	4172	0	16.4732	35.1069	19.2011	1161.835	4589.533	24.6018	31.805	32.3032
l13be3_3	3	-8598	4172	0	16.0761	34.2993	19.7012	1137.367	4482.478	23.6017	35.0059	35.0038
l13bc1_1	1	-9627	2106	0.6951	13.0668	26.7222	62.8118	914.8037	3465.763	23.6017	24.0028	28.3024
l13bc1_2	2	-9629	2106	0.8511	14.04	29.0599	72.9159	984.7003	3782.234	26.6021	26.9037	31.1029
l13bc1_3	3	-9631	2106	0.725	14.4621	30.2234	69.8146	1014.276	3935.830	29.4026	26.7036	30.1027
l13bc2_1	4	-9653	2058	0.7301	13.6564	27.6513	63.1119	952.5141	3587.908	22.2015	21.5021	28.4025
l13bc2_2	5	-9655	2059	0.5548	14.0459	28.9033	56.1094	983.3926	3756.972	23.4016	24.203	30.3028
l13bc2_3	6	-9657	2060	0.6454	14.5448	29.8682	55.9094	1018.804	3885.264	19.0011	25.3031	28.4025
l13bc3_1	7	-9657	2052	0.5926	14.6282	29.918	59.3106	1027.960	3894.577	24.8018	28.504	31.7031
l13bc3_2	8	-9659	2052	0.8668	14.8957	31.2707	70.3148	1043.456	4080.036	23.4016	26.2034	31.9031
l13bc3_3	9	-9661	2052	0.8799	15.4959	31.9418	74.5167	1091.059	4169.612	26.8022	32.2047	31.3031
l13bc4_1	10	-9682	2001	0.6366	14.6174	29.9331	62.3116	1026.350	3893.349	25.802	28.3038	29.9029
l13bc4_2	11	-9686	2001	0.8722	15.066	30.8569	75.6171	1057.544	4023.281	28.2024	28.604	31.2029
l13bc4_3	12	-9690	2001	0.8266	14.9014	31.3498	69.2144	1046.173	4090.590	24.2018	28.9041	34.3036
l13bc5_1	13	-9687	1995	0.9143	13.3301	27.9184	74.5167	934.6132	3627.450	25.4019	26.7033	29.6026
l13bc5_2	14	-9689	1995	0.6268	14.2875	29.3976	59.0104	1003.009	3820.697	23.0016	27.8038	29.0026
l13bc5_3	15	-9691	1995	0.8276	15.2948	31.7007	74.0164	1072.137	4134.452	28.8025	27.6036	31.203
l13bm1_1	1	-12665	-1889	1.3799	13.4225	28.2279	104.1325	937.5295	3676.814	33.4033	23.8028	28.7026
l13bm1_2	2	-12669	-1891	1.0388	12.8153	27.567	89.424	896.002	3585.864	34.8036	23.1024	29.2026
l13bm1_3	3	-12670	-1890	1.1284	13.9882	29.3244	89.524	981.2803	3821.106	30.4028	27.0034	27.3023
l13bm2_1	4	-12685	-1902	0.8627	14.6197	30.85	69.7146	1024.338	4024.408	23.0016	25.203	28.7026
l13bm2_2	5	-12686	-1901	0.8363	15.1753	31.8395	73.9164	1065.394	4155.670	28.4024	28.6038	31.303
l13bm2_3	6	-12687	-1900	1.077	15.3461	31.8343	89.424	1077.773	4161.923	32.6032	30.0045	35.8041
l13bm3_1	7	-12699	-1926	0.9977	13.9801	29.3404	78.8186	980.2744	3823.663	25.802	26.6037	31.103
l13bm3_2	8	-12700	-1925	0.9232	14.564	30.0548	74.9168	1023.231	3913.411	25.2019	28.8042	26.3021
l13bm3_3	9	-12702	-1924	0.9751	15.3388	32.0661	79.8191	1076.666	4191.757	27.8023	27.9039	31.103
l13bm4_1	10	-12717	-1944	1.0806	14.3558	29.7275	82.6205	1002.506	3872.471	25.602	23.1026	27.4023
l13bm4_2	11	-12718	-1942	1.3091	14.9694	31.3342	100.1301	1047.380	4094.074	32.6032	26.0033	30.5028
l13bm4_3	12	-12719	-1940	1.1482	14.4695	31.3573	94.6269	1012.868	4095.918	35.0037	25.5032	30.2028
l13bm5_1	13	-12754	-1985	0.9496	13.391	28.0782	76.6176	935.8199	3654.736	25.802	22.4026	29.6026
l13bm5_2	14	-12752	-1983	1.0543	13.837	28.7636	82.1202	969.8134	3741.633	26.4021	26.8035	27.7023
l13bm5_3	15	-12754	-1981	1.016	14.4389	29.7655	79.619	1012.063	3874.620	25.602	27.7036	29.2026
l13ba1_1	1	-14009	-3564	0.6633	11.7761	25.7344	54.1088	821.0172	3331.466	17.0009	19.5018	26.1021
l13ba1_2	2	-14043	-3564	0.3309	11.363	24.6971	42.6054	796.2977	3189.326	20.6013	22.2023	25.602
l13ba1_3	3	-14077	-3564	0	11.6936	24.1696	19.5011	822.4241	3112.188	15.8007	24.5029	23.0017
l13ba2_1	4	-14028	-3596	0.7333	12.323	27.0199	55.3092	861.5209	3505.685	15.0007	22.0025	27.0023
l13ba2_2	5	-14064	-3596	0.0904	11.3762	23.5476	31.803	797.8049	3035.696	20.4012	21.7024	25.802
l13ba2_3	6	-14100	-3596	0	11.3628	23.5869	26.7021	798.2068	3038.751	19.6012	22.3022	23.3017
l13ba3_1	7	-14071	-3650	0.934	12.0063	25.3319	70.9151	840.1121	3280.163	21.0013	23.8028	25.402
l13ba3_2	8	-14101	-3643	0.1461	11.5397	23.5776	32.2031	807.5517	3039.464	18.201	20.402	25.0019
l13ba3_3	9	-14131	-3636	0	13.5594	29.2145	21.0013	953.1176	3793.383	16.8008	25.6033	31.4031
l13ba4_1	10	-14115	-3694	0.9443	11.3252	24.5529	71.5153	793.6853	3180.051	21.4014	23.9027	26.0021
l13ba4_2	11	-14143	-3685	0.2216	11.6358	23.5597	31.3029	815.2892	3034.780	13.8006	21.8024	21.8014
l13ba4_3	12	-14171	-3676	0	11.305	23.1469	21.5014	792.6805	2976.340	20.0012	20.8022	19.0011
l13ba5_1	13	-14169	-3742	1.1406	12.5042	26.3725	78.5185	870.6683	3426.361	19.0011	20.2019	29.6027
l13ba5_2	14	-14190	-3742	0.0459	13.0306	28.1354	25.602	912.1895	3651.772	16.4008	21.0021	31.6031
l13ba5_3	15	-14211	-3742	0	11.6418	23.5843	26.6021	818.9069	3035.595	19.4011	24.2028	22.2015
l13le1_1	1	-16480	6807	0	16.7183	35.436	23.3016	1181.573	4645.656	18.401	32.7054	36.6041
l13le1_2	2	-16399	6807	0	16.589	35.1897	20.7013	1177.343	4609.472	21.2013	37.5068	34.0035
l13le1_3	3	-16319	6807	0	16.5747	34.9852	24.0017	1165.964	4573.912	18.8011	28.3039	31.0029
l13le2_1	4	-16470	6763	0	16.8366	35.0994	23.7017	1186.508	4592.205	20.0012	31.2049	36.2041
l13le2_2	5	-16409	6763	0	16.6031	35.2871	17.3009	1169.388	4615.331	17.4009	30.3047	33.6036
l13le2_3	6	-16348	6763	0	16.4816	35.1684	18.701	1160.929	4599.913	21.2013	30.3046	34.3036
l13le3_1	7	-16489	6667	0	16.6333	35.3989	19.3011	1170.093	4631.469	20.0012	28.9041	34.5036
l13le3_2	8	-16427	6667	0	16.5388	35.1412	19.8012	1168.179	4595.905	20.2012	33.0051	31.7031
l13le3_3	9	-16365	6667	0	16.3916	35.0051	19.9012	1157.102	4579.153	19.8012	31.6048	31.103
l13lc1_1	1	-17357	3469	1.2138	12.2608	26.6856	96.3278	853.6807	3465.661	33.8034	20.102	25.8021
l13lc1_2	2	-17355	3469	1.4224	12.8628	27.7159	106.534	898.4149	3608.035	34.2035	23.9027	29.0026
l13lc1_3	3	-17353	3469	1.5543	12.465	28.0666	113.6387	869.5625	3655.861	35.8038	22.7024	27.5023
l13lc2_1	4	-17358	3456	1.2591	12.6001	27.8848	97.0282	880.2182	3627.552	32.6032	23.2024	27.2022
l13lc2_2	5	-17357	3459	1.2507	12.2617	27.8281	95.9276	853.6807	3619.071	32.2031	19.9019	25.8021

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
113lc2_3	6	-17355	3459	1.4808	13.0691	28.6898	112.638	913.5971	3738.054	37.8043	24.4029	26.1021
113lc3_1	7	-17360	3442	1.314	12.314	26.9463	93.3261	857.9023	3504.562	26.2021	20.5022	27.0022
113lc3_2	8	-17358	3443	1.5961	12.3345	27.0463	113.7388	861.0183	3519.471	33.6034	23.5027	27.2023
113lc3_3	9	-17356	3443	1.1318	12.7698	27.8645	90.9248	892.0811	3622.954	32.2031	23.0025	27.1022
113lc4_1	10	-17364	3417	1.2057	11.6646	26.7317	101.9312	816.9976	3475.156	40.4049	24.3028	28.1024
113lc4_2	11	-17360	3417	1.3511	12.6257	28.1833	103.332	880.0172	3669.148	34.8036	21.9022	29.6028
113lc4_3	12	-17356	3417	0.942	13.2277	29.0679	71.1152	923.6523	3778.654	21.2013	22.2025	24.2018
113lc5_1	13	-17371	3367	1.1907	12.4796	27.0264	87.523	869.0599	3510.281	26.002	20.3019	25.5021
113lc5_2	14	-17368	3367	1.4154	12.2439	26.6937	104.4327	853.2787	3470.357	32.6032	21.5021	27.1023
113lc5_3	15	-17365	3367	0.9722	12.423	27.2847	81.1197	870.4672	3544.8	29.8027	24.4027	26.1021
113lm1_1	1	-17820	28	0.8513	13.5201	28.4864	67.1135	942.96	3701.655	21.0013	21.6022	28.7026
113lm1_2	2	-17815	28	1.2064	12.8878	28.8899	80.2193	901.1295	3761.779	18.401	24.4032	29.5026
113lm1_3	3	-17811	28	0.9198	13.5733	30.2668	69.3144	949.5975	3945.248	20.6013	24.0029	30.2028
113lm2_1	4	-17820	20	0.9957	12.8893	28.4234	72.1156	896.002	3693.067	19.8012	18.6016	25.9021
113lm2_2	5	-17814	20	0.8741	12.626	27.9437	76.1174	883.7368	3632.150	29.4026	23.7027	28.5025
113lm2_3	6	-17808	20	0.5811	12.6355	28.9696	46.8066	881.5251	3765.665	13.8006	19.7019	28.1024
113lm3_1	7	-17820	20	0.3408	10.2353	25.6785	35.5038	715.9344	3324.326	14.0006	18.8018	27.1022
113lm3_2	8	-17817	22	1.3225	14.1473	30.2426	106.8342	991.8425	3943.610	39.0046	28.0039	28.1024
113lm3_3	9	-17810	20	0.9836	14.7405	32.0622	84.5214	1032.79	4192.578	32.6032	26.5036	35.8039
113lm4_1	10	-17821	6	1.0997	12.2498	26.6877	78.0183	850.8664	3461.782	20.8013	18.1015	24.7019
113lm4_2	11	-17815	6	1.145	12.7889	26.9929	84.9216	889.1655	3504.052	25.2019	19.0017	24.8019
113lm4_3	12	-17810	6	0.753	12.0506	27.5992	57.81	841.5191	3584.230	17.0009	20.702	27.4023
113lm5_1	13	-17823	-39	1.0933	11.9279	25.1383	76.1174	830.7654	3257.628	18.8011	20.0019	25.0019
113lm5_2	14	-17817	-39	1.0504	11.5353	25.9097	82.4204	805.6425	3359.725	27.8023	21.5021	24.1018
113lm5_3	15	-17812	-39	0.8668	11.6631	26.411	61.3113	814.0834	3423.707	15.2007	20.9022	25.402
113la1_1	1	-17718	-3752	0.9888	11.7692	24.2606	79.9192	823.8311	3139.493	27.2022	23.8029	24.5019
113la1_2	2	-17588	-3752	0.0036	12.6557	28.9142	17.3009	888.9645	3751.143	10.2003	23.9028	28.8025
113la1_3	3	-17459	-3752	0.0109	13.1713	28.8323	18.201	926.2668	3736.315	10.6003	26.1034	27.1023
113la2_1	4	-17698	-3807	0.9706	11.0606	23.678	84.6215	772.5865	3064.007	33.2033	21.6022	26.9022
113la2_2	5	-17554	-3807	0.0384	10.9697	23.8481	30.8028	769.4722	3072.970	22.0015	21.5025	25.302
113la2_3	6	-17411	-3807	0.0053	12.8606	27.4304	17.7009	898.616	3547.660	10.2003	20.002	25.802
113la3_1	7	-17678	-3902	0.9037	11.5421	25.8133	73.9164	807.3507	3346.666	26.002	22.7024	27.4023
113la3_2	8	-17550	-3902	0	10.7841	23.5336	22.6015	758.0199	3031.623	21.0013	22.7023	25.9021
113la3_3	9	-17422	-3902	0	13.165	28.079	18.9011	926.1662	3638.486	16.2008	26.0032	28.4025
113la4_1	10	-17664	-3956	0.9829	12.4582	27.0241	76.3175	870.7688	3511.2	24.4018	22.8025	29.1026
113la4_2	11	-17526	-3956	0	13.1378	28.7995	22.5015	923.4512	3735.191	17.801	25.1031	28.6025
113la4_3	12	-17389	-3956	0.005	11.1557	23.6788	21.1013	784.7431	3051.379	13.6006	23.5025	25.1019
113la5_1	13	-17642	-4052	1.0517	12.9328	28.5917	74.1165	905.3524	3722.716	19.2011	24.2028	28.6025
113la5_2	14	-17505	-4052	0	13.3895	30.0426	28.0024	940.7476	3901.333	22.0015	24.9029	28.0024
113la5_3	15	-17368	-4052	0	11.7411	24.3436	19.5011	822.1227	3138.78	13.2005	20.502	25.0019

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l14be1_1	1	-18395	5598	0	16.5975	35.9009	18.9011	1168.884	4693.262	19.8012	31.305	32.5032
l14be1_2	2	-18254	5598	0	16.3135	35.7209	19.3011	1148.644	4667.864	20.2012	30.8047	31.5031
l14be1_3	3	-18114	5598	0	16.3879	35.1008	19.1011	1153.578	4583.161	18.201	31.2047	33.7036
l14be2_1	4	-18335	5470	0	16.25	35.601	21.4014	1145.724	4652.75	19.0011	32.3052	32.7033
l14be2_2	5	-18207	5470	0	16.4446	35.4244	19.5011	1159.318	4630.647	16.2008	32.4052	34.8038
l14be2_3	6	-18080	5470	0	16.188	34.8495	20.8013	1141.294	4559.526	18.8011	31.1045	37.2043
l14be3_1	7	-18313	5365	0	16.4902	35.847	20.9013	1159.821	4690.177	23.0016	29.7042	36.7042
l14be3_2	8	-18190	5365	0	16.5706	35.426	21.1013	1167.474	4628.899	22.4015	31.8048	32.9033
l14be3_3	9	-18067	5365	0	16.3488	34.939	20.0012	1149.148	4560.759	21.4014	29.5042	33.3036
l14bc1_1	1	-17928	2250	0	13.2392	28.3583	0.8	924.9595	3664.548	0.6	21.5023	24.6019
l14bc1_2	2	-17924	2248	0	12.8118	29.3923	2.3	895.0972	3805.965	1.6	21.0021	27.4023
l14bc1_3	3	-17920	2246	0	12.9015	29.6187	0.8	904.6485	3834.406	2.4	24.803	27.5023
l14bc2_1	4	-17924	2218	0	13.8936	29.852	1.6	972.5292	3856.814	1	27.2036	31.1029
l14bc2_2	5	-17922	2218	0	14.4124	31.0216	1.2	1008.341	4012.731	0.4	26.7034	28.7026
l14bc2_3	6	-17921	2212	0	12.5221	29.3619	0.9	877.4034	3801.26	0.8	23.7026	28.5026
l14bc3_1	7	-17923	2191	0	13.7179	30.2051	0.9	956.537	3905.631	0.8	22.3023	28.6027
l14bc3_2	8	-17923	2193	0	13.8362	30.7784	0.8	967.5001	3984.977	1.2	24.1027	27.1022
l14bc3_3	9	-17920	2193	0	13.6007	30.368	1.1	949.3964	3937.160	1	21.3023	30.2028
l14bc4_1	10	-17924	2139	0	13.3942	29.3167	0.8	937.7306	3792.565	1.6	24.9029	30.3029
l14bc4_2	11	-17925	2134	0	13.4802	29.0515	0.6	944.5691	3757.790	1.2	24.9032	27.2023
l14bc4_3	12	-17924	2134	0	13.4103	29.24	1.5	938.6357	3788.678	0.4	23.3027	30.903
l14bc5_1	13	-17924	2111	0	12.2398	29.0912	1.2	853.0776	3760.245	1.6	20.1018	29.3027
l14bc5_2	14	-17925	2112	0	13.0966	28.3617	1.2	917.9208	3665.161	2.4	25.2031	28.4025
l14bc5_3	15	-17924	2112	0	12.3113	28.3835	0.8	861.8224	3669.557	1.2	22.7026	27.5024
l14bm1_1	1	-17546	-2251	1.2488	14.5623	30.4709	89.2239	1017.295	3963.575	24.8018	28.6038	34.9038
l14bm1_2	2	-17536	-2251	0.6249	14.2705	31.3615	59.2105	993.7538	4071.839	24.0017	23.4028	32.2032
l14bm1_3	3	-17526	-2251	0.4302	13.6997	29.9999	49.6074	954.2238	3885.366	23.2016	22.2024	28.3025
l14bm2_1	4	-17544	-2281	1.0264	14.2207	31.6847	78.4184	996.1682	4119.796	25.0019	30.5048	31.8031
l14bm2_2	5	-17536	-2281	0.8395	13.8608	30.6585	63.1119	966.4942	3974.634	18.201	25.1032	26.4022
l14bm2_3	6	-17528	-2281	0.3039	12.861	29.3733	37.2042	897.4095	3801.157	16.8008	22.7025	28.8025
l14bm3_1	7	-17543	-2298	1.5189	14.354	30.7241	110.2364	996.0676	3997.368	33.6034	22.5025	31.4031
l14bm3_2	8	-17538	-2298	0.5566	13.544	29.7756	59.5106	945.7759	3858.451	27.4023	24.9027	29.7028
l14bm3_3	9	-17533	-2298	0.8286	14.2738	30.9572	66.0131	995.1622	4015.292	21.4014	25.3032	27.6024
l14bm4_1	10	-17544	-2306	1.0409	13.6108	30.0789	80.2193	949.8992	3907.167	26.002	25.503	30.0027
l14bm4_2	11	-17535	-2306	0.4577	12.5706	27.2755	51.9081	877.6045	3521.208	24.2018	23.6025	26.5021
l14bm4_3	12	-17526	-2306	0.4187	14.7097	30.5163	46.7065	1030.576	3956.613	20.4012	28.404	29.4026
l14bm5_1	13	-17543	-2320	1.0019	13.008	29.2244	72.4157	901.4312	3788.473	20.2012	18.9017	27.4024
l14bm5_2	14	-17536	-2319	0.8199	13.9277	31.2281	76.1174	973.4344	4056.061	32.2031	26.8038	29.5027
l14bm5_3	15	-17529	-2318	0.6374	13.7968	30.2474	55.4092	960.6606	3921.805	19.6012	22.6024	29.1026
l14ba1_1	1	-17313	-5053	0.9543	13.7632	30.3099	75.5171	962.1693	3937.570	25.2019	26.5034	28.6025
l14ba1_2	2	-17284	-5053	0.1079	12.1459	27.9137	22.4015	849.5598	3609.568	10.8004	22.2023	28.6027
l14ba1_3	3	-17256	-5053	0.0863	13.5525	29.7436	20.5013	950.8044	3856.507	9.6003	25.9032	30.2027
l14ba2_1	4	-17308	-5097	1.0944	13.8932	30.8153	91.325	972.2274	4015.189	34.6036	27.0036	32.7034
l14ba2_2	5	-17278	-5097	0.0861	12.927	29.3656	22.5015	905.7545	3807.090	11.8004	24.0027	31.0029
l14ba2_3	6	-17248	-5097	0	13.6533	29.2729	18.001	954.6261	3789.598	12.4005	23.0026	29.5027
l14ba3_1	7	-17301	-5161	1.3599	12.4808	29.0713	90.6246	869.0599	3780.188	22.4015	22.9025	30.6028
l14ba3_2	8	-17264	-5159	0	13.7142	30.0141	20.9013	958.4479	3880.249	13.8006	24.0026	26.8022
l14ba3_3	9	-17227	-5158	0	12.8712	29.6551	14.4006	897.8117	3831.132	11.2004	21.4022	25.2019
l14ba4_1	10	-17295	-5210	1.085	12.469	29.141	64.5125	868.2557	3774.358	9.0002	23.8027	26.4022
l14ba4_2	11	-17241	-5210	0.038	14.4507	31.1991	26.8022	1010.152	4035.778	18.001	27.0035	31.6032
l14ba4_3	12	-17188	-5210	0	13.8468	29.74	20.4012	967.1983	3842.080	14.4006	25.1029	31.3031
l14ba5_1	13	-17284	-5259	1.2191	13.7144	30.3531	88.2233	952.6147	3936.546	26.002	24.0028	30.703
l14ba5_2	14	-17234	-5259	0.0726	13.4501	28.1411	23.5017	939.3397	3627.450	13.0005	24.9029	28.7026
l14ba5_3	15	-17185	-5259	0	13.5331	29.2971	18.601	944.4685	3783.257	14.0006	23.5027	29.5027
l14le1_1	1	-9690	4289	0	16.0833	35.0093	22.4015	1129.011	4560.245	21.8014	30.6045	34.7037
l14le1_2	2	-9827	4289	0	16.4898	35.1996	21.0013	1154.585	4581.209	18.8011	28.6037	32.4032
l14le1_3	3	-9964	4289	0	15.9697	34.6207	21.2013	1120.957	4502.096	19.4011	31.0049	31.503
l14le2_1	4	-9706	4215	0	16.5081	35.1266	21.2013	1160.727	4578.331	21.6014	32.9052	37.1042
l14le2_2	5	-9836	4215	0	16.3305	35.2965	20.7013	1141.999	4588.505	22.6015	27.6037	28.8025
l14le2_3	6	-9966	4215	0	15.9388	34.827	18.601	1118.339	4527.675	21.8014	30.5045	29.1026
l14le3_1	7	-9757	3988	0	16.3862	35.2826	21.6014	1149.349	4595.699	21.2013	31.1046	37.9044
l14le3_2	8	-9858	3988	0	16.3315	34.9538	21.0013	1144.113	4549.148	19.8012	29.1043	33.6036
l14le3_3	9	-9960	3988	0	16.1845	34.8265	21.0013	1136.662	4526.442	20.2012	32.4052	30.4029
l14lc1_1	1	-10141	1516	0.3397	13.1351	27.3925	30.0027	913.3961	3530.909	7.4002	21.6022	28.1024
l14lc1_2	2	-10142	1516	0.1301	13.0904	26.4011	21.3014	916.312	3395.642	8.0002	26.5035	25.202
l14lc1_3	3	-10144	1516	0.4016	13.4811	28.6829	34.1035	939.3397	3708.709	8.8002	22.9025	29.9028
l14lc2_1	4	-10140	1505	0.4209	13.0635	27.1352	33.0033	915.407	3511.710	6.6001	26.1034	31.303
l14lc2_2	5	-10142	1505	0.5449	14.0632	27.7987	46.9066	982.2861	3597.409	14.4006	24.503	28.1024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l14lc2_3	6	-10145	1505	0.3491	14.434	30.048	36.1039	1009.648	3890.995	13.0005	26.3032	27.2023
l14lc3_1	7	-10144	1483	0.2564	13.097	27.1978	27.5023	913.5971	3514.978	8.6002	21.4023	28.3025
l14lc3_2	8	-10145	1483	0	12.5986	26.3311	18.601	884.6415	3388.397	11.6004	27.7039	26.8022
l14lc3_3	9	-10147	1483	0.5445	13.0505	28.1486	45.7063	909.4747	3639.304	14.0006	22.7024	27.7023
l14lc4_1	10	-10145	1465	0.3903	13.2208	26.6026	37.8043	927.9763	3429.015	12.6005	29.204	25.3019
l14lc4_2	11	-10147	1465	0.4339	13.9422	28.7725	43.4057	973.3339	3717.706	16.4008	25.3031	27.0022
l14lc4_3	12	-10149	1465	0.6864	15.0538	30.569	60.3109	1052.915	3958.046	21.6014	29.5042	27.1023
l14lc5_1	13	-10151	1414	0.7593	12.6246	25.2098	57.4099	878.2076	3244.985	15.2007	22.8025	24.3018
l14lc5_2	14	-10154	1414	0.7624	13.4702	26.7573	57.0098	939.6414	3454.840	14.6006	25.5032	28.3024
l14lc5_3	15	-10157	1414	0.7972	14.4449	29.8973	63.6121	1007.838	3872.266	20.0012	26.8036	29.4027
l14lm1_1	1	-10856	-2756	0.5938	12.8492	28.58	55.9094	898.3144	3701.348	22.2015	25.003	29.4026
l14lm1_2	2	-10858	-2755	0.4814	14.2079	29.276	39.2046	987.6175	3785.609	10.0003	20.902	25.402
l14lm1_3	3	-10861	-2755	0.1721	15.1273	31.1564	23.5017	1061.167	4037.212	8.4002	30.3045	31.403
l14lm2_1	4	-10860	-2786	0.4493	14.104	28.7581	40.0048	986.6116	3717.502	12.2004	27.5035	28.7026
l14lm2_2	5	-10861	-2783	0.3787	14.1631	28.9218	35.4038	989.5288	3744.700	10.8004	24.6028	29.2026
l14lm2_3	6	-10864	-2783	0.6615	13.7206	28.4772	47.4067	956.8387	3683.458	10.0003	23.9028	25.502
l14lm3_1	7	-10862	-2806	0.4371	12.8125	27.7434	41.2051	892.9859	3584.230	14.4006	21.8023	25.9021
l14lm3_2	8	-10863	-2803	0.3176	13.7006	27.4824	36.304	955.9336	3544.289	14.4006	23.8027	24.9019
l14lm3_3	9	-10866	-2803	0.5262	14.4785	29.6631	46.5065	1008.642	3842.387	15.2007	23.4026	30.1029
l14lm4_1	10	-10864	-2821	0.328	13.7544	27.843	45.5062	962.4711	3594.548	23.2016	27.1037	28.9026
l14lm4_2	11	-10865	-2821	0.7215	13.9869	28.4589	56.3095	978.9667	3682.129	16.0008	28.904	30.0028
l14lm4_3	12	-10867	-2821	0.4053	14.2337	28.6426	41.5052	996.1682	3705.131	15.6007	27.5037	30.5028
l14lm5_1	13	-10864	-2838	0.579	13.6352	27.2602	49.7074	950.905	3518.246	15.8007	24.703	27.1023
l14lm5_2	14	-10866	-2837	0.4603	13.9749	28.5005	42.3054	977.1561	3683.867	14.0006	27.0034	29.2027
l14lm5_3	15	-10869	-2837	0.4807	13.7826	28.529	42.1053	964.7844	3687.036	13.0005	28.4039	30.0028
l14la1_1	1	-11152	-4790	0.2631	13.0192	29.039	34.5036	906.8605	3750.632	15.8007	22.1024	27.5024
l14la1_2	2	-11182	-4790	0.0483	12.5608	29.0632	18.9011	875.795	3750.734	10.0003	21.8023	26.9022
l14la1_3	3	-11213	-4790	0	13.5998	29.7944	16.8008	950.3015	3850.163	14.6006	24.7031	30.0027
l14la2_1	4	-11151	-4819	0.1804	11.8271	25.7895	26.3021	823.5296	3318.205	11.2004	20.6019	27.1023
l14la2_2	5	-11185	-4819	0	13.6102	30.188	23.0016	955.0284	3905.017	17.4009	28.204	30.2028
l14la2_3	6	-11219	-4819	0	13.0116	29.3467	23.8017	911.184	3791.849	17.4009	25.6034	29.2026
l14la3_1	7	-11150	-4849	0.2795	13.5511	29.532	36.404	944.5691	3820.389	16.8008	22.8025	29.7027
l14la3_2	8	-11189	-4849	0	12.7502	28.8881	18.601	892.3827	3729.976	13.2005	24.8031	28.4025
l14la3_3	9	-11228	-4849	0	13.0136	28.9556	15.2007	911.5862	3736.315	10.4003	25.903	25.902
l14la4_1	10	-11156	-4895	0.2866	13.5877	29.7042	34.5036	946.681	3841.875	14.6006	22.4024	28.1025
l14la4_2	11	-11197	-4895	0.0441	12.4784	28.4395	15.2007	870.4672	3671.703	6.4001	21.3023	27.3024
l14la4_3	12	-11239	-4895	0	12.9184	28.3573	20.1012	904.548	3659.949	14.8007	25.0031	27.4023
l14la5_1	13	-11162	-4936	0.3423	14.1571	30.2142	34.6036	988.2211	3915.356	12.0004	24.4029	31.103
l14la5_2	14	-11199	-4936	0.0529	11.8491	27.4155	18.9011	823.9316	3534.280	9.8003	18.5015	27.5023
l14la5_3	15	-11237	-4936	0.0262	11.7817	26.3576	13.9006	818.103	3388.805	5.8001	17.3014	22.8017

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
115be1_1	1	15712	33179	0	16.7276	35.2556	19.1011	1176.437	4592.513	19.0011	33.4054	33.9036
115be1_2	2	15630	33179	0	16.2921	35.4521	21.4014	1141.999	4616.77	24.4018	29.104	31.203
115be1_3	3	15548	33179	0	16.1372	34.8052	18.601	1136.562	4528.600	16.2008	35.0061	33.1033
115be2_1	4	15713	33122	0	16.6492	35.7684	22.3015	1166.769	4657.788	18.601	29.7042	31.8032
115be2_2	5	15636	33122	0	16.4388	35.2751	20.2012	1154.484	4589.841	19.6012	32.6054	33.1034
115be2_3	6	15558	33122	0	16.2897	35.2499	18.601	1142.301	4583.469	19.8012	31.3047	32.4033
115be3_1	7	15711	33018	0	16.3449	35.2733	19.6012	1144.616	4588.814	21.2013	29.8043	34.6038
115be3_2	8	15668	33018	0	16.5177	35.8234	19.1011	1158.009	4661.283	21.6014	31.2047	32.5032
115be3_3	9	15625	33018	0	16.6057	35.4733	19.9012	1163.648	4615.947	18.8011	30.2044	32.4033
115bc1_1	1	15567	29022	1.329	13.6741	29.2803	91.1249	951.8101	3803.612	23.2016	23.2026	26.6023
115bc1_2	2	15564	29022	1.0857	14.1269	29.5165	77.9182	984.5997	3830.416	21.0013	25.0028	29.0026
115bc1_3	3	15561	29022	1.6198	14.8914	31.3007	114.039	1038.324	4074.708	32.4031	27.5035	28.9026
115bc2_1	4	15563	28992	1.143	14.0631	30.2568	86.4224	981.1797	3931.632	27.2022	26.0034	30.1028
115bc2_2	5	15562	28994	1.0505	14.4573	30.5369	79.9192	1007.636	3965.418	24.8018	26.0031	31.9031
115bc2_3	6	15558	28994	0.8182	14.7279	31.3232	71.5153	1030.375	4067.433	27.2022	29.7043	33.3034
115bc3_1	7	15556	28918	1.0022	13.187	27.412	76.4175	918.1219	3539.795	23.4016	24.6031	24.8019
115bc3_2	8	15554	28918	1.2281	14.0548	29.0953	87.4229	975.245	3765.154	24.0017	24.1028	30.1028
115bc3_3	9	15551	28917	1.2824	13.972	29.7101	96.0277	971.4228	3849.549	30.4028	25.503	29.6028
115bc4_1	10	15545	28853	1.1819	13.2463	27.533	82.4204	918.5241	3557.261	21.2013	22.9025	29.7027
115bc4_2	11	15543	28853	1.1053	15.0009	31.7776	83.2208	1046.978	4130.763	25.602	27.9037	30.5028
115bc4_3	12	15540	28853	0.973	14.7364	31.3805	85.8221	1031.783	4072.761	34.4035	30.5047	27.1022
115bc5_1	13	15541	28819	1.1627	14.3677	30.9402	95.1271	1000.695	4024.612	35.0037	24.5029	31.403
115bc5_2	14	15540	28820	1.0923	14.0962	28.7026	82.7205	983.9962	3721.489	25.2019	26.7036	29.0026
115bc5_3	15	15536	28819	1.2177	14.7183	31.9727	97.3284	1023.835	4158.746	34.8036	24.0028	28.4024
115bm1_1	1	15015	26245	1.6552	13.8539	29.5874	116.7409	961.6664	3842.898	33.8034	23.6027	29.3027
115bm1_2	2	15007	26245	1.0277	13.7534	29.3281	82.9206	958.5485	3795.736	29.0025	25.9032	25.502
115bm1_3	3	14999	26245	1.2614	13.5615	28.6617	98.0288	944.0662	3713.105	33.2033	25.0032	27.2024
115bm2_1	4	15014	26238	1.3156	13.9297	28.1406	96.3278	969.0088	3641.041	28.4024	25.0032	24.8019
115bm2_2	5	15008	26238	1.5906	13.9068	31.2944	114.039	965.7902	4073.068	34.8036	23.0026	28.7025
115bm2_3	6	15002	26238	1.0645	13.0407	29.6087	77.418	907.0616	3847.605	22.4015	21.5022	30.4029
115bm3_1	7	15007	26224	1.173	13.0885	28.8873	87.2228	912.0889	3744.598	27.0022	25.103	28.7025
115bm3_2	8	15006	26224	2.031	13.2443	28.592	128.7497	919.5296	3716.786	28.4024	23.7029	27.7024
115bm3_3	9	14997	26224	1.197	13.0221	27.6934	84.7215	908.7709	3592.812	22.8016	24.403	26.9023
115bm4_1	10	15006	26215	1.2509	12.6035	27.7281	88.2233	874.5887	3584.434	24.4018	21.3021	21.7015
115bm4_2	11	15003	26215	1.4932	13.034	28.2121	106.3339	905.4529	3661.278	31.0029	22.0022	26.4021
115bm4_3	12	14997	26215	1.3341	13.0571	28.9639	99.0294	905.855	3757.075	31.403	20.6019	25.202
115bm5_1	13	14975	26104	1.388	13.0032	27.9182	110.7368	905.5534	3621.012	40.2048	24.4029	28.4025
115bm5_2	14	14967	26104	1.4933	14.5381	31.4261	108.035	1015.182	4094.484	32.6032	27.2037	28.3024
115bm5_3	15	14962	26103	1.6178	14.3124	30.2767	115.0397	1000.292	3939.106	33.6034	29.5042	30.2029
115ba1_1	1	13953	22336	0.8404	12.3184	24.8525	73.116	854.2838	3206.857	27.2022	18.9018	27.2023
115ba1_2	2	13945	22336	1.4531	14.3005	30.0585	103.8323	992.949	3902.970	30.0027	23.0026	27.1023
115ba1_3	3	13937	22336	1.3207	13.271	29.0291	89.7241	923.6523	3764.438	22.6015	24.6028	28.2024
115ba2_1	4	13932	22305	1.0685	13.0768	27.1411	77.7181	905.855	3507.830	21.6014	19.7018	26.2021
115ba2_2	5	13924	22309	1.2447	13.6399	28.5869	99.4296	954.7267	3707.278	35.2037	29.3041	27.9024
115ba2_3	6	13916	22312	0.6674	12.7285	27.6762	56.6096	888.5623	3572.788	19.4011	24.803	24.1018
115ba3_1	7	13893	22202	1.69	12.6276	26.1467	120.1433	874.8903	3380.131	35.2037	22.2024	25.1019
115ba3_2	8	13884	22202	1.7595	12.6723	28.2599	131.0515	878.6098	3667.308	44.0058	22.5026	29.9027
115ba3_3	9	13874	22202	1.3306	13.7017	29.4119	103.4321	954.0227	3814.967	35.6038	25.4032	28.1026
115ba4_1	10	13874	22151	1.7154	13.0505	27.4004	118.4421	903.442	3547.251	32.6032	22.5025	29.5027
115ba4_2	11	13863	22151	1.3805	13.5736	28.9099	96.5279	940.5464	3737.849	26.4021	22.4024	23.2018
115ba4_3	12	13852	22151	0.6873	10.1419	25.4241	58.4102	704.8875	3275.371	21.6014	19.1018	25.2019
115ba5_1	13	13848	22091	1.1948	11.3948	23.3933	102.3314	790.2692	3016.859	40.2048	19.2019	23.2017
115ba5_2	14	13833	22091	1.2813	12.6562	27.3816	107.2345	880.6204	3543.574	41.8052	23.9029	26.8022
115ba5_3	15	13815	22091	1.1246	12.4417	25.6787	78.6185	863.6318	3315.859	19.8012	20.6021	23.6017
115le1_1	1	9123	31457	0	16.5628	34.7904	28.0024	1163.144	4531.784	25.2019	30.4047	31.603
115le1_2	2	9182	31457	0	16.5191	35.3542	23.9017	1160.727	4611.733	22.0015	29.8044	30.2028
115le1_3	3	9240	31457	0	16.1354	35.134	21.5014	1131.226	4582.647	21.4014	27.5038	33.2033
115le2_1	4	9198	31363	0	16.3307	35.619	22.5015	1146.932	4646.376	19.6012	30.2045	33.4034
115le2_2	5	9239	31363	0	16.2342	35.0679	20.9013	1141.999	4568.98	19.8012	32.0052	30.903
115le2_3	6	9279	31363	0	16.1669	34.2897	21.3014	1132.132	4460.910	22.0015	28.0038	33.0034
115le3_1	7	9220	31323	0	16.3093	35.3776	25.902	1144.214	4609.780	23.4016	30.7049	36.7042
115le3_2	8	9257	31323	0	16.1522	34.7225	20.6013	1130.219	4516.375	21.2013	28.2037	34.4036
115le3_3	9	9293	31323	0	16.2627	34.9067	18.401	1138.777	4538.668	17.4009	29.1041	31.8034
115lc1_1	1	10547	28564	1.6957	12.8885	26.6008	122.0447	897.7112	3452.696	36.604	25.3032	30.7029
115lc1_2	2	10553	28571	1.5763	12.8068	27.6359	107.7348	889.2661	3574.831	28.8025	24.9031	28.5025
115lc1_3	3	10562	28575	0.9619	12.1547	26.33	84.2213	843.4287	3395.336	33.6034	21.9024	28.3024
115lc2_1	4	10556	28553	1.5599	13.2602	28.722	117.3413	921.4401	3715.048	39.2046	25.8033	24.9019
115lc2_2	5	10564	28553	1.5937	13.3578	29.9831	123.2456	928.2779	3888.743	44.0058	25.303	27.7024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
115lc2_3	6	10571	28553	0.9133	11.5695	25.6603	72.6158	805.4415	3309.637	24.4018	22.6022	25.9021
115lc3_1	7	10571	28519	1.6031	12.6145	28.2329	110.9369	873.885	3667.001	31.0029	19.502	27.3023
115lc3_2	8	10585	28519	1.3468	12.5613	26.9292	92.9259	872.6787	3482.405	24.4018	23.2027	26.8022
115lc3_3	9	10595	28519	0.5736	11.8297	26.6999	53.2085	823.9316	3442.999	20.6013	22.0024	26.002
115lc4_1	10	10580	28485	1.5601	12.7229	27.8677	105.3333	881.123	3610.896	27.2022	20.6019	26.3021
115lc4_2	11	10588	28485	1.7167	12.5423	26.9939	115.8402	869.663	3493.943	30.2027	22.2024	23.9018
115lc4_3	12	10596	28485	1.0415	13.2578	29.2697	81.62	921.9429	3799.214	27.4023	22.4025	32.0031
115lc5_1	13	10587	28458	1.3839	11.6518	25.9504	94.0265	807.3507	3357.480	24.2018	19.1017	24.702
115lc5_2	14	10598	28458	1.1817	12.9352	29.1836	87.623	899.0182	3789.189	27.2022	21.6021	29.4027
115lc5_3	15	10609	28458	1.1844	12.5405	28.1552	94.2266	875.795	3647.786	33.6034	25.2032	23.1018
115lm1_1	1	11399	26017	1.3189	13.4948	29.1261	88.2233	938.7363	3788.882	20.8013	21.5021	28.5025
115lm1_2	2	11401	26014	1.5994	13.6029	29.5649	109.9362	947.2844	3848.833	29.6026	23.4026	26.6021
115lm1_3	3	11403	26014	2.5748	13.951	30.8669	168.9856	972.2274	4037.212	43.4057	27.5037	32.3032
115lm2_1	4	11399	25999	1.482	12.9404	27.1269	96.1277	895.4993	3518.348	20.8013	17.8016	24.9019
115lm2_2	5	11402	25999	1.5969	14.6442	31.6679	115.8402	1020.514	4130.353	35.6038	25.5032	30.6029
115lm2_3	6	11405	25999	1.8227	13.7186	30.3527	136.0555	957.4422	3960.504	45.6062	26.1035	30.0027
115lm3_1	7	11401	25982	0.8666	11.8405	24.3488	64.4124	822.9266	3144.486	17.4009	18.8017	24.1018
115lm3_2	8	11408	25982	1.2659	11.4396	25.4108	87.1228	795.7953	3288.832	22.6015	20.6021	23.7018
115lm3_3	9	11414	25982	1.7297	13.4073	29.8186	119.4428	933.9092	3885.468	33.4033	23.8027	27.3022
115lm4_1	10	11456	25639	1.5321	11.4403	24.9539	98.7292	793.7858	3233.668	21.6014	18.7016	23.0017
115lm4_2	11	11462	25639	1.5392	11.9412	26.246	98.9294	831.6699	3407.990	21.6014	22.4023	27.8023
115lm4_3	12	11467	25639	1.3612	12.0015	26.4666	94.4267	836.8959	3431.873	25.4019	23.3024	26.1021
115lm5_1	13	11461	25531	1.1672	11.8925	25.9846	89.2239	826.7454	3369.622	29.0025	19.7018	28.4025
115lm5_2	14	11466	25539	1.4463	12.7822	27.7366	107.8349	889.2661	3603.335	34.6036	21.7024	26.6022
115lm5_3	15	11471	25546	1.4996	12.8764	28.2991	100.7304	896.3036	3676.814	25.2019	22.3024	24.3018
115la1_1	1	12518	21343	0.939	12.2521	26.7665	67.5137	854.3843	3467.703	17.801	22.2025	27.3022
115la1_2	2	12523	21337	1.156	13.0794	28.0082	92.8258	912.1895	3628.778	33.0033	25.5033	28.7026
115la1_3	3	12556	21337	0.8766	12.0574	26.6485	63.4121	839.911	3440.447	16.8008	23.0026	25.0019
115la2_1	4	12526	21301	0.7755	13.885	29.0164	58.9104	967.1983	3751.552	16.4008	24.7031	26.1021
115la2_2	5	12537	21301	0.802	12.1881	27.1685	62.7118	849.4592	3507.319	19.6012	23.7028	25.6021
115la2_3	6	12570	21301	0.4792	12.0793	27.4148	43.3056	841.0166	3534.586	15.0007	21.6022	24.1018
115la3_1	7	12535	21256	0.2097	13.3956	27.5416	24.6018	934.5126	3549.498	7.8002	23.9028	26.9022
115la3_2	8	12565	21256	0.4924	11.6158	25.9699	44.806	808.858	3346.054	15.8007	21.4022	26.7023
115la3_3	9	12595	21256	0.7063	12.2779	27.4438	52.7083	856.0931	3545.413	14.0006	23.8027	28.4024
115la4_1	10	12615	21173	1.0783	13.6895	29.5286	80.9196	957.4422	3827.858	24.8018	29.3041	30.1028
115la4_2	11	12631	21174	0.6638	12.7542	27.4692	53.9087	886.9538	3545.719	16.8008	21.9023	26.5021
115la4_3	12	12647	21175	0.6965	11.7044	24.8853	56.5096	812.6765	3201.965	17.801	19.6019	22.1015
115la5_1	13	12659	21147	0.8808	12.5549	28.6236	69.7146	878.3082	3709.016	23.2016	27.0037	31.0029
115la5_2	14	12665	21150	0.8393	12.8228	27.7454	59.7107	893.388	3585.354	14.6006	24.2026	27.3022
115la5_3	15	12670	21153	0.679	12.5236	27.2521	53.9087	870.7688	3517.020	16.2008	21.6023	26.2021

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
116be1_1	1	16414	6004	0	16.5263	36.0642	22.0015	1160.929	4705.294	19.8012	30.6046	31.803
116be1_2	2	16255	6004	0	16.3094	35.9409	20.6013	1146.932	4694.599	16.8008	30.5044	33.0033
116be1_3	3	16095	6004	0	16.2665	35.4262	21.3014	1143.811	4620.984	22.2015	30.4047	29.5027
116be2_1	4	16390	5872	0	16.5121	35.856	19.2011	1157.102	4681.128	19.2011	27.2033	33.6035
116be2_2	5	16256	5872	0	16.4417	35.9558	21.1013	1158.411	4696.656	20.0012	32.8057	33.1034
116be2_3	6	16121	5872	0	16.3031	35.1915	20.5013	1146.53	4592.719	22.4015	30.6046	33.2035
116be3_1	7	16404	5775	0	16.199	36.5576	21.4014	1141.697	4780.181	23.8017	32.3053	31.9032
116be3_2	8	16254	5775	0	16.2137	35.5455	19.2011	1141.193	4640.105	19.0011	32.005	34.7036
116be3_3	9	16103	5775	0	16.1971	35.7565	18.301	1135.958	4667.658	21.6014	27.9036	33.5035
116bc1_1	1	15556	1673	0.9531	13.2202	27.9905	73.5162	922.144	3628.267	22.8016	23.3024	25.702
116bc1_2	2	15552	1673	1.2492	12.6893	26.7684	92.4256	886.5517	3472.399	28.0024	25.4031	28.9025
116bc1_3	3	15548	1673	1.2619	14.9738	32.0368	91.9253	1050.500	4182.222	27.0022	30.6045	32.5032
116bc2_1	4	15553	1657	1.1038	13.8415	29.3647	82.9206	970.0146	3821.310	25.2019	27.7035	29.9027
116bc2_2	5	15550	1657	0.8735	13.3676	30.4421	66.3132	931.0936	3963.985	20.0012	20.9022	31.603
116bc2_3	6	15546	1657	0.3953	14.6946	32.1323	41.7052	1031.482	4183.043	16.8008	28.0037	30.1029
116bc3_1	7	15552	1636	0.8446	12.3177	26.0952	65.913	855.691	3376.356	20.2012	18.4016	24.9019
116bc3_2	8	15549	1636	0.846	13.0682	27.3592	68.7142	913.4966	3549.090	22.8016	24.403	30.1027
116bc3_3	9	15545	1636	1.0152	13.4492	28.5266	80.8196	937.6301	3707.073	27.2022	22.2026	28.6025
116bc4_1	10	15549	1624	1.0065	13.4945	28.1742	78.0183	945.2731	3659.233	24.6018	26.3033	26.3022
116bc4_2	11	15547	1622	0.9018	13.3969	28.7593	68.0139	934.5126	3733.657	19.8012	23.2026	29.0027
116bc4_3	12	15542	1622	0.9218	13.9536	29.8128	72.2156	974.1385	3876.155	23.0016	23.9028	28.7026
116bc5_1	13	15548	1609	0.8339	13.5534	28.1993	61.6114	947.2844	3659.846	16.2008	24.1029	27.5024
116bc5_2	14	15545	1609	0.8759	14.2034	29.9224	65.2128	995.5646	3891.200	18.001	27.9039	29.9027
116bc5_3	15	15542	1609	1.0172	14.2181	30.5222	81.0197	997.1742	3976.99	27.4023	27.9036	29.3026
116bm1_1	1	14607	-1944	1.1967	13.943	29.6518	92.0254	975.5468	3862.954	30.0027	26.0033	30.1028
116bm1_2	2	14605	-1940	1.0974	14.6631	30.6932	86.6225	1027.457	4003.513	29.0025	27.7038	32.5033
116bm1_3	3	14602	-1939	1.1525	14.8773	31.0385	88.0232	1039.632	4045.817	27.8023	25.203	27.9024
116bm2_1	4	14600	-1960	0.8426	12.501	27.4154	65.3128	871.1709	3553.788	20.0012	20.602	24.7019
116bm2_2	5	14597	-1959	1.3529	15.0933	31.4474	97.7286	1058.651	4103.809	28.2024	30.4046	30.9029
116bm2_3	6	14594	-1959	1.3559	14.5993	31.2618	92.2255	1018.402	4074.400	23.0016	25.303	29.9027
116bm3_1	7	14597	-1969	1.3096	13.4694	28.837	82.5204	933.6075	3738.156	15.6007	20.502	26.2021
116bm3_2	8	14594	-1967	1.3183	14.9322	31.5405	96.1277	1040.236	4104.321	28.6025	26.1033	31.5031
116bm3_3	9	14591	-1965	1.0765	14.7953	31.6678	71.7154	1033.192	4126.663	15.4007	25.6033	30.7029
116bm4_1	10	14573	-2034	1.0937	13.969	29.9158	76.9177	976.6532	3893.349	19.8012	25.9033	30.1027
116bm4_2	11	14572	-2033	1.3712	14.421	30.6596	97.6286	1008.441	3991.429	27.6023	27.8038	27.7023
116bm4_3	12	14571	-2032	0.9009	14.7276	31.3551	76.6176	1028.564	4080.958	28.4024	25.6031	31.203
116bm5_1	13	14566	-2064	1.1201	14.4111	30.4003	81.1197	1005.222	3955.691	22.6015	24.0028	27.6024
116bm5_2	14	14565	-2060	1.0953	14.8391	31.1148	80.2193	1040.940	4052.066	22.8016	30.5044	30.6029
116bm5_3	15	14563	-2060	1.1915	15.0955	31.6218	94.927	1057.142	4118.566	33.0033	28.7042	25.9022
116ba1_1	1	13714	-4022	1.0944	12.9112	28.0164	74.9168	897.7112	3634.399	18.001	21.002	28.1024
116ba1_2	2	13713	-4018	1.4777	13.2912	28.0069	97.2284	922.2446	3635.114	22.2015	20.702	26.5022
116ba1_3	3	13710	-4016	1.0049	12.9591	27.0139	67.0135	901.9339	3496.802	13.8006	22.3024	27.3023
116ba2_1	4	13705	-4036	0.849	12.2979	26.7452	64.2124	855.2889	3460.557	18.601	20.1021	25.902
116ba2_2	5	13702	-4035	0.7457	12.92	27.8857	61.5113	899.5209	3607.422	20.6013	21.5024	24.6019
116ba2_3	6	13699	-4035	1.2203	14.4816	30.8998	89.8242	1010.956	4029.529	26.8022	25.103	33.1035
116ba3_1	7	13695	-4054	0.9017	12.9855	28.047	65.6129	905.855	3641.041	17.4009	21.6024	25.6021
116ba3_2	8	13691	-4052	1.322	14.6649	30.6206	92.5257	1023.935	3993.374	24.4018	24.3028	27.7024
116ba3_3	9	13687	-4051	0.8757	15.511	32.6093	74.5167	1087.234	4261.493	27.2022	27.2036	32.8033
116ba4_1	10	13677	-4087	1.1557	12.8528	27.3528	81.9201	895.7004	3551.030	21.8014	21.1021	23.6017
116ba4_2	11	13675	-4085	1.5666	13.2209	27.7669	103.5322	923.8535	3609.977	24.2018	26.1032	26.9022
116ba4_3	12	13672	-4084	0.7581	14.1623	29.4582	65.3128	991.9431	3826.119	23.4016	26.8035	28.5025
116ba5_1	13	13656	-4133	1.3388	13.2624	27.9179	87.0227	924.859	3624.997	18.401	24.403	27.9023
116ba5_2	14	13654	-4130	0.9771	13.9495	28.9	75.4171	973.1327	3747.461	23.4016	25.0031	27.7023
116ba5_3	15	13652	-4130	1.078	14.3781	31.1288	82.6205	1005.825	4048.070	26.4021	27.6038	26.3021
116le1_1	1	9449	5888	0	16.3237	35.8547	17.7009	1151.463	4687.812	18.8011	32.9054	33.2034
116le1_2	2	9512	5888	0	16.4961	35.2405	17.6009	1159.720	4602.277	19.6012	30.4045	36.2041
116le1_3	3	9574	5888	0	16.585	35.2012	19.0011	1167.273	4592.410	17.801	31.2045	29.4027
116le2_1	4	9387	5841	0	16.6129	35.7848	20.6013	1169.992	4668.069	18.401	33.1053	30.3028
116le2_2	5	9487	5841	0	16.6879	35.8614	19.4011	1173.315	4682.670	17.801	31.8049	36.9041
116le2_3	6	9586	5841	0	16.4373	34.8623	20.6013	1153.477	4539.695	22.2015	30.004	32.0031
116le3_1	7	9383	5790	0	16.5884	36.0358	17.0009	1166.669	4697.993	21.2013	33.2054	33.2033
116le3_2	8	9484	5790	0	16.422	35.6895	17.7009	1151.967	4655.526	16.8008	28.9041	33.0033
116le3_3	9	9584	5790	0	16.4406	35.1477	19.7012	1157.908	4584.703	21.4014	33.6057	35.9039
116lc1_1	1	9421	2689	1.8787	11.3142	25.3742	130.9514	783.0351	3295.053	38.2044	17.9016	26.0021
116lc1_2	2	9429	2689	1.5697	11.4628	25.285	108.8355	796.6996	3276.390	30.2027	20.9019	24.6019
116lc1_3	3	9436	2689	1.7668	11.7172	25.9977	115.54	813.2794	3375.54	27.8023	20.102	25.502
116lc2_1	4	9420	2657	1.6627	10.5905	24.0315	107.7348	734.2137	3114.735	25.2019	18.2017	24.9019
116lc2_2	5	9429	2657	2.0374	11.6587	25.5942	133.3533	806.5468	3327.182	32.8032	17.9015	26.3021

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
116lc2_3	6	9438	2657	1.7685	12.4175	25.7291	129.15	864.3354	3341.157	40.2048	22.9026	26.8022
116lc3_1	7	9421	2643	1.4722	11.2886	25.8378	100.2301	784.3412	3348.400	26.6021	20.0019	23.7017
116lc3_2	8	9429	2643	1.881	11.7796	27.0831	118.8424	817.098	3520.799	26.4021	20.102	26.4021
116lc3_3	9	9436	2643	1.6672	11.9766	27.5829	111.2371	830.2629	3588.316	28.6025	18.2016	26.2021
116lc4_1	10	9419	2613	1.8773	12.1179	26.1331	129.15	836.8959	3385.335	36.0039	18.3016	23.9018
116lc4_2	11	9427	2611	1.6476	11.9614	27.5707	108.8355	827.5494	3580.143	27.2022	17.3013	23.5018
116lc4_3	12	9434	2610	1.1934	11.5961	25.9174	85.1217	806.2454	3354.624	24.0017	20.0018	23.2016
116lc5_1	13	9418	2599	1.576	11.0762	24.7736	111.6374	769.7736	3206.144	33.0033	21.3023	24.7018
116lc5_2	14	9423	2599	1.6672	12.3816	27.8458	110.1364	856.4951	3611.100	27.4023	19.2017	25.7021
116lc5_3	15	9428	2598	1.5084	12.1572	26.6202	106.9343	841.2176	3443.203	31.2029	19.5017	24.4018
116lm1_1	1	9834	-2122	1.4234	10.8007	24.5498	96.1277	752.0931	3182.395	24.6018	20.502	25.302
116lm1_2	2	9911	-2122	0	11.6548	23.6956	19.5011	816.4951	3049.546	16.2008	22.1024	26.1021
116lm1_3	3	9988	-2122	0	12.869	26.8723	16.5008	899.1187	3469.336	12.4005	21.3022	27.3023
116lm2_1	4	9840	-2168	1.2652	11.8482	25.7801	94.7269	823.6301	3337.179	30.0027	20.802	25.402
116lm2_2	5	9911	-2168	0	11.4962	24.2041	18.8011	804.2357	3110.762	13.2005	21.9021	24.8019
116lm2_3	6	9982	-2168	0.0521	12.3659	26.9098	19.2011	864.9385	3472.808	9.8003	22.8028	28.3024
116lm3_1	7	9840	-2191	1.448	13.3688	27.8173	106.8342	930.6913	3600.985	33.2033	26.1032	27.4023
116lm3_2	8	9910	-2191	0	11.498	24.0139	19.5011	803.3314	3078.776	15.4007	22.5025	24.2019
116lm3_3	9	9979	-2191	0	13.8385	29.511	15.5007	964.382	3815.581	13.8006	21.9022	31.503
116lm4_1	10	9845	-2246	1.1634	12.6421	27.9478	84.3213	879.213	3612.837	24.6018	23.4028	23.7018
116lm4_2	11	9907	-2246	0	11.831	24.9739	14.2006	826.8459	3206.246	9.6003	22.7025	23.7017
116lm4_3	12	9968	-2246	0	13.1295	28.2461	15.8007	916.0103	3646.356	8.6002	21.5022	26.9022
116lm5_1	13	9859	-2317	1.3801	12.4013	27.1606	98.329	860.9178	3524.782	28.4024	20.7022	30.5029
116lm5_2	14	9914	-2317	0	11.3044	24.2142	15.7007	790.872	3113.309	9.4003	21.3022	24.3018
116lm5_3	15	9968	-2317	0	11.6165	23.0856	21.3014	812.576	2961.072	16.8008	22.5025	24.1017
116la1_1	1	9757	-5025	1.5882	11.1755	24.4129	105.5334	776.5047	3159.975	26.002	21.4022	26.5021
116la1_2	2	9806	-5025	0	11.5956	23.1107	22.7015	809.7624	2969.622	17.0009	19.902	24.8019
116la1_3	3	9854	-5025	0	13.1272	28.1281	13.4005	917.418	3637.669	9.8003	21.7022	28.4026
116la2_1	4	9759	-5058	1.4985	12.0117	26.0104	99.9299	836.9964	3378.499	24.2018	22.0022	26.9022
116la2_2	5	9807	-5058	0	11.1185	22.6966	19.3011	780.8248	2919.956	12.8005	22.6024	24.9019
116la2_3	6	9854	-5058	0	13.0779	26.8118	15.4007	918.2225	3461.578	12.6005	25.1033	24.2018
116la3_1	7	9761	-5083	1.3448	11.714	25.6304	94.4267	813.8824	3323.102	26.002	19.3017	25.0019
116la3_2	8	9804	-5083	0.0076	11.7801	23.5107	22.9016	825.439	3018.386	15.0007	23.3026	22.4016
116la3_3	9	9847	-5083	0	11.833	25.341	16.3008	829.4589	3262.726	11.4004	23.9026	26.7022
116la4_1	10	9765	-5109	1.4583	13.6807	29.6721	104.4327	952.9164	3858.554	30.8028	25.6031	33.4034
116la4_2	11	9806	-5109	0	11.4414	23.6193	19.8012	800.6183	3026.532	14.4006	23.3026	22.3015
116la4_3	12	9846	-5109	0	11.8802	24.4063	13.2005	829.0569	3129.915	13.0005	22.0024	23.9018
116la5_1	13	9768	-5129	1.4059	11.7748	25.7047	95.0271	819.0074	3322.694	24.0017	23.3027	26.0021
116la5_2	14	9806	-5129	0	13.6019	29.2771	26.3021	949.0947	3778.347	20.0012	23.4026	27.3023
116la5_3	15	9843	-5129	0	14.0368	28.9268	17.3009	982.588	3732.225	15.0007	27.0037	28.2024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
117be1_1	1	-16455	6072	0	17.4803	36.0704	21.1013	1145.019	5012.045	26.6021	31.6046	20.4013
117be1_2	2	-16356	6072	0	17.4261	35.8155	23.1016	1139.582	4979.594	22.2015	29.2043	22.5016
117be1_3	3	-16258	6072	0	17.1585	35.2655	19.9012	1123.272	4894.837	22.2015	31.5046	22.4015
117be2_1	4	-16477	6005	0	17.2754	36.6052	23.3016	1128.608	5093.046	25.602	28.3038	23.4016
117be2_2	5	-16377	6005	0	17.3874	36.1036	20.1012	1137.367	5018.742	21.4014	29.4039	19.7012
117be2_3	6	-16277	6005	0	17.1485	35.8433	20.7013	1119.950	4981.036	24.6018	28.1038	22.2015
117be3_1	7	-16482	5953	0	17.4208	36.3054	21.6014	1141.092	5048.109	20.2012	30.9045	19.7012
117be3_2	8	-16403	5953	0	17.4561	36.0465	20.8013	1142.603	5013.384	21.4014	30.2044	22.7016
117be3_3	9	-16325	5953	0	17.1479	35.7258	21.3014	1124.480	4964.555	19.2011	32.7055	22.8016
117bc1_1	1	-16924	2434	2.7895	13.2442	29.5258	160.1769	856.9977	4081.880	48.6071	22.3025	19.5011
117bc1_2	2	-16922	2435	2.6346	15.4154	32.8258	150.9683	1002.405	4553.669	44.806	27.2036	20.1012
117bc1_3	3	-16921	2433	2.8881	14.2127	30.5012	168.5852	920.8368	4220.673	52.6083	24.0027	19.3011
117bc2_1	4	-16925	2427	2.9616	14.6114	31.2835	176.5935	945.9771	4333.104	57.61	23.4026	19.6012
117bc2_2	5	-16927	2426	2.0278	13.3694	28.807	133.6536	866.7479	3973.815	51.8081	23.3027	17.2009
117bc2_3	6	-16924	2426	3.77	14.2154	32.2177	203.4241	920.4346	4469.845	52.8084	23.9027	18.601
117bc3_1	7	-16931	2388	1.8272	12.9967	27.9673	118.9424	842.8257	3854.154	45.0061	23.2024	17.7009
117bc3_2	8	-16932	2388	1.7764	12.5608	26.8028	116.5407	813.4804	3688.876	44.606	22.0023	17.801
117bc3_3	9	-16930	2388	3.3307	13.0166	28.7874	189.9081	838.6045	3976.785	56.8097	19.4017	17.7009
117bc4_1	10	-16933	2336	2.1301	13.5121	28.4553	131.8521	874.0861	3924.466	45.8063	21.8024	17.801
117bc4_2	11	-16931	2336	2.3773	12.8476	27.1921	129.8506	831.0668	3746.439	34.2035	22.0024	18.001
117bc4_3	12	-16925	2336	2.5188	13.1671	28.3234	144.3625	854.0828	3908.804	43.2056	24.4028	19.1011
117bc5_1	13	-16937	2307	2.4732	13.9545	27.647	152.1694	904.8496	3808.011	52.0081	25.1031	15.7007
117bc5_2	14	-16935	2307	2.6208	14.4851	30.227	147.4652	938.334	4180.787	41.8052	23.8027	20.0012
117bc5_3	15	-16930	2307	1.8813	13.7634	31.9638	121.0439	893.388	4428.462	45.4062	23.9027	22.5015
117bm1_1	1	-17110	-2233	1.8579	12.7134	27.177	119.3427	824.032	3740.712	44.2059	22.8024	16.3008
117bm1_2	2	-17102	-2233	1.5676	12.2583	26.1702	99.9299	792.8815	3595.979	36.2039	20.6019	15.2007
117bm1_3	3	-17094	-2233	0.7928	14.2635	28.0947	60.611	926.8701	3870.015	26.4021	24.7029	20.8013
117bm2_1	4	-17104	-2351	1.8181	12.6864	27.3073	108.3352	820.5148	3758.711	34.8036	20.9022	15.9008
117bm2_2	5	-17098	-2350	1.2586	13.0737	27.1479	90.9248	845.2379	3736.315	39.0046	20.6019	20.7013
117bm2_3	6	-17092	-2349	1.0161	12.8092	26.3971	74.5167	831.3683	3626.121	32.0031	23.1026	16.0008
117bm3_1	7	-17108	-2387	1.6857	14.4619	31.0163	102.6316	938.0323	4288.882	34.0035	23.4026	18.401
117bm3_2	8	-17100	-2388	1.1707	14.46	31.346	81.3198	942.1555	4335.669	32.8032	26.8037	19.9012
117bm3_3	9	-17093	-2389	0.7617	13.1225	27.6173	58.8104	849.0572	3797.986	26.2021	20.4021	17.801
117bm4_1	10	-17111	-2410	2.2399	14.8354	32.578	134.0539	965.0861	4515.655	43.8058	26.7036	18.7011
117bm4_2	11	-17103	-2410	1.5427	16.1977	32.9684	98.5291	1054.123	4567.849	35.0037	27.5035	20.8013
117bm4_3	12	-17095	-2410	1.1577	14.2882	30.8085	71.8155	927.574	4257.185	23.8017	23.4025	18.501
117bm5_1	13	-17108	-2419	2.0128	15.2443	32.2569	121.2441	992.6473	4468.407	39.6047	27.8037	19.0011
117bm5_2	14	-17103	-2419	1.4801	15.6902	32.6443	94.927	1021.118	4524.079	34.0035	26.7035	21.3014
117bm5_3	15	-17098	-2419	1.4191	14.7928	31.808	90.2244	957.8445	4399.100	32.0031	21.8023	18.401
117ba1_1	1	-17572	-5594	1.8986	12.3952	26.9465	111.137	802.7285	3708.198	34.6036	22.3024	17.901
117ba1_2	2	-17563	-5594	1.1771	13.7062	28.7665	78.2184	889.4672	3967.774	29.4026	23.3025	20.7013
117ba1_3	3	-17555	-5594	0.8514	13.0854	26.4827	58.0101	847.7505	3638.793	21.8014	22.0023	19.3011
117ba2_1	4	-17579	-5635	1.375	12.5175	25.3852	87.9232	811.3702	3485.059	31.403	22.6025	16.5008
117ba2_2	5	-17572	-5637	1.2928	12.518	26.2911	83.721	809.2599	3612.122	30.6028	20.4021	17.4009
117ba2_3	6	-17565	-5639	0.8377	14.8336	30.8296	61.4113	962.7728	4257.185	25.602	23.6026	19.4011
117ba3_1	7	-17580	-5663	1.2719	14.5418	30.9605	78.9187	943.5634	4277.495	26.4021	23.7026	18.9011
117ba3_2	8	-17574	-5663	0.8703	14.2179	30.2352	65.913	921.4401	4171.765	29.0025	22.0024	18.501
117ba3_3	9	-17569	-5663	0.8128	14.9006	31.507	63.212	970.7187	4358.452	28.4024	26.5033	21.4014
117ba4_1	10	-17579	-5681	1.4731	12.4946	24.8647	92.0254	810.6667	3407.786	31.603	24.1029	14.1006
117ba4_2	11	-17565	-5681	0.7325	14.7832	30.9837	55.9094	958.6491	4281.598	24.2018	22.5027	22.1015
117ba4_3	12	-17551	-5681	0.1394	12.9642	26.4348	30.3028	842.1221	3629.187	21.6014	22.6022	17.7009
117ba5_1	13	-17578	-5693	1.1112	14.7298	31.2556	74.1165	959.9566	4318.841	27.8023	27.7037	18.7011
117ba5_2	14	-17565	-5693	0.7584	14.8275	31.1129	55.9094	967.6006	4298.115	23.2016	28.6039	20.0012
117ba5_3	15	-17552	-5693	0.1302	14.1211	28.7868	27.3022	919.1274	3962.756	18.8011	24.803	17.6009
117le1_1	1	-7921	3638	0.0019	17.7562	36.6881	25.4019	1160.224	5101.396	21.4014	29.3041	22.5015
117le1_2	2	-8067	3638	0	17.582	37.2198	21.7014	1149.148	5173.982	22.6015	29.9044	20.1012
117le1_3	3	-8213	3638	0.0164	16.92	36.4354	23.8017	1105.957	5062.022	19.4011	29.304	19.3011
117le2_1	4	-7947	3594	0.0342	17.8823	37.6452	25.2019	1168.381	5237.212	20.0012	29.6042	21.3014
117le2_2	5	-8092	3594	0	17.4239	37.192	25.902	1135.051	5175.529	25.802	25.5032	23.0017
117le2_3	6	-8238	3594	0	17.2972	35.7902	22.6015	1129.313	4970.735	19.2011	28.404	22.2015
117le3_1	7	-8013	3538	0	17.3736	36.3868	19.4011	1134.347	5055.735	20.4012	28.3039	20.5013
117le3_2	8	-8133	3538	0	17.211	36.2459	20.6013	1123.373	5035.950	20.2012	27.9039	21.1013
117le3_3	9	-8253	3538	0	17.2598	35.6886	21.1013	1129.313	4958.272	20.6013	30.3046	22.0015
117lc1_1	1	-9308	51	1.0274	13.4636	27.5774	76.1174	910.7818	3743.678	22.6015	26.0031	16.7008
117lc1_2	2	-9314	53	0.9694	13.2592	28.6577	76.7177	894.9966	3895.191	26.4021	23.4025	16.7008
117lc1_3	3	-9320	55	0.7374	13.8129	29.2036	69.5145	932.3003	3972.381	29.4026	23.0024	20.7013
117lc2_1	4	-9311	43	0.916	13.5394	27.6445	76.3175	913.9993	3752.882	27.8023	23.8028	17.901
117lc2_2	5	-9316	45	0.9605	13.9151	29.2699	78.4184	942.0549	3982.110	28.2024	26.7034	18.501

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l17lc2_3	6	-9322	46	1.1621	13.659	29.6802	92.3256	926.0657	4041.719	33.4033	28.3037	17.4009
l17lc3_1	7	-9315	35	1.0985	13.5175	27.826	82.4204	911.5862	3774.154	25.802	24.3029	15.3007
l17lc3_2	8	-9321	37	1.2986	15.1961	31.0988	94.0265	1027.155	4241.390	28.2024	27.7038	19.5011
l17lc3_3	9	-9327	38	1.0501	14.9667	32.1197	85.2218	1011.258	4383.599	31.2029	26.1034	19.4011
l17lc4_1	10	-9320	19	0.912	12.5633	25.8962	76.2174	846.0419	3507.830	28.0024	21.0023	16.3008
l17lc4_2	11	-9326	21	1.0318	13.2501	28.3051	85.622	893.187	3843.615	32.4031	22.9024	15.9008
l17lc4_3	12	-9332	22	1.0252	13.7581	28.8998	75.317	927.8757	3926.002	22.2015	23.7027	15.5007
l17lc5_1	13	-9325	9	0.9317	13.3228	27.4784	78.1183	899.1187	3729.976	29.0025	23.4025	17.801
l17lc5_2	14	-9329	10	1.2044	13.9266	28.8004	97.6286	939.6414	3920.167	36.2039	24.4028	19.9012
l17lc5_3	15	-9334	11	0.9323	14.2009	29.686	87.0227	958.8503	4039.055	38.0043	24.3028	17.5009
l17lm1_1	1	-11304	-3846	1.5464	13.9776	27.463	101.1307	908.9719	3778.756	37.6042	26.6034	15.0007
l17lm1_2	2	-11310	-3845	1.3508	13.9604	28.2166	84.3213	905.5534	3888.129	28.6025	23.7028	17.801
l17lm1_3	3	-11316	-3845	1.5865	14.3378	28.4512	93.3261	933.2053	3923.136	28.2024	27.0034	16.8008
l17lm2_1	4	-11310	-3856	1.3291	14.109	26.9878	83.9211	916.1109	3707.891	28.8025	26.1033	16.4008
l17lm2_2	5	-11315	-3858	1.4525	14.9835	28.727	88.9237	972.7303	3960.811	28.8025	25.303	18.201
l17lm2_3	6	-11320	-3858	1.0893	15.3453	30.9741	81.5199	997.6772	4280.675	35.8038	25.603	18.101
l17lm3_1	7	-11324	-3882	1.2901	15.0354	28.2297	77.418	976.2509	3882.910	23.6017	26.4033	15.8008
l17lm3_2	8	-11326	-3877	1.3598	14.2639	29.0097	86.4224	924.4568	3997.471	30.4028	23.8028	18.201
l17lm3_3	9	-11332	-3877	1.2013	14.8779	29.8833	80.8196	969.4111	4122.256	30.8028	28.404	17.3009
l17lm4_1	10	-11342	-3913	1.264	13.9184	26.3864	77.418	902.1349	3626.223	24.8018	24.0027	18.301
l17lm4_2	11	-11347	-3912	1.4201	13.6879	27.8522	88.3234	886.8533	3834.611	30.0027	23.1025	17.6009
l17lm4_3	12	-11352	-3912	1.1015	14.9155	28.941	74.9168	965.9913	3987.844	28.6025	22.3023	16.0008
l17lm5_1	13	-11361	-3952	1.0393	14.8953	27.4433	68.9142	965.4884	3773.847	24.8018	23.6025	15.7007
l17lm5_2	14	-11364	-3951	1.7307	15.1083	30.8861	103.4321	983.2921	4267.442	32.8032	27.9037	16.9009
l17lm5_3	15	-11368	-3951	0.9325	15.5199	29.9175	65.4128	1008.944	4125.843	25.602	26.3034	17.6009
l17la1_1	1	-12397	-5718	1.6457	12.4487	25.4156	99.9299	803.3314	3484.651	33.0033	20.9019	17.6009
l17la1_2	2	-12403	-5716	1.3535	14.5565	28.7863	85.4219	944.3679	3960.197	29.4026	25.4032	16.3008
l17la1_3	3	-12410	-5714	1.0041	13.1072	25.6498	71.2152	847.248	3515.284	29.0025	21.9024	18.401
l17la2_1	4	-12403	-5732	1.3001	13.8269	27.2711	82.4204	894.1923	3743.167	28.6025	22.8024	16.2008
l17la2_2	5	-12408	-5730	1.4606	14.5793	29.3137	87.3229	944.3679	4037.314	27.2022	23.9028	17.801
l17la2_3	6	-12414	-5729	1.1086	13.9765	27.4471	77.0178	902.4366	3768.017	30.6028	20.7021	15.1007
l17la3_1	7	-12417	-5750	1.5885	13.8577	27.229	95.7275	897.6106	3740.712	30.6028	24.7028	18.601
l17la3_2	8	-12422	-5748	1.386	13.8644	28.719	90.9248	896.8063	3951.596	34.0035	22.6024	18.501
l17la3_3	9	-12430	-5747	1.5358	15.5462	31.4377	91.1249	1011.258	4338.030	28.0024	28.604	17.3009
l17la4_1	10	-12434	-5770	1.766	12.7187	25.9154	97.1283	819.2084	3556.955	25.4019	19.2018	17.3009
l17la4_2	11	-12440	-5767	1.2077	13.3324	28.2172	76.6176	865.4412	3879.839	26.8022	25.103	18.401
l17la4_3	12	-12447	-5764	0.9369	14.634	28.0609	65.5129	946.4799	3855.893	25.602	22.2024	17.0009
l17la5_1	13	-12442	-5785	1.4885	13.4371	26.2002	87.4229	869.1604	3594.446	26.2021	22.9025	16.3008
l17la5_2	14	-12449	-5785	1.2792	14.3956	27.7697	85.8221	929.5852	3814.660	32.6032	21.2021	15.6007
l17la5_3	15	-12457	-5785	0.9564	13.2778	25.9339	66.2132	859.8121	3557.159	25.802	23.0027	18.7011

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
118be1_1	1	17185	4775	0	17.5934	36.484	24.4018	1150.356	5071.400	23.6017	30.6045	24.7018
118be1_2	2	17051	4775	0	17.2324	36.0384	20.7013	1126.695	5005.451	23.4016	29.9045	20.8013
118be1_3	3	16917	4775	0	16.8614	35.2314	19.8012	1103.440	4889.381	21.4014	30.9044	21.7014
118be2_1	4	17187	4664	0	17.5606	36.6405	18.601	1148.543	5093.046	22.0015	30.3043	21.0013
118be2_2	5	17054	4664	0	17.3704	36.1415	21.9014	1136.864	5019.360	22.6015	31.1048	19.8012
118be2_3	6	16921	4664	0	16.8659	35.5416	19.3011	1100.722	4935.305	20.6013	27.8036	22.6015
118be3_1	7	17190	4587	0.035	17.4894	36.622	25.2019	1142.301	5089.335	20.0012	29.3041	22.3015
118be3_2	8	17064	4587	0	17.1941	36.0957	22.0015	1124.984	5018.124	24.0017	30.1046	22.6015
118be3_3	9	16938	4587	0	17.1488	35.752	21.5014	1119.950	4962.598	22.4015	29.2042	22.0015
118bc1_1	1	16774	-426	0.9026	14.8637	29.3012	66.9134	1003.009	4058.110	26.8022	28.1036	19.1011
118bc1_2	2	16775	-426	1.0603	14.2938	28.465	68.414	963.678	3943.508	22.0015	27.0034	23.3016
118bc1_3	3	16773	-426	1.2434	15.6616	31.6326	83.5209	1055.833	4393.043	29.8027	27.0035	17.7009
118bc2_1	4	16764	-456	1.7792	13.7065	27.8297	114.6394	922.4457	3851.800	39.2046	25.4029	19.2011
118bc2_2	5	16762	-456	1.4892	14.0933	28.9998	97.5285	946.2787	4014.063	34.0035	23.7026	19.2011
118bc2_3	6	16758	-456	1.3286	13.6045	29.2484	94.6269	915.1053	4045.714	37.8043	24.8028	17.3009
118bc3_1	7	16755	-474	1.401	13.449	27.9257	92.5257	904.9501	3861.317	32.6032	25.3031	19.9012
118bc3_2	8	16754	-477	1.3401	13.889	27.1918	88.9237	932.7025	3756.870	31.2029	24.6026	20.9013
118bc3_3	9	16752	-477	1.729	13.7998	30.0512	107.7348	930.3896	4165.921	34.8036	27.1036	20.9013
118bc4_1	10	16751	-488	1.4379	13.9698	27.9369	94.5268	940.3453	3858.758	33.0033	27.4035	19.8012
118bc4_2	11	16749	-488	1.5805	14.7966	30.3733	100.03	997.7778	4211.444	32.8032	28.1037	19.7012
118bc4_3	12	16752	-484	1.4556	14.2533	27.9639	94.1266	960.2584	3860.498	31.803	28.7042	17.901
118bc5_1	13	16736	-529	1.04	12.9782	24.2148	72.4157	871.8746	3336.873	26.6021	24.1027	18.201
118bc5_2	14	16733	-529	0.8569	14.0081	26.6745	62.0115	942.5577	3681.618	23.6017	25.7032	17.801
118bc5_3	15	16730	-529	1.7658	14.043	30.5621	111.137	947.7872	4244.056	36.604	26.9035	19.6012
118bm1_1	1	15223	-3006	1.2483	13.4854	28.1433	85.9221	908.9719	3895.294	32.2031	25.9033	18.301
118bm1_2	2	15219	-3003	1.3262	13.1658	28.5352	86.1222	888.864	3955.077	29.4026	26.2031	19.4011
118bm1_3	3	15218	-3012	2.0017	13.4638	29.4148	124.0461	904.1458	4076.45	40.0048	23.1025	19.4011
118bm2_1	4	15214	-3017	1.5798	13.8052	29.2149	97.2284	925.8646	4041.207	30.2027	22.6025	16.8008
118bm2_2	5	15214	-3019	1.5504	13.7986	28.4635	98.4291	928.7807	3944.122	32.4031	24.3028	16.6008
118bm2_3	6	15210	-3019	1.5165	13.6383	29.9736	95.5274	921.0379	4162.539	31.2029	26.6035	19.9012
118bm3_1	7	15211	-3023	1.5414	14.2308	30.0334	92.4256	957.3416	4163.051	27.0022	25.203	18.301
118bm3_2	8	15208	-3025	1.6884	14.0244	29.873	107.2345	945.0719	4146.445	35.8038	25.4029	18.001
118bm3_3	9	15206	-3023	1.6675	14.8385	32.0769	110.5366	1000.594	4468.099	40.0048	25.4033	20.3012
118bm4_1	10	15186	-3062	1.5542	13.2725	29.0818	104.7329	891.4778	4031.168	38.8045	22.0022	19.6012
118bm4_2	11	15182	-3063	1.6511	13.8468	29.2606	97.8287	932.5014	4061.798	27.8023	24.0027	17.5009
118bm4_3	12	15178	-3063	1.4146	13.278	28.7225	88.5235	894.8961	3980.983	28.2024	24.4028	16.3008
118bm5_1	13	15175	-3080	1.2276	12.9079	26.4732	76.6176	866.4464	3660.460	23.6017	21.5021	18.101
118bm5_2	14	15173	-3079	1.6091	13.786	28.9125	100.7304	929.384	4012.219	32.4031	25.503	20.0012
118bm5_3	15	15170	-3079	1.3664	12.8755	27.1349	87.523	863.4308	3756.870	29.0025	19.9018	17.6009
118ba1_1	1	14400	-4206	1.2474	12.2977	25.5125	77.518	827.7504	3518.450	23.8017	24.2031	15.7007
118ba1_2	2	14394	-4207	1.8331	13.3047	28.2307	113.5387	895.3988	3912.182	36.2039	24.2028	18.301
118ba1_3	3	14390	-4205	1.4514	12.7934	29.2961	91.325	862.6266	4066.614	29.8027	24.1027	20.8013
118ba2_1	4	14391	-4220	1.6122	13.2822	28.0213	104.833	892.6843	3882.705	36.404	22.5024	17.801
118ba2_2	5	14386	-4217	1.446	13.6549	29.7229	95.3273	921.239	4126.765	33.8034	25.8032	20.5013
118ba2_3	6	14381	-4215	1.2696	13.977	29.0182	89.0238	943.6639	4022.359	34.4035	27.3035	18.401
118ba3_1	7	14379	-4231	1.57	13.1042	27.049	91.6252	880.6204	3742.758	24.8018	22.7026	17.0009
118ba3_2	8	14375	-4230	1.5778	14.2636	30.7004	102.7317	962.9739	4266.724	35.8038	26.5034	17.7009
118ba3_3	9	14371	-4229	1.1869	14.5652	31.6985	80.1193	984.1974	4411.111	29.0025	26.9033	19.7012
118ba4_1	10	14354	-4277	1.7886	12.1962	26.6056	106.8342	819.6104	3680.187	31.403	21.7023	15.9008
118ba4_2	11	14350	-4275	2.0917	12.8788	28.456	126.7482	868.9594	3951.289	39.0046	25.0028	19.8012
118ba4_3	12	14346	-4274	1.2422	12.5712	27.7762	85.722	844.8358	3846.48	32.4031	20.8021	15.6007
118ba5_1	13	14315	-4334	2.1278	13.8989	30.0456	125.0469	937.0267	4167.357	35.8038	27.1036	19.7012
118ba5_2	14	14310	-4334	1.4867	13.0429	28.268	96.8281	879.1124	3918.017	33.6034	24.4028	18.001
118ba5_3	15	14306	-4334	1.0639	13.8615	29.2336	73.9164	932.3003	4054.729	27.6023	22.8023	18.601
118le1_1	1	8430	4223	0	17.3247	36.3649	20.7013	1130.118	5052.953	21.0013	27.8035	23.4017
118le1_2	2	8715	4223	0	17.5586	35.2597	20.3012	1143.912	4889.278	21.6014	26.8034	20.4013
118le1_3	3	8999	4223	0	16.8663	34.7934	21.8014	1102.333	4822.782	18.001	30.7045	23.4017
118le2_1	4	8486	4124	0	17.7398	36.3893	22.0015	1159.418	5055.529	21.4014	30.2044	22.7016
118le2_2	5	8740	4124	0	17.1839	35.5807	22.0015	1122.467	4938.601	22.8016	29.5043	22.9016
118le2_3	6	8994	4124	0	17.271	35.001	18.701	1130.319	4850.468	19.6012	31.9051	18.9011
118le3_1	7	8494	4045	0	17.8732	36.4696	22.0015	1169.186	5065.732	21.0013	31.3048	21.3014
118le3_2	8	8727	4045	0	17.3874	35.6401	21.6014	1135.656	4945.089	19.0011	29.5042	20.9013
118le3_3	9	8959	4045	0	17.1388	35.1397	20.7013	1120.453	4875.895	24.8018	30.0046	21.7014
118lc1_1	1	9416	2653	3.1175	11.7675	30.8433	181.8992	788.0587	4280.060	53.4086	19.902	19.0011
118lc1_2	2	9423	2653	2.2353	13.9132	32.5712	139.1581	936.3228	4524.490	46.2064	26.3034	23.0016
118lc1_3	3	9429	2653	2.0183	14.5733	33.3827	124.8467	978.5643	4635.787	40.6049	24.5028	18.601
118lc2_1	4	9414	2637	3.091	13.2684	32.872	182.9003	890.6736	4571.240	55.2091	23.5026	22.1015
118lc2_2	5	9419	2637	2.5864	14.0877	32.1146	151.0684	945.2731	4455.262	43.6057	24.3028	18.501

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
118lc2_3	6	9427	2636	1.9948	13.9838	33.2445	118.9424	941.0493	4617.284	35.8038	25.4031	17.3009
118lc3_1	7	9411	2629	2.6698	11.8028	28.6646	165.6823	787.054	3961.425	55.2091	18.1015	18.601
118lc3_2	8	9416	2627	1.4706	13.3913	31.4377	101.631	900.5263	4356.502	39.6047	24.8028	20.9013
118lc3_3	9	9420	2625	2.02	14.9258	34.218	127.1485	1006.228	4762.382	42.8055	28.0038	22.3015
118lc4_1	10	9410	2621	2.7494	11.31	28.919	158.6755	758.7231	4001.567	45.2061	21.502	19.4011
118lc4_2	11	9414	2615	1.8139	12.1565	27.7979	112.4379	815.6912	3836.350	36.404	22.7024	17.501
118lc4_3	12	9420	2613	1.6049	13.1616	29.196	99.9299	881.7262	4034.651	32.2031	22.0024	18.001
118lc5_1	13	9395	2578	2.5676	13.7044	31.1441	156.2732	918.8257	4313.095	49.6074	24.0028	17.801
118lc5_2	14	9403	2582	2.3391	13.154	30.2059	147.1649	881.5251	4184.068	49.8074	22.3024	19.7012
118lc5_3	15	9410	2582	1.9192	14.2207	31.9024	119.1426	952.8158	4423.534	38.8045	22.7023	20.1012
118lm1_1	1	9283	1446	3.0568	12.9075	31.9337	173.0898	868.1552	4443.864	46.6065	23.9025	23.4016
118lm1_2	2	9295	1446	2.2178	12.3452	29.3851	130.351	829.1574	4072.249	38.0043	22.1023	19.2011
118lm1_3	3	9307	1446	1.245	12.7721	28.6389	80.5194	855.7915	3960.709	27.2022	20.0019	17.2009
118lm2_1	4	9285	1437	1.8803	11.4841	27.6614	125.3471	771.381	3823.766	46.8066	21.7022	19.6012
118lm2_2	5	9295	1437	2.0731	13.8552	32.1014	119.9431	930.3896	4458.959	33.4033	23.0025	19.4011
118lm2_3	6	9304	1437	1.4393	12.8783	28.8856	103.7323	866.0443	4000.236	42.6054	23.3026	20.7013
118lm3_1	7	9284	1427	2.5983	10.1365	26.3184	161.6784	679.181	3636.443	54.2088	18.0015	15.2007
118lm3_2	8	9292	1427	1.949	11.6909	27.7174	131.2517	782.4323	3830.416	49.8074	18.9017	16.4008
118lm3_3	9	9299	1427	1.6236	12.3841	28.5997	110.7368	829.5594	3951.596	42.4054	20.7021	17.4009
118lm4_1	10	9288	1407	2.6111	12.343	28.164	150.4679	825.841	3897.034	41.8052	20.3018	19.2011
118lm4_2	11	9298	1407	1.7951	12.6157	28.5239	114.8396	845.2379	3946.477	39.4047	20.602	18.9011
118lm4_3	12	9307	1407	1.1423	12.4256	28.103	79.9192	832.3734	3883.217	30.8028	20.3021	20.2012
118lm5_1	13	9287	1394	2.4942	11.5378	27.2393	151.0684	772.0842	3763.926	47.4067	19.6016	17.5009
118lm5_2	14	9296	1391	2.0956	11.7848	27.5019	128.6496	791.1734	3799.418	41.2051	22.1022	17.5009
118lm5_3	15	9305	1388	1.0666	12.3989	28.6116	74.6167	831.6699	3953.234	28.6025	21.002	17.801
118la1_1	1	9316	-2570	2.7881	11.8233	28.4225	165.4821	791.4749	3943.406	49.8074	18.5017	18.201
118la1_2	2	9326	-2570	1.7621	12.7548	29.2365	104.6328	859.7116	4055.037	30.6028	24.4029	18.401
118la1_3	3	9336	-2570	1.4825	12.5906	27.1262	100.4303	844.9363	3753.086	37.4042	21.4022	19.7012
118la2_1	4	9321	-2591	2.3306	11.1694	25.1413	141.2598	746.9702	3469.949	44.0058	18.6016	15.9008
118la2_2	5	9328	-2591	2.2531	12.2542	27.9046	129.6504	823.3286	3866.331	35.6038	22.0022	18.101
118la2_3	6	9334	-2591	1.509	11.9074	26.4708	100.1301	799.0107	3655.963	36.2039	21.0019	17.0009
118la3_1	7	9318	-2673	1.9541	13.2628	28.6108	113.9389	888.1602	3965.418	31.803	20.0019	18.401
118la3_2	8	9333	-2673	1.8139	13.1751	30.9461	117.0411	886.3506	4303.861	41.005	22.1023	19.3011
118la3_3	9	9347	-2673	1.5536	13.9201	31.6862	93.6263	934.7137	4407.518	28.0024	21.2022	20.0012
118la4_1	10	9325	-2801	1.8227	12.9237	28.5519	113.0383	867.8536	3953.234	36.404	22.3023	16.7008
118la4_2	11	9352	-2800	1.6851	15.5207	32.944	107.1344	1045.971	4584.600	35.8038	26.5033	19.9012
118la4_3	12	9353	-2801	1.6306	14.368	32.2487	101.1307	968.9082	4484.121	32.4031	26.5032	19.7012
118la5_1	13	9355	-3035	1.1453	14.0859	27.5378	83.2208	947.385	3806.579	33.4033	25.603	19.0011
118la5_2	14	9368	-3035	1.646	12.062	25.8875	92.2255	808.657	3576.874	22.6015	21.002	20.6013
118la5_3	15	9381	-3035	1.4897	14.0565	31.2661	94.3267	946.1782	4346.342	31.2029	24.3028	22.0015

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
119be1_1	1	6972	28988	0	16.7514	35.8096	20.2012	1133.944	4995.973	19.8012	29.8039	22.0015
119be1_2	2	7028	29029	0	16.2693	35.4725	19.5011	1101.427	4945.707	19.0011	29.5041	20.6013
119be1_3	3	7083	29069	0	15.9945	34.9102	22.3015	1080.289	4869.820	20.2012	25.9035	21.8014
119be2_1	4	7062	28908	0	16.6586	36.1298	23.5017	1130.017	5048.728	21.0013	30.8044	23.1016
119be2_2	5	7109	28939	0	16.6839	36.1752	20.8013	1131.528	5052.541	21.2013	30.6044	20.3012
119be2_3	6	7155	28970	0	16.3355	36.0322	21.9014	1105.554	5029.664	20.0012	28.404	20.5013
119be3_1	7	7139	28841	0	17.2267	36.4526	21.4014	1168.884	5096.035	19.2011	32.2051	26.002
119be3_2	8	7174	28868	0	16.7154	35.9009	20.1012	1133.340	5011.221	23.6017	31.0048	21.5014
119be3_3	9	7208	28895	0	16.4571	35.6513	21.6014	1116.326	4974.546	20.0012	31.3049	21.1013
119bc1_1	1	9021	26363	1.5327	13.0255	30.1964	103.0318	876.6998	4195.756	38.2044	22.4025	21.8014
119bc1_2	2	9021	26365	1.3884	12.5188	30.6672	92.1255	846.846	4257.082	33.4033	26.3031	19.4011
119bc1_3	3	9023	26365	1.8089	12.9502	31.853	126.8483	874.9908	4431.850	51.2079	25.8034	21.8014
119bc2_1	4	9027	26354	1.2703	12.8985	29.8488	93.8264	867.5521	4136.297	39.6047	22.4024	17.3009
119bc2_2	5	9029	26354	1.3227	13.537	31.3025	99.7298	913.9993	4348.497	43.4057	26.1033	20.6013
119bc2_3	6	9030	26354	1.5164	13.6919	31.7893	110.5366	922.0435	4423.842	46.4065	23.4028	22.9016
119bc3_1	7	9030	26350	1.2539	12.6119	28.986	93.6263	851.2684	4015.292	40.0048	25.003	18.001
119bc3_2	8	9032	26350	1.4154	14.0301	30.9675	99.4296	944.8708	4297.808	39.2046	25.203	20.4013
119bc3_3	9	9034	26350	1.3826	13.6968	31.2105	93.4262	924.0546	4336.490	34.6036	25.3031	19.7012
119bc4_1	10	9042	26338	1.2001	13.2557	31.1467	89.1238	891.6789	4322.330	37.8043	22.7026	19.2011
119bc4_2	11	9044	26338	1.975	13.0783	32.3078	125.7474	880.6204	4497.371	43.4057	22.9026	21.0013
119bc4_3	12	9046	26338	1.8042	13.3575	32.895	123.6459	902.5371	4582.853	48.207	26.0031	22.5015
119bc5_1	13	9069	26303	1.1558	13.7558	31.3121	86.7226	928.6802	4351.166	37.0041	25.8034	20.7013
119bc5_2	14	9071	26304	1.6155	13.2914	32.2136	111.3372	895.8009	4484.942	43.4057	23.4027	21.8014
119bc5_3	15	9073	26305	1.6126	14.3862	33.4289	116.4407	971.5233	4663.134	48.407	25.8032	22.8016
119bm1_1	1	13545	22291	0	13.0976	29.3334	2.2	883.9379	4062.720	2	24.203	18.001
119bm1_2	2	13548	22295	0	13.2278	31.4768	1.8	890.4725	4372.514	3	20.602	17.0009
119bm1_3	3	13550	22298	0	13.9176	32.7613	2.4	943.7645	4562.197	2	27.7038	21.2014
119bm2_1	4	13567	22281	0	12.99	28.9481	1	877.504	4003.718	1.2	25.8032	19.5011
119bm2_2	5	13567	22283	0	12.1464	28.1838	2.2	818.4044	3900.309	2	21.4021	17.901
119bm2_3	6	13570	22285	0.0514	12.4864	28.9867	11.1004	840.514	4015.292	5.2001	20.4021	15.8008
119bm3_1	7	13574	22274	0	12.4766	28.0574	1.4	841.0166	3880.249	1.2	22.4026	16.2008
119bm3_2	8	13576	22278	0.175	12.2233	28.8204	20.7013	823.9316	3997.061	10.0003	21.3024	20.7013
119bm3_3	9	13577	22281	0.6881	12.9993	30.1868	52.2082	876.9008	4196.064	21.2013	22.5024	19.5011
119bm4_1	10	13640	22229	0	11.5134	28.0301	1.5	773.7921	3877.895	2.2	18.4016	17.0009
119bm4_2	11	13642	22231	0	12.3534	28.1921	2	835.9914	3905.017	1.6	25.003	19.7012
119bm4_3	12	13644	22233	0	13.0342	28.8417	1.8	876.8003	3993.681	2.2	21.1021	17.6009
119bm5_1	13	13660	22218	0	11.6262	28.1225	2	783.437	3893.042	3.8	20.602	19.0011
119bm5_2	14	13662	22220	0	12.78	30.0241	2.1	861.6215	4163.564	2.6	22.0022	17.3009
119bm5_3	15	13663	22222	0	13.371	30.7548	1.1	901.8333	4271.443	2.2	22.9022	20.3012
119ba1_1	1	16336	20317	0.9529	10.8892	25.6315	78.5185	734.8163	3537.650	37.0041	22.6025	17.3009
119ba1_2	2	16381	20318	0.0398	11.2702	24.5745	26.6021	755.7094	3380.54	21.0013	18.8017	16.4008
119ba1_3	3	16426	20319	0.1005	11.1989	24.1383	21.4014	751.7917	3317.287	13.4005	20.2021	16.2008
119ba2_1	4	16416	20246	0.8785	11.9273	26.506	70.5149	800.9198	3657.598	31.803	21.0022	17.6009
119ba2_2	5	16454	20263	0	11.5549	25.5343	20.3012	776.9066	3517.837	18.201	20.8019	17.901
119ba2_3	6	16491	20280	0	13.672	29.4543	18.301	918.2225	4075.220	15.8007	21.4021	18.9011
119ba3_1	7	16442	20223	1.0827	11.6606	27.1653	75.1169	784.2408	3756.768	28.4024	21.202	19.8012
119ba3_2	8	16498	20223	0	11.9921	27.1934	20.5013	808.9585	3757.177	19.0011	23.3027	21.3014
119ba3_3	9	16554	20223	0	11.1039	23.8639	18.001	747.8742	3279.755	18.8011	22.2022	16.3008
119ba4_1	10	16529	20154	0.8375	13.8176	31.3212	69.4145	934.412	4348.805	32.4031	27.2039	18.401
119ba4_2	11	16587	20154	0.1012	13.0444	29.5066	28.1024	876.1971	4083.827	20.2012	20.7021	19.1011
119ba4_3	12	16645	20154	0	11.0764	24.3531	18.9011	745.8652	3349.522	18.001	21.7024	16.8009
119ba5_1	13	16641	20085	0.3651	11.545	25.0685	37.2042	777.8107	3451.165	18.8011	23.3027	17.4009
119ba5_2	14	16655	20104	0	11.634	25.9955	20.8013	784.8436	3584.945	19.2011	23.3027	19.5011
119ba5_3	15	16669	20122	0	10.4238	23.605	19.7012	704.2849	3244.475	21.6014	23.1025	17.1009
119le1_1	1	8707	8656	0	16.1526	36.9561	20.2012	1078.981	5067.072	21.4014	34.0054	21.7014
119le1_2	2	8358	8254	0	16.3279	35.7934	20.3012	1085.523	4902.766	18.001	28.704	19.5011
119le1_3	3	8793	8582	0	16.4054	37.1691	23.1016	1093.978	5101.911	26.4021	32.4051	26.1021
119le2_1	4	8582	8168	0	15.9779	35.7996	22.2015	1062.979	4900.604	20.4012	30.5046	23.4016
119le2_2	5	8968	8380	0	16.8747	36.8741	21.1013	1119.144	5055.220	19.8012	27.1035	22.1015
119le2_3	6	8744	8050	0	16.0853	35.655	19.1011	1068.916	4883.410	20.2012	28.504	22.2015
119le3_1	1	9199	8124	0	16.5647	36.7525	23.0016	1104.548	5048.006	19.2011	30.7044	22.3015
119le3_2	2	9122	8005	0.0155	16.3895	36.2326	22.1015	1095.589	4970.323	17.6009	34.005	21.6014
119le3_3	3	9044	7885	0	16.0442	35.5815	19.6012	1070.426	4878.056	21.6014	31.2045	20.2012
119lc1_1	1	15359	30216	0.9259	14.2603	30.4846	60.7111	957.1405	4226.109	20.0012	22.2023	20.4012
119lc1_2	2	15357	30216	0.5689	14.6779	30.3406	45.0061	989.9312	4203.241	18.401	26.8036	18.001
119lc1_3	3	15355	30215	0.5884	15.4794	31.6733	53.2085	1043.959	4397.663	25.802	27.1034	20.9013
119lc2_1	4	15362	30212	0.7058	13.0682	27.5101	54.809	876.3982	3800.339	22.8016	21.0021	18.9011
119lc2_2	5	15359	30212	0.7453	14.7803	30.7598	50.8077	999.991	4265.596	17.2009	30.0042	19.4011

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
l19lc2_3	6	15356	30212	0.7502	15.3939	31.9578	54.6089	1042.349	4439.141	20.8013	31.1049	20.6013
l19lc3_1	7	15383	30172	0.9561	13.4424	28.3952	58.2102	900.0236	3928.049	16.2008	19.3018	17.5009
l19lc3_2	8	15381	30172	0.6528	14.8244	29.1819	49.1072	997.6772	4037.724	19.0011	25.7031	18.7011
l19lc3_3	9	15379	30172	0.7623	15.5128	31.1204	54.2088	1046.877	4318.636	19.8012	28.3037	21.0013
l19lc4_1	10	15421	30095	0.4738	13.4366	27.1655	41.1051	905.7545	3749.302	18.201	26.2032	18.301
l19lc4_2	11	15418	30095	0.6773	14.2981	28.8258	52.0081	961.1635	3985.489	21.0013	24.1027	17.0009
l19lc4_3	12	15415	30095	0.5211	15.3241	30.6376	41.005	1034.098	4246.107	16.2008	28.1037	18.8011
l19lc5_1	13	15428	30083	0.4445	13.3199	27.2849	36.504	894.3934	3767.506	14.8007	22.4022	19.5011
l19lc5_2	14	15427	30083	0.2314	12.8213	27.0265	26.2021	860.9178	3728.033	13.0005	21.2021	15.6007
l19lc5_3	15	15425	30082	0.6162	15.7515	32.4107	54.1088	1065.092	4505.075	25.602	29.3042	19.7012
l19lm1_1	1	17967	25915	0.8694	13.8628	29.3676	58.7103	931.7975	4066.819	20.2012	23.2026	19.5011
l19lm1_2	2	17965	25913	0.8019	15.2429	32.1836	64.4124	1028.161	4471.796	28.6025	26.8036	20.3012
l19lm1_3	3	17962	25911	0.4409	15.641	32.4295	44.906	1055.632	4503.534	23.4016	27.5038	18.201
l19lm2_1	4	17988	25894	0.6747	13.6495	28.4803	56.4095	917.5186	3939.822	25.602	22.9025	18.401
l19lm2_2	5	17985	25892	0.8309	15.0569	31.4618	54.4089	1020.011	4368.408	17.4009	31.4049	20.9013
l19lm2_3	6	17982	25890	0.9283	15.5363	33.0566	59.0104	1048.890	4596.110	18.201	28.2039	20.2012
l19lm3_1	7	17997	25877	0.9487	13.8321	28.9166	59.9108	931.9986	3997.164	18.201	26.2032	16.1008
l19lm3_2	8	17995	25877	0.5683	13.9551	29.4954	48.9072	941.8538	4083.007	22.4015	27.3035	20.6013
l19lm3_3	9	17992	25876	0.786	15.1093	31.6166	55.6093	1018.200	4388.526	20.4012	26.0034	18.9011
l19lm4_1	10	18009	25862	0.7807	13.7405	28.7613	56.2095	924.2557	3978.833	21.2013	24.0026	18.7011
l19lm4_2	11	18005	25862	0.7285	15.2183	31.1382	51.4079	1024.539	4320.175	18.401	24.903	17.801
l19lm4_3	12	18001	25861	0.4891	15.5023	32.3845	49.8074	1047.28	4501.48	26.4021	27.9039	20.2012
l19lm5_1	13	18027	25837	0.8561	13.8904	29.155	58.4102	931.1941	4034.241	20.4012	20.9021	17.5009
l19lm5_2	14	18023	25837	0.6885	14.3296	30.1947	50.7077	964.2815	4181.915	19.4011	24.3028	16.9009
l19lm5_3	15	18019	25837	0.4961	15.6461	31.1596	44.4059	1056.638	4320.688	20.6013	29.5042	20.6013
l19la1_1	1	20685	21690	0.7206	12.913	27.1069	59.0104	869.5625	3743.780	26.4021	24.6029	19.7012
l19la1_2	2	20657	21679	0.2453	11.7707	25.3609	33.7034	797.403	3493.228	20.0012	27.5035	17.0009
l19la1_3	3	20629	21668	0	10.5157	23.3651	19.5011	709.4066	3206.755	19.6012	22.7023	14.9007
l19la2_1	4	20704	21647	0.7322	12.6212	27.6733	58.1101	849.7607	3822.129	25.2019	24.0027	18.7011
l19la2_2	5	20673	21643	0.1093	13.8584	30.1695	26.9022	934.0098	4176.686	18.601	24.603	17.3009
l19la2_3	6	20642	21638	0	11.4574	24.7855	23.1016	770.1754	3405.949	19.2011	21.6021	15.5007
l19la3_1	7	20728	21616	0.8501	12.3735	27.2551	62.4117	835.2879	3765.972	24.8018	25.7032	19.7012
l19la3_2	8	20690	21616	0.2436	12.5167	26.1871	26.5021	844.8358	3610.283	12.8005	26.0032	18.9011
l19la3_3	9	20651	21616	0	10.8391	23.9083	22.0015	728.1873	3285.568	23.0016	20.1021	17.2009
l19la4_1	10	20744	21589	0.9111	11.8927	25.5952	66.9134	799.5131	3525.599	26.8022	22.8025	16.7008
l19la4_2	11	20715	21581	0.2328	11.4894	25.6818	33.7034	772.4861	3536.118	20.6013	21.5023	17.5009
l19la4_3	12	20685	21573	0	11.6921	24.9056	21.3014	783.6379	3425.340	22.2015	19.3018	16.4008
l19la5_1	13	20764	21557	0.9766	12.2602	26.4747	73.5162	820.9167	3651.977	30.8028	19.7019	18.101
l19la5_2	14	20739	21541	0.0832	12.6337	27.4025	28.9025	849.6603	3785.303	21.6014	22.3023	21.5014
l19la5_3	15	20714	21524	0	11.6069	25.0514	19.6012	780.4229	3449.225	18.8011	21.2022	17.901

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I20be1_1	1	8866	5623	0.1664	16.3809	36.1437	32.7032	1089.952	4957.757	22.4015	29.1043	21.2013
I20be1_2	2	8913	5623	0	16.6504	36.1249	20.2012	1109.480	4953.019	20.6013	30.9048	20.0012
I20be1_3	3	8959	5623	0	16.2333	34.95	19.3011	1081.397	4784.399	20.2012	30.7044	19.5011
I20be2_1	4	8888	5566	0.0636	16.7179	35.9037	30.2027	1114.715	4924.286	23.8017	31.9049	22.8016
I20be2_2	5	8928	5566	0	16.609	35.7462	20.4012	1106.561	4900.912	19.4011	30.9047	22.2015
I20be2_3	6	8967	5566	0.0045	15.931	35.1045	22.3015	1060.060	4805.596	18.201	29.5044	20.7013
I20be3_1	7	8890	5515	0.1068	16.8544	35.6654	29.9027	1121.057	4889.587	21.8014	29.5042	22.2015
I20be3_2	8	8927	5515	0	16.6034	35.6542	25.702	1104.548	4887.528	23.6017	29.3041	22.0015
I20be3_3	9	8964	5515	0	15.8502	34.9431	20.3012	1053.116	4782.341	23.6017	27.9039	20.5013
I20bc1_1	1	9013	2262	0.9764	13.9308	31.5653	71.1152	921.7418	4299.244	29.4026	25.103	19.3011
I20bc1_2	2	9018	2262	0.8221	14.36	32.8222	72.8159	949.8992	4475.802	37.2042	25.6031	23.0016
I20bc1_3	3	9022	2262	0.7769	14.6123	33.6086	65.6129	970.0146	4583.572	31.803	29.404	21.7014
I20bc2_1	4	9012	2240	0.4758	11.6066	28.2036	43.8058	767.8648	3823.152	21.8014	22.7023	18.9011
I20bc2_2	5	9017	2240	1.2394	15.1815	34.2554	89.424	1005.121	4682.773	37.4042	26.7035	23.0016
I20bc2_3	6	9022	2240	0.801	14.885	33.7446	62.2116	983.4932	4603.819	27.4023	24.7032	20.5013
I20bc3_1	7	9015	2222	0.9454	13.7564	31.7641	70.615	907.866	4325.511	30.2027	22.8026	19.5012
I20bc3_2	8	9019	2222	1.3788	14.5388	32.7706	94.927	960.1578	4471.899	37.4042	24.3029	22.2015
I20bc3_3	9	9022	2222	1.2054	14.1022	32.5996	93.6263	933.1047	4450.436	43.0055	25.003	23.1016
I20bc4_1	10	9021	2185	0.7459	13.7767	31.3645	63.312	913.6977	4273.802	30.6028	26.5034	21.0013
I20bc4_2	11	9024	2185	1.1916	13.9069	32.8242	89.424	920.5352	4481.964	39.4047	24.5029	20.4012
I20bc4_3	12	9027	2185	1.1898	14.3871	33.3495	85.2218	952.2124	4558.704	35.2037	24.8029	22.9016
I20bc5_1	13	9025	2142	0.8045	11.6225	27.2455	64.5125	767.9653	3692.965	29.6026	21.8023	17.901
I20bc5_2	14	9028	2142	1.3254	12.635	30.3391	95.4273	838.705	4133.222	40.2048	26.2033	21.9014
I20bc5_3	15	9031	2142	0.9346	14.244	33.0037	77.6181	942.256	4507.129	37.6042	24.1029	21.4014
I20bm1_1	1	10070	-3025	0.9344	13.2242	30.65	78.6185	872.5782	4170.125	38.6045	21.6023	17.1009
I20bm1_2	2	10074	-3023	0.7761	12.45	29.2081	67.8138	822.0222	3971.460	34.0035	21.2022	19.8012
I20bm1_3	3	10078	-3022	0.9398	13.2949	31.7699	75.9173	881.123	4331.770	35.8038	25.0031	20.3012
I20bm2_1	4	10076	-3037	0.8043	13.7746	32.0487	69.1143	910.1785	4371.590	34.2035	22.8024	21.6014
I20bm2_2	5	10079	-3037	0.9524	12.5443	30.9876	75.5171	831.0668	4224.160	35.0037	23.4025	20.6013
I20bm2_3	6	10082	-3037	0.8654	13.1785	32.4053	74.7167	871.6735	4422.302	37.6042	22.7025	20.9013
I20bm3_1	7	10083	-3059	0.8134	11.8841	27.4182	70.1147	786.2502	3715.048	34.8036	23.2025	16.0008
I20bm3_2	8	10086	-3059	1.1986	12.1009	29.9934	87.523	801.2213	4081.368	37.4042	23.2023	18.8011
I20bm3_3	9	10088	-3059	1.1228	12.9875	31.5461	81.62	860.6163	4298.628	34.4035	24.6029	17.801
I20bm4_1	10	10093	-3095	1.0854	11.9195	27.6228	85.5219	785.0446	3745.314	39.6047	20.202	18.301
I20bm4_2	11	10098	-3095	0.7672	13.174	31.0527	72.6158	868.8589	4227.544	39.2046	21.2022	20.3012
I20bm4_3	12	10102	-3095	1.076	13.0343	32.9047	84.2213	862.124	4494.700	39.0046	22.8026	23.5017
I20bm5_1	13	10099	-3115	1.179	12.5273	30.2966	86.6225	829.7604	4123.998	37.2042	24.5028	21.2013
I20bm5_2	14	10102	-3115	1.4522	12.458	31.6021	100.1301	824.3336	4305.502	40.2048	23.5026	19.0011
I20bm5_3	15	10105	-3115	1.2999	12.7075	32.1728	93.9265	838.102	4383.086	40.0048	21.2021	18.8011
I20ba1_1	1	12048	-7668	0.2463	13.4505	29.5143	31.803	888.6628	4004.845	18.401	24.0029	19.0011
I20ba1_2	2	12122	-7668	0.0662	12.0973	27.4288	24.8018	799.5131	3710.856	18.401	23.3024	19.2011
I20ba1_3	3	12195	-7668	0.0341	14.3064	30.4074	26.7021	944.6696	4124.613	21.4014	25.0031	18.501
I20ba2_1	4	12070	-7719	0.2367	14.1506	29.9239	39.3046	936.4233	4056.573	26.2021	27.7038	19.6012
I20ba2_2	5	12147	-7719	0	12.9377	28.7762	26.4021	855.2889	3891.097	24.8018	25.5031	17.3009
I20ba2_3	6	12224	-7719	0	14.1604	30.6612	23.9017	937.2278	4155.158	21.0013	27.7038	17.4009
I20ba3_1	7	12087	-7756	0.341	14.1335	30.1287	38.7045	934.0098	4083.929	21.6014	26.8033	19.7012
I20ba3_2	8	12160	-7756	0	12.9403	29.0397	24.0017	854.9874	3926.104	24.8018	25.303	17.3009
I20ba3_3	9	12233	-7756	0.2065	13.7093	30.472	29.2026	904.4474	4131.172	17.4009	24.7028	20.9013
I20ba4_1	10	12110	-7790	0.0954	13.9827	30.3254	32.4031	922.5462	4113.032	24.8018	24.3029	20.0012
I20ba4_2	11	12175	-7790	0.0091	13.0905	29.9288	25.2019	864.637	4053.397	21.0013	24.0028	15.9008
I20ba4_3	12	12240	-7790	0	12.3617	26.7877	24.5018	813.6814	3619.990	22.4015	20.8021	18.401
I20ba5_1	13	12165	-7864	0.1225	13.3978	29.7213	32.8032	886.8533	4033.524	24.2018	25.8032	21.0014
I20ba5_2	14	12226	-7864	0.0363	14.1833	32.7032	25.4019	937.3284	4454.646	20.2012	23.9029	21.8014
I20ba5_3	15	12286	-7864	0.0426	14.3171	30.8847	21.6014	948.4913	4197.089	16.0008	26.5036	17.5009
I20le1_1	1	16252	6814	0	16.4439	35.9166	24.0017	1092.468	4912.444	26.6021	30.1043	21.2013
I20le1_2	2	16219	6814	0	16.3805	35.4455	21.4014	1088.241	4843.263	21.2013	31.3044	24.1017
I20le1_3	3	16185	6814	0	15.4649	35.2162	21.4014	1024.64	4805.185	23.0016	27.8039	20.5013
I20le2_1	4	16244	6783	0	16.9356	35.5383	25.902	1123.775	4851.292	23.8017	31.2047	21.6014
I20le2_2	5	16217	6783	0	16.2594	35.7036	21.9014	1078.176	4870.335	22.0015	30.0046	19.0011
I20le2_3	6	16190	6783	0	15.6986	35.0833	23.6017	1039.934	4785.531	20.0012	28.5042	22.3015
I20le3_1	7	16235	6745	0	16.984	35.6963	19.8012	1124.682	4869.923	19.8012	29.404	20.1012
I20le3_2	8	16214	6745	0	16.2467	35.5796	24.0017	1077.169	4850.674	22.0015	30.4044	19.4011
I20le3_3	9	16193	6745	0	15.9102	35.1812	19.5011	1053.116	4796.850	18.8011	27.9038	19.8012
I20lc1_1	1	16168	4566	0.1972	14.8257	28.5187	25.802	979.9726	3859.270	14.0006	28.204	17.0009
I20lc1_2	2	16167	4566	0.2072	15.0313	27.6615	23.1016	991.9431	3741.428	10.8004	27.5036	19.3011
I20lc1_3	3	16165	4566	0.2285	16.0464	29.6286	24.3018	1059.758	4014.677	11.2004	28.9039	19.2011
I20lc2_1	4	16169	4548	0.4265	15.3587	30.323	37.8043	1015.685	4114.877	17.2009	29.0041	20.5013
I20lc2_2	5	16165	4548	0.2109	16.4111	30.6202	28.4024	1081.698	4157.311	16.0008	25.5032	18.501

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I20lc2_3	6	16161	4548	0.3451	16.0998	31.372	31.9031	1067.306	4267.955	14.4006	30.4045	20.2012
I20lc3_1	7	16170	4530	0.4217	13.4885	27.1858	38.8045	891.6789	3677.632	18.401	26.2035	16.5008
I20lc3_2	8	16167	4530	0.3206	13.8014	26.7689	29.0025	914.4016	3623.158	12.4005	28.1036	17.4009
I20lc3_3	9	16164	4530	0.3685	15.0415	29.5826	35.6038	997.7778	4014.165	17.2009	30.1045	16.1008
I20lc4_1	10	16173	4505	0.6074	12.9167	26.3798	47.2067	852.6756	3570.541	19.6012	24.2028	19.1011
I20lc4_2	11	16170	4505	0.1895	13.7508	26.8211	26.7021	911.0834	3629.085	15.2007	27.9036	16.5008
I20lc4_3	12	16166	4505	0.4275	14.1219	27.8961	37.3042	932.7025	3782.029	16.6008	25.1029	18.201
I20lc5_1	13	16174	4483	0.6115	12.1358	25.4042	47.7068	802.9294	3433.302	20.0012	24.8029	15.6007
I20lc5_2	14	16171	4483	0.4242	13.0679	25.7018	35.4038	863.3303	3476.075	14.8007	24.6027	16.7008
I20lc5_3	15	16167	4483	0.3437	13.8431	26.8954	30.5028	911.6867	3643.494	13.0005	22.2023	18.201
I20lm1_1	1	16033	-4981	0.7189	12.9409	27.6602	56.4095	854.2838	3743.269	24.6018	24.7029	19.0011
I20lm1_2	2	16032	-4983	0.3345	13.5194	27.8391	37.6042	895.2982	3769.245	20.6013	26.4036	14.6006
I20lm1_3	3	16028	-4983	0.2807	14.1121	28.0705	32.0031	932.7025	3805.658	17.0009	25.4029	19.2011
I20lm2_1	4	16032	-4996	0.5754	12.7802	26.8879	51.1078	843.6298	3640.019	24.8018	23.5027	18.8011
I20lm2_2	5	16028	-4996	0.1486	13.8082	27.2595	26.9022	914.0999	3690.205	17.0009	26.8035	17.7009
I20lm2_3	6	16024	-4996	0.2458	13.4005	27.1354	32.4031	886.4511	3672.521	18.8011	26.0033	18.501
I20lm3_1	7	16031	-5028	0.2755	13.2607	26.4287	33.6034	877.4034	3574.524	18.8011	26.003	17.3009
I20lm3_2	8	16028	-5028	0.1723	13.9699	26.6337	23.5017	922.3451	3601.700	12.6005	25.5032	18.501
I20lm3_3	9	16025	-5028	0.1166	14.0193	27.2174	29.9027	925.764	3682.436	21.2013	25.303	17.901
I20lm4_1	10	16034	-5036	0.1624	12.2024	25.5514	29.7026	807.9536	3449.838	19.4011	25.0032	14.7006
I20lm4_2	11	16031	-5036	0.1649	13.4011	26.7667	25.702	881.7262	3618.049	15.2007	21.4022	15.9008
I20lm4_3	12	16028	-5036	0.0508	13.8421	26.4541	20.4012	914.0999	3575.342	14.2006	25.5031	17.6009
I20lm5_1	13	16035	-5068	0.2721	10.6996	24.5078	31.503	706.7955	3304.946	17.2009	21.5023	16.6008
I20lm5_2	14	16032	-5068	0.0824	12.8156	25.8031	16.9009	845.9414	3484.447	9.6003	24.2029	18.401
I20lm5_3	15	16029	-5068	0.0431	13.5517	25.8969	15.5007	894.695	3494.147	9.6003	26.0032	17.4009
I20la1_1	1	16031	-7484	0.3962	12.4335	26.3836	40.3049	820.0123	3567.272	21.0013	22.7025	18.701
I20la1_2	2	15995	-7484	0.1145	12.0465	24.66	22.1015	794.5896	3324.326	13.6006	22.9025	16.6008
I20la1_3	3	15959	-7484	0	13.858	29.8179	21.6014	916.8148	4047.148	19.6012	25.5031	19.9012
I20la2_1	4	16035	-7520	0.3209	12.8552	27.0689	36.2039	850.2633	3664.241	19.8012	25.4031	20.6013
I20la2_2	5	15993	-7520	0.0188	14.0311	28.9147	23.6017	927.4734	3922.009	18.8011	25.1031	19.9012
I20la2_3	6	15951	-7520	0	13.9212	29.2983	19.6012	919.5296	3974.532	19.0011	24.0027	18.501
I20la3_1	7	16029	-7559	0.3349	12.0175	24.9037	35.0037	791.4749	3362.072	18.001	21.3023	17.901
I20la3_2	8	15984	-7559	0	11.5017	24.1116	21.3014	755.3076	3250.694	21.2013	18.0015	16.0008
I20la3_3	9	15939	-7559	0	11.7802	24.5652	19.0011	779.7196	3312.698	20.4012	24.3027	15.2007
I20la4_1	10	16027	-7602	0.3998	12.465	26.0709	37.9043	823.8311	3524.680	18.401	23.9028	16.3008
I20la4_2	11	15987	-7602	0	13.9856	29.4314	18.9011	926.669	3995.525	19.0011	26.9037	20.8013
I20la4_3	12	15947	-7602	0	12.2785	25.0427	17.3009	812.6765	3379.009	18.601	25.4031	17.1009
I20la5_1	13	16019	-7724	0.2473	11.7103	25.285	34.7036	773.7921	3413.297	21.2013	23.0026	16.2008
I20la5_2	14	16008	-7724	0.0794	12.1641	25.4844	27.3022	801.7236	3442.182	20.2012	21.2021	16.7009
I20la5_3	15	15997	-7724	0.1063	13.0182	27.5528	24.7018	861.6215	3732.737	16.6008	25.4033	20.6013

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I21be1_1	1	-9934	32003	0	16.3035	37.0448	23.2016	1103.843	5177.179	24.2018	29.304	24.8019
I21be1_2	2	-10151	32003	0	15.9686	36.8585	20.7013	1083.107	5146.037	24.6018	30.9046	20.7013
I21be1_3	3	-10368	32003	0	16.2519	36.6285	19.1011	1100.823	5118.817	24.2018	28.9041	22.4015
I21be2_1	4	-9964	31933	0	16.5879	37.255	23.1016	1124.682	5209.462	21.2013	30.6046	24.0017
I21be2_2	5	-10161	31933	0	16.6993	37.12	20.8013	1130.420	5187.699	21.2013	29.0039	22.1015
I21be2_3	6	-10358	31933	0	16.3872	36.3517	22.1015	1107.266	5075.523	20.6013	26.5033	19.7012
I21be3_1	7	-9988	31686	0	16.2252	37.0053	21.4014	1102.434	5172.023	28.2024	32.6049	22.9016
I21be3_2	8	-10169	31686	0	16.4319	36.8525	22.2015	1114.010	5150.883	23.0016	30.0044	21.8014
I21be3_3	9	-10350	31686	0	16.4089	36.4958	23.0016	1110.487	5097.788	22.4015	28.2037	20.9013
I21bc1_1	1	-10197	27921	1.435	13.2508	28.0069	84.8216	890.1709	3872.164	23.6017	23.5026	18.8011
I21bc1_2	2	-10198	27920	1.0456	14.5028	29.5084	72.3157	979.7714	4085.159	26.6021	29.104	17.5009
I21bc1_3	3	-10202	27920	1.6309	15.0506	31.1348	104.6328	1012.164	4318.943	35.4038	25.3031	17.6009
I21bc2_1	4	-10194	27873	1.0223	12.4968	25.4424	63.0119	836.5944	3507.932	18.201	19.8019	17.501
I21bc2_2	5	-10196	27877	1.0557	12.8788	26.3216	73.3161	866.5469	3633.172	27.2022	24.6029	19.6012
I21bc2_3	6	-10199	27877	0.9221	14.3804	28.5705	62.2116	968.1035	3948.217	21.4014	26.9035	19.2011
I21bc3_1	7	-10194	27862	1.4312	13.1915	27.2835	86.0222	888.1602	3771.597	24.8018	25.003	17.901
I21bc3_2	8	-10197	27865	1.0915	14.3683	29.5395	79.7191	966.1925	4091.922	32.2031	24.4029	19.5012
I21bc3_3	9	-10201	27865	1.7304	14.4077	30.6895	102.9318	970.9199	4258.416	29.8027	26.8033	20.2012
I21bc4_1	10	-10194	27849	1.5163	12.5726	25.5659	84.1212	843.8307	3525.905	19.4011	22.8025	17.701
I21bc4_2	11	-10197	27845	1.377	13.005	26.8198	79.4189	871.0704	3704.108	20.4012	20.8021	18.401
I21bc4_3	12	-10202	27845	1.58	14.1749	30.0454	91.5251	952.8158	4165.409	24.4018	23.4027	16.2008
I21bc5_1	13	-10195	27835	0.8345	12.384	24.3504	57.2098	829.3584	3349.829	19.8012	20.5021	15.0007
I21bc5_2	14	-10196	27838	1.1333	13.6568	27.1655	71.1152	919.8313	3756.256	21.8014	25.6032	17.901
I21bc5_3	15	-10199	27835	1.103	13.8062	28.8833	68.9142	930.2891	3996.242	21.0013	25.9033	17.4009
I21bm1_1	1	-10198	24622	1.4202	11.9535	26.0542	86.3223	801.4222	3598.124	25.802	20.5021	20.2012
I21bm1_2	2	-10202	24622	1.1628	11.905	25.6148	74.0164	795.5944	3531.420	23.8017	17.9014	17.0009
I21bm1_3	3	-10206	24622	1.3794	14.1024	30.2979	88.9237	952.4135	4202.216	30.0027	27.9037	19.4011
I21bm2_1	4	-10199	24592	1.7106	12.8496	28.0074	101.0306	864.1344	3872.164	28.8025	24.0029	17.2009
I21bm2_2	5	-10203	24592	1.223	13.9413	30.0124	85.2218	943.0605	4160.283	32.6032	29.204	19.0011
I21bm2_3	6	-10207	24592	1.1845	15.2628	31.9963	81.5199	1031.985	4442.529	30.4028	30.7046	20.9013
I21bm3_1	7	-10198	24580	1.5782	11.6635	25.8782	95.6274	782.3318	3571.460	28.8025	20.6021	17.6009
I21bm3_2	8	-10202	24580	0.935	11.8047	25.2343	61.7114	797.0011	3477.912	20.6013	25.9032	18.401
I21bm3_3	9	-10207	24580	1.4583	13.2733	28.0489	83.4209	893.187	3880.556	21.2013	24.2028	17.4009
I21bm4_1	10	-10198	24553	1.368	12.7111	28.1104	89.1238	855.1884	3884.547	30.8028	23.8025	16.1008
I21bm4_2	11	-10202	24553	1.2227	12.5623	27.5366	77.7181	841.5191	3803.715	25.2019	20.1019	17.701
I21bm4_3	12	-10206	24553	1.0267	14.1525	29.724	75.0169	950.6032	4115.697	30.2027	23.3026	18.8011
I21bm5_1	13	-10196	24543	1.7918	13.0944	28.4782	104.933	877.8055	3941.767	29.4026	21.4022	19.4011
I21bm5_2	14	-10200	24543	1.7528	12.7819	27.5616	104.833	857.1987	3813.126	30.8028	21.4022	19.8012
I21bm5_3	15	-10205	24543	1.2666	13.3501	28.4689	81.62	900.4257	3937.468	27.2022	26.4031	16.9009
I21ba1_1	1	-10793	20078	0.835	12.3845	25.8827	53.8087	834.1824	3567.578	16.6008	24.3027	15.2007
I21ba1_2	2	-10798	20078	1.2067	12.3079	26.3724	82.0202	829.8609	3640.019	30.0027	25.003	16.3008
I21ba1_3	3	-10804	20078	1.648	14.6356	31.3148	102.4315	986.2092	4350.242	32.6032	25.7032	18.301
I21ba2_1	4	-10790	20064	1.7888	11.7766	26.2467	111.3372	791.0729	3623.260	36.0039	21.9023	16.2008
I21ba2_2	5	-10794	20064	1.6968	11.3785	25.7626	104.3326	765.6547	3556.546	32.8032	22.7025	18.301
I21ba2_3	6	-10798	20064	1.4639	14.192	31.4064	97.2284	957.1405	4363.892	35.0037	25.7033	19.0011
I21ba3_1	7	-10790	20050	1.6215	12.4166	26.1163	102.6316	835.9914	3605.276	33.8034	24.903	18.201
I21ba3_2	8	-10795	20050	1.6657	11.5556	25.8514	100.9305	775.0981	3565.842	30.6028	20.5021	15.3007
I21ba3_3	9	-10800	20050	2.0311	12.829	29.5474	126.8483	863.0287	4101.964	41.8052	22.8025	21.1013
I21ba4_1	10	-10790	20037	1.319	11.6934	24.4628	85.4219	783.437	3367.479	28.8025	20.4021	15.7007
I21ba4_2	11	-10796	20037	1.5349	12.0385	25.8385	99.2295	809.2599	3564.309	34.0035	23.0025	16.7008
I21ba4_3	12	-10802	20037	1.5493	13.5419	30.1296	97.0282	911.5862	4179.147	31.403	24.2028	19.3011
I21ba5_1	13	-10792	20031	1.7486	11.6208	25.2527	109.4359	783.6379	3482.303	35.6038	25.203	16.6008
I21ba5_2	14	-10798	20031	1.3547	12.4948	27.5949	86.6225	842.6247	3815.172	28.8025	25.303	18.401
I21ba5_3	15	-10805	20031	1.3916	11.6923	26.3541	86.2223	784.8436	3638.691	27.0022	20.8021	17.901
I21le1_1	1	-17676	31329	0	16.5696	37.1951	21.8014	1121.259	5200.591	22.0015	27.9037	21.4014
I21le1_2	2	-17439	31329	0	16.2649	36.7254	23.1016	1103.843	5134.386	21.2013	31.0047	23.8017
I21le1_3	3	-17203	31329	0	15.6484	36.3057	19.9012	1060.966	5071.606	22.2015	29.3041	22.0015
I21le2_1	4	-17643	31235	0	16.5362	36.7224	22.6015	1124.178	5133.870	21.0013	33.3052	23.9017
I21le2_2	5	-17413	31235	0	16.2725	36.7721	23.5017	1105.655	5140.057	22.0015	32.8054	25.1019
I21le2_3	6	-17183	31235	0	16.0956	36.1085	19.6012	1086.832	5039.041	24.8018	26.6033	23.4017
I21le3_1	7	-17537	31105	0	16.0637	36.6899	23.2016	1090.153	5129.334	24.8018	30.7045	23.8017
I21le3_2	8	-17334	31105	0	16.3268	36.8844	22.5015	1103.340	5155.833	21.0013	26.3035	22.0015
I21le3_3	9	-17132	31105	0	16.0684	36.4828	22.3015	1088.643	5094.283	20.4012	29.5044	21.5014
I21lc1_1	1	-16877	26696	2.0793	13.505	30.4473	138.3574	880.4193	4094.484	54.0088	23.4026	18.501
I21lc1_2	2	-16872	26696	2.0069	13.9104	31.6154	125.4472	908.2681	4258.723	44.0058	24.703	20.3012
I21lc1_3	3	-16867	26696	1.147	13.442	30.2805	81.4199	877.6045	4067.228	33.6034	24.403	20.1012
I21lc2_1	4	-16875	26683	2.2341	12.636	28.6961	128.4495	825.3385	3850.879	38.0043	24.703	17.0009
I21lc2_2	5	-16870	26683	1.92	13.3789	30.0978	121.2441	874.8903	4044.382	43.2056	26.4034	19.6012

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I21lc2_3	6	-16866	26683	1.2341	13.7216	30.7465	84.4214	896.8063	4130.865	33.2033	25.6031	18.7011
I21lc3_1	7	-16860	26608	1.6654	13.2199	30.0024	111.8375	863.3303	4031.168	43.8058	24.4028	18.501
I21lc3_2	8	-16856	26608	1.9123	13.0047	29.8545	111.4372	847.8511	4010.990	33.8034	23.3027	19.7012
I21lc3_3	9	-16852	26608	1.6258	13.8184	31.447	98.0288	906.5588	4230.108	31.603	29.104	18.701
I21lc4_1	10	-16837	26487	1.7192	14.293	31.4983	113.8389	932.5014	4235.852	43.6057	24.803	17.4009
I21lc4_2	11	-16831	26487	1.7505	14.5547	32.2589	112.8382	952.1118	4345.727	41.4051	27.3036	21.0013
I21lc4_3	12	-16825	26487	0.6519	13.0929	29.4134	58.1101	858.0028	3943.406	29.4026	27.1036	18.601
I21lc5_1	13	-16829	26450	1.9738	14.1065	31.1856	116.0404	919.228	4193.911	35.8038	23.8029	18.001
I21lc5_2	14	-16822	26450	1.563	13.6086	30.1634	98.1289	887.9591	4053.397	34.0035	24.1029	19.1011
I21lc5_3	15	-16816	26450	0.8341	13.0706	28.7532	67.4136	854.2838	3856.098	31.603	24.9029	20.3012
I21lm1_1	1	-16308	24197	1.4705	11.4934	25.8145	98.1289	759.0244	3493.228	37.0041	23.9027	22.1015
I21lm1_2	2	-16196	24197	0.0259	14.3062	31.6721	22.3015	947.5861	4308.478	17.4009	26.3031	19.7012
I21lm1_3	3	-16085	24197	0.037	14.7947	31.5947	28.2024	978.6649	4294.627	22.8016	26.3032	19.2011
I21lm2_1	4	-16299	24136	1.4441	12.2095	27.3186	102.5315	806.5468	3701.961	42.4054	24.3028	20.0012
I21lm2_2	5	-16182	24136	0	13.7903	30.1105	21.9014	910.2791	4087.208	19.8012	23.6027	20.7013
I21lm2_3	6	-16066	24136	0.048	12.5434	27.2182	23.8017	828.7554	3676.609	18.001	24.4025	16.6008
I21lm3_1	7	-16282	24092	1.2195	11.9086	25.547	80.8196	782.2314	3448.307	29.4026	20.5021	15.9008
I21lm3_2	8	-16162	24092	0.0446	13.1203	30.6808	24.9019	869.9646	4170.330	19.4011	25.803	20.7013
I21lm3_3	9	-16043	24092	0	12.7315	27.9793	23.9017	839.0065	3786.939	23.2016	21.7023	19.0011
I21lm4_1	10	-16262	24039	1.612	13.4703	29.4782	104.6328	890.1709	3999.826	37.8043	26.2035	17.5009
I21lm4_2	11	-16143	24039	0.014	11.513	26.3113	24.4018	757.9194	3553.277	20.0012	20.1019	19.2011
I21lm4_3	12	-16024	24039	0.1408	14.1347	29.9441	28.4024	930.2891	4059.647	19.0011	22.5024	20.2012
I21lm5_1	13	-16203	23899	1.5234	13.8642	30.4597	98.7292	917.3175	4144.805	35.4038	26.9034	23.0016
I21lm5_2	14	-16082	23899	0	11.9601	26.3387	22.3015	789.6663	3556.035	21.6014	22.8026	16.8008
I21lm5_3	15	-15962	23899	0	14.2125	30.4049	24.6018	939.9431	4127.380	22.0015	26.3031	21.7014
I21la1_1	1	-14863	20171	1.1691	12.0757	26.6696	87.3229	793.6853	3611.203	38.0043	19.5017	16.2008
I21la1_2	2	-14834	20171	0.4277	11.4384	25.1853	46.8066	749.3809	3401.561	26.4021	16.3012	16.2008
I21la1_3	3	-14805	20171	0.0843	11.4999	24.8911	25.2019	760.7322	3356.868	18.001	23.6025	14.0006
I21la2_1	4	-14847	20151	1.1595	11.6579	25.9265	80.1193	769.2712	3510.485	31.2029	22.3023	18.9011
I21la2_2	5	-14819	20151	0.2145	12.6353	27.3138	36.8041	832.6749	3696.134	24.6018	21.8022	17.3009
I21la2_3	6	-14791	20151	0.0206	11.4314	24.4036	27.4023	756.9149	3291.381	22.6015	24.4029	16.5008
I21la3_1	7	-14810	20103	1.119	11.5478	26.4318	80.4194	759.8281	3577.793	33.2033	19.6018	15.7007
I21la3_2	8	-14778	20103	0.3561	11.7158	25.1586	34.3035	773.5912	3398.703	16.6008	22.7025	17.6009
I21la3_3	9	-14746	20103	0.0709	11.8565	25.5832	27.1022	784.7431	3457.290	20.4012	23.6027	15.0007
I21la4_1	10	-14764	20038	1.0467	13.3346	29.7243	74.5167	882.5304	4047.456	30.0027	24.703	21.4014
I21la4_2	11	-14719	20038	0.1465	13.4663	28.8191	32.4031	889.3666	3907.986	22.8016	24.1028	19.0011
I21la4_3	12	-14674	20038	0	11.865	24.7813	24.6018	781.1262	3341.055	20.8013	20.6021	14.1006
I21la5_1	13	-14691	19932	1.1721	12.0874	27.5101	88.9237	798.4078	3729.260	39.6047	23.0025	16.6008
I21la5_2	14	-14662	19932	0.4999	14.3321	31.5877	47.6068	947.8878	4305.297	24.4018	24.1028	18.8011
I21la5_3	15	-14633	19932	0.0172	13.2362	29.0224	26.4021	873.885	3939.515	21.8014	22.8025	20.4013

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I22be1_1	1	-20110	3665	0	16.559	36.0443	20.6013	1098.910	4929.744	21.8014	29.5043	22.7016
I22be1_2	2	-20037	3665	0	16.3831	35.8621	21.5014	1087.838	4900.191	23.2016	30.5045	21.5014
I22be1_3	3	-19965	3665	0	16.3177	35.512	20.9013	1084.215	4854.380	22.6015	30.8048	23.3016
I22be2_1	4	-20088	3604	0	16.6942	36.3507	20.5013	1109.983	4973.207	23.6017	31.6049	22.4015
I22be2_2	5	-20023	3604	0	16.3552	36.3493	22.2015	1085.926	4975.370	19.6012	29.104	22.1015
I22be2_3	6	-19958	3604	0	16.3388	36.2672	19.3011	1084.517	4963.010	18.201	28.8039	21.5014
I22be3_1	7	-20035	3495	0	16.6326	35.7104	22.7015	1103.843	4884.130	23.2016	29.3041	22.5015
I22be3_2	8	-19969	3495	0	16.6839	36.0281	20.7013	1107.064	4929.744	22.8016	29.004	22.7016
I22be3_3	9	-19929	3495	0	16.3995	36.0393	18.201	1091.864	4933.246	23.4016	31.8051	22.0015
I22bc1_1	1	-18926	1115	2.2079	12.7039	30.0122	140.6593	837.1974	4082.905	50.4076	21.9023	18.201
I22bc1_2	2	-18920	1116	2.164	13.8443	32.0296	136.7561	915.7087	4365.124	48.207	26.2034	18.9011
I22bc1_3	3	-18915	1117	2.1822	14.1887	33.2381	133.8537	939.8425	4539.901	44.606	27.0037	20.3013
I22bc2_1	4	-18916	1092	2.4662	13.0223	30.7273	152.0694	857.8018	4189.297	51.4079	21.4022	21.0013
I22bc2_2	5	-18912	1093	2.2351	13.6329	31.747	142.0605	899.3198	4331.462	50.6077	22.8025	20.5013
I22bc2_3	6	-18909	1094	2.3814	14.4577	32.8485	147.1649	955.3301	4483.094	49.8074	25.9033	20.6013
I22bc3_1	7	-18911	1074	2.577	12.3284	29.6734	150.3678	814.7868	4036.290	45.4062	24.1027	17.4009
I22bc3_2	8	-18907	1074	2.3578	13.1836	31.1043	147.265	870.8693	4237.902	51.0078	24.2028	19.0011
I22bc3_3	9	-18904	1074	2.3449	14.079	32.7408	142.2607	933.1047	4471.283	46.4065	27.3033	19.4011
I22bc4_1	10	-18901	1046	2.1851	12.8726	31.1166	144.2624	849.9618	4242.826	55.0091	22.8025	20.4013
I22bc4_2	11	-18895	1046	2.3754	13.956	32.6156	144.4626	924.7584	4454.852	47.4067	27.0035	20.5013
I22bc4_3	12	-18889	1046	1.7743	14.2888	32.1356	113.4386	946.5804	4381.443	40.2048	27.1038	17.901
I22bc5_1	13	-18894	1032	2.5741	13.2324	31.9193	161.278	876.1971	4356.605	56.4095	25.7033	19.4011
I22bc5_2	14	-18891	1032	2.3928	14.0721	32.5856	147.5653	930.5908	4447.150	49.8074	25.803	19.3011
I22bc5_3	15	-18888	1032	2.2943	15.1718	33.8105	145.0631	1004.819	4623.143	51.0078	27.6037	20.5013
I22bm1_1	1	-17131	-3275	1.6055	12.1688	27.0854	112.638	802.5275	3672.827	46.0063	22.0023	17.4009
I22bm1_2	2	-17128	-3275	2.1322	12.1292	29.333	135.7553	800.4174	3988.971	48.6071	22.0022	17.6009
I22bm1_3	3	-17126	-3275	2.6275	12.2381	30.0708	160.0768	805.6425	4092.844	53.2085	20.602	17.6009
I22bm2_1	4	-17111	-3314	1.7204	12.4947	28.5569	109.636	822.4241	3877.690	38.6045	20.6022	17.6009
I22bm2_2	5	-17108	-3313	2.3724	12.7299	29.7669	146.2641	840.2125	4047.660	49.4073	23.9027	18.9011
I22bm2_3	6	-17105	-3313	2.1324	13.3684	29.7771	131.7521	880.3188	4048.275	44.2059	22.3021	17.801
I22bm3_1	7	-17099	-3340	2.2053	12.5785	29.7034	136.5559	830.3633	4041.719	46.4065	23.3025	20.4013
I22bm3_2	8	-17096	-3340	2.2914	12.7888	30.6455	149.9674	845.5394	4174.738	56.4095	24.1027	18.401
I22bm3_3	9	-17093	-3340	1.9611	13.5861	30.8241	120.2434	896.2031	4198.832	39.6047	23.0027	19.5011
I22bm4_1	10	-17089	-3375	1.6874	12.5425	28.8057	113.7388	828.8559	3916.482	44.0058	23.4027	19.7012
I22bm4_2	11	-17085	-3375	2.2925	12.9494	30.4568	142.9613	856.3946	4149.418	49.2073	24.3026	17.901
I22bm4_3	12	-17081	-3375	1.9115	13.9396	31.1105	127.5488	920.0324	4239.749	48.8071	23.8028	20.5013
I22bm5_1	13	-17073	-3403	2.1663	12.6584	29.8288	129.4503	838.102	4058.212	40.805	25.403	17.5009
I22bm5_2	14	-17070	-3403	2.2561	13.5086	30.8886	142.7611	893.7902	4207.035	50.4076	26.2033	19.4012
I22bm5_3	15	-17068	-3403	2.2912	13.8631	31.1748	138.2573	912.6922	4246.107	44.4059	22.1023	18.301
I22ba1_1	1	-16271	-5046	2.1693	11.6983	29.0595	133.4534	770.6777	3949.548	45.0061	20.5019	17.901
I22ba1_2	2	-16268	-5046	2.5963	11.969	29.936	147.5653	791.4749	4077.577	42.0053	23.4026	19.1011
I22ba1_3	3	-16265	-5046	2.4579	13.5718	32.3208	153.871	898.0128	4413.883	53.6086	25.303	20.6013
I22ba2_1	4	-16270	-5051	2.1655	12.1264	28.9548	136.5559	798.9102	3937.775	48.0069	20.9021	19.5011
I22ba2_2	5	-16266	-5051	2.6575	13.4175	32.6341	163.7804	887.2554	4462.040	55.6093	24.5028	23.3017
I22ba2_3	6	-16263	-5051	2.3841	14.5503	33.6398	149.2668	961.8676	4597.652	51.8081	25.103	18.301
I22ba3_1	7	-16262	-5066	2.2375	11.8164	28.1388	135.455	776.6052	3820.185	44.0058	19.0017	15.9008
I22ba3_2	8	-16258	-5064	2.4202	13.0409	31.8238	150.4679	861.0183	4345.418	51.8081	22.4025	20.0012
I22ba3_3	9	-16254	-5063	2.1696	14.1796	32.6003	135.8553	936.3228	4451.360	47.0066	24.4029	22.4015
I22ba4_1	10	-16250	-5090	1.7503	11.4697	27.6492	120.7437	755.2072	3748.791	48.8071	20.102	16.6008
I22ba4_2	11	-16247	-5090	2.6592	11.3024	29.6044	157.3743	745.5639	4030.656	49.6074	20.9021	19.7012
I22ba4_3	12	-16244	-5090	2.6519	13.2818	31.1776	156.073	876.0966	4246.518	48.0069	23.7027	18.301
I22ba5_1	13	-16240	-5107	2.0813	12.5325	29.0379	125.9476	825.238	3948.934	40.6049	21.0021	19.8012
I22ba5_2	14	-16238	-5105	2.6429	11.7926	30.5569	164.9816	780.4229	4162.846	57.81	23.8027	18.301
I22ba5_3	15	-16237	-5103	2.7304	12.7368	31.9348	171.6884	840.1121	4361.531	60.8111	22.1023	23.0016
I22le1_1	1	-11645	5866	0	16.9786	37.0936	21.9014	1129.011	5093.871	21.6014	29.1043	22.6015
I22le1_2	2	-11731	5866	0	16.1453	36.6495	22.4015	1075.358	5029.355	24.0017	30.1044	21.4014
I22le1_3	3	-11817	5866	0	16.6214	36.3982	20.9013	1103.138	4991.75	24.0017	28.0039	25.1019
I22le2_1	4	-11638	5812	0.065	16.9369	36.9203	26.4021	1126.695	5069.545	20.0012	30.2043	25.4019
I22le2_2	5	-11725	5812	0	16.8419	36.7964	20.0012	1118.440	5047.182	23.2016	28.7042	23.5017
I22le2_3	6	-11812	5812	0	16.8384	36.1828	19.8012	1119.446	4964.658	19.0011	29.2044	24.2018
I22le3_1	7	-11635	5729	0	16.89	36.6958	22.1015	1122.064	5032.961	26.2021	28.7039	21.3014
I22le3_2	8	-11704	5729	0	16.9275	36.6213	20.1012	1123.272	5021.627	17.0009	27.5037	20.7013
I22le3_3	9	-11773	5729	0	16.3144	36.3671	18.9011	1084.718	4987.938	20.2012	29.1043	23.1016
I22lc1_1	1	-10975	3140	1.1738	12.9499	26.5923	76.4175	853.8818	3602.211	26.6021	23.2026	17.1009
I22lc1_2	2	-10980	3138	0.9817	13.3418	27.8194	73.6163	884.0384	3777.427	31.403	26.8036	19.7012
I22lc1_3	3	-10986	3136	1.0141	15.0772	31.1163	70.9151	995.8664	4242.210	27.4023	24.5029	21.1013
I22lc2_1	4	-10973	3124	1.2001	13.4653	28.1974	81.4199	890.7741	3831.03	30.6028	25.1031	17.6009
I22lc2_2	5	-10977	3123	1.2557	13.9676	29.1796	80.8196	923.7529	3970.334	27.8023	25.103	18.9011

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I22lc2_3	6	-10981	3122	0.9995	14.0804	29.3202	68.5141	929.8868	3986.820	25.602	24.1027	18.601
I22lc3_1	7	-10967	3101	1.2021	12.8387	26.6307	74.1165	845.8409	3609.261	23.2016	21.9023	16.8008
I22lc3_2	8	-10971	3101	1.2497	14.2937	28.6961	81.5199	945.5748	3900.002	28.6025	26.6034	18.9011
I22lc3_3	9	-10976	3101	1.0557	14.6568	30.7137	73.5162	970.8193	4185.606	28.4024	26.5033	18.9011
I22lc4_1	10	-10963	3079	1.3805	13.5224	27.8544	90.2244	895.1977	3783.973	32.2031	26.2033	18.101
I22lc4_2	11	-10967	3079	1.5156	13.8302	30.1024	92.9259	916.7142	4099.915	29.8027	26.6035	17.1009
I22lc4_3	12	-10971	3078	1.1233	14.2783	30.4177	80.1193	948.2901	4145.727	32.4031	28.704	20.3012
I22lc5_1	13	-10959	3066	1.0613	12.839	26.4464	78.6185	850.1628	3586.069	33.2033	25.8032	18.201
I22lc5_2	14	-10963	3065	1.2514	13.8058	28.8775	86.4224	911.3851	3925.387	33.6034	23.8028	18.301
I22lc5_3	15	-10968	3064	1.1477	13.9642	29.2996	77.3179	922.5462	3985.694	28.6025	24.4028	19.7012
I22lm1_1	1	-10448	509	1.6212	13.5241	29.1527	107.1344	893.7902	3961.630	39.8048	25.7031	21.2013
I22lm1_2	2	-10451	509	1.368	14.5901	31.4064	96.9282	964.4826	4276.777	39.6047	25.6032	18.401
I22lm1_3	3	-10455	509	1.6061	15.4114	32.4149	97.2284	1017.597	4416.655	30.4028	25.603	17.4009
I22lm2_1	4	-10447	499	1.7976	13.306	29.3439	110.8368	879.5145	3987.844	36.604	25.503	19.6012
I22lm2_2	5	-10451	499	1.6293	14.4767	30.6427	97.5285	955.4307	4167.46	29.8027	25.0028	18.001
I22lm2_3	6	-10455	498	1.691	14.4994	31.2422	102.3314	960.6606	4256.057	32.2031	28.0038	19.6012
I22lm3_1	7	-10444	474	1.4958	13.5274	27.8619	98.8293	891.4778	3780.802	36.2039	23.0023	18.401
I22lm3_2	8	-10448	474	1.4143	14.1787	29.5859	94.7269	936.1216	4022.564	35.4038	24.5032	18.701
I22lm3_3	9	-10452	473	1.299	14.1138	29.747	84.1212	935.116	4044.997	29.4026	27.5035	18.8011
I22lm4_1	10	-10441	456	1.5143	13.5381	28.107	94.5268	896.3036	3814.660	31.2029	27.0034	17.801
I22lm4_2	11	-10445	456	1.7514	14.2049	30.2516	104.833	940.4459	4117.029	32.2031	27.0034	18.001
I22lm4_3	12	-10450	455	1.1795	14.0769	30.0895	83.3208	930.088	4089.770	33.4033	25.0028	17.7009
I22lm5_1	13	-10434	413	1.3093	13.0137	27.9977	89.0238	860.9178	3797.782	34.0035	25.7033	18.401
I22lm5_2	14	-10439	413	1.6335	14.1774	30.2346	100.7304	940.9487	4115.799	32.8032	29.2042	19.6012
I22lm5_3	15	-10444	413	1.5569	14.2914	29.9949	93.5262	947.5861	4077.577	28.6025	29.0039	17.6009
I22la1_1	1	-9681	-3885	1.6889	14.4569	30.8271	106.7342	955.0284	4199.550	36.604	24.9029	19.7012
I22la1_2	2	-9689	-3885	1.5134	14.8271	31.7944	97.5285	985.2033	4335.464	34.4035	30.4046	19.7012
I22la1_3	3	-9697	-3885	0.845	14.0614	30.7978	65.3128	934.0098	4192.988	28.6025	28.804	20.2012
I22la2_1	4	-9685	-3926	1.5168	13.3937	29.0344	94.827	886.049	3946.375	31.603	25.5031	19.0011
I22la2_2	5	-9694	-3926	1.4572	13.4896	28.8597	90.5246	891.6789	3919.860	29.6026	25.0031	17.4009
I22la2_3	6	-9704	-3926	0.8764	11.6315	25.775	69.1143	769.7736	3488.327	31.2029	23.9027	18.501
I22la3_1	7	-9688	-3942	1.6084	13.3732	28.7917	101.3308	883.6362	3913.820	34.4035	24.2028	18.301
I22la3_2	8	-9694	-3942	1.2511	14.6028	29.5399	80.2193	966.2931	4017.033	27.2022	26.7035	18.7011
I22la3_3	9	-9701	-3942	1.0932	13.587	29.4575	74.1165	900.6268	4004.845	27.6023	26.6036	17.801
I22la4_1	10	-9690	-3965	1.4279	13.932	29.3683	89.0238	923.049	3989.995	29.2026	27.5036	16.5008
I22la4_2	11	-9693	-3965	0.9639	15.365	31.0668	72.4157	1016.188	4224.263	30.8028	27.5035	18.201
I22la4_3	12	-9696	-3966	1.4878	13.9238	29.8331	96.7281	922.2446	4059.339	34.6036	27.0034	20.1012
I22la5_1	13	-9690	-3982	1.2738	14.0056	29.3413	90.1244	925.4623	3985.489	36.404	25.5031	18.401
I22la5_2	14	-9691	-3982	0.9596	14.0022	29.7231	74.9168	926.5684	4041.002	33.6034	25.9031	19.4011
I22la5_3	15	-9693	-3982	1.2759	15.0419	31.3258	87.0227	993.452	4265.801	33.2033	25.3031	19.6012

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I23be1_1	1	9480	31854	0	16.5617	36.0943	25.802	1103.843	4938.807	23.6017	33.7055	22.2015
I23be1_2	2	9584	31854	0	16.2226	35.9153	24.3018	1075.559	4914.607	21.0013	27.6038	23.4016
I23be1_3	3	9687	31854	0	16.1286	35.3424	22.1015	1071.432	4831.839	18.601	29.9043	22.5015
I23be2_1	4	9492	31797	0	16.6448	35.9179	18.601	1105.756	4911.209	19.6012	30.3046	19.9012
I23be2_2	5	9573	31797	0	15.984	35.8073	18.401	1063.582	4900.707	20.2012	30.7048	22.4015
I23be2_3	6	9654	31797	0	15.8403	35.4255	21.1013	1054.324	4843.881	22.4015	31.0048	20.1012
I23be3_1	7	9476	31733	0.0389	16.5209	36.1734	27.6023	1099.716	4950.135	22.2015	31.7049	19.6012
I23be3_2	8	9560	31733	0	16.1018	35.9455	22.3015	1071.734	4922.124	22.8016	30.6046	21.7014
I23be3_3	9	9644	31733	0	15.901	35.7325	18.501	1057.242	4892.161	22.4015	29.8044	24.5018
I23bc1_1	1	9152	29394	2.2362	11.1788	25.2897	136.656	734.9167	3423.605	45.0061	20.1018	18.701
I23bc1_2	2	9156	29394	2.4638	11.7248	27.5725	149.5671	771.4814	3742.144	49.0072	20.602	18.101
I23bc1_3	3	9159	29394	3.1385	12.5911	29.4738	171.8886	828.2529	4011.707	44.0058	21.202	19.1011
I23bc2_1	4	9151	29381	2.264	10.6532	26.4266	139.6585	704.2849	3586.069	47.4067	22.5024	21.7014
I23bc2_2	5	9155	29381	2.5224	10.7074	27.0015	157.3743	705.5904	3664.650	54.809	19.9018	17.1009
I23bc2_3	6	9158	29381	2.5585	11.3433	28.2894	163.2799	747.8742	3847.605	59.2105	20.8021	20.2012
I23bc3_1	7	9148	29363	2.2417	10.8476	25.1156	130.5511	716.0349	3395.234	38.8045	22.5025	14.1006
I23bc3_2	8	9153	29363	2.187	11.8328	27.0729	135.0547	779.6191	3672.930	45.4062	21.5021	18.301
I23bc3_3	9	9157	29363	2.5489	12.5896	29.4206	148.8665	830.3633	4002.182	44.806	22.6025	17.4009
I23bc4_1	10	9145	29346	2.4848	10.8885	26.0749	150.1676	715.0305	3537.752	48.8071	18.2016	20.2012
I23bc4_2	11	9149	29345	2.2338	10.9932	26.938	141.5601	726.1786	3655.554	50.4076	22.0024	18.501
I23bc4_3	12	9153	29343	2.4298	12.4792	29.1857	150.2677	821.9217	3972.484	51.0078	21.3021	21.1013
I23bc5_1	13	9144	29333	2.0567	11.2806	27.0791	126.9483	742.8518	3670.885	42.8055	20.402	17.0009
I23bc5_2	14	9147	29332	2.4302	11.192	28.2287	140.8595	738.5327	3836.657	42.0053	21.1021	18.101
I23bc5_3	15	9150	29330	2.4148	12.0443	29.7167	140.6593	793.0825	4042.743	42.4054	20.902	20.0012
I23bm1_1	1	8902	26336	1.4913	13.067	27.9002	92.6257	863.6318	3781.722	30.4028	25.6032	17.2009
I23bm1_2	2	8906	26336	1.7979	12.7822	28.8543	113.3385	842.1221	3915.765	39.2046	22.1024	15.8007
I23bm1_3	3	8909	26336	2.4267	11.6035	28.7832	143.3616	767.6639	3912.694	44.606	23.9028	18.7011
I23bm2_1	4	8899	26316	1.4733	12.0205	25.8044	96.9282	793.3839	3495.474	35.4038	23.4027	21.2013
I23bm2_2	5	8905	26316	1.3129	12.2548	26.6743	86.9227	809.1595	3613.757	31.803	23.5026	18.9011
I23bm2_3	6	8911	26316	2.5999	11.1838	27.3518	146.6645	738.6331	3714.844	40.805	22.3023	18.6011
I23bm3_1	7	8903	26288	1.6592	12.1127	26.6152	105.0331	799.2116	3606.400	36.2039	22.6026	16.5008
I23bm3_2	8	8907	26288	2.1109	12.0026	27.4454	130.6512	788.2596	3726.602	44.0058	18.6018	18.501
I23bm3_3	9	8910	26288	2.0505	11.7134	28.0416	134.3541	771.8833	3808.420	50.4076	20.802	18.401
I23bm4_1	10	8903	26252	1.6143	12.033	26.5474	93.8264	794.9915	3598.226	26.8022	23.5027	17.901
I23bm4_2	11	8908	26252	2.0186	11.6432	26.7242	120.7437	766.7597	3623.464	37.8043	20.502	16.3008
I23bm4_3	12	8913	26251	2.5047	10.8369	26.8364	149.3669	711.2142	3642.881	47.4067	17.3013	18.7011
I23bm5_1	13	8904	26204	1.5697	12.063	26.5826	98.4291	794.5896	3600.781	33.2033	21.5023	17.5009
I23bm5_2	14	8911	26204	2.148	11.5992	27.2321	133.1532	764.3487	3697.054	45.2061	21.1019	20.0012
I23bm5_3	15	8917	26204	2.5725	12.1457	27.9446	152.0694	800.2164	3797.679	47.0066	22.2022	21.6014
I23ba1_1	1	8945	22000	2.1967	12.5888	29.2114	135.3549	830.8658	3974.941	45.4062	23.0026	21.0013
I23ba1_2	2	9030	22000	0	12.823	29.3934	27.2022	852.173	3986.206	23.6017	27.4036	16.0008
I23ba1_3	3	9114	22000	0.1621	14.293	30.7101	31.2029	946.2787	4172.790	21.0013	26.5035	19.4011
I23ba2_1	4	8942	21931	2.0994	13.1556	29.9653	134.9546	869.2609	4079.011	48.8071	24.4028	19.9012
I23ba2_2	5	9013	21931	0.1217	11.808	27.2136	31.703	782.7337	3682.845	23.2016	24.5031	17.2009
I23ba2_3	6	9084	21931	0.1479	13.2961	29.3475	23.4016	880.3188	3982.724	13.8006	25.203	18.701
I23ba3_1	7	8942	21887	2.2024	13.3273	31.0171	138.1572	881.8267	4228.570	48.0069	25.403	20.7013
I23ba3_2	8	9018	21887	0.0184	12.7158	28.6241	27.4023	845.7404	3883.421	22.8016	27.9037	19.3011
I23ba3_3	9	9093	21887	0.0817	11.5123	26.1042	24.2018	761.7368	3528.867	17.2009	23.4028	19.9012
I23ba4_1	10	8964	21808	2.1275	12.0415	27.4446	125.8475	794.4891	3720.262	38.6045	23.1024	15.9008
I23ba4_2	11	9024	21808	0.1719	13.3197	30.7544	31.403	883.9379	4179.967	21.0013	27.4034	21.6014
I23ba4_3	12	9084	21808	0.0577	11.7073	26.2833	25.1019	771.0796	3547.660	19.0011	20.5021	15.7007
I23ba5_1	13	8955	21752	1.7905	13.9876	30.8993	114.9396	926.1662	4205.805	41.005	27.3036	19.0011
I23ba5_2	14	9015	21752	0.5293	11.2356	26.042	51.0078	743.8563	3515.897	26.8022	24.0025	15.1007
I23ba5_3	15	9075	21752	0	11.67	26.3562	19.9012	772.1847	3558.793	16.8008	23.9027	16.9009
I23le1_1	1	18019	29045	0	16.5477	37.1879	21.3014	1100.118	5096.035	19.4011	30.3042	22.6015
I23le1_2	2	17862	29045	0	16.5053	36.7113	22.7015	1096.897	5022.760	22.2015	30.1043	17.7009
I23le1_3	3	17704	29045	0	16.6909	34.7955	20.8013	1110.587	4747.260	24.0017	33.305	18.701
I23le2_1	4	17892	28935	0	16.7118	36.7997	19.3011	1108.977	5038.938	22.0015	29.204	23.8017
I23le2_2	5	17772	28935	0	16.4041	36.401	21.4014	1091.764	4985.877	21.0013	31.2046	22.8016
I23le2_3	6	17651	28935	0	16.2358	35.8329	20.0012	1078.377	4900.604	21.0013	29.6045	21.2014
I23le3_1	7	17843	28863	0	16.5855	36.9499	22.1015	1105.655	5059.651	18.201	33.5053	20.4012
I23le3_2	8	17731	28863	0	16.5161	36.6574	19.8012	1101.125	5021.833	18.001	32.605	19.6012
I23le3_3	9	17619	28863	0	15.9017	35.473	20.1012	1057.745	4849.336	19.0011	30.4046	18.8011
I23lc1_1	1	16985	26912	1.5458	13.3207	27.797	95.4273	877.0013	3764.233	31.0029	23.6027	17.901
I23lc1_2	2	16981	26912	1.2566	13.0384	27.0002	85.8221	859.1085	3651.466	32.8032	24.1027	17.4009
I23lc1_3	3	16973	26912	1.1837	13.4468	28.1923	81.9201	888.7634	3818.241	31.803	26.3032	16.2008
I23lc2_1	4	16982	26899	1.0352	12.5096	25.1677	72.6158	822.6251	3395.336	28.2024	22.5024	17.0009
I23lc2_2	5	16977	26900	1.3572	12.8152	26.7259	88.2233	846.645	3616.21	31.2029	25.4031	16.3008

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I23lc2_3	6	16968	26900	1.5038	13.5259	29.4772	88.4234	894.3934	4003.923	25.802	25.9033	18.301
I23lc3_1	7	16977	26873	1.343	12.2574	25.0681	87.523	807.2502	3383.703	31.0029	23.2026	16.1008
I23lc3_2	8	16969	26873	1.5285	12.6298	27.0349	95.5274	834.7854	3665.264	31.803	25.0032	19.5011
I23lc3_3	9	16961	26873	1.5173	13.6563	29.5264	95.4273	903.8442	4012.526	32.2031	26.5035	18.101
I23lc4_1	10	16970	26853	1.2688	12.1896	25.3185	83.721	802.0251	3418.706	30.2027	22.1024	16.5008
I23lc4_2	11	16964	26853	1.2345	13.8158	27.9378	81.9201	912.1895	3786.632	29.6026	25.3028	16.7009
I23lc4_3	12	16957	26853	1.6076	13.6586	29.3925	101.4309	903.3414	3995.627	34.6036	26.0033	19.7012
I23lc5_1	13	16951	26801	1.2724	12.1119	25.1478	80.7195	797.3026	3397.173	27.0022	21.7022	15.3007
I23lc5_2	14	16946	26801	1.5257	12.9329	27.5822	98.2289	856.3946	3738.565	34.6036	26.8034	16.5008
I23lc5_3	15	16941	26801	1.5588	13.1062	28.6579	92.6257	868.3563	3890.176	27.8023	27.0035	17.2009
I23lm1_1	1	15657	23634	1.4607	13.0977	27.1122	87.9232	864.838	3673.543	26.8022	25.7032	21.3014
I23lm1_2	2	15650	23637	1.4227	12.2662	26.5521	95.0271	808.5565	3591.994	35.6038	23.1025	17.3009
I23lm1_3	3	15643	23640	1.5445	13.9491	29.1514	95.0271	922.3451	3956.613	30.6028	26.8036	17.1009
I23lm2_1	4	15653	23618	1.6716	11.6771	25.0941	100.9305	767.1616	3390.438	31.603	20.502	17.3009
I23lm2_2	5	15646	23621	1.8797	11.8622	25.8946	115.3399	779.0164	3503.235	37.8043	20.202	18.001
I23lm2_3	6	15639	23624	1.595	12.8389	27.6763	106.2338	845.0369	3750.223	40.0048	22.7023	20.1012
I23lm3_1	7	15648	23600	1.6055	11.2574	24.4403	98.0288	738.0305	3295.563	31.403	18.9018	14.7007
I23lm3_2	8	15637	23601	1.9654	11.9135	26.3733	122.0447	784.6426	3570.949	41.2051	22.7025	20.4013
I23lm3_3	9	15626	23601	1.6377	12.8308	27.0786	97.2284	843.6298	3662.606	29.2026	22.2026	15.9008
I23lm4_1	10	15615	23542	1.7269	11.7157	24.8102	106.534	770.7782	3346.054	35.0037	22.6024	15.5007
I23lm4_2	11	15603	23546	1.7148	12.5674	27.0492	106.6341	825.7405	3661.278	35.6038	20.9019	16.3008
I23lm4_3	12	15591	23550	1.5698	14.7316	29.8931	99.9299	972.2274	4056.881	34.4035	26.2034	15.6007
I23lm5_1	13	15562	23446	1.6672	12.0978	25.4121	98.0288	798.3073	3434.425	28.8025	24.9031	19.2011
I23lm5_2	14	15554	23447	1.762	12.1342	26.7291	113.4386	799.5131	3619.582	40.6049	22.3023	16.9009
I23lm5_3	15	15545	23447	1.4954	12.6271	26.5957	90.6246	832.4739	3596.694	28.2024	23.9026	16.0008
I23la1_1	1	13732	20746	1.9407	13.1463	26.6205	111.8375	870.1656	3606.809	31.603	28.7039	20.3012
I23la1_2	2	13724	20748	1.5094	12.1633	25.4075	96.1277	799.8145	3434.118	33.2033	21.8023	17.4009
I23la1_3	3	13715	20749	1.3246	11.9699	25.7641	89.524	790.5706	3485.366	34.0035	24.2028	17.801
I23la2_1	4	13713	20725	1.3471	11.5821	24.2946	92.1255	761.0336	3279.246	35.6038	20.4022	15.7007
I23la2_2	5	13706	20727	1.4495	11.5335	24.4429	96.7281	761.134	3298.622	36.2039	23.6028	14.0006
I23la2_3	6	13698	20729	1.4961	11.4129	24.4519	86.1222	752.0931	3302.294	23.8017	22.3024	16.1008
I23la3_1	7	13698	20706	1.3288	11.4307	22.7594	85.622	751.9927	3064.313	29.6026	22.0022	13.5006
I23la3_2	8	13690	20707	1.5349	11.6862	24.6511	97.5285	767.5634	3330.242	33.6034	20.202	16.5008
I23la3_3	9	13682	20707	1.4557	10.9429	24.7002	98.1289	723.7681	3339.219	37.6042	23.5026	16.5008
I23la4_1	10	13684	20686	1.5904	11.2368	22.8767	104.1325	739.5371	3085.091	37.8043	21.7022	15.3007
I23la4_2	11	13676	20687	1.4995	11.7474	24.5552	103.4321	772.8879	3320.347	40.805	20.9021	16.9009
I23la4_3	12	13668	20688	1.2784	13.3089	27.9493	87.0227	879.1124	3792.360	33.2033	25.003	18.9011
I23la5_1	13	13658	20659	1.6222	12.4558	25.4904	101.1307	818.4044	3446.878	33.6034	21.3022	16.8009
I23la5_2	14	13652	20661	1.4568	12.209	25.386	91.1249	804.2357	3434.527	30.2027	22.5024	17.7009
I23la5_3	15	13646	20662	1.397	11.6427	24.9996	85.4219	768.3671	3381.356	27.0022	23.1027	18.001

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I24be1_1	1	-17435	32309	0.115	16.9772	36.6854	31.3029	1122.265	4997.313	23.0016	30.2043	20.4012
I24be1_2	2	-17376	32309	0	17.127	36.0519	18.8011	1131.528	4905.648	20.0012	30.0043	19.6012
I24be1_3	3	-17317	32309	0	16.4016	35.0527	19.0011	1083.007	4763.308	20.0012	29.6044	21.3014
I24be2_1	4	-17430	32285	0.0973	17.6455	36.8163	27.1022	1166.064	5017.093	19.4011	30.5044	22.0015
I24be2_2	5	-17381	32285	0	17.0137	35.7714	19.5011	1126.997	4871.468	21.6014	31.9052	20.5013
I24be2_3	6	-17333	32285	0	16.6317	35.2427	20.6013	1096.495	4795.923	19.2011	26.5035	20.0012
I24be3_1	7	-17432	32235	0	17.3899	36.7404	22.2015	1148.443	5007.821	21.6014	28.9039	21.3014
I24be3_2	8	-17393	32235	0	16.8585	36.4246	19.3011	1114.312	4960.641	20.2012	30.0042	21.3014
I24be3_3	9	-17354	32235	0	16.5182	35.5526	17.7009	1091.965	4835.647	18.601	30.2046	20.3013
I24bc1_1	1	-17891	29201	1.7069	12.9204	28.0464	106.8342	849.0572	3786.837	36.404	23.8027	15.7007
I24bc1_2	2	-17880	29201	1.7218	12.6416	28.1565	112.7381	828.6549	3805.351	41.8052	20.8022	16.6008
I24bc1_3	3	-17870	29201	1.7113	13.3587	30.6463	111.5373	882.4299	4153.518	41.2051	27.6035	18.401
I24bc2_1	4	-17894	29169	1.6583	12.3666	26.3763	100.4303	810.5663	3559.100	31.803	21.3023	18.601
I24bc2_2	5	-17882	29169	2.0341	12.5856	28.0153	120.7437	827.4489	3789.905	37.4042	23.5026	19.6012
I24bc2_3	6	-17871	29169	1.7728	12.8852	29.9876	114.9396	846.3434	4062.311	42.2053	21.9025	17.0009
I24bc3_1	7	-17899	29104	2.002	13.2921	29.0983	124.9468	873.885	3941.358	42.8055	24.0028	20.4012
I24bc3_2	8	-17886	29104	1.7186	12.7444	28.8243	109.1357	841.5191	3898.569	38.4044	26.7034	16.5008
I24bc3_3	9	-17873	29104	1.7825	12.7676	29.6437	110.7368	838.906	4015.189	37.6042	22.2024	18.001
I24bc4_1	10	-17904	29019	1.9857	12.3291	27.3282	122.8453	812.0736	3692.965	41.4051	24.9031	18.501
I24bc4_2	11	-17892	29015	1.8129	13.1284	29.2569	113.1384	860.9178	3962.142	38.6045	21.3023	19.5012
I24bc4_3	12	-17880	29010	1.513	13.4169	31.5616	100.03	883.1336	4283.958	37.6042	23.5027	18.7011
I24bc5_1	13	-17907	28972	2.1013	12.6576	27.7607	126.548	829.6599	3756.154	40.4049	20.9019	19.4011
I24bc5_2	14	-17894	28972	1.9741	12.9493	28.6713	112.1377	850.1628	3878.918	31.2029	22.9026	19.4011
I24bc5_3	15	-17882	28972	1.6126	13.4668	31.1478	105.8336	885.848	4228.262	39.4047	23.3026	21.0013
I24bm1_1	1	-17891	26558	1.9361	12.9249	28.2116	117.9417	852.0725	3815.684	38.4044	26.2033	18.701
I24bm1_2	2	-17883	26558	1.8956	13.0121	28.8941	120.2434	855.3895	3910.749	42.4054	23.5028	18.501
I24bm1_3	3	-17875	26558	2.127	12.2629	29.367	136.0555	805.6425	3979.754	49.4073	21.7024	19.4011
I24bm2_1	4	-17889	26541	1.686	13.0475	28.3367	109.8362	858.0028	3833.076	40.2048	24.0027	19.7012
I24bm2_2	5	-17882	26542	2.5211	13.3499	29.7877	140.259	879.0119	4040.387	37.4042	25.0033	18.8011
I24bm2_3	6	-17875	26543	2.306	12.6774	29.186	135.6552	832.0718	3956.408	41.6052	21.4021	19.3011
I24bm3_1	7	-17885	26501	1.7361	12.8815	27.5281	109.536	847.9516	3721.387	37.8043	24.7029	18.8011
I24bm3_2	8	-17874	26501	1.8687	12.6316	28.4505	119.1426	830.2629	3849.754	42.4054	22.6026	17.4009
I24bm3_3	9	-17863	26501	1.3919	12.713	28.8784	92.0254	836.2929	3907.064	34.2035	23.2027	18.7011
I24bm4_1	10	-17882	26464	1.7221	12.5845	27.5492	104.6328	828.5544	3721.182	33.6034	24.7029	17.2009
I24bm4_2	11	-17873	26464	2.1426	12.6601	28.8086	127.3486	834.2829	3901.947	39.8048	25.2031	20.3012
I24bm4_3	12	-17865	26464	1.8085	12.5744	28.9795	119.0425	825.037	3925.592	44.806	20.7022	19.3011
I24bm5_1	13	-17862	26353	2.0466	13.3322	29.0517	124.7467	876.1971	3933.065	40.805	23.8025	18.501
I24bm5_2	14	-17856	26353	2.2195	13.1776	29.7598	135.455	866.4464	4034.241	44.806	23.7026	19.5011
I24bm5_3	15	-17851	26353	2.1179	12.5927	30.0291	135.9554	824.836	4072.761	49.6074	19.0017	17.901
I24ba1_1	1	-18265	23333	1.6965	12.6455	27.0155	106.3339	829.2579	3646.764	36.2039	21.8022	17.4009
I24ba1_2	2	-18213	23333	1.4461	12.2197	27.1901	92.6257	803.4318	3670.374	32.6032	23.3026	19.0011
I24ba1_3	3	-18161	23333	0.1717	12.0428	25.3135	35.8038	789.9677	3401.459	25.2019	21.2023	16.0008
I24ba2_1	4	-18268	23296	1.5282	12.2893	25.985	94.0265	803.5323	3496.597	30.6028	20.502	16.1008
I24ba2_2	5	-18214	23296	0.8878	12.7662	28.72	63.7122	839.308	3881.170	25.602	22.9025	19.0011
I24ba2_3	6	-18160	23296	0.0837	14.6776	30.8805	27.0022	966.5948	4178.839	19.8012	25.5031	18.401
I24ba3_1	7	-18273	23282	1.3483	12.1489	25.777	88.1233	796.2977	3466.070	31.803	22.2026	15.0007
I24ba3_2	8	-18214	23282	0.839	12.2638	26.8471	63.7122	804.7382	3618.764	27.4023	21.5022	17.7009
I24ba3_3	9	-18156	23282	0.1305	12.2477	25.9057	31.2029	805.341	3485.570	22.2015	23.1026	18.301
I24ba4_1	10	-18274	23230	1.1841	12.1051	26.5104	82.0202	798.2068	3575.444	32.2031	25.2032	17.901
I24ba4_2	11	-18229	23230	0.6741	12.5071	29.2028	58.3102	824.3336	3949.241	28.6025	23.7027	18.201
I24ba4_3	12	-18184	23230	0.2369	13.2658	30.2009	32.7032	877.1019	4086.491	19.8012	26.9036	17.901
I24ba5_1	13	-18278	23171	1.8796	11.809	26.2998	117.4414	774.0935	3549.907	40.2048	20.3019	16.8009
I24ba5_2	14	-18223	23171	0.5555	11.794	25.9018	51.3079	772.7875	3486.693	26.002	19.5018	16.1008
I24ba5_3	15	-18168	23171	0.2258	13.7266	29.6815	32.4031	902.7382	4010.785	19.8012	23.2026	15.5007
I24le1_1	1	-8816	30452	0	17.164	37.2472	24.1017	1135.656	5090.263	20.6013	29.0041	22.0015
I24le1_2	2	-9043	30452	0	16.3499	36.4535	20.4012	1085.725	4978.254	18.8011	31.9048	20.6013
I24le1_3	3	-9270	30452	0	16.2802	36.2347	20.6013	1081.698	4950.444	23.2016	32.0049	21.6014
I24le2_1	4	-8870	30403	0	17.0416	37.1919	24.1017	1128.105	5085.109	23.8017	28.9039	22.2015
I24le2_2	5	-9092	30403	0	17.0014	36.5702	20.8013	1128.004	4992.573	22.2015	32.3051	21.1013
I24le2_3	6	-9315	30403	0	16.5701	35.6871	20.4012	1094.985	4866.320	20.8013	27.8037	20.7013
I24le3_1	7	-8944	30280	0	16.8082	37.1726	24.3018	1113.003	5081.398	21.0013	29.0042	21.1013
I24le3_2	8	-9150	30280	0	16.778	36.5389	20.2012	1111.594	4989.792	19.6012	29.9041	20.2012
I24le3_3	9	-9356	30280	0	16.4312	36.1664	19.6012	1089.549	4936.953	23.4016	30.6044	20.4013
I24lc1_1	1	-10100	27369	1.2354	13.7875	27.9298	78.7186	903.9447	3775.279	26.6021	21.6021	16.3008
I24lc1_2	2	-10104	27369	1.5412	13.7809	28.8786	92.3256	908.4692	3910.238	28.2024	26.1034	18.501
I24lc1_3	3	-10112	27369	1.1007	15.0279	30.5815	74.6167	989.4282	4144.190	27.8023	26.3034	20.1012
I24lc2_1	4	-10100	27367	1.2741	13.6641	27.5251	80.7195	896.2031	3717.911	27.0022	22.4024	18.301
I24lc2_2	5	-10106	27367	1.4091	14.2414	29.4896	90.3245	935.6188	3992.043	31.403	23.6025	17.5009

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
I24lc2_3	6	-10113	27367	1.2284	14.5325	30.4559	87.3229	956.0342	4125.433	35.6038	25.0031	18.101
I24lc3_1	7	-10104	27356	1.2889	13.4928	27.2584	79.7191	888.6628	3681.312	25.4019	25.6029	16.9009
I24lc3_2	8	-10110	27356	1.34	14.1119	29.7349	87.523	930.3896	4026.046	31.403	26.5035	17.2009
I24lc3_3	9	-10116	27356	1.1455	15.1392	31.4304	75.317	996.1682	4264.775	26.8022	24.9031	19.0011
I24lc4_1	10	-10111	27340	1.7871	13.9776	28.7861	106.7342	918.4235	3895.191	32.8032	24.1027	17.6009
I24lc4_2	11	-10118	27340	1.2266	14.7748	29.8639	84.4214	974.9432	4042.129	32.6032	28.2039	16.2008
I24lc4_3	12	-10125	27340	1.2773	14.6899	31.1376	78.8186	968.2041	4225.699	25.2019	26.2034	20.3012
I24lc5_1	13	-10113	27330	1.2444	13.5578	28.0045	79.619	892.1816	3781.109	27.2022	25.3031	16.4008
I24lc5_2	14	-10120	27330	1.1415	13.8166	29.0947	79.9192	909.8769	3935.727	31.603	25.2031	17.2009
I24lc5_3	15	-10128	27330	1.0636	14.7306	31.1231	72.4157	971.4228	4219.135	27.2022	27.1035	18.701
I24lm1_1	1	-11416	24384	1.6129	12.5541	26.9604	103.0318	826.3434	3641.655	36.2039	24.3028	18.401
I24lm1_2	2	-11434	24384	1.7205	12.9112	27.8719	107.6347	850.4644	3766.483	36.604	25.503	17.801
I24lm1_3	3	-11453	24384	1.4417	14.0319	30.1217	88.4234	922.5462	4080.650	28.4024	24.1028	19.0011
I24lm2_1	4	-11427	24348	2.192	12.5453	27.1523	126.2478	825.841	3670.885	36.404	24.7029	18.601
I24lm2_2	5	-11446	24352	1.7432	13.2313	28.524	112.1377	867.7531	3856.303	40.2048	21.9024	16.7008
I24lm2_3	6	-11465	24356	1.3655	13.9823	29.9943	91.8253	922.3451	4062.003	34.8036	27.1035	18.501
I24lm3_1	7	-11442	24321	1.5269	12.4035	26.4632	103.8323	814.4853	3570.438	40.4049	22.7026	18.401
I24lm3_2	8	-11458	24331	1.5105	13.2626	28.5844	98.7292	872.3771	3865.717	36.0039	24.3029	18.601
I24lm3_3	9	-11474	24341	1.3388	13.9527	30.2728	88.9237	918.7252	4101.657	33.0033	25.2031	19.1011
I24lm4_1	10	-11454	24303	1.6338	12.371	26.5426	105.8336	810.4658	3580.654	38.2044	20.8021	17.1009
I24lm4_2	11	-11469	24310	1.6186	14.3723	30.5047	97.6286	947.6867	4132.607	30.6028	27.7038	18.8011
I24lm4_3	12	-11485	24317	1.2002	13.7416	29.6902	82.3203	905.9556	4018.774	31.803	25.803	16.4008
I24lm5_1	13	-11471	24283	1.8216	12.5963	26.7334	109.7361	826.5444	3606.911	34.6036	22.5025	16.3008
I24lm5_2	14	-11481	24289	1.6141	13.9307	30.3649	103.9324	914.2004	4114.979	37.2042	22.7024	20.4012
I24lm5_3	15	-11492	24295	1.4529	13.9127	29.4717	92.9259	912.7927	3988.254	32.4031	22.4025	17.7009
I24la1_1	1	-13599	21231	1.7289	11.655	24.5597	100.7304	763.0427	3307.802	29.2026	20.0018	16.8009
I24la1_2	2	-13665	21231	0.3095	11.462	26.2896	38.7045	757.9194	3544.595	23.0016	24.7029	17.4009
I24la1_3	3	-13731	21231	0	11.2586	24.8663	23.5017	740.5416	3344.830	20.2012	21.2022	18.201
I24la2_1	4	-13650	21183	1.3636	12.0167	26.36	89.1238	794.1877	3560.121	32.2031	26.3034	19.2011
I24la2_2	5	-13712	21183	0	11.3333	25.8733	29.8027	746.3674	3482.303	26.4021	21.7022	16.0008
I24la2_3	6	-13774	21183	0	10.8944	25.6059	23.6017	719.3491	3447.388	20.4012	22.5025	16.2008
I24la3_1	7	-13683	21131	1.4191	10.2957	24.1759	99.2295	679.5827	3258.444	40.4049	22.8024	18.701
I24la3_2	8	-13757	21131	0.0033	11.3964	24.8768	24.3018	751.8922	3346.156	20.2012	23.4026	16.5008
I24la3_3	9	-13831	21131	0.0114	12.462	27.0861	29.0025	818.304	3652.488	24.6018	20.402	16.4008
I24la4_1	10	-13778	21037	1.6037	11.7566	26.2273	97.5285	772.1847	3540.306	31.2029	21.202	16.6008
I24la4_2	11	-13845	21037	0.5434	10.8247	24.2381	49.4073	711.9172	3261.605	24.6018	20.7021	17.6009
I24la4_3	12	-13912	21037	0.0782	11.2546	24.9857	24.9019	741.0438	3362.48	18.001	21.6021	17.3009
I24la5_1	13	-13845	20980	1.4645	11.3154	25.274	98.4291	745.8652	3406.459	37.6042	23.5027	15.4007
I24la5_2	14	-13918	20980	0.4935	11.8418	26.219	46.5065	779.3177	3537.446	23.6017	22.0024	19.6012
I24la5_3	15	-13992	20980	0.0365	11.4862	25.6001	27.7023	756.5131	3447.898	22.4015	21.9023	17.801

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h5be1_1	1	-18592	31516	0.1401	15.8348	34.672	36.304	1166.367	4728.127	22.4015	35.2059	35.604
h5be1_2	2	-18548	31516	0	14.7409	35.3727	23.2016	1084.718	4826.178	20.6013	31.6047	32.8034
h5be1_3	3	-18504	31516	0	14.5838	34.9235	23.5017	1070.325	4765.571	20.8013	28.6037	36.004
h5be2_1	4	-18590	31507	0.1363	16.1145	34.8663	34.4035	1186.307	4756.21	20.6013	34.3056	34.0035
h5be2_2	5	-18549	31507	0	15.5126	33.4526	20.5013	1143.106	4557.676	21.6014	33.8052	35.2038
h5be2_3	6	-18509	31507	0	14.7394	34.0209	24.1017	1081.598	4632.497	22.0015	28.7042	31.203
h5be3_1	7	-18583	31476	0.2072	16.036	35.9919	36.704	1176.336	4913.680	19.8012	30.7048	32.6033
h5be3_2	8	-18546	31476	0	16.3396	35.063	26.002	1200.810	4780.798	23.0016	32.005	32.5032
h5be3_3	9	-18510	31476	0	14.9355	34.3294	21.4014	1096.293	4678.249	24.2018	29.2042	33.3035
h5bc1_1	1	-18164	28381	0.2389	14.37	31.2586	40.6049	1055.431	4244.877	22.0015	30.3043	30.5028
h5bc1_2	2	-18152	28381	0.0642	14.4471	30.7755	27.7023	1058.953	4172.483	17.2009	28.2038	30.5029
h5bc1_3	3	-18140	28381	0	14.4134	30.5947	23.3016	1054.525	4146.445	18.8011	26.5034	32.7034
h5bc2_1	4	-18160	28358	0.1348	13.8858	30.69	37.0041	1018.502	4163.871	23.4016	28.0037	30.5029
h5bc2_2	5	-18148	28358	0	13.9103	30.1687	27.1022	1018.502	4090.897	22.8016	26.3035	34.6038
h5bc2_3	6	-18137	28358	0	14.1816	30.9109	23.0016	1039.833	4193.501	19.4011	27.5037	31.1029
h5bc3_1	7	-18161	28317	0.0581	14.2443	30.9806	31.703	1044.663	4201.088	21.6014	28.504	30.2029
h5bc3_2	8	-18147	28317	0	14.2808	30.7876	24.9019	1047.078	4175.251	20.6013	28.104	32.3032
h5bc3_3	9	-18134	28317	0	12.9224	28.5119	21.3014	946.0776	3850.572	19.4011	26.1032	29.3026
h5bc4_1	10	-18163	28304	0.1001	13.431	30.0376	35.5038	985.2033	4071.019	23.6017	27.9041	31.403
h5bc4_2	11	-18148	28305	0	14.6285	31.573	26.6021	1072.238	4278.829	21.2013	28.6038	27.7024
h5bc4_3	12	-18133	28305	0	14.4668	31.406	23.2016	1059.356	4259.339	19.4011	27.4038	31.6031
h5bc5_1	13	-18158	28293	0.0558	13.2949	29.9375	31.803	974.6415	4055.959	22.0015	27.0036	30.9029
h5bc5_2	14	-18144	28293	0.0448	14.4031	30.6499	27.0022	1056.638	4153.210	17.4009	29.0042	29.1026
h5bc5_3	15	-18131	28293	0	14.6298	31.7499	27.1022	1075.659	4310.735	22.4015	31.4046	32.6032
h5bm1_1	1	-17593	22970	1.0125	14.3306	31.0229	88.7236	1046.072	4218.110	33.2033	27.0034	29.2027
h5bm1_2	2	-17589	22970	0.9454	14.5868	31.5665	73.2161	1061.771	4291.139	21.0013	24.9031	31.003
h5bm1_3	3	-17586	22970	0.3885	14.5051	31.3729	55.1091	1059.356	4259.236	29.4026	26.0031	31.1031
h5bm2_1	4	-17590	22952	1.1545	12.9291	27.8149	105.9337	938.7363	3767.404	43.6057	22.4024	28.4025
h5bm2_2	5	-17588	22952	1.3927	14.3492	30.6859	118.0418	1043.959	4179.147	44.0058	24.4029	31.303
h5bm2_3	6	-17586	22952	1.8214	14.8055	30.7583	144.5627	1076.364	4192.168	49.2073	25.403	30.3028
h5bm3_1	7	-17583	22929	1.1725	13.5431	30.3971	92.1255	989.9312	4131.480	29.4026	28.6039	29.5027
h5bm3_2	8	-17580	22930	1.0301	14.7663	31.5629	84.3213	1080.189	4297.294	27.8023	29.7044	32.7033
h5bm3_3	9	-17577	22930	1.2048	14.806	31.3359	111.2371	1079.685	4263.955	46.2064	27.5038	31.5032
h5bm4_1	10	-17583	22929	0.9199	13.5649	29.5033	83.8211	988.5229	4001.875	32.8032	24.5029	26.6022
h5bm4_2	11	-17578	22929	1.2744	14.5507	31.2629	94.6269	1062.979	4255.954	26.4021	28.904	30.5029
h5bm4_3	12	-17573	22928	0.4283	14.4964	31.7223	47.3067	1056.940	4308.991	19.8012	24.303	31.103
h5bm5_1	13	-17576	22914	0.9769	14.5836	30.9376	84.4214	1063.079	4207.035	30.4028	26.2031	33.0033
h5bm5_2	14	-17574	22913	1.1851	14.6649	32.0182	93.026	1069.42	4354.758	29.4026	28.2038	30.3028
h5bm5_3	15	-17573	22912	1.246	14.547	31.6425	106.2338	1062.677	4308.786	39.6047	29.704	34.3036
h5ba1_1	1	-16423	19613	0.5082	14.45	31.2678	53.3085	1055.531	4236.467	22.0015	29.1041	31.9031
h5ba1_2	2	-16416	19613	0.2866	15.2187	31.7097	36.504	1112.701	4298.013	15.4007	29.6045	32.8033
h5ba1_3	3	-16409	19613	0.0092	14.6559	31.5926	20.3012	1070.124	4279.034	12.4005	26.6035	33.4035
h5ba2_1	4	-16420	19603	0.5018	14.6293	30.9508	53.8087	1067.004	4191.450	22.6015	27.2036	29.6027
h5ba2_2	5	-16412	19603	0.1863	14.7888	31.9606	30.9029	1079.283	4326.947	14.8007	27.8039	31.6031
h5ba2_3	6	-16404	19603	0	14.4699	31.5327	17.901	1057.745	4266.929	11.6004	28.6039	33.9035
h5ba3_1	7	-16416	19577	0.2588	12.6755	28.6555	32.8032	922.6468	3864.284	13.6006	23.5027	28.6025
h5ba3_2	8	-16409	19577	0.0818	14.5805	31.458	18.201	1063.482	4252.98	7.0001	27.7037	33.6034
h5ba3_3	9	-16403	19577	0	14.032	30.2322	14.6006	1025.847	4080.138	9.4003	28.8039	31.0029
h5ba4_1	10	-16412	19539	0	11.1224	26.0095	11.1004	808.5565	3488.633	4.2001	21.1022	27.8024
h5ba4_2	11	-16407	19539	0.0077	14.0887	31.1053	12.5005	1029.972	4202.934	4.8001	29.3039	33.6035
h5ba4_3	12	-16402	19539	0	14.6325	31.3081	7.1002	1069.520	4230.211	4.6001	28.7041	28.8027
h5ba5_1	13	-16410	19518	0	13.0982	27.4582	7.7002	954.425	3694.192	5.8001	24.2027	28.9025
h5ba5_2	14	-16403	19518	0	13.9399	30.5645	4.7001	1021.923	4133.325	2.6	30.0043	31.6031
h5ba5_3	15	-16396	19518	0	13.9319	30.3485	4.4001	1021.520	4102.682	3.8	29.7041	29.2026
h5le1_1	1	-9456	32061	0	16.2949	35.5072	24.3018	1201.213	4855.718	22.4015	32.605	33.6034
h5le1_2	2	-9487	32061	0	16.3492	35.629	25.702	1205.040	4874.144	21.8014	31.9049	32.3032
h5le1_3	3	-9519	32061	0	16.0785	35.1179	24.0017	1182.681	4805.596	23.8017	28.7042	34.2036
h5le2_1	4	-9465	32041	0	16.4296	35.385	24.6018	1211.688	4841.102	23.0016	33.3053	36.5041
h5le2_2	5	-9491	32041	0	15.9988	35.359	21.6014	1177.444	4841.514	22.6015	29.804	38.0046
h5le2_3	6	-9517	32041	0	16.0727	35.5152	21.4014	1180.365	4855.306	21.4014	27.9039	31.9031
h5le3_1	7	-9468	32025	0	16.0895	35.7756	27.4023	1187.314	4899.368	22.8016	33.6054	38.8048
h5le3_2	8	-9492	32025	0	16.3374	36.0292	24.9019	1202.724	4922.948	23.2016	32.7053	33.5035
h5le3_3	9	-9516	32025	0	16.1672	35.6663	26.2021	1186.810	4874.865	22.8016	28.6042	34.7037
h5lc1_1	1	-9541	29250	0.3551	13.4313	27.0355	39.8048	978.2626	3643.801	15.2007	24.103	27.5023
h5lc1_2	2	-9543	29254	0.3914	14.1044	28.8284	44.2059	1028.664	3892.530	18.001	27.0037	30.5028
h5lc1_3	3	-9550	29254	0.4456	14.0896	29.8483	50.5077	1026.048	4032.602	22.0015	25.5033	27.4023
h5lc2_1	4	-9540	29254	0.0621	12.5921	25.3405	23.1016	922.9484	3410.031	12.4005	26.8037	26.7022
h5lc2_2	5	-9543	29254	0.3515	14.4575	29.2191	46.2064	1057.544	3949.651	21.8014	29.8043	32.0032

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h5lc2_3	6	-9548	29254	1.0632	14.6338	30.3452	100.5303	1070.627	4115.184	42.2053	32.605	31.6031
h5lc3_1	7	-9542	29246	0.3626	13.5216	26.8445	46.5065	986.7122	3624.180	21.4014	24.7028	29.1026
h5lc3_2	8	-9544	29246	0.4195	15.0195	30.2159	48.1069	1097.703	4089.975	20.4012	29.104	30.6029
h5lc3_3	9	-9550	29246	0.5135	14.0812	30.3864	52.0081	1030.375	4113.032	20.4012	29.6043	27.6023
h5lc4_1	10	-9541	29240	0.1881	13.1132	26.1744	24.9019	956.7382	3524.986	8.2002	24.903	30.0028
h5lc4_2	11	-9546	29240	0.5768	14.9218	31.2382	57.1098	1093.274	4235.852	22.2015	31.6048	28.9025
h5lc4_3	12	-9551	29239	0.5338	15.116	31.4548	59.3106	1105.655	4265.288	26.4021	29.8044	28.6025
h5lc5_1	13	-9541	29235	0.1373	12.5515	24.9898	27.3022	918.5241	3360.235	13.0005	26.5033	27.7023
h5lc5_2	14	-9545	29235	0.4061	14.1771	28.762	50.0075	1036.01	3889.971	23.0016	27.7039	31.4032
h5lc5_3	15	-9550	29235	0.6211	12.4941	25.7207	72.1156	909.5753	3464.947	35.0037	23.8025	26.7022
h5lm1_1	1	-9983	24344	0.8474	14.5654	29.8498	76.6176	1065.495	4062.720	28.4024	27.6039	35.2038
h5lm1_2	2	-9985	24344	0.6955	12.4788	24.2755	87.8231	911.8878	3282.917	46.4065	23.4027	27.7025
h5lm1_3	3	-9991	24344	0.6615	14.6533	30.646	67.3136	1075.257	4173.405	28.2024	29.2043	32.1032
h5lm2_1	4	-9987	24329	0.4535	12.5905	25.7026	56.9097	923.3506	3474.339	27.6023	26.1033	25.6021
h5lm2_2	5	-9991	24329	1.0423	15.2636	31.2973	81.9201	1121.863	4264.467	24.2018	33.5053	29.6027
h5lm2_3	6	-9995	24329	0.7657	15.1214	31.8526	69.4145	1108.171	4336.388	25.4019	29.5041	28.2024
h5lm3_1	7	-9993	24309	0.1666	13.2037	28.6719	28.0024	964.7844	3880.761	12.8005	23.3027	27.5024
h5lm3_2	8	-9999	24309	0.7857	15.1427	31.4832	77.2179	1106.36	4279.546	32.2031	28.4038	31.7032
h5lm3_3	9	-10005	24309	0.5466	14.0399	29.7086	65.4128	1026.853	4027.583	32.0031	27.3034	28.8026
h5lm4_1	10	-9996	24303	0.6182	14.5183	29.8653	62.1116	1065.595	4052.168	25.0019	31.3049	29.1026
h5lm4_2	11	-10001	24303	0.7683	15.0989	31.2886	78.2184	1101.427	4253.185	34.0035	26.6035	32.9033
h5lm4_3	12	-10007	24303	0.5293	14.4282	30.7695	60.9111	1057.343	4174.123	28.4024	30.1046	29.0025
h5lm5_1	13	-9998	24296	0.8139	13.2472	26.7596	78.7186	966.6954	3622.238	32.0031	25.2032	29.6027
h5lm5_2	14	-10002	24296	0.7291	14.4149	29.23	72.7159	1054.123	3963.883	30.2027	29.3042	34.3036
h5lm5_3	15	-10008	24296	0.6874	14.974	31.7445	75.9173	1094.683	4313.710	35.8038	28.504	30.0027
h5la1_1	1	-10817	20824	0.6336	13.1213	27.1193	65.4128	958.9509	3684.889	27.4023	21.5022	29.0027
h5la1_2	2	-10826	20825	0.8128	12.2723	27.0417	62.0115	897.4095	3678.45	16.0008	22.3026	31.7031
h5la1_3	3	-10838	20825	0.2461	12.9296	28.674	40.3049	949.5975	3893.861	21.4014	25.3029	28.6025
h5la2_1	4	-10820	20817	0.745	13.6337	27.9551	74.6167	998.6832	3794.918	31.2029	25.9032	26.7022
h5la2_2	5	-10824	20815	0.6667	12.2264	27.628	58.7103	893.6896	3751.552	20.0012	22.1023	28.2024
h5la2_3	6	-10829	20815	0.9025	13.7096	30.5422	83.1207	1003.512	4160.181	33.0033	25.803	28.3024
h5la3_1	7	-10834	20788	0.8936	14.0301	29.07	78.7186	1029.369	3958.558	28.2024	27.8039	30.7029
h5la3_2	8	-10839	20789	0.7051	13.6168	29.282	66.8134	995.8664	3980.983	25.802	24.4028	28.9025
h5la3_3	9	-10846	20789	0.5063	13.5027	30.8368	52.2082	991.6413	4197.191	21.2013	27.5036	28.6026
h5la4_1	10	-10850	20765	0.5712	12.239	26.2571	65.6129	894.3934	3557.874	31.0029	21.8024	27.4023
h5la4_2	11	-10856	20767	0.5155	12.7076	28.5633	54.0088	929.4846	3884.240	22.4015	21.7024	28.7026
h5la4_3	12	-10862	20768	0.6328	13.1249	29.4037	62.2116	963.678	4003.206	25.0019	26.5035	30.4028
h5la5_1	13	-10860	20746	0.5584	11.4952	24.335	53.3085	841.4186	3290.158	19.2011	22.2025	24.7019
h5la5_2	14	-10866	20746	0.9949	11.4078	24.948	84.0212	836.0919	3385.131	29.2026	24.2027	27.0022
h5la5_3	15	-10877	20745	0.3085	12.8086	28.2701	42.9055	939.8425	3836.759	21.0013	24.1029	25.302

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h6be1_1	1	-19234	4021	0	15.9677	36.9156	22.1015	726.279	4931.804	19.0011	21.4023	31.1029
h6be1_2	2	-19207	4021	0	15.5846	36.4747	19.7012	704.4858	4873.424	23.2016	17.1015	36.504
h6be1_3	3	-19174	4021	0	14.3709	35.0244	17.901	650.8684	4667.144	19.6012	17.7015	31.403
h6be2_1	4	-19268	4097	0	15.7248	37.2441	22.4015	714.7292	4981.448	22.4015	20.7022	34.7037
h6be2_2	5	-19225	4097	0	15.5013	36.7061	17.2009	700.3685	4901.530	20.4012	16.7013	32.3032
h6be2_3	6	-19188	4097	0	14.6857	34.9957	17.801	664.6226	4664.985	19.2011	17.1015	31.103
h6be3_1	7	-19316	4246	0	15.4727	37.1636	23.1016	699.9668	4969.087	19.2011	17.2015	33.4034
h6be3_2	8	-19267	4246	0	15.586	36.7573	19.7012	706.1929	4911.209	19.2011	18.4017	32.4032
h6be3_3	9	-19234	4242	0	15.0137	35.5623	17.1009	680.6872	4745.408	20.6013	18.5017	32.9033
h6bc1_1	1	9517	28621	0.8645	12.4977	28.3987	85.0217	907.4637	3818.344	37.4042	26.5036	26.002
h6bc1_2	2	9521	28621	1.1675	12.3467	29.1511	101.1307	894.9966	3929.789	39.6047	25.6031	28.7026
h6bc1_3	3	9524	28621	1.1754	12.569	30.1394	92.9259	911.9883	4067.843	31.2029	26.6035	29.3026
h6bc2_1	4	9514	28608	0.8484	12.4522	27.7725	80.6195	900.8279	3730.794	33.6034	23.6028	27.3023
h6bc2_2	5	9517	28608	1.225	12.3607	29.162	95.0271	893.8907	3933.782	30.8028	24.1027	32.4032
h6bc2_3	6	9520	28608	0.9201	12.2705	29.2777	85.3218	885.3453	3944.122	35.6038	21.0021	30.4029
h6bc3_1	7	9516	28593	1.1044	12.336	28.4091	100.2301	893.388	3825.812	41.4051	24.703	28.7025
h6bc3_2	8	9520	28593	0.9989	12.4304	28.9304	82.9206	902.7382	3899.285	29.2026	26.9036	31.203
h6bc3_3	9	9523	28592	1.1476	12.6902	30.0625	93.3261	922.144	4055.037	32.8032	28.5042	29.8027
h6bc4_1	10	9518	28576	1.0497	10.9944	24.9023	84.1212	794.0872	3338.811	27.8023	22.0024	28.2024
h6bc4_2	11	9522	28576	0.9987	12.1638	28.7255	88.9237	879.0119	3867.661	35.4038	22.6024	29.5027
h6bc4_3	12	9526	28576	1.0624	12.4927	29.0051	86.3223	904.7491	3906.553	29.6026	25.1029	29.3026
h6bc5_1	13	9518	28564	1.1628	11.4332	25.969	98.329	826.645	3490.165	36.604	22.8026	28.6025
h6bc5_2	14	9522	28564	1.0493	12.2233	28.3806	95.9276	884.2394	3823.561	39.8048	23.4026	30.903
h6bc5_3	15	9525	28564	0.9945	12.8084	29.3341	88.9237	929.5852	3955.589	35.2037	26.3032	30.1028
h6bm1_1	1	9309	24372	1.0662	13.0119	29.4236	80.1193	940.1442	3964.599	23.0016	23.6026	29.0025
h6bm1_2	2	9322	24372	0.0405	12.2521	27.6533	27.2022	889.5677	3704.108	18.201	24.4031	28.8026
h6bm1_3	3	9334	24372	0.0151	10.9927	24.5931	25.502	796.5992	3282.917	17.6009	20.502	25.002
h6bm2_1	4	9306	24347	0.779	12.2959	27.9407	66.7133	891.88	3761.881	23.2016	24.3029	29.3026
h6bm2_2	5	9318	24347	0.5178	13.7098	30.5417	50.4076	997.2748	4119.284	19.0011	27.5035	29.8027
h6bm2_3	6	9330	24346	0.0575	11.3093	24.9784	24.3018	820.3138	3340.953	14.4006	21.0023	26.5022
h6bm3_1	7	9303	24313	0.6324	11.2632	24.0868	69.7146	815.8922	3222.658	32.6032	22.0023	22.8016
h6bm3_2	8	9316	24310	0.4031	13.5998	29.9386	42.9055	986.511	4033.831	16.8008	24.3031	29.9028
h6bm3_3	9	9329	24306	0.0213	11.5366	25.6888	28.6025	837.7	3431.566	20.4012	23.2026	25.102
h6bm4_1	10	9297	24291	0.8481	12.06	25.2316	75.0169	870.9698	3380.845	27.4023	21.4023	23.5017
h6bm4_2	11	9314	24291	0.3061	11.668	25.3238	35.6038	844.0318	3388.499	14.0006	20.402	25.0019
h6bm4_3	12	9331	24291	0.0411	10.8512	24.1678	21.9014	788.5611	3227.347	12.8005	21.9022	24.1018
h6bm5_1	13	9290	24264	0.7658	11.8829	25.8895	69.3144	857.9023	3474.135	26.002	20.1019	25.1019
h6bm5_2	14	9300	24257	0.6704	11.0339	25.4625	69.0143	800.4174	3415.746	30.8028	23.1028	27.3025
h6bm5_3	15	9310	24250	0.0368	10.7258	23.8983	21.1013	780.0211	3194.014	12.2004	22.3025	27.7024
h6ba1_1	1	9390	21490	0.9542	10.654	26.8664	80.8196	775.5	3634.194	29.8027	21.0021	24.0017
h6ba1_2	2	9406	21490	0.7646	11.1504	25.8301	63.9123	811.5712	3488.531	21.0013	21.2021	26.1021
h6ba1_3	3	9422	21490	0.2614	12.1663	27.8465	37.1041	889.7687	3766.585	17.801	24.2028	30.1027
h6ba2_1	4	9391	21457	1.171	12.5729	29.7023	93.4262	916.7142	4036.085	31.403	25.103	30.0027
h6ba2_2	5	9407	21457	0.6124	9.7864	24.215	54.5089	710.6117	3263.746	19.4011	17.4014	25.1019
h6ba2_3	6	9423	21457	0.2589	13.375	31.0154	44.706	979.9726	4209.701	25.602	27.6035	32.5032
h6ba3_1	7	9388	21428	1.0171	12.3123	29.0487	86.3223	895.9015	3942.894	31.603	22.6025	30.0027
h6ba3_2	8	9411	21428	0.5664	13.2908	30.7011	54.6089	973.1327	4172.073	21.0013	27.4038	32.7032
h6ba3_3	9	9433	21428	0.1812	11.4743	26.3739	37.1041	839.71	3555.116	21.6014	24.1028	25.902
h6ba4_1	10	9390	21397	0.8953	12.774	28.8821	77.418	932.4008	3917.608	28.0024	25.2032	28.5025
h6ba4_2	11	9410	21397	0.5821	11.3258	25.7456	54.0088	826.042	3471.378	19.6012	22.9025	25.2019
h6ba4_3	12	9429	21397	0.1392	11.4012	26.8599	28.8025	829.1574	3620.297	15.4007	18.6016	24.1018
h6ba5_1	13	9395	21359	0.9894	13.1051	31.01	93.2261	959.152	4220.263	39.8048	28.1039	31.503
h6ba5_2	14	9409	21359	0.6104	11.7976	26.3493	49.7074	858.2039	3555.729	13.8006	21.3023	26.002
h6ba5_3	15	9422	21359	0.4456	11.059	26.1354	50.7077	804.7382	3528.561	23.0016	19.4018	26.4021
h6le1_1	1	17255	31163	0	17.3635	35.6429	25.0019	1202.623	4865.188	27.4023	31.6048	29.9028
h6le1_2	2	17249	31163	0	16.8662	34.9933	20.7013	1163.547	4777.917	20.8013	26.2032	32.5033
h6le1_3	3	17242	31163	0	17.4339	35.9239	21.0013	1208.465	4910.694	22.8016	31.9048	33.0034
h6le2_1	4	17241	31095	0	17.3873	36.1841	19.0011	1206.350	4948.179	18.201	32.8054	33.3035
h6le2_2	5	17236	31095	0	16.9436	35.7044	21.9014	1174.221	4873.835	20.2012	32.3049	31.9031
h6le2_3	6	17231	31095	0	16.3784	34.6847	21.7014	1129.514	4727.304	19.0011	26.6034	30.1028
h6le3_1	7	17241	31098	0	16.8309	35.1637	22.8016	1163.245	4798.599	20.2012	28.204	28.9026
h6le3_2	8	17241	31140	0	17.1773	35.4215	21.5014	1187.515	4842.131	22.0015	27.6038	31.2031
h6le3_3	9	17241	31127	0.0047	16.5707	34.9852	22.6015	1147.637	4778.432	18.401	29.3044	29.3026
h6lc1_1	1	16639	28031	0.7642	15.1404	31.8759	69.6145	1110.587	4341.827	25.602	30.4043	31.503
h6lc1_2	2	16639	28031	0.7642	15.1404	31.8759	69.6145	1110.587	4341.827	25.602	30.4043	31.503
h6lc1_3	3	16639	28031	0.6692	15.2896	32.051	61.3113	1121.762	4367.176	21.8014	29.9044	31.303
h6lc2_1	4	16638	28022	0.2469	13.2478	26.8327	43.9058	971.6239	3625.917	24.4018	26.9034	27.5023
h6lc2_2	5	16636	28023	0.6131	15.2915	32.7362	60.4109	1122.265	4460.910	23.8017	30.5046	30.9029

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h6lc2_3	6	16633	28024	0.623	15.5227	33.3858	56.0094	1136.562	4550.483	19.0011	29.1039	33.0033
h6lc3_1	7	16634	28008	0.522	14.7033	30.821	65.2128	1077.773	4187.041	32.8032	29.004	30.0027
h6lc3_2	8	16632	28008	0.4148	14.7424	31.6819	50.1075	1083.409	4312.685	23.0016	30.8047	33.6034
h6lc3_3	9	16629	28008	0.5655	15.2302	32.5743	52.1081	1113.708	4435.855	17.801	27.3035	33.6035
h6lc4_1	10	16628	27999	0.6682	15.2453	31.0184	55.9094	1116.426	4213.188	16.2008	29.0042	27.2022
h6lc4_2	11	16626	27998	0.6178	15.3141	32.2483	60.7111	1121.863	4385.447	23.8017	30.7044	33.0033
h6lc4_3	12	16623	27997	0.7507	15.9261	32.9938	70.5149	1168.280	4499.014	27.0022	31.6047	33.8035
h6lc5_1	13	16618	27978	0.5592	14.7717	30.9033	55.2091	1080.289	4201.703	21.0013	26.7037	32.7032
h6lc5_2	14	16616	27980	0.5481	15.1222	31.6038	58.7103	1109.178	4301.912	25.0019	29.6042	32.6033
h6lc5_3	15	16613	27981	0.7381	15.4218	32.903	60.8111	1134.548	4487.100	18.201	34.3057	34.3036
h6lm1_1	1	14729	24234	0.5441	12.5395	27.0557	48.0069	915.0048	3662.913	14.8007	22.3024	28.8025
h6lm1_2	2	14693	24233	0.1029	11.1672	24.3228	32.2031	818.103	3281.081	20.0012	22.4025	29.6026
h6lm1_3	3	14657	24232	0.053	12.578	29.4317	19.9012	921.9429	3990.712	10.4003	24.5029	31.203
h6lm2_1	4	14704	24202	0.6717	12.8048	26.1103	62.8118	934.8143	3527.846	23.0016	24.1031	25.9021
h6lm2_2	5	14670	24207	0.044	11.9338	25.2755	30.2027	874.7897	3405.133	20.6013	24.5028	26.4022
h6lm2_3	6	14636	24211	0	14.0111	30.8389	18.701	1027.155	4177.506	13.4005	27.5037	28.2025
h6lm3_1	7	14663	24156	0.7852	12.7033	27.2756	71.7154	924.1551	3688.978	27.0022	21.8024	26.7022
h6lm3_2	8	14636	24171	0.1789	11.7322	26.2313	28.6025	858.4049	3540.510	13.0005	23.8028	30.5028
h6lm3_3	9	14608	24186	0.0383	12.0822	27.2231	17.6009	877.1019	3674.667	8.6002	17.2015	30.9029
h6lm4_1	10	14621	24127	0.6579	12.8587	29.2149	46.7065	936.4233	3958.456	8.6002	22.6024	28.9025
h6lm4_2	11	14600	24140	0.0933	10.9296	23.8909	26.7021	799.4126	3208.896	15.0007	22.7024	24.9019
h6lm4_3	12	14579	24152	0.0129	11.8416	26.4328	23.9017	865.1396	3557.772	16.0008	22.5024	24.0018
h6lm5_1	13	14575	24068	0.5904	12.6663	28.1117	51.9081	925.2612	3801.26	16.8008	25.2032	26.6022
h6lm5_2	14	14541	24071	0.0161	11.7515	26.9606	21.7014	862.2245	3637.465	13.8006	25.6031	28.5025
h6lm5_3	15	14507	24074	0.0192	13.1418	30.3452	19.6012	958.4479	4104.116	11.6004	23.4027	31.303
h6la1_1	1	13381	21109	0.8685	11.1712	25.1655	68.6141	811.9731	3400.540	20.4012	20.1019	28.2025
h6la1_2	2	13358	21109	0.4898	10.999	24.4803	54.5089	804.4367	3298.929	24.2018	23.3027	24.8019
h6la1_3	3	13335	21109	0.0359	12.3684	27.8327	26.5021	907.4637	3759.324	17.6009	26.5031	29.1026
h6la2_1	4	13355	21056	0.6819	11.8654	25.769	66.8134	861.5209	3473.625	27.2022	20.0019	24.5018
h6la2_2	5	13323	21061	0.5681	11.1182	24.1074	54.6089	809.7624	3243.965	20.4012	21.2021	23.7017
h6la2_3	6	13291	21066	0.2168	14.0172	30.8309	39.1046	1026.350	4179.557	21.6014	27.5037	30.5028
h6la3_1	7	13283	20963	0.9672	12.2524	26.2638	70.4149	890.0704	3547.047	17.0009	22.2023	27.9024
h6la3_2	8	13267	20964	0.6944	11.3526	25.4283	59.1105	824.032	3429.015	19.2011	19.3018	26.2021
h6la3_3	9	13250	20965	0.4248	11.909	26.0716	42.7055	867.6526	3506.809	15.4007	22.9026	22.6015
h6la4_1	10	13253	20933	0.7007	12.3924	26.6061	57.61	899.3198	3589.134	17.0009	20.4022	26.0021
h6la4_2	11	13232	20933	0.8118	14.4916	31.9455	83.5209	1059.959	4340.390	37.8043	29.3041	29.4027
h6la4_3	12	13211	20933	0.1725	11.7572	26.2486	28.7025	860.0132	3538.671	13.4005	24.0027	28.1025
h6la5_1	13	13179	20857	0.6674	13.7884	31.1309	65.6129	1004.316	4224.775	27.0022	23.9027	29.4027
h6la5_2	14	13140	20864	0	11.2674	25.6654	22.5015	824.635	3449.123	16.0008	24.0029	24.9019
h6la5_3	15	13100	20870	0	13.0609	31.1205	26.6021	957.6434	4216.264	22.6015	26.9037	28.8025

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h7be1_1	1	8316	2911	0	16.3601	35.878	26.002	1203.328	4917.799	21.2013	28.804	38.0046
h7be1_2	2	8411	2911	0	15.9999	36.4708	21.2013	1179.66	4997.003	19.6012	32.4053	37.0041
h7be1_3	3	8506	2911	0	16.1976	36.0294	18.201	1193.256	4933.554	21.0013	31.1046	34.4036
h7be2_1	4	8355	2872	0	16.2384	35.7679	24.1017	1198.997	4895.661	27.0022	33.9057	33.9036
h7be2_2	5	8443	2872	0	16.1264	36.3403	22.0015	1185.702	4975.473	17.801	28.7043	31.8031
h7be2_3	6	8530	2872	0	16.1098	36.1069	21.2013	1187.112	4938.189	18.001	31.9053	30.3028
h7be3_1	7	8442	2789	0	16.3898	35.9735	25.0019	1206.249	4923.359	21.4014	30.7046	34.7037
h7be3_2	8	8488	2829	0	16.3148	36.1018	21.2013	1201.112	4943.338	21.4014	31.0046	36.3041
h7be3_3	9	8534	2868	0	15.924	35.7075	22.9016	1174.725	4885.572	18.001	33.6056	37.0041
h7bc1_1	1	9198	1838	1.889	11.6641	24.538	158.5754	848.0521	3334.628	59.8107	21.7024	27.1024
h7bc1_2	2	9206	1838	1.5685	13.1135	29.0272	116.941	956.6376	3956.306	34.6036	24.4027	28.8026
h7bc1_3	3	9215	1838	1.1757	12.4703	28.5618	89.1238	907.0616	3884.752	26.2021	19.902	26.1021
h7bc2_1	4	9207	1824	2.0834	12.6461	28.4267	161.3781	919.6302	3879.533	54.2088	22.3023	27.8024
h7bc2_2	5	9211	1825	0.9016	12.2309	27.8961	76.8177	893.187	3787.962	27.0022	22.9027	27.6024
h7bc2_3	6	9217	1824	1.1697	12.5202	28.7001	94.827	913.7982	3904.813	32.2031	23.0025	26.9022
h7bc3_1	7	9210	1815	2.2262	10.8375	25.5484	174.191	788.963	3478.627	61.0112	22.4025	24.1018
h7bc3_2	8	9218	1813	0.9182	12.8918	29.2128	73.5162	941.2504	3975.249	22.8016	22.8025	29.1026
h7bc3_3	9	9227	1814	1.0485	13.2818	29.4982	85.2218	970.6181	4021.847	28.0024	24.0027	32.6032
h7bc4_1	10	9222	1791	2.0519	11.2684	25.3177	167.384	816.1937	3443.713	61.8115	18.4017	24.6019
h7bc4_2	11	9229	1792	1.3653	13.4733	30.0824	106.2338	984.8009	4106.268	33.8034	25.3031	31.2029
h7bc4_3	12	9235	1792	1.1128	14.3569	32.3418	95.8275	1055.330	4427.743	35.6038	29.8043	33.3034
h7bc5_1	13	9227	1780	1.6797	12.454	27.8355	132.8529	909.173	3795.429	45.2061	24.103	29.0026
h7bc5_2	14	9233	1785	1.2277	13.839	30.5067	95.6274	1012.868	4165.512	29.6026	25.5031	28.8025
h7bc5_3	15	9239	1789	1.0677	14.9538	32.1297	85.622	1100.118	4394.172	27.0022	31.3047	31.303
h7bm1_1	1	11638	-2233	0.9692	11.9929	27.29	78.5185	875.594	3708.709	25.4019	21.9023	28.3025
h7bm1_2	2	11653	-2233	0.6404	12.2022	26.56	55.0091	891.7794	3603.948	17.2009	21.6023	28.5025
h7bm1_3	3	11668	-2233	0.604	12.2487	27.4848	53.6086	897.309	3728.238	17.801	23.5027	24.0017
h7bm2_1	4	11644	-2246	0.9627	12.6823	27.8934	80.4194	924.7584	3790.826	27.2022	20.9022	25.302
h7bm2_2	5	11660	-2246	0.4422	12.8972	28.6367	43.0055	946.4799	3893.042	14.8007	25.2031	30.3028
h7bm2_3	6	11675	-2246	0.5833	12.0192	27.3125	58.5103	881.5251	3706.358	23.8017	24.2029	26.2021
h7bm3_1	7	11673	-2273	0.7321	12.3258	27.262	61.4113	901.4312	3700.837	19.4011	23.4027	29.8027
h7bm3_2	8	11685	-2272	0.5378	13.566	30.632	55.6093	993.2509	4171.868	23.0016	24.203	29.8028
h7bm3_3	9	11697	-2272	0.5563	11.2788	25.2253	54.5089	824.7355	3413.093	21.0013	21.7024	26.9023
h7bm4_1	10	11699	-2297	0.928	13.0372	28.9173	76.6176	955.0284	3934.806	25.2019	26.2034	30.3028
h7bm4_2	11	11708	-2295	1.1522	12.0069	27.4015	96.628	877.705	3722.818	34.8036	24.0027	26.3021
h7bm4_3	12	11717	-2294	0.671	12.0424	27.0958	72.9159	878.1071	3672.827	34.0035	20.7022	27.2022
h7bm5_1	13	11722	-2322	1.1721	13.0697	29.2958	90.6246	957.4422	3989.790	27.6023	27.0034	29.1027
h7bm5_2	14	11730	-2321	1.0557	13.1653	30.0527	89.424	959.4537	4094.279	32.2031	21.6024	28.6025
h7bm5_3	15	11737	-2321	0.7425	14.9195	32.4391	80.7195	1091.059	4427.846	38.0043	25.1033	31.403
h7ba1_1	1	13117	-4052	1.7802	11.5385	26.1636	135.7553	841.2176	3556.035	43.8058	24.3029	26.7022
h7ba1_2	2	13148	-4053	0.4085	11.3392	25.2084	46.9066	832.8759	3409.113	20.4012	24.7029	24.902
h7ba1_3	3	13179	-4053	0.0609	12.6636	27.2853	29.5026	931.898	3693.579	19.2011	27.3038	27.8023
h7ba2_1	4	13135	-4077	1.5079	11.8473	26.5578	119.3427	863.0287	3613.655	40.2048	21.4021	26.1021
h7ba2_2	5	13162	-4076	0.3956	11.0034	24.4811	49.1072	806.6473	3312.391	23.2016	21.9024	25.802
h7ba2_3	6	13191	-4076	0.2145	12.7772	28.2221	36.0039	939.6414	3832.360	18.601	26.4033	29.8027
h7ba3_1	7	13166	-4110	1.8469	11.4487	26.2011	144.8629	836.3934	3570.643	49.6074	24.1029	26.4021
h7ba3_2	8	13189	-4110	0.4	11.4282	25.1551	47.2067	836.2929	3407.582	21.0013	20.9022	27.7023
h7ba3_3	9	13211	-4110	0.1447	11.8924	26.3109	29.9027	874.4882	3564.105	15.8007	24.2028	25.502
h7ba4_1	10	13187	-4136	1.381	11.2726	25.0609	114.3392	824.3336	3406.357	41.2051	23.5028	26.6021
h7ba4_2	11	13210	-4134	0.4763	11.3924	25.5189	54.709	837.499	3459.638	25.0019	24.5029	26.3021
h7ba4_3	12	13232	-4133	0.3354	13.2744	27.8684	51.3079	972.5292	3784.28	27.8023	23.4028	28.3024
h7ba5_1	13	13212	-4168	1.1257	12.0178	26.9497	91.9253	879.0119	3663.731	31.2029	23.8029	26.3021
h7ba5_2	14	13235	-4168	0.5841	11.2534	26.1316	55.3092	825.037	3542.246	20.8013	22.7024	23.4016
h7ba5_3	15	13257	-4168	0.2719	12.5106	29.5081	42.3054	919.8313	4017.545	22.6015	25.0028	29.4027
h7le1_1	1	15629	6202	0	15.9333	36.2806	22.3015	1171.804	4967.542	19.4011	29.4043	34.7037
h7le1_2	2	15526	6202	0	16.3076	36.4498	25.3019	1201.817	4994.016	20.6013	32.2051	37.2043
h7le1_3	3	15422	6202	0	16.2447	36.2678	21.7014	1199.903	4967.336	21.8014	34.3058	34.1036
h7le2_1	4	15634	6153	0	16.4353	36.1852	22.7015	1209.875	4951.783	20.4012	31.0046	32.9033
h7le2_2	5	15536	6153	0	16.1364	36.4322	23.7017	1186.508	4985.981	22.8016	29.9043	34.0035
h7le2_3	6	15437	6153	0	15.8426	36.3394	19.7012	1166.971	4972.383	23.8017	31.7051	33.5036
h7le3_1	7	15635	6109	0	16.2753	36.2641	26.002	1196.680	4960.847	23.8017	30.004	33.0033
h7le3_2	8	15539	6109	0	16.1179	36.2053	23.5017	1187.012	4957.963	22.6015	31.2046	36.004
h7le3_3	9	15442	6109	0	16.0764	36.1604	24.0017	1184.594	4950.96	20.6013	31.8049	35.4039
h7lc1_1	1	16175	4410	0.1594	11.7796	24.3641	32.2031	863.5313	3284.957	17.0009	23.2025	24.3018
h7lc1_2	2	16166	4413	0.9452	13.7526	30.1238	78.8186	1007.234	4102.374	26.4021	26.2032	27.0022
h7lc1_3	3	16157	4413	0.6491	14.2238	31.7036	58.0101	1044.965	4321.611	20.0012	29.104	29.6027
h7lc2_1	4	16178	4404	0.39	11.3661	23.1743	47.3067	831.3683	3123.395	21.0013	21.8023	23.9017
h7lc2_2	5	16169	4404	0.7603	12.8455	29.2484	64.9126	937.8312	3981.188	21.8014	21.7023	30.1028

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h7lc2_3	6	16159	4404	0.6437	14.5029	31.8537	59.5106	1063.482	4346.752	21.6014	26.9033	31.803
h7lc3_1	7	16180	4398	0.2364	11.7085	24.1538	34.1035	861.5209	3261.502	15.2007	25.8033	25.702
h7lc3_2	8	16177	4394	0.7312	13.1949	29.7882	64.6125	968.4053	4056.573	22.8016	26.9038	30.4029
h7lc3_3	9	16170	4392	0.5343	12.9494	29.0334	52.3082	948.1895	3949.036	19.8012	23.4027	29.4027
h7lc4_1	10	16193	4368	0.5213	10.959	23.7436	54.1088	804.5372	3207.877	22.0015	24.2028	25.8021
h7lc4_2	11	16189	4365	0.748	13.9252	30.9682	65.6129	1020.414	4226.109	22.8016	25.103	30.2028
h7lc4_3	12	16183	4362	0.8127	14.7731	32.7299	71.7154	1083.007	4472.105	25.802	27.3037	31.203
h7lc5_1	13	16200	4354	0.4054	12.2114	25.0888	40.0048	893.4886	3390.131	13.0005	22.9025	26.1021
h7lc5_2	14	16195	4351	1.0149	12.6129	28.1228	81.3198	924.3562	3824.277	25.802	26.5035	29.5027
h7lc5_3	15	16188	4348	0.6696	14.2367	31.2501	59.3106	1044.462	4257.287	20.2012	28.3039	31.2032
h7lm1_1	1	17150	1457	0.7305	13.3381	28.0448	64.5125	976.1503	3805.863	22.2015	26.6035	31.303
h7lm1_2	2	17126	1457	0.5252	11.9682	26.8961	53.7087	874.1866	3640.837	21.8014	22.6027	27.6024
h7lm1_3	3	17100	1457	0.143	14.2291	29.9182	32.3031	1042.047	4060.057	18.001	25.9033	31.3031
h7lm2_1	4	17132	1442	0.7785	12.6697	27.134	69.4145	923.3506	3675.485	25.0019	22.2023	26.7022
h7lm2_2	5	17157	1441	0.6409	12.4174	26.3687	58.9104	907.6649	3566.659	21.0013	24.3028	26.0021
h7lm2_3	6	17105	1441	0.0212	12.51	27.2285	27.6023	914.6026	3678.245	19.2011	22.7024	28.0024
h7lm3_1	7	17161	1422	1.1302	11.9941	25.942	87.0227	871.573	3512.425	25.802	20.4021	24.4018
h7lm3_2	8	17135	1422	0.6468	12.6339	26.7209	61.2112	918.5241	3614.064	23.0016	20.0021	26.3021
h7lm3_3	9	17108	1421	0	13.3418	28.2753	23.4016	977.5585	3825.403	17.6009	25.1032	28.1024
h7lm4_1	10	17166	1393	0.8851	12.9562	26.6798	73.6163	947.0833	3614.575	23.6017	25.403	26.5022
h7lm4_2	11	17142	1387	0.6504	11.7402	25.7663	61.0112	856.8972	3480.873	23.0016	23.1026	26.4021
h7lm4_3	12	17116	1381	0.0681	13.4779	28.0767	21.8014	983.5938	3794.201	11.0004	23.0025	29.4027
h7lm5_1	13	17171	1350	0.833	13.382	28.252	71.2152	976.7538	3835.838	24.0017	23.9028	29.2027
h7lm5_2	14	17148	1349	0.5497	12.3232	26.9221	56.7096	897.7112	3645.334	23.4016	20.7021	28.6025
h7lm5_3	15	17123	1347	0	13.9547	30.0261	27.8023	1025.344	4074.195	23.0016	28.0036	30.0027
h7la1_1	1	17850	-3084	0.7071	13.7881	28.4847	64.4124	1010.152	3861.214	23.0016	28.4038	28.8025
h7la1_2	2	17829	-3084	0.6421	14.101	30.7652	65.4128	1033.293	4182.120	27.6023	27.9036	28.7026
h7la1_3	3	17807	-3084	0.4774	12.7971	26.9674	46.6065	932.7025	3645.947	16.4008	21.7024	27.1022
h7la2_1	4	17849	-3108	1.0337	13.2589	28.0652	90.9248	968.9082	3808.932	34.0035	26.5034	30.5028
h7la2_2	5	17830	-3108	0.6665	11.736	24.8237	58.2102	856.2941	3352.991	19.0011	22.1022	26.7022
h7la2_3	6	17809	-3108	0.4851	14.1229	29.4038	54.3088	1035.909	3990.404	23.6017	28.604	30.4029
h7la3_1	7	17844	-3137	0.7759	12.5996	26.4492	71.9155	919.8313	3575.648	27.4023	24.603	26.7022
h7la3_2	8	17825	-3137	0.5372	12.7524	27.43	58.5103	931.898	3712.390	25.602	23.8026	26.4021
h7la3_3	9	17803	-3137	0.5122	13.8059	29.4248	53.0084	1010.252	3992.555	21.2013	25.9032	28.9025
h7la4_1	10	17841	-3162	0.5484	12.1272	25.1954	49.9075	883.7368	3397.377	16.2008	21.4022	23.2017
h7la4_2	11	17819	-3162	0.5845	13.85	30.0518	63.1119	1015.383	4082.392	28.0024	28.0036	29.8027
h7la4_3	12	17796	-3162	0.1673	13.2273	28.1308	35.4038	967.9023	3807.704	20.0012	24.203	29.2027
h7la5_1	13	17835	-3201	0.4771	11.5914	23.9658	48.7071	845.3384	3227.041	18.401	21.8022	25.0019
h7la5_2	14	17818	-3199	0.5984	14.101	30.3508	68.6141	1033.293	4120.309	32.8032	28.8041	29.8027
h7la5_3	15	17800	-3199	0.3451	12.9976	27.7425	41.4051	951.8101	3754.211	17.6009	25.8032	29.2026

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h8be1_1	1	17513	6026	0	16.4079	35.9274	27.2022	751.7917	4845.425	22.6015	20.0019	35.1038
h8be1_2	2	17468	6026	0	16.8107	36.542	21.6014	767.8648	4926.449	23.0016	18.2016	32.2031
h8be1_2	3	17429	6026	0	15.267	36.2495	24.7018	697.6571	4886.395	28.4024	17.7016	32.4032
h8be2_1	4	17485	5987	0	16.6002	36.0216	28.3024	757.9194	4854.277	24.8018	17.8015	33.2034
h8be2_2	5	17443	5987	0	16.3957	36.8759	23.8017	751.4904	4981.345	24.2018	20.202	37.3042
h8be2_3	6	17419	5987	0	15.5783	36.0922	23.6017	713.022	4870.953	29.4026	18.0017	32.1032
h8be3_1	7	17461	5933	0	16.078	35.914	29.5026	739.5371	4845.631	22.8016	22.3024	34.6036
h8be3_2	8	17426	5933	0	16.1378	35.971	24.5018	737.4278	4849.336	31.603	18.2017	35.1038
h8be3_3	9	17402	5933	0	14.5954	35.4802	24.4018	671.1486	4789.132	25.0019	20.2019	33.5035
h8bc1_1	1	16653	27909	1.0124	12.5131	30.0337	82.6205	579.4054	4098.480	28.0024	16.8014	32.9033
h8bc1_2	2	16650	27910	0.8846	12.4254	30.1591	75.5171	575.2912	4103.091	27.2022	17.2015	27.4024
h8bc1_3	3	16644	27910	0.195	10.1244	26.6032	43.6057	468.9588	3596.694	28.2024	14.3009	27.9023
h8bc2_1	4	16649	27900	0.8383	13.8558	32.6358	76.3175	643.6404	4459.062	29.8027	19.3017	29.9027
h8bc2_2	5	16646	27899	1.1406	13.3666	30.8133	93.126	620.4528	4198.319	32.0031	20.1019	28.7026
h8bc2_3	6	16639	27899	0.7925	13.1004	31.0852	68.0139	605.5983	4236.672	23.8017	16.3013	30.7029
h8bc3_1	7	16646	27885	0.7791	13.2889	32.4483	68.5141	614.1294	4426.614	25.2019	16.1012	28.3025
h8bc3_2	8	16642	27885	1.1782	14.0401	32.214	95.6274	649.8645	4401.153	32.6032	18.5016	32.1031
h8bc3_3	9	16635	27885	0.627	12.3121	30.9262	60.9111	567.063	4211.855	25.0019	13.0007	27.4023
h8bc4_1	10	16645	27866	1.2547	12.1383	28.1203	99.1295	560.9424	3823.356	32.6032	16.6014	26.9022
h8bc4_2	11	16636	27866	0.7685	13.1613	30.2041	73.016	610.9176	4112.212	29.6026	18.6017	28.9025
h8bc4_3	12	16626	27866	0.3148	11.94	30.3865	43.8058	552.3137	4131.275	22.6015	14.601	27.1023
h8bc5_1	13	16641	27856	1.1017	12.1219	27.8621	87.9232	559.939	3789.598	28.6025	15.8012	29.4026
h8bc5_2	14	16631	27856	0.5604	11.9072	28.685	59.7107	550.2067	3897.341	26.6021	14.601	28.7025
h8bc5_3	15	16621	27856	0.511	12.9157	31.4738	60.1108	599.978	4290.729	29.4026	18.2016	31.403
h8bm1_1	1	15531	-2212	0.5695	11.5118	25.6916	52.5083	524.7247	3432.689	18.8011	14.201	27.4023
h8bm1_2	2	15508	-2212	0.0885	12.1805	26.4838	35.8038	556.2266	3531.318	24.4018	14.9011	26.2022
h8bm1_3	3	15492	-2212	0.0046	11.9791	25.5375	23.3016	546.2938	3395.336	15.6007	14.4011	24.4018
h8bm2_1	4	15522	-2242	0.7898	12.3748	26.9278	62.3116	562.3471	3601.496	18.001	13.8009	26.2021
h8bm2_2	5	15496	-2242	0	10.9786	25.2988	20.3012	502.2556	3365.949	18.8011	14.9011	25.402
h8bm2_3	6	15478	-2242	0.0112	11.9909	27.5256	23.2016	545.1902	3671.294	15.6007	12.4007	25.602
h8bm3_1	7	15508	-2279	0.5816	11.4884	26.0001	54.1088	524.3234	3470.664	20.0012	15.6011	27.9024
h8bm3_2	8	15485	-2279	0	11.1873	25.0607	23.1016	510.6812	3333.914	16.6008	14.0009	26.1021
h8bm3_3	9	15471	-2279	0	12.2648	26.5372	21.1013	559.939	3536.833	17.6009	14.901	27.4023
h8bm4_1	10	15501	-2317	0.415	12.3013	28.3644	49.6074	561.2434	3793.179	23.4016	15.6013	28.2025
h8bm4_2	11	15479	-2317	0.0298	10.7023	25.0836	26.3021	490.7214	3335.138	18.001	15.8012	23.4017
h8bm4_3	12	15457	-2315	0	12.2365	27.1396	26.002	558.3336	3618.253	23.4016	14.8011	27.8023
h8bm5_1	13	15502	-2349	0.5351	11.1704	25.0724	52.0081	508.7754	3343.810	20.0012	14.001	26.8022
h8bm5_2	14	15471	-2349	0.0281	10.4447	24.572	22.6015	477.2824	3264.664	14.4006	13.9009	22.7016
h8bm5_3	15	15452	-2347	0	12.0007	26.4518	23.2016	545.0899	3524.986	19.4011	11.9007	27.1022
h8ba1_1	1	14691	-5772	0.7051	11.249	25.0975	63.8122	510.4806	3346.258	23.8017	12.8008	25.3019
h8ba1_2	2	14683	-5772	0.424	10.9098	24.1138	49.1072	497.1404	3207.877	22.2015	14.1009	24.8019
h8ba1_3	3	14671	-5774	0.2812	12.2172	27.6074	36.1039	555.8253	3684.481	16.0008	14.0009	27.5023
h8ba2_1	4	14689	-5789	0.6869	12.8897	28.3464	67.1135	588.3366	3793.076	27.8023	17.2014	29.6026
h8ba2_2	5	14677	-5791	0.2152	13.5136	29.8016	41.8052	616.9398	3987.435	24.6018	16.7013	29.6028
h8ba2_3	6	14668	-5791	0.2591	12.1474	27.3288	37.5042	557.3303	3648.297	18.401	18.6017	29.9027
h8ba3_1	7	14685	-5815	0.6999	12.3462	27.2146	61.1112	561.6447	3636.443	21.2013	14.7011	26.3021
h8ba3_2	8	14675	-5815	0.3166	11.9235	25.9387	45.8063	540.3746	3453.105	23.8017	11.9007	24.6018
h8ba3_3	9	14664	-5820	0.2129	11.7053	26.5732	32.5032	532.7501	3543.574	15.6007	13.5008	27.5023
h8ba4_1	10	14688	-5831	0.9432	13.4955	31.1022	78.9187	617.3412	4183.453	28.0024	19.3018	35.604
h8ba4_2	11	14676	-5829	0.3528	11.2686	24.8403	43.2056	511.7846	3305.966	19.6012	12.5007	25.0019
h8ba4_3	12	14665	-5831	0.1643	11.3446	26.4034	35.3037	518.1041	3521.105	20.8013	14.9011	28.7025
h8ba5_1	13	14679	-5857	0.4763	11.8513	26.4767	50.7077	539.7726	3533.667	21.4014	14.3009	25.602
h8ba5_2	14	14666	-5857	0.2388	11.8173	26.0133	37.9043	536.3617	3466.580	19.6012	12.2007	27.1023
h8ba5_3	15	14656	-5857	0.1986	11.366	25.9089	28.6025	517.7028	3449.736	12.4005	13.9009	26.4023
h8le1_1	1	9398	34214	0	15.214	36.1676	25.1019	709.507	4950.444	20.8013	21.5022	33.3034
h8le1_2	2	9660	34214	0	14.8196	36.4164	24.0017	690.9292	4985.568	23.2016	21.3024	35.0038
h8le1_3	3	9921	34214	0	14.4414	35.4422	18.8011	671.3494	4847.792	24.4018	18.4016	31.403
h8le2_1	4	9417	34161	0	15.0033	36.3667	24.6018	698.1592	4981.963	23.8017	19.8018	36.2042
h8le2_2	5	9672	34161	0	14.8235	36.1021	24.1017	692.335	4943.235	21.4014	22.2022	35.2037
h8le2_3	6	9926	34161	0	15.0107	35.2171	19.1011	696.2513	4814.755	22.6015	17.6014	33.2035
h8le3_1	7	9425	34092	0	14.8592	36.2096	25.1019	691.5317	4962.392	21.8014	19.1017	34.2036
h8le3_2	8	9676	34092	0	14.8908	36.2334	21.4014	693.7408	4960.229	23.4016	20.202	31.103
h8le3_3	9	9927	34092	0	14.7256	35.5159	19.8012	684.5027	4854.998	20.4012	19.2017	33.0033
h8lc1_1	1	9686	5654	1.235	12.7756	28.2903	97.5285	576.9971	3782.643	32.4031	12.7007	23.7018
h8lc1_2	2	9691	5654	0.9267	12.7595	28.7039	84.1212	578.8033	3836.554	33.8034	15.1011	28.0025
h8lc1_3	3	9695	5654	1.1159	13.092	28.9053	84.1212	594.96	3870.936	24.6018	16.2013	29.0026
h8lc2_1	4	9686	5643	1.1239	12.9048	28.2854	94.3267	585.4264	3779.268	34.4035	15.7012	26.3021
h8lc2_2	5	9690	5643	1.1121	13.166	28.8765	90.6246	597.469	3864.182	31.2029	15.4012	26.4021

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h8lc2_3	6	9695	5643	0.7265	13.3969	29.6228	71.5153	609.2114	3964.087	30.4028	15.6012	26.2021
h8lc3_1	7	9682	5614	0.8229	11.5417	25.1345	87.8231	523.4206	3352.175	42.0053	13.2008	26.7022
h8lc3_2	8	9687	5614	0.8837	13.1462	29.241	79.7191	601.082	3918.017	31.2029	18.8017	28.7025
h8lc3_3	9	9694	5616	0.8926	13.2204	28.9674	80.2193	601.082	3873.597	31.2029	16.4013	27.9024
h8lc4_1	10	9682	5602	1.4656	13.119	28.4996	117.6415	595.5622	3823.05	41.2051	15.8012	29.4027
h8lc4_2	11	9686	5604	1.1995	13.6686	29.5505	101.1307	619.7501	3959.173	37.4042	15.6012	29.9027
h8lc4_3	12	9694	5603	0.8216	13.2485	28.9075	75.9173	602.5873	3864.796	30.2027	15.9011	24.5018
h8lc5_1	13	9679	5594	1.0589	12.3398	26.9612	96.1277	558.6346	3602.211	39.2046	13.6008	27.8023
h8lc5_2	14	9687	5594	0.886	13.426	29.1264	74.6167	608.3081	3899.285	25.802	14.4009	32.0033
h8lc5_3	15	9694	5594	0.8585	12.9101	28.5996	72.9159	585.6271	3823.356	25.602	14.501	26.5021
h8lm1_1	1	10352	-755	1.2332	12.9143	27.6013	99.8299	584.1218	3676.814	34.6036	16.0012	27.8024
h8lm1_2	2	10356	-755	0.7669	12.3157	28.3961	69.9147	560.9424	3791.031	27.4023	17.0014	28.2024
h8lm1_3	3	10362	-755	0.4723	12.0924	27.1844	54.0088	549.4041	3622.647	25.0019	14.4009	26.5022
h8lm2_1	4	10353	-767	1.2876	12.6111	27.3946	101.8311	571.4781	3650.035	34.2035	16.7013	26.4021
h8lm2_2	5	10357	-767	0.9283	13.4818	29.2467	77.0178	613.2261	3914.639	26.2021	16.9014	30.3028
h8lm2_3	6	10362	-767	0.6445	12.6514	27.9632	61.0112	574.087	3732.532	23.8017	14.4009	27.7024
h8lm3_1	7	10353	-784	1.1612	13.1391	28.5055	97.1283	597.5693	3808.113	35.4038	18.3016	30.4028
h8lm3_2	8	10355	-784	0.6573	12.5626	27.7593	65.2128	569.7723	3701.042	27.4023	14.1009	24.0017
h8lm3_3	9	10362	-784	0.6741	12.9692	27.9568	63.4121	589.3401	3729.158	24.6018	15.8012	27.1023
h8lm4_1	10	10352	-803	1.2196	12.3534	26.6017	108.8355	559.4373	3548.579	44.2059	15.001	27.0022
h8lm4_2	11	10356	-804	0.943	12.274	28.0362	76.5176	558.133	3743.473	25.602	16.2012	26.0021
h8lm4_3	12	10361	-805	0.6845	12.3646	27.3116	64.2124	558.6346	3632.968	25.2019	13.0008	24.1017
h8lm5_1	13	10353	-826	0.9473	12.047	27.3684	79.519	546.5948	3650.853	28.4024	15.4012	28.5025
h8lm5_2	14	10354	-825	1.3551	12.6249	27.7192	97.9288	572.4815	3695.316	27.2022	16.9014	24.5018
h8lm5_3	15	10359	-825	0.6677	12.0281	26.761	64.7126	546.2938	3553.584	26.6021	16.2012	23.5017
h8la1_1	1	10962	-5027	1.7116	13.7747	28.6045	135.5551	620.6535	3820.697	47.0066	14.8011	28.2025
h8la1_2	2	10968	-5027	0.8988	13.5378	30.1345	76.0173	614.029	4031.885	27.0022	16.2012	33.1034
h8la1_3	3	10973	-5027	0.4238	12.8977	29.4858	48.6071	586.1288	3938.901	22.0015	15.4011	31.1029
h8la2_1	4	10973	-5057	1.094	12.4795	26.0099	102.0312	565.8589	3463.211	43.0055	15.9011	26.2021
h8la2_2	5	10978	-5057	1.002	12.6358	28.5947	80.7195	573.1839	3813.842	27.0022	16.0012	24.902
h8la2_3	6	10982	-5057	0.6044	12.1855	28.2222	58.3102	552.8153	3765.460	23.4016	14.1009	26.7022
h8la3_1	7	10977	-5076	1.1017	12.0351	26.6646	88.5235	544.2873	3557.567	29.8027	13.5008	26.4022
h8la3_2	8	10981	-5076	1.3216	12.4301	27.2917	108.6354	561.3438	3646.764	39.4047	13.6009	29.3026
h8la3_3	9	10984	-5076	1.0988	12.8037	28.5053	95.5274	583.1183	3807.704	37.0041	18.1015	26.4022
h8la4_1	10	11012	-5155	1.6245	12.9285	28.1399	124.4464	588.0355	3767.404	40.6049	18.3015	28.8027
h8la4_2	11	11003	-5121	1.0592	12.1447	27.5594	90.2244	550.909	3679.472	33.8034	15.301	27.8024
h8la4_3	12	11009	-5121	0.5941	12.6037	28.4754	59.4106	571.7791	3798.498	24.8018	14.9011	29.3026
h8la5_1	13	11011	-5156	1.5938	12.8264	26.5418	121.0439	580.6096	3543.370	38.0043	16.2013	28.5026
h8la5_2	14	11016	-5156	0.9393	13.1166	28.9607	72.5158	593.0533	3873.699	21.4014	13.4008	30.1028
h8la5_3	15	11020	-5156	0.7062	12.6988	29.8533	66.1131	579.2047	3991.429	26.6021	17.9015	28.8026

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h9be1_1	1	17584	30267	0	16.1732	35.7884	25.702	1187.717	4887.116	21.6014	30.2046	34.3037
h9be1_2	2	17529	30267	0	16.1742	35.3713	20.3012	1188.321	4828.751	20.0012	30.2045	33.0033
h9be1_3	3	17473	30267	0	15.9878	35.0872	21.3014	1176.236	4789.338	19.0011	31.1044	31.603
h9be2_1	4	17549	30218	0	16.0242	34.8373	20.5013	1179.559	4753.843	19.0011	31.8049	31.7032
h9be2_2	5	17499	30218	0	16.2368	35.3362	19.4011	1195.975	4832.559	25.0019	31.6048	34.8037
h9be2_3	6	17449	30218	0	16.2426	35.0124	20.2012	1193.961	4784.090	22.8016	29.2041	32.5033
h9be3_1	7	17475	30121	0	15.9423	35.5476	20.7013	1173.214	4866.629	22.4015	29.1041	33.8036
h9be3_2	8	17441	30121	0.1152	14.7265	32.2168	30.4028	1084.013	4389.04	17.6009	29.9043	31.9032
h9be3_3	9	17407	30121	0	15.8767	34.2659	21.0013	1168.079	4683.596	22.0015	29.4044	35.8039
h9bc1_1	1	16702	27456	0.4965	14.5152	30.6398	53.2085	1065.897	4171.047	22.0015	28.1038	29.5027
h9bc1_2	2	16699	27456	0.8884	15.142	32.6251	74.2165	1111.393	4456.084	24.4018	29.8041	31.8031
h9bc1_3	3	16696	27456	0.6443	15.5206	32.6299	65.713	1141.193	4452.900	27.4023	31.905	33.5035
h9bc2_1	4	16699	27442	0.665	13.9258	28.5255	60.1108	1017.697	3870.015	20.6013	24.903	28.8025
h9bc2_2	5	16694	27443	0.8011	15.9234	33.625	70.815	1169.388	4595.288	25.0019	31.3047	33.3034
h9bc2_3	6	16689	27443	0.5985	15.2479	32.0491	59.3106	1116.426	4369.434	23.2016	26.8034	32.5034
h9bc3_1	7	16690	27412	0.7522	12.1633	25.8393	61.3113	889.4672	3494.555	18.001	24.303	25.0019
h9bc3_2	8	16685	27412	0.6096	12.6006	26.7036	62.9119	923.6523	3613.450	26.4021	26.4033	25.902
h9bc3_3	9	16679	27412	0.8277	15.1394	31.9462	72.3157	1111.191	4359.376	25.2019	29.7042	32.0031
h9bc4_1	10	16669	27372	1.175	14.302	30.1962	97.8287	1051.909	4122.051	33.8034	31.0047	30.6028
h9bc4_2	11	16665	27370	1.0112	13.0226	27.6061	94.3267	955.7324	3750.427	38.4044	28.504	28.8025
h9bc4_3	12	16659	27368	0.4196	14.5548	32.0176	51.2079	1069.621	4365.329	24.0017	28.5039	30.1027
h9bc5_1	13	16642	27302	0.9604	14.8498	31.5869	84.6215	1087.335	4312.992	31.2029	27.3036	34.5037
h9bc5_2	14	16639	27302	0.4411	14.3237	31.2459	53.9087	1054.726	4261.185	25.602	30.0044	32.5032
h9bc5_3	15	16636	27302	0.6814	14.4629	31.833	60.3109	1061.368	4346.547	20.6013	27.3038	31.9031
h9bm1_1	1	15149	24347	1.0338	12.7453	27.8901	93.7263	931.3953	3793.485	37.0041	22.8024	25.802
h9bm1_2	2	15139	24347	0.4423	13.1482	28.4688	47.6068	961.767	3869.299	19.2011	22.4025	30.4028
h9bm1_3	3	15129	24347	0.4084	12.6096	27.1285	36.604	924.2557	3674.156	9.8003	24.703	26.4022
h9bm2_1	4	15121	24288	0.8629	13.7037	29.3342	65.4128	1004.920	3986.820	16.8008	28.2038	27.5024
h9bm2_2	5	15115	24285	0.5377	12.7002	26.5415	48.0069	929.2835	3594.446	14.8007	24.2029	28.8025
h9bm2_3	6	15109	24281	0.6563	13.6584	28.873	59.0104	999.8904	3919.860	20.2012	25.8032	27.8024
h9bm3_1	7	15110	24253	1.0093	12.8548	28.1837	78.0183	938.2335	3828.779	22.6015	23.4025	27.8024
h9bm3_2	8	15102	24251	0.6652	13.3429	28.6388	64.9126	974.7421	3888.027	25.802	23.0025	26.4022
h9bm3_3	9	15094	24249	0.4503	12.7534	27.4366	45.6062	934.8143	3717.502	16.8008	25.0029	26.3021
h9bm4_1	10	15089	24207	1.2201	13.2324	28.0797	93.126	967.1983	3820.799	27.0022	24.1027	25.1019
h9bm4_2	11	15082	24209	0.5442	12.057	26.5069	53.3085	882.5304	3592.812	20.2012	22.9025	27.6023
h9bm4_3	12	15074	24209	0.6193	12.8528	27.1199	64.7126	945.2731	3683.254	27.6023	27.6036	28.9026
h9bm5_1	13	15056	24163	1.0088	13.5051	29.0152	79.3189	987.7181	3949.958	23.6017	24.5029	27.6023
h9bm5_2	14	15048	24163	0.8873	14.2061	30.4131	74.7167	1043.053	4149.212	24.8018	27.5038	28.4025
h9bm5_3	15	15039	24163	0.5455	12.8605	29.0061	57.0098	946.681	3946.784	24.0017	27.9035	28.8025
h9ba1_1	1	15101	24247	0.9062	13.4507	28.6315	77.1178	987.014	3901.025	26.2021	26.5032	30.0028
h9ba1_2	2	15092	24246	0.5072	14.6571	30.7272	51.4079	1076.364	4190.527	19.6012	27.3037	32.6032
h9ba1_3	3	15082	24245	0.4526	14.7294	31.2486	45.9063	1080.491	4262.621	16.8008	25.4032	29.7027
h9ba2_1	4	15086	24204	0.6227	12.6836	27.8641	57.9101	928.5796	3788.575	21.0013	23.0026	29.7027
h9ba2_2	5	15079	24202	0.7427	12.0187	26.4146	56.8097	876.9008	3580.245	14.2006	20.3021	23.5017
h9ba2_3	6	15071	24199	0.7856	13.1324	28.0909	67.9138	959.4537	3811.387	23.0016	23.4026	24.8019
h9ba3_1	7	15047	24154	0.9584	13.3119	29.3498	77.7181	973.3339	3995.115	24.8018	25.2031	31.8032
h9ba3_2	8	15041	24155	1.0931	14.4203	30.2212	95.4273	1055.431	4113.134	35.4038	27.7036	27.3023
h9ba3_3	9	15034	24156	0.4465	13.9436	29.689	47.9069	1023.332	4035.368	19.2011	27.8038	31.7031
h9ba4_1	10	15030	24124	0.8992	13.2524	28.5654	72.7159	966.6954	3879.021	22.4015	22.8025	26.5021
h9ba4_2	11	15027	24129	0.8027	14.065	30.5115	74.0164	1031.582	4156.490	28.4024	27.9039	30.7029
h9ba4_3	12	15024	24133	0.6536	13.4568	29.4132	55.0091	982.9903	4000.236	16.6008	22.4025	28.2025
h9ba5_1	13	15012	24050	1.0442	13.1332	28.4582	85.3218	963.4768	3872.573	28.0024	27.3035	27.5023
h9ba5_2	14	15006	24052	0.8148	13.9837	30.3405	70.815	1024.338	4130.660	24.6018	26.1033	26.7022
h9ba5_3	15	15000	24054	0.6788	14.1257	29.8803	64.7126	1032.488	4064.052	24.8018	24.1029	28.8026
h9le1_1	1	10220	32428	0	15.9934	35.7549	23.2016	1179.156	4897.412	25.4019	32.0049	36.1042
h9le1_2	2	10378	32428	0	16.6825	36.1212	20.3012	1229.417	4940.455	22.6015	33.3056	32.0032
h9le1_3	3	10536	32428	0	16.1992	36.0845	22.2015	1190.033	4938.704	20.8013	29.6043	37.6044
h9le2_1	4	10304	32008	0	16.5903	35.9112	24.9019	1224.078	4914.195	22.0015	34.1057	33.3035
h9le2_2	5	10364	32008	0	16.3395	36.2872	20.6013	1207.760	4974.134	19.6012	35.4061	36.9042
h9le2_3	6	10423	32008	0	16.615	36.3096	20.7013	1224.280	4979.285	20.4012	31.3047	36.6041
h9le3_1	7	10303	31984	0	16.225	35.269	29.0025	1197.486	4829.369	25.0019	32.4052	32.9034
h9le3_2	8	10361	31984	0	16.5961	36.0193	20.2012	1224.481	4936.438	22.4015	32.9053	35.3039
h9le3_3	9	10419	31984	0	16.3043	36.3016	20.4012	1202.220	4978.77	22.6015	30.7042	32.2032
h9lc1_1	1	10172	29333	1.6933	13.4548	29.9851	132.953	982.7891	4093.459	44.606	25.7033	28.3025
h9lc1_2	2	10175	29334	1.1228	12.3468	28.7432	87.8231	900.3252	3913.206	27.6023	21.4022	27.6023
h9lc1_3	3	10181	29334	0.9172	14.0508	31.1071	87.1228	1029.771	4244.364	36.2039	26.9036	31.003
h9lc2_1	4	10170	29317	1.2556	11.9018	27.8789	100.7304	870.3667	3800.032	34.2035	23.6027	31.403
h9lc2_2	5	10173	29319	1.1892	12.95	29.9702	91.4251	943.4628	4083.212	28.0024	22.0024	29.1026

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h9lc2_3	6	10178	29317	0.8061	11.8837	28.2497	67.2135	868.2557	3838.089	22.4015	22.5024	28.9026
h9lc3_1	7	10165	29301	1.2219	12.2206	28.6307	95.2272	889.6682	3896.215	30.4028	21.002	28.7025
h9lc3_2	8	10170	29302	1.2128	11.5795	27.3802	104.6328	844.1323	3715.048	40.4049	22.1024	23.5017
h9lc3_3	9	10175	29301	1.3161	14.1763	31.6565	108.1351	1036.613	4318.225	38.2044	27.9041	30.903
h9lc4_1	10	10165	29281	1.7138	11.886	27.378	134.4542	862.124	3725.068	45.8063	19.702	28.4025
h9lc4_2	11	10170	29280	1.3994	11.6145	27.7825	115.0397	849.8613	3781.620	42.0053	25.403	29.6027
h9lc4_3	12	10177	29279	0.8237	14.1953	31.7471	72.7159	1040.538	4333.515	26.4021	27.3036	33.1033
h9lc5_1	13	10161	29266	0.902	12.2503	26.7446	71.3153	893.2875	3627.450	21.0013	21.4021	26.4022
h9lc5_2	14	10167	29264	1.2557	12.803	30.0727	99.2295	932.8031	4098.275	32.8032	22.1023	28.6025
h9lc5_3	15	10173	29262	0.9659	13.312	31.4218	79.9192	973.4344	4282.316	27.4023	25.4029	28.9025
h9lm1_1	1	10437	25802	1.0543	11.4097	25.4886	103.1319	830.1624	3454.636	45.8063	19.8019	27.1024
h9lm1_2	2	10442	25802	1.5127	12.5404	28.3473	120.8438	913.8988	3857.019	41.6052	23.7027	28.3025
h9lm1_3	3	10447	25802	1.2606	12.4557	28.8356	104.0325	908.5698	3926.616	37.2042	23.1026	30.3028
h9lm2_1	4	10438	25795	1.183	11.6355	26.5684	105.5334	846.9465	3598.124	42.4054	22.2024	25.802
h9lm2_2	5	10444	25795	1.2963	12.7078	29.6141	107.1344	925.5629	4028.198	38.8045	23.7028	30.3028
h9lm2_3	6	10450	25795	1.189	13.2618	30.446	102.2313	967.8018	4142.960	38.8045	25.2032	28.4025
h9lm3_1	7	10439	25790	0.9966	11.8983	27.3159	89.0238	867.6526	3705.846	34.8036	22.5024	28.5025
h9lm3_2	8	10442	25790	1.4337	12.527	29.0144	121.144	911.4856	3952.825	46.0063	21.4023	29.4027
h9lm3_3	9	10445	25790	1.4494	12.8999	29.1503	118.0418	940.4459	3970.743	41.8052	23.6027	28.8025
h9lm4_1	10	10440	25784	0.8862	11.4498	27.5585	87.3229	836.4939	3742.042	38.8045	22.3023	27.8025
h9lm4_2	11	10445	25784	1.2047	12.0327	28.6775	105.3333	878.2076	3897.750	41.6052	23.8028	27.3023
h9lm4_3	12	10449	25784	1.3145	12.4014	28.6631	112.4379	906.8605	3902.151	43.0055	25.5031	29.3026
h9lm5_1	13	10443	25760	1.5852	11.9794	28.7558	121.144	874.5887	3923.238	39.2046	23.9027	31.203
h9lm5_2	14	10447	25760	1.4137	13.1897	30.54	106.434	962.5717	4168.689	32.2031	24.0028	29.9027
h9lm5_3	15	10451	25760	1.3826	13.029	30.2619	104.7329	949.7986	4131.172	32.0031	22.3024	29.7028
h9la1_1	1	10704	22049	0.7008	12.8468	28.5753	61.4113	940.647	3883.626	21.0013	24.903	28.8026
h9la1_2	2	10731	22049	0.3643	11.516	25.9234	44.706	843.4287	3506.502	20.4012	23.1027	27.0022
h9la1_3	3	10758	22049	0.1583	12.3929	26.6115	29.3026	905.9556	3598.737	14.4006	21.3021	25.402
h9la2_1	4	10713	22214	0.9876	11.3125	24.2478	92.1255	824.836	3281.183	37.6042	21.2024	24.4018
h9la2_2	5	10728	22214	0.9126	13.0323	29.198	82.3203	954.425	3974.225	31.803	25.5031	27.5023
h9la2_3	6	10743	22214	0.6776	13.1652	28.8345	65.1127	965.1867	3925.592	25.602	25.0032	29.4026
h9la3_1	7	10721	22189	0.9093	12.8825	28.1525	78.2184	940.4459	3830.416	27.6023	22.5026	30.4029
h9la3_2	8	10733	22189	0.6901	12.9626	28.0681	56.6096	950.1004	3814.354	16.4008	24.7029	25.402
h9la3_3	9	10750	22189	0.5864	13.4538	29.9866	64.4124	987.2151	4086.491	29.4026	25.7029	29.6026
h9la4_1	10	10714	22167	0.7795	11.4282	24.8855	72.0156	835.7904	3371.458	27.6023	22.2023	25.6021
h9la4_2	11	10736	22167	0.4651	11.996	27.0668	46.9066	878.7103	3672.521	17.801	22.8026	27.4023
h9la4_3	12	10757	22167	0.2379	13.5942	30.1302	36.704	997.5766	4099.505	18.201	24.703	27.2022
h9la5_1	13	10715	22149	0.7156	12.619	27.4138	63.8122	925.9651	3726.704	22.4015	25.1031	26.9022
h9la5_2	14	10734	22149	0.7035	12.374	28.1134	72.2156	906.3578	3824.891	31.803	23.0027	26.7022
h9la5_3	15	10753	22149	0.4749	14.1745	30.8868	55.1091	1040.638	4214.418	25.2019	26.0031	30.7029

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h10be1_1	1	6769	23478	0	16.4477	37.5747	22.3015	722.8642	5150.161	22.6015	20.202	35.8039
h10be1_2	2	6854	23478	0	16.322	37.2074	23.5017	717.5413	5095.52	22.4015	20.4021	33.7034
h10be1_3	3	6979	23478	0	15.5542	36.452	20.4012	681.8921	4988.144	21.8014	18.5017	36.304
h10be2_1	4	6720	23341	0	16.6326	37.6187	8.9002	730.9996	5155.833	8.0002	20.302	35.3038
h10be2_2	5	6919	23341	0	16.0809	36.3405	20.3012	704.2849	4967.954	25.802	18.1017	32.4032
h10be2_3	6	7017	23341	0	15.6174	35.7761	20.2012	685.4064	4890.925	22.6015	19.402	35.6038
h10be3_1	7	6789	23560	0	16.5438	37.5698	24.2018	726.9821	5147.996	20.8013	19.8019	31.9032
h10be3_2	8	6956	23560	0.033	16.2291	36.7196	22.6015	712.9215	5030.076	17.6009	19.6019	35.4038
h10be3_3	9	7059	23560	0	15.2978	36.2312	22.2015	673.7591	4955.594	25.802	21.5024	35.1038
h10bc1_1	1	17935	27939	1.1252	14.8365	30.3475	79.8191	982.085	4133.837	31.803	26.3033	20.2012
h10bc1_2	2	17936	27939	1.2263	14.5629	30.1581	79.8191	966.1925	4112.007	27.8023	27.4035	20.5013
h10bc1_3	3	17933	27939	1.2226	15.2066	32.4203	80.9196	1007.435	4429.489	29.2026	26.0032	19.9012
h10bc2_1	4	17934	27919	1.055	15.5142	32.7278	81.1197	1026.954	4469.640	36.0039	25.7032	19.4011
h10bc2_2	5	17937	27919	1.359	14.7861	31.0122	85.622	980.2744	4230.519	28.4024	26.6033	17.801
h10bc2_3	6	17933	27919	1.3453	15.935	33.0033	84.3213	1058.249	4512.265	27.6023	28.704	17.7009
h10bc3_1	7	17940	27910	1.3267	13.5269	28.555	86.5225	897.4095	3884.957	30.6028	26.7035	18.301
h10bc3_2	8	17937	27910	1.1529	15.2368	32.0622	79.0187	1009.447	4376.003	30.0027	26.2034	17.6009
h10bc3_3	9	17934	27910	1.1885	15.8684	32.7901	79.1188	1052.613	4482.580	28.6025	27.4035	18.9011
h10bc4_1	10	17941	27898	1.2315	14.5043	29.8785	84.0212	960.8618	4069.277	31.803	26.5034	19.2011
h10bc4_2	11	17939	27898	1.237	15.3492	32.4439	85.9221	1019.206	4432.569	33.6034	28.5037	19.7012
h10bc4_3	12	17937	27898	1.2902	15.7891	33.3811	82.4204	1053.821	4566.205	28.0024	34.0053	20.1012
h10bc5_1	13	17940	27873	1.1451	14.1115	28.8078	80.6195	934.0098	3912.694	31.803	26.1034	15.5007
h10bc5_2	14	17937	27873	1.1864	15.4307	32.4394	82.1202	1026.350	4430.002	31.803	30.8045	20.2012
h10bc5_3	15	17933	27873	1.3852	15.822	33.9207	88.3234	1050.500	4643.394	30.2027	28.3038	20.0012
h10bm1_1	1	17654	23611	1.6891	15.4924	31.9431	103.8323	1024.036	4367.689	33.4033	24.2028	22.3015
h10bm1_2	2	17655	23611	1.0622	15.1729	31.7689	75.6171	1007.133	4334.541	30.2027	29.1041	22.3015
h10bm1_3	3	17653	23611	1.1417	15.9288	32.9089	83.0207	1058.148	4497.782	34.4035	29.9041	21.8015
h10bm2_1	4	17655	23607	1.1537	14.1197	28.5637	83.0207	936.9261	3885.264	33.8034	28.2037	20.5013
h10bm2_2	5	17655	23607	1.069	14.7196	29.9922	80.2193	975.245	4083.827	34.4035	27.2036	20.5013
h10bm2_3	6	17652	23607	1.2922	15.6911	33.3683	89.6241	1041.041	4559.012	35.2037	28.6041	19.1011
h10bm3_1	7	17650	23583	1.2708	14.1778	29.6263	84.9216	939.6414	4033.114	31.2029	26.6033	18.201
h10bm3_2	8	17648	23583	1.3656	15.2353	32.6789	89.9243	1011.258	4464.505	32.6032	28.4038	19.8012
h10bm3_3	9	17646	23583	1.3049	15.5865	34.1868	87.2228	1033.595	4677.529	32.4031	27.0034	18.501
h10bm4_1	10	17648	23574	1.2834	14.8446	31.5027	83.721	981.6826	4294.833	29.6026	24.803	17.1009
h10bm4_2	11	17646	23574	1.3906	15.6347	32.8914	90.2244	1035.406	4500.555	31.803	26.0034	23.7017
h10bm4_3	12	17644	23574	1.088	15.9277	33.805	81.0197	1058.349	4624.890	34.6036	29.104	19.2011
h10bm5_1	13	17644	23556	1.1472	15.1243	30.8644	76.5176	1005.423	4206.625	27.6023	30.2043	18.001
h10bm5_2	14	17642	23556	1.3103	15.6855	33.1484	81.0197	1038.827	4532.606	25.802	25.9032	19.5011
h10bm5_3	15	17640	23556	0.921	15.0887	33.267	64.9126	1001.701	4548.634	25.2019	27.2035	19.6012
h10ba1_1	1	17204	20969	0.7851	12.5219	28.1193	61.3113	828.3534	3816.400	27.0022	23.5028	17.901
h10ba1_2	2	17146	20969	0	11.9522	26.2043	24.4018	789.5658	3547.353	20.8013	21.4022	18.201
h10ba1_3	3	17087	20969	0	11.8917	26.7	23.4016	788.3601	3616.618	21.8014	23.8028	18.101
h10ba2_1	4	17205	20934	0.6249	11.6191	25.869	54.1088	768.568	3501.294	26.002	22.5025	16.0008
h10ba2_2	5	17149	20934	0.034	11.6598	26.2693	23.4016	772.7875	3555.218	18.201	23.4028	16.6008
h10ba2_3	6	17093	20934	0	13.3417	30.601	23.2016	885.848	4167.46	20.0012	25.303	19.3011
h10ba3_1	7	17210	20880	0.5079	12.2582	26.8626	52.4082	813.7819	3641.552	28.8025	25.6035	16.6008
h10ba3_2	8	17155	20880	0	12.7247	27.7007	22.1015	841.8206	3760.142	21.2013	22.7026	20.2012
h10ba3_3	9	17099	20880	0	13.4738	30.9944	22.0015	896.1025	4223.750	24.8018	26.8033	20.0012
h10ba4_1	10	17219	20791	0.5801	13.8965	31.4683	47.5068	921.9429	4289.908	21.2013	25.5031	16.9009
h10ba4_2	11	17158	20791	0	11.5086	25.5726	24.5018	764.3487	3460.455	21.6014	24.3026	15.8008
h10ba4_3	12	17097	20791	0	11.7112	25.9375	21.5014	775.8014	3514.570	17.801	22.9025	20.8013
h10ba5_1	13	17240	20742	0.5997	13.0738	29.3109	53.9087	867.5521	3987.025	26.8022	25.5033	18.301
h10ba5_2	14	17173	20742	0.0648	12.4037	26.4974	25.1019	818.5049	3591.279	18.601	21.2023	21.2014
h10ba5_3	15	17105	20742	0	12.6564	28.5794	24.1017	839.911	3881.067	24.4018	24.7028	17.6009
h10le1_1	1	14732	20786	0.0024	16.6459	37.0186	25.0019	732.5062	5071.297	21.0013	19.5018	36.8041
h10le1_2	2	14596	20786	0	16.4292	36.7956	21.4014	720.956	5033.889	26.002	18.1016	36.104
h10le1_3	3	14486	20786	0	15.9306	36.417	23.0016	700.2681	4979.491	24.0017	18.8017	33.0033
h10le2_1	4	14745	20888	0	16.5185	37.0247	24.3018	726.8816	5067.381	21.4014	20.102	36.9042
h10le2_2	5	14612	20888	0	16.1266	37.3563	23.1016	710.4108	5108.611	23.2016	20.6022	30.4028
h10le2_3	6	14498	20888	0	16.2808	35.8518	22.0015	714.7292	4892.470	20.4012	18.5018	29.3026
h10le3_1	7	14764	21037	0	16.7403	37.0925	25.702	739.2358	5075.317	25.4019	22.8025	35.3038
h10le3_2	8	14652	21037	0	16.2453	37.2783	21.9014	717.0391	5105.828	25.802	21.4021	33.9035
h10le3_3	9	14540	21037	0	16.3697	35.9404	21.7014	720.1525	4912.033	22.8016	19.7019	33.9035
h10lc1_1	1	10249	26896	1.5196	12.5061	27.5988	97.7286	827.0469	3756.461	34.4035	22.6027	19.4012
h10lc1_2	2	10257	26897	1.0226	13.849	31.1623	74.8168	920.1329	4255.749	31.2029	26.5035	18.7011
h10lc1_3	3	10265	26897	0.6763	14.1427	31.3528	58.9104	941.0493	4282.932	28.8025	28.0039	20.5013
h10lc2_1	4	10254	26883	1.5362	13.5263	29.5297	100.2301	898.2139	4029.734	36.2039	26.8035	21.5014
h10lc2_2	5	10262	26884	0.8583	13.8055	30.7347	68.0139	915.407	4197.191	30.8028	24.7031	21.4014

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h10lc2_3	6	10270	26884	0.5646	13.0921	29.4259	51.9081	866.3458	4006.791	26.2021	22.7025	18.7011
h10lc3_1	7	10262	26865	1.4011	13.8833	30.5996	97.2284	920.5352	4178.736	38.6045	25.3032	20.0012
h10lc3_2	8	10268	26864	1.0883	13.7535	30.8203	76.8177	914.6026	4209.804	30.6028	27.4038	20.9014
h10lc3_3	9	10274	26863	0.8073	14.1386	32.2697	66.9134	937.8312	4412.035	31.803	25.103	20.9013
h10lc4_1	10	10266	26852	1.4496	13.9145	30.1148	92.4256	921.7418	4109.752	31.803	24.8028	19.5011
h10lc4_2	11	10272	26852	1.033	14.8078	32.2879	74.1165	981.8838	4411.932	30.0027	25.9033	17.901
h10lc4_3	12	10278	26852	1.0823	14.5177	33.0265	74.9168	963.8792	4523.360	29.0025	25.9035	21.5014
h10lc5_1	13	10269	26837	1.9434	13.9196	30.8011	117.5414	920.9374	4206.420	37.4042	24.1027	19.1011
h10lc5_2	14	10277	26837	1.2267	14.0163	31.5657	76.8177	930.1885	4312.787	25.2019	26.1033	19.9012
h10lc5_3	15	10284	26837	1.0348	13.9377	31.68	73.2161	926.8701	4325.408	29.2026	28.1037	19.1011
h10lm1_1	1	11154	24472	1.4779	13.557	29.8716	103.9324	897.4095	4072.044	42.2053	24.1026	19.1011
h10lm1_2	2	11158	24474	1.6951	14.9726	32.4494	109.636	994.458	4437.189	39.2046	28.104	19.3011
h10lm1_3	3	11162	24475	1.5541	14.789	33.1633	104.0325	981.6826	4539.593	39.4047	27.2034	22.6015
h10lm2_1	4	11156	24470	1.5313	14.7357	32.3254	101.8311	979.1679	4418.606	38.0043	28.604	20.9013
h10lm2_2	5	11161	24470	1.7098	15.0318	32.9085	110.7368	998.7838	4500.555	39.8048	28.8039	19.5011
h10lm2_3	6	11165	24470	1.3161	14.2442	32.4342	85.9221	944.1668	4431.748	30.8028	25.7032	21.1013
h10lm3_1	7	11164	24454	1.5683	14.9251	32.2606	104.7329	987.8187	4407.107	39.4047	25.5032	20.8013
h10lm3_2	8	11168	24454	1.6942	14.574	32.9091	108.7355	970.3163	4500.350	38.6045	30.5045	21.0013
h10lm3_3	9	11171	24454	1.5353	14.478	33.3747	104.3326	960.7612	4566.924	40.6049	26.8034	21.8014
h10lm4_1	10	11168	24438	1.6602	13.7149	30.7085	106.434	911.6867	4190.014	37.6042	28.7039	22.2015
h10lm4_2	11	11174	24438	1.3815	14.6742	32.2506	92.6257	972.1268	4401.358	34.8036	26.4033	19.1011
h10lm4_3	12	11180	24437	1.3099	14.4963	33.1936	89.424	961.4653	4536.408	34.6036	26.7034	20.2012
h10lm5_1	13	11172	24428	1.2843	14.2141	30.4538	91.325	937.2278	4149.725	37.2042	21.8023	19.9012
h10lm5_2	14	11176	24429	1.378	14.507	32.7594	94.6269	965.7902	4478.164	37.0041	29.7042	19.1011
h10lm5_3	15	11180	24429	1.4925	13.776	31.8745	99.6298	916.0103	4353.423	37.6042	28.3038	21.1013
h10la1_1	1	11924	20441	1.3423	14.2629	31.738	94.0265	946.0776	4340.082	37.8043	26.0032	22.5015
h10la1_2	2	11948	20441	0.274	12.5795	28.6788	39.0046	834.5844	3900.923	24.6018	24.2028	19.0011
h10la1_3	3	11971	20441	0.0657	11.2949	25.6462	28.6025	748.6778	3475.768	22.2015	22.1023	17.5009
h10la2_1	4	11942	20413	1.7155	14.0675	31.6402	112.7381	935.7194	4322.227	41.8052	29.104	19.0011
h10la2_2	5	11963	20413	0.5996	11.8408	27.2251	56.2095	784.9441	3697.565	29.2026	23.2024	18.001
h10la2_3	6	11983	20413	0.0833	11.6409	26.0864	31.3029	771.7828	3536.629	24.2018	23.1026	18.7011
h10la3_1	7	11966	20379	1.7248	13.7568	31.0043	111.7374	911.0834	4236.364	40.4049	24.503	20.9013
h10la3_2	8	11986	20379	0.7401	12.2916	27.2796	59.4106	810.8677	3709.220	26.8022	19.8019	20.0012
h10la3_3	9	12006	20379	0.1451	12.0408	26.7438	32.7032	795.5944	3629.902	23.2016	20.502	18.201
h10la4_1	10	11980	20359	1.5458	12.9334	29.3784	107.4346	858.0028	4008.122	43.2056	25.0031	20.6013
h10la4_2	11	12001	20359	0.5547	11.2928	25.6832	53.9087	746.0661	3482.711	28.6025	20.0018	17.1009
h10la4_3	12	12022	20359	0.1977	11.5576	26.0019	30.3028	765.3533	3525.599	18.8011	21.8023	17.2009
h10la5_1	13	11996	20329	1.4792	12.9598	29.8585	102.7317	861.2194	4073.581	41.2051	26.2031	18.501
h10la5_2	14	12020	20329	0.5925	11.7121	26.4836	53.2085	775.7009	3597.001	26.4021	21.9023	17.801
h10la5_3	15	12044	20329	0	11.0117	25.3598	32.4031	729.2921	3436.160	29.6026	21.0021	18.001

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h1lbe1_1	1	-9452	5018	0	16.8169	32.4071	23.5017	1165.259	4393.351	20.8013	35.7062	25.502
h1lbe1_2	2	-9505	5018	0	17.2414	35.1129	22.7015	1188.925	4780.695	21.6014	29.4041	32.5032
h1lbe1_3	3	-9559	5018	0	16.8366	34.9464	26.3021	1165.36	4760.016	23.8017	33.4051	35.2039
h1lbe2_1	4	-9452	4998	0	17.4237	34.4477	25.4019	1207.458	4688.326	27.8023	35.4064	32.3031
h1lbe2_2	5	-9516	4998	0	17.1309	35.2415	23.2016	1181.976	4801.068	23.2016	29.3044	32.2032
h1lbe2_3	6	-9581	4998	0	16.8271	34.658	22.3015	1162.339	4716.607	24.2018	31.2045	32.7032
h1lbe3_1	7	-9453	4962	0	16.9061	34.8129	24.9019	1169.891	4738.825	23.6017	33.3054	33.0033
h1lbe3_2	8	-9516	4962	0	16.6522	35.0645	21.9014	1154.484	4778.020	21.2013	34.4057	34.0036
h1lbe3_3	9	-9580	4962	0	16.601	34.7708	20.9013	1147.537	4736.459	23.4016	31.1047	34.1036
h1lbc1_1	1	-9516	1415	0.0246	14.7698	27.9612	11.2004	1014.176	3775.790	6.0001	26.3035	31.603
h1lbc1_2	2	-9519	1415	0.0117	14.849	29.4753	8.4002	1024.036	3985.489	3.8	29.8041	30.1028
h1lbc1_3	3	-9522	1415	0	16.0838	31.0824	9.5003	1108.876	4211.547	7.8002	29.8045	29.7029
h1lbc2_1	4	-9516	1415	0.0305	14.8086	28.304	12.2004	1020.213	3822.845	6.8001	29.5044	30.9029
h1lbc2_2	5	-9519	1415	0	15.1764	29.2823	8.8002	1042.751	3956.920	6.6001	27.1036	30.7029
h1lbc2_3	6	-9522	1415	0	16.3023	31.0577	7.7002	1125.185	4204.984	7.0001	31.905	28.8027
h1lbc3_1	7	-9516	1411	0.0887	15.0769	29.235	12.6005	1041.141	3949.548	5.0001	31.8048	27.6023
h1lbc3_2	8	-9519	1411	0	15.6029	29.804	5.4001	1071.936	4030.656	5.4001	26.7035	29.8028
h1lbc3_3	9	-9522	1411	0	16.1843	31.4318	6.0001	1118.339	4264.878	3.8	31.7048	31.9031
h1lbc4_1	10	-9516	1410	0.0071	15.2143	29.2937	12.1004	1051.003	3959.889	7.6002	31.8044	28.2025
h1lbc4_2	11	-9518	1410	0	15.602	29.8966	8.6002	1074.854	4044.690	6.6001	29.1044	28.9026
h1lbc4_3	12	-9521	1410	0	16.1549	31.0467	6.3001	1116.024	4206.933	4	32.7055	32.2031
h1lbc5_1	13	-9516	1406	0.126	14.9448	29.4685	15.8007	1031.079	3982.314	6.8001	30.5045	27.5024
h1lbc5_2	14	-9518	1406	0	15.3934	29.2679	9.2003	1057.846	3954.668	6.2001	27.6037	30.6029
h1lbc5_3	15	-9521	1406	0	15.2817	29.8459	6.2001	1052.814	4034.548	4.2001	29.704	29.6027
h1lbm1_1	1	-9914	-2121	1.188	14.622	28.3762	79.519	1001.198	3817.934	29.2026	28.304	28.3025
h1lbm1_2	2	-9919	-2121	0.7797	15.7523	30.0939	56.8097	1080.793	4062.003	22.4015	29.6043	31.7031
h1lbm1_3	3	-9924	-2121	0.6613	15.9974	32.2614	50.0075	1099.917	4363.995	20.4012	30.7045	30.8029
h1lbm2_1	4	-9915	-2128	0.8699	14.779	29.2868	63.0119	1010.755	3947.808	25.2019	25.5034	29.0026
h1lbm2_2	5	-9920	-2128	0.6096	15.7392	30.6972	49.3073	1076.364	4144.395	21.6014	25.5032	30.4028
h1lbm2_3	6	-9925	-2128	0.4459	15.9343	31.5242	41.1051	1093.274	4262.621	19.8012	28.6039	33.6034
h1lbm3_1	7	-9920	-2153	1.1035	15.1523	29.2011	77.1178	1038.626	3938.594	30.0027	27.6039	27.3022
h1lbm3_2	8	-9925	-2153	0.8722	15.6515	30.3568	57.0098	1074.049	4101.247	19.0011	28.504	29.8028
h1lbm3_3	9	-9930	-2153	0.3267	15.645	32.058	37.6042	1077.371	4339.261	21.0013	31.2052	33.5035
h1lbm4_1	10	-9920	-2156	1.1187	14.6097	28.7096	79.619	1001.902	3869.299	32.0031	28.1039	27.9024
h1lbm4_2	11	-9922	-2156	0.9533	15.3549	29.5842	66.8134	1053.217	3991.531	25.602	28.2039	27.5024
h1lbm4_3	12	-9925	-2156	0.7707	15.1655	29.8702	50.6077	1042.45	4037.621	16.6008	29.3042	32.2031
h1lbm5_1	13	-9920	-2159	1.2273	13.8565	27.257	82.9206	947.385	3668.534	31.0029	24.6029	26.1022
h1lbm5_2	14	-9923	-2159	0.6997	14.6766	28.6317	53.4086	1004.618	3854.768	22.2015	27.0035	29.6027
h1lbm5_3	15	-9926	-2159	0.7994	15.6294	31.202	57.61	1073.345	4215.546	22.6015	30.2047	32.2032
h1lba1_1	1	-10676	-6156	1.1456	13.4788	29.0633	81.2198	953.3187	3926.309	24.6018	21.9024	28.2024
h1lba1_2	2	-10683	-6156	0.7781	12.89	27.512	72.2156	918.0214	3707.176	31.803	26.5034	23.7017
h1lba1_3	3	-10690	-6156	0.4017	13.0206	28.1224	48.307	922.9484	3792.156	24.6018	21.3021	27.0022
h1lba2_1	4	-10675	-6167	0.8735	12.8086	26.6476	65.4128	907.4637	3588.112	20.6013	23.0023	27.4023
h1lba2_2	5	-10686	-6167	0.5393	12.9317	28.5392	52.2082	922.4457	3853.233	22.6015	27.6038	30.6029
h1lba2_3	6	-10698	-6167	0.3755	11.6086	27.4372	40.0048	826.3434	3694.192	18.001	24.0028	26.7022
h1lba3_1	7	-10679	-6174	0.9867	12.5997	25.3646	76.1174	889.7687	3407.582	26.002	21.002	25.0019
h1lba3_2	8	-10689	-6174	0.7027	11.4481	24.66	60.7111	808.9585	3306.476	23.8017	20.1019	23.6018
h1lba3_3	9	-10699	-6174	0.4947	12.6447	29.6228	44.0058	895.3988	3992.248	16.8008	22.3024	28.2025
h1lba4_1	10	-10691	-6233	1.1515	14.6477	31.1181	88.7236	1038.022	4204.062	31.803	26.3033	28.1024
h1lba4_2	11	-10703	-6233	0.4842	14.0156	29.6561	48.6071	993.6533	3997.471	21.2013	24.6029	28.4024
h1lba4_3	12	-10715	-6233	0.1051	12.1195	26.5441	27.8023	861.3199	3559.202	17.2009	25.203	27.3023
h1lba5_1	13	-10697	-6265	0.9337	13.3097	26.4713	73.6163	944.0662	3559.304	25.802	26.3036	28.4024
h1lba5_2	14	-10710	-6265	0.5791	12.5328	26.4089	53.6086	888.3613	3547.047	22.0015	23.8029	26.7022
h1lba5_3	15	-10724	-6265	0.1732	12.5936	27.5148	22.6015	895.2982	3700.428	9.0002	24.4027	26.8023
h1lle1_1	1	-17227	4578	0	17.3385	36.022	22.9016	1193.961	4895.353	22.0015	31.3047	34.8038
h1lle1_2	2	-17129	4578	0	17.7012	36.1905	19.5011	1218.941	4915.431	20.4012	32.2048	33.6034
h1lle1_3	3	-17032	4578	0	17.2297	35.7074	21.1013	1186.810	4848.719	24.0017	31.7047	32.7033
h1lle2_1	4	-17234	4547	0	17.3167	35.988	22.8016	1194.364	4888.249	27.6023	33.2055	32.5033
h1lle2_2	5	-17125	4547	0	17.3913	35.7025	17.801	1197.889	4843.675	20.6013	33.0053	33.2034
h1lle2_3	6	-17017	4547	0	17.2952	35.7811	20.1012	1190.537	4856.953	18.601	32.1049	35.3038
h1lle3_1	7	-17218	4492	0	17.6552	36.183	23.2016	1219.243	4910.179	20.6013	36.2065	31.8031
h1lle3_2	8	-17123	4492	0	17.4369	36.1348	19.1011	1201.515	4910.385	21.0013	32.7054	36.304
h1lle3_3	9	-17028	4492	0	17.3074	35.6525	20.7013	1193.860	4842.028	19.6012	34.1057	36.204
h1llc1_1	1	-17033	1211	1.5471	13.2231	27.3231	109.7361	903.6431	3687.138	45.4062	22.2024	27.1022
h1llc1_2	2	-17028	1211	1.063	13.7171	29.4309	77.7181	940.3453	3980.676	32.6032	24.1028	29.1026
h1llc1_3	3	-17024	1211	1.1848	14.3874	30.9925	82.8206	989.8306	4202.011	33.0033	28.7036	35.904
h1llc2_1	4	-17029	1092	1.6251	13.2456	28.2872	110.7368	904.548	3815.070	43.6057	22.8024	28.0024
h1llc2_2	5	-17029	1192	1.2587	12.7288	27.1494	85.3218	870.0651	3656.780	32.6032	23.2023	28.7025

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h11lc2_3	6	-17025	1192	1.2451	12.6828	28.1958	82.2203	864.3354	3799.930	30.2027	19.9018	26.5022
h11lc3_1	7	-17032	1172	1.5316	11.9391	26.2187	100.9305	813.179	3527.539	37.6042	19.7018	26.5022
h11lc3_2	8	-17027	1172	1.2347	11.7846	26.0153	87.623	804.7382	3498.435	36.0039	21.8024	28.3024
h11lc3_3	9	-17023	1172	1.0193	14.3434	30.6088	70.715	978.8661	4137.835	27.4023	22.2025	32.2031
h11lc4_1	10	-17030	1099	1.5585	14.1477	30.2209	103.4321	969.3105	4080.036	39.0046	26.9033	28.4025
h11lc4_2	11	-17025	1099	1.092	14.6331	30.7268	76.4175	1000.795	4151.775	30.2027	24.7028	29.6027
h11lc4_3	12	-17020	1099	1.1621	14.1853	30.2867	82.1202	972.2274	4090.795	33.2033	26.0035	27.5023
h11lc5_1	13	-17028	1080	1.5286	12.4375	25.7625	108.7355	852.173	3467.090	45.2061	25.0033	26.3021
h11lc5_2	14	-17023	1080	1.1816	14.7984	30.69	85.2218	1012.465	4152.493	35.4038	24.4028	31.203
h11lc5_3	15	-17019	1080	1.2385	14.6485	30.9975	88.4234	1002.304	4199.037	36.404	23.2024	30.2028
h11lm1_1	1	-17029	-2597	1.4662	12.6326	26.6518	96.9282	861.6215	3581.267	36.0039	22.8024	27.7023
h11lm1_2	2	-17023	-2597	1.2652	13.34	28.1504	71.0151	905.5534	3786.223	18.001	18.5017	26.5022
h11lm1_3	3	-17018	-2597	0.9908	14.3479	30.2493	70.715	981.7832	4083.417	28.4024	24.903	29.5027
h11lm2_1	4	-17031	-2624	1.8091	14.541	29.8892	121.144	997.2748	4040.285	46.4065	27.4038	29.8028
h11lm2_2	5	-17024	-2623	1.1427	14.8002	30.3354	83.5209	1011.158	4091.922	35.2037	25.0031	29.8027
h11lm2_3	6	-17017	-2623	1.1029	14.7406	29.9656	73.6163	1009.145	4041.002	26.8022	26.7033	28.6025
h11lm3_1	7	-17033	-2664	1.5108	10.7355	24.3691	112.0376	729.493	3269.048	49.6074	17.3015	24.8019
h11lm3_2	8	-17032	-2664	1.9206	13.545	28.9945	114.5393	925.0601	3913.616	35.6038	23.0027	28.5025
h11lm3_3	9	-17019	-2664	1.361	14.0396	29.0089	86.3223	959.4537	3907.986	29.4026	24.3029	25.4021
h11lm4_1	10	-17034	-2705	1.8015	12.9788	27.1429	127.2486	888.6628	3658.007	52.8084	24.2027	24.8019
h11lm4_2	11	-17028	-2705	1.614	12.5799	27.277	105.3333	861.2194	3673.236	38.6045	24.4028	27.1023
h11lm4_3	12	-17023	-2705	1.1581	13.6234	28.7145	74.9168	933.0042	3873.699	26.002	24.803	28.7025
h11lm5_1	13	-17042	-2849	1.4545	12.1417	26.1537	96.1277	832.1724	3520.901	35.6038	24.3027	27.1022
h11lm5_2	14	-17036	-2849	1.7166	12.1175	27.0024	104.1325	829.5594	3640.224	33.4033	23.0026	27.7023
h11lm5_3	15	-17031	-2849	1.3457	14.382	30.4467	84.3213	982.8897	4123.896	28.0024	22.0023	33.0034
h11la1_1	1	-16797	-6352	1.5898	11.5565	23.2314	100.9305	790.3696	3121.357	34.6036	21.9025	23.4017
h11la1_2	2	-16780	-6352	0.3476	11.5452	23.4851	39.9048	790.9725	3150.192	22.4015	22.4025	23.8017
h11la1_3	3	-16763	-6352	0.2252	11.7812	24.6643	29.7026	804.9391	3314.126	17.0009	19.4017	24.3018
h11la2_1	4	-16788	-6373	2.0886	13.617	27.5155	130.0507	934.7137	3719.649	43.8058	25.8031	27.0022
h11la2_2	5	-16768	-6373	0.4538	12.2445	25.2464	38.2044	838.6045	3399.826	16.6008	21.6024	27.3023
h11la2_3	6	-16749	-6373	0.3202	14.5218	29.7687	35.8038	997.1742	4028.300	19.4011	25.503	32.4032
h11la3_1	7	-16774	-6424	1.9667	12.6889	25.8675	123.6459	871.8746	3486.693	42.4054	26.9035	26.0021
h11la3_2	8	-16753	-6424	0.5676	11.5331	24.5572	50.1075	789.6663	3301.172	24.2018	21.4021	26.1021
h11la3_3	9	-16732	-6424	0.2163	14.5378	30.8049	32.5032	997.8784	4171.252	20.2012	24.403	30.6028
h11la4_1	10	-16761	-6472	0.9961	12.1688	24.8805	66.3132	828.0519	3342.688	23.6017	18.8017	26.7022
h11la4_2	11	-16740	-6472	0.4181	12.1762	24.9413	39.6047	834.6849	3349.217	19.4011	23.6028	23.9018
h11la4_3	12	-16720	-6472	0.1227	13.7917	29.1858	29.5026	949.4969	3939.617	20.8013	27.5038	27.4023
h11la5_1	13	-16745	-6524	1.6323	13.9121	28.5883	102.2313	953.2181	3866.126	34.4035	24.8031	31.5031
h11la5_2	14	-16724	-6524	0.3601	12.2985	24.7096	31.403	842.3232	3316.574	13.4005	23.6027	25.2019
h11la5_3	15	-16704	-6524	0.1266	12.347	25.7701	27.7023	849.4592	3464.334	18.8011	25.8032	24.1017

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h12be1_1	1	-7467	22104	0	16.2466	36.3965	21.7014	755.8099	4978.77	23.4016	21.2021	34.4037
h12be1_2	2	-7461	22126	0	15.9342	35.471	30.0027	743.3541	4850.880	23.4016	22.4024	33.7035
h12be1_3	3	-7458	22137	0	15.5023	35.275	25.502	721.4581	4823.194	31.403	20.3021	33.7035
h12be2_1	4	-7371	21989	0	16.6811	35.1707	24.0017	776.0023	4812.594	22.8016	19.702	31.7031
h12be2_2	5	-7371	22034	0	16.5526	36.5703	22.0015	770.075	5014.518	22.8016	19.6019	33.3034
h12be2_3	6	-7371	22079	0	16.3871	36.4906	23.2016	762.7413	4997.931	22.2015	20.602	32.9033
h12be3_1	7	-7421	22028	0	16.3384	36.6544	23.7017	762.0381	5030.900	25.0019	21.4023	37.5043
h12be3_2	8	-7421	22068	0	16.4245	36.6128	20.5013	766.2574	5025.130	23.8017	21.3022	35.3037
h12be3_3	9	-7419	22126	0	15.7614	35.8486	24.2018	732.2048	4912.753	25.802	18.1018	34.4038
h12bc1_1	1	-11621	30967	1.166	14.5909	30.8768	80.5194	972.2274	4210.009	31.0029	31.6048	19.1011
h12bc1_2	2	-11624	30967	1.0205	15.0834	30.941	76.5176	1000.695	4220.981	32.6032	27.5038	19.9012
h12bc1_3	3	-11627	30966	1.1658	14.5432	31.5056	78.6185	968.4053	4300.065	29.2026	30.5044	20.0012
h12bc2_1	4	-11619	30958	1.231	14.2197	30.6042	82.8206	944.0662	4170.125	30.8028	27.7037	17.2009
h12bc2_2	5	-11621	30958	1.0961	14.5159	30.9013	77.3179	963.4768	4210.829	30.6028	28.1036	18.701
h12bc2_3	6	-11623	30958	1.092	14.9061	31.3735	73.016	987.6175	4279.034	26.4021	26.2032	18.301
h12bc3_1	7	-11615	30937	1.1696	13.9967	29.7993	77.6181	927.574	4054.934	28.0024	26.5035	17.801
h12bc3_2	8	-11617	30937	1.0266	14.3892	29.554	70.3148	954.3244	4020.720	26.2021	27.9037	19.1011
h12bc3_3	9	-11620	30937	0.9204	14.0849	29.766	64.2124	933.8087	4049.197	24.4018	27.3037	19.8012
h12bc4_1	10	-11610	30923	1.0913	13.7077	27.8425	72.3157	909.6758	3778.654	25.602	28.404	17.0009
h12bc4_2	11	-11612	30923	1.2001	14.3257	29.7774	78.7186	951.6089	4051.758	27.8023	29.3039	17.901
h12bc4_3	12	-11615	30922	1.0811	14.3593	30.6479	74.9168	950.1004	4175.558	28.8025	25.0032	19.2011
h12bc5_1	13	-11601	30881	1.4564	15.1103	31.4856	89.424	1000.091	4294.935	28.4024	26.6033	21.3014
h12bc5_2	14	-11605	30881	1.2367	15.2258	32.6884	83.8211	1009.950	4467.072	31.603	27.6035	21.5014
h12bc5_3	15	-11609	30881	0.8096	15.2053	32.8698	62.8118	1008.341	4492.440	27.4023	26.4035	20.5013
h12bm1_1	1	-10976	26639	1.2281	14.429	32.2859	82.3203	955.7324	4408.75	30.6028	25.3032	19.7012
h12bm1_2	2	-10977	26639	1.0561	15.4152	32.9296	73.116	1023.533	4499.939	28.0024	28.6037	20.9013
h12bm1_3	3	-10979	26639	0.9873	15.597	33.28	72.2156	1036.513	4547.093	29.8027	29.5044	18.6011
h12bm2_1	4	-10972	26628	1.0838	13.228	29.6896	71.4153	876.0966	4039.260	25.4019	25.1029	19.2011
h12bm2_2	5	-10973	26628	1.0237	14.0283	30.1186	68.0139	927.8757	4099.505	24.2018	24.9031	19.9012
h12bm2_3	6	-10975	26628	1.0209	14.454	31.0913	69.3144	957.2411	4236.98	25.602	25.7032	18.201
h12bm3_1	7	-10967	26611	1.0767	14.111	30.1677	72.1156	933.7081	4106.883	26.2021	25.4032	20.2013
h12bm3_2	8	-10969	26611	0.785	14.998	30.6685	55.6093	993.7538	4175.353	21.0013	27.5035	19.8012
h12bm3_3	9	-10971	26610	1.2025	16.1425	32.7717	75.5171	1070.426	4479.293	24.4018	27.9039	20.6013
h12bm4_1	10	-10965	26601	0.9094	13.8538	29.3584	64.2124	918.5241	3994.910	24.8018	26.3032	18.9011
h12bm4_2	11	-10967	26601	0.7668	14.9257	30.6757	58.7103	990.5347	4182.632	24.8018	28.0039	22.0015
h12bm4_3	12	-10969	26601	0.8927	15.2708	31.7482	65.6129	1013.371	4333.515	26.8022	27.9038	20.7013
h12bm5_1	13	-10963	26596	0.9637	14.9234	30.9979	69.2144	987.8187	4226.006	27.6023	25.4031	19.0011
h12bm5_2	14	-10965	26596	0.5786	15.7158	31.4279	51.2079	1042.148	4283.547	24.6018	28.2038	19.8012
h12bm5_3	15	-10967	26596	0.8408	16.181	32.2967	59.7107	1070.829	4409.981	22.8016	25.8032	20.2012
h12ba1_1	1	-10427	22419	1.3883	12.0261	26.5661	87.523	795.6949	3603.948	29.4026	23.7027	18.401
h12ba1_2	2	-10464	22419	0	11.3536	25.5092	18.301	752.8967	3449.532	23.2016	23.2026	15.3007
h12ba1_3	3	-10502	22419	0	11.2356	24.8463	21.7014	742.6509	3354.624	20.2012	21.6022	16.0008
h12ba2_1	4	-10428	22379	1.0029	12.444	26.6718	66.2132	825.439	3615.290	23.2016	26.6034	18.7011
h12ba2_2	5	-10466	22379	0.0623	11.6234	24.8602	25.0019	766.7597	3356.154	18.601	20.9021	15.6007
h12ba2_3	6	-10505	22379	0	13.1092	29.6084	23.6017	869.1604	4023.076	21.8014	25.003	18.9011
h12ba3_1	7	-10410	22301	1.2361	11.7811	25.9443	84.5214	780.1215	3517.225	32.4031	24.1031	19.0011
h12ba3_2	8	-10452	22301	0	11.569	25.4358	22.4015	766.7597	3437.283	22.2015	24.0026	16.8009
h12ba3_3	9	-10495	22300	0.0252	12.7613	29.5452	23.8017	851.972	4018.877	19.0011	29.504	19.3011
h12ba4_1	10	-10396	22235	1.1353	14.6368	31.4822	81.2198	970.9199	4295.653	33.0033	27.4037	21.2013
h12ba4_2	11	-10439	22235	0	13.5701	29.5491	21.9014	902.7382	4020.515	18.8011	28.0038	21.1013
h12ba4_3	12	-10482	22235	0	13.7606	30.4257	18.701	916.312	4138.245	18.601	29.2041	17.2009
h12ba5_1	13	-10399	22196	1.1211	14.2097	30.3127	76.7177	939.038	4131.172	29.0025	23.4029	19.9012
h12ba5_2	14	-10441	22196	0	11.6792	26.0518	19.6012	771.5819	3530.297	17.4009	20.3021	18.8011
h12ba5_3	15	-10484	22196	0	12.3324	28.0249	20.5013	822.6251	3805.454	24.8018	28.6039	19.7012
h12le1_1	1	-7785	30720	0	16.1199	35.4588	24.6018	703.0798	5332.772	28.6025	18.5015	28.2024
h12le1_2	2	-7785	30720	0	16.4689	35.1803	28.2024	721.2573	5290.867	24.8018	21.5022	27.7023
h12le1_3	3	-7785	30699	0	16.9104	37.2222	25.3019	738.0305	5610.365	22.2015	18.6016	25.902
h12le2_1	4	-7785	30695	0	16.2831	36.55	23.7017	710.21	5502.456	23.8017	18.6017	29.0025
h12le2_2	5	-7828	30711	0.0068	16.488	37.3511	26.9022	723.6677	5621.946	22.8016	23.7026	27.8023
h12le2_3	6	-7829	30696	0	16.258	36.9611	23.3016	707.4985	5562.810	23.4016	17.5016	30.0027
h12le3_1	7	-7775	30722	0.03	16.4399	35.2261	24.7018	717.4409	5287.152	19.6012	20.3019	27.0022
h12le3_2	8	-7765	30692	0	16.0496	35.4495	29.0025	698.8622	5321.830	26.4021	18.3017	26.5021
h12le3_3	9	-7829	30680	0	16.6852	36.9918	23.6017	728.5891	5566.945	23.2016	20.3019	29.6026
h12lc1_1	1	-19416	28430	1.6261	13.9401	30.8396	105.9337	923.7529	4205.600	38.4044	26.1032	19.6012
h12lc1_2	2	-19410	28431	1.1348	14.1337	31.8314	84.4214	935.8199	4346.240	36.404	24.7029	21.8014
h12lc1_3	3	-19405	28431	0.6783	13.9644	31.8768	59.1105	930.1885	4352.705	29.0025	29.204	21.4014
h12lc2_1	4	-19412	28417	0.2462	14.2972	31.5749	25.602	946.4799	4303.040	12.2004	24.2027	18.7011
h12lc2_2	5	-19406	28418	1.3812	13.8216	31.9991	93.6263	916.2114	4369.024	36.0039	25.4032	19.5011

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h12lc2_3	6	-19400	28418	0.9385	13.9901	32.3667	71.4153	926.0657	4421.481	31.2029	23.8026	21.7014
h12lc3_1	7	-19404	28402	0	13.7635	30.7568	5.3001	911.3851	4187.759	4	23.9026	19.9012
h12lc3_2	8	-19400	28403	0	13.8995	32.5275	6.1001	926.5684	4440.475	4	28.9038	19.5011
h12lc3_3	9	-19397	28404	0	14.3989	32.6781	8.0002	954.8273	4462.143	4.2001	24.703	20.1012
h12lc4_1	10	-19399	28391	0	14.1784	30.5325	5.6001	941.8538	4160.078	3.2	27.2037	22.2015
h12lc4_2	11	-19396	28391	0	13.7112	31.3627	5.7001	906.2572	4275.648	5.8001	21.4023	19.9012
h12lc4_3	12	-19394	28391	0	13.0269	31.0651	6.3001	864.838	4233.288	6.8001	24.4029	19.2011
h12lc5_1	13	-19396	28377	0	14.2282	29.8444	5.1001	946.2787	4059.135	3.8	28.8039	18.501
h12lc5_2	14	-19392	28378	0	14.3626	31.2643	6.2001	950.2009	4263.339	4.6001	23.2026	22.0015
h12lc5_3	15	-19388	28379	0	13.9884	32.7559	7.9002	930.2891	4474.877	8.2002	26.3031	19.3011
h12lm1_1	1	-18515	25919	1.4436	14.5373	31.6681	89.1238	963.0745	4320.277	28.8025	26.6033	20.3012
h12lm1_2	2	-18510	25919	1.217	14.2928	31.7074	79.9192	948.6924	4326.023	28.6025	27.4035	19.0011
h12lm1_3	3	-18506	25919	1.0626	14.1915	32.31	80.3194	938.8368	4410.598	35.2037	24.1028	20.7013
h12lm2_1	4	-18515	25912	1.2758	14.5759	31.4719	92.3256	966.6954	4289.498	38.6045	27.7038	18.001
h12lm2_2	5	-18510	25912	1.0427	14.443	32.1685	79.0187	961.8676	4387.192	34.6036	30.9047	17.701
h12lm2_3	6	-18506	25912	1.1501	14.3851	33.0564	83.1207	951.6089	4515.758	34.6036	24.0028	19.6012
h12lm3_1	7	-18512	25902	1.4214	14.5912	31.4041	94.5268	966.3937	4282.522	35.0037	26.1033	18.001
h12lm3_2	8	-18505	25902	1.0447	12.5872	28.9173	77.418	835.6899	3931.837	33.0033	26.0034	18.201
h12lm3_3	9	-18499	25902	0.8445	12.6321	30.5652	63.6121	838.504	4166.434	27.2022	24.5028	19.1011
h12lm4_1	10	-18509	25888	1.2202	13.1675	28.9234	80.1193	874.6892	3937.058	28.6025	27.3036	20.5013
h12lm4_2	11	-18503	25888	1.2221	13.8305	30.7117	80.7195	916.0103	4186.528	29.2026	25.203	20.1012
h12lm4_3	12	-18498	25888	0.9655	13.604	31.3212	70.9151	900.8279	4272.981	29.6026	23.7025	19.0011
h12lm5_1	13	-18502	25866	1.2101	12.8736	28.2914	86.9227	851.4695	3845.047	35.8038	23.4026	17.2009
h12lm5_2	14	-18498	25866	1.3238	13.0651	29.3327	90.1244	862.6266	3993.784	34.6036	21.7022	19.0011
h12lm5_3	15	-18494	25866	1.0264	13.6786	30.3803	77.6181	905.6539	4141.115	33.8034	24.703	22.2015
h12la1_1	1	-17524	22440	1.7805	12.3445	29.3504	120.9439	818.9069	3997.778	47.6068	25.2031	19.8012
h12la1_2	2	-17484	22440	0.0542	12.3901	29.9802	30.0027	823.4291	4078.601	24.2018	25.5035	21.2013
h12la1_3	3	-17445	22440	0	11.582	25.931	22.1015	768.568	3508.442	21.2013	24.7029	18.9011
h12la2_1	4	-17510	22422	1.1228	10.5601	24.75	84.8216	698.0588	3350.543	37.4042	20.9021	18.101
h12la2_2	5	-17470	22422	0.1026	12.8325	29.1158	34.4035	850.7659	3954.360	26.6021	24.8029	18.9011
h12la2_3	6	-17430	22422	0	10.7807	24.6097	27.7023	712.5198	3326.468	25.2019	20.402	18.8011
h12la3_1	7	-17484	22379	1.1729	11.0096	25.73	85.2218	728.9908	3489.654	35.8038	22.2025	19.1011
h12la3_2	8	-17436	22379	0.0936	11.1843	25.1186	31.3029	740.2402	3399.01	23.8017	21.7023	18.701
h12la3_3	9	-17389	22379	0.1508	11.0346	24.8637	27.5023	729.7943	3363.908	17.801	20.702	17.1009
h12la4_1	10	-17444	22324	0.9463	11.1813	25.4568	75.0169	739.4366	3450.042	34.4035	21.6022	18.8011
h12la4_2	11	-17401	22324	0.0292	10.9025	24.8176	29.8027	719.6503	3353.297	24.8018	19.3017	15.0007
h12la4_3	12	-17359	22324	0.0043	11.0409	24.7271	25.3019	730.7987	3342.381	21.2013	21.6022	16.9009
h12la5_1	13	-17409	22281	0.8012	10.9554	25.1194	68.5141	726.0781	3401.357	33.6034	22.8025	17.6009
h12la5_2	14	-17373	22281	0	11.1	25.1269	32.2031	733.7114	3399.214	28.4024	20.5022	18.101
h12la5_3	15	-17337	22281	0	10.8908	24.5009	24.1017	720.2529	3310.862	25.4019	20.802	16.8008

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h13be1_1	1	-18559	30329	0	16.8185	35.3892	26.6021	1242.715	4850.880	25.2019	32.5051	31.8031
h13be1_2	2	-18522	30329	0	16.6173	35.8741	21.2013	1227.302	4922.948	21.0013	32.305	36.7042
h13be1_3	3	-18486	30329	0	16.0856	34.8971	21.7014	1186.508	4778.432	22.6015	30.9044	33.9036
h13be2_1	4	-18540	30281	0	17.0691	35.871	25.3019	1260.347	4919.446	22.4015	33.0053	36.304
h13be2_2	5	-18510	30281	0	16.5429	35.4723	23.9017	1223.575	4857.262	23.8017	35.2061	33.2034
h13be2_3	6	-18480	30281	0	16.329	35.1761	23.1016	1206.450	4820.518	21.6014	33.1052	36.304
h13be3_1	7	-18523	30233	0	16.8336	35.3174	26.002	1244.428	4841.205	20.6013	34.3058	37.1042
h13be3_2	8	-18498	30233	0	16.647	35.2746	22.5015	1228.007	4839.147	20.8013	30.9047	38.7046
h13be3_3	9	-18473	30233	0	16.3751	35.3319	23.8017	1209.573	4843.160	23.8017	31.7046	32.0032
h13bc1_1	1	8803	2256	1.7979	11.6597	29.0629	88.4234	749.0796	3947.705	20.2012	15.6011	18.6011
h13bc1_2	2	8808	2255	1.2405	13.0467	29.9159	71.1152	843.4287	4065.179	22.8016	20.802	15.9008
h13bc1_3	3	8812	2254	1.1861	14.083	32.8014	74.5167	918.0214	4480.629	28.2024	27.3035	19.8012
h13bc2_1	4	8811	2227	1.7495	11.9486	27.6505	90.1244	768.568	3755.438	23.2016	16.1012	17.7009
h13bc2_2	5	8814	2227	1.7104	12.3215	31.3261	98.4291	800.9198	4271.751	33.4033	23.4025	18.401
h13bc2_3	6	8816	2227	1.7384	14.1518	33.9148	108.1351	922.4457	4641.75	41.8052	27.2037	20.2012
h13bc3_1	7	8817	2191	1.8294	11.184	28.0338	89.7241	721.5586	3812.001	20.2012	16.8013	17.3009
h13bc3_2	8	8821	2191	1.5111	11.2047	28.1697	83.8211	723.8685	3827.346	26.002	18.2016	18.701
h13bc3_3	9	8824	2191	1.1867	12.5143	30.6076	80.7195	810.7673	4165.614	34.6036	21.4023	18.401
h13bc4_1	10	8822	2167	1.9559	13.0109	29.698	110.3365	840.313	4043.153	35.8038	20.202	19.7012
h13bc4_2	11	8829	2168	1.1212	12.6248	29.1693	77.1178	813.2794	3958.354	33.2033	18.4014	18.201
h13bc4_3	12	8835	2168	0.879	13.5876	32.8688	53.0084	881.6256	4480.115	18.001	23.8028	19.3011
h13bc5_1	13	8826	2149	1.9148	12.5565	28.366	102.9318	806.0444	3848.935	30.0027	16.9014	20.2012
h13bc5_2	14	8831	2149	1.6648	12.8876	29.591	87.2228	831.8708	4014.677	23.6017	21.8021	19.2012
h13bc5_3	15	8835	2149	1.2149	13.3011	30.6537	68.5141	858.4049	4167.049	21.2013	20.1019	18.101
h13bm1_1	1	-16601	24368	1.7336	12.4411	27.9871	144.6628	910.8823	3820.083	54.4089	26.0034	28.0024
h13bm1_2	2	-16587	24368	1.0375	12.3253	28.1945	88.2233	901.6323	3841.875	31.803	22.8024	28.8026
h13bm1_3	3	-16574	24368	0.4148	12.5108	28.2119	45.6062	916.2114	3836.145	18.8011	21.9022	29.2026
h13bm2_1	4	-16592	24348	1.8265	11.8584	26.5043	136.0555	862.0235	3614.268	41.2051	19.7018	28.0025
h13bm2_2	5	-16583	24350	0.9096	11.8647	26.9902	72.1156	866.0443	3665.468	21.8014	20.6022	24.0018
h13bm2_3	6	-16568	24352	0.2347	14.0214	29.5394	42.7055	1028.463	4013.653	24.0017	25.6032	29.9027
h13bm3_1	7	-16583	24317	1.5208	11.9095	27.4075	106.0337	865.3406	3725.784	26.6021	19.8018	23.7017
h13bm3_2	8	-16580	24324	1.1961	11.9934	27.2299	86.6225	871.3719	3702.473	22.6015	18.4016	27.6024
h13bm3_3	9	-16568	24324	0.2334	13.2021	28.7751	39.4047	968.707	3905.734	21.0013	25.6032	30.5028
h13bm4_1	10	-16576	24278	1.6293	11.0897	25.1244	133.5535	809.9634	3416.971	48.6071	23.3028	27.5023
h13bm4_2	11	-16567	24280	0.9424	11.5831	26.2394	77.2179	842.7252	3556.035	25.4019	19.4019	25.602
h13bm4_3	12	-16554	24281	0.217	13.2454	28.9826	28.6025	970.5175	3937.775	11.0004	24.2028	33.7034
h13bm5_1	13	-16566	24232	1.2463	12.4268	27.2178	107.4346	908.5698	3709.629	40.4049	22.9027	29.5026
h13bm5_2	14	-16560	24232	1.3943	14.1097	30.7018	112.2378	1035.104	4194.218	38.0043	29.2041	30.5028
h13bm5_3	15	-16549	24231	0.7022	14.2818	31.7281	75.8172	1046.978	4332.488	35.2037	26.1034	32.2031
h13ba1_1	1	-16205	21232	1.634	11.4846	26.1413	117.2412	840.1121	3559.406	32.2031	25.7034	32.2032
h13ba1_2	2	-16089	21232	0	10.9146	23.9061	31.0029	801.0203	3223.168	26.002	22.0024	25.9021
h13ba1_3	3	-15973	21232	0.078	13.7832	30.9761	28.3024	1012.365	4209.701	17.4009	26.5034	27.6023
h13ba2_1	4	-16206	21423	1.2654	11.6961	26.3022	105.9337	858.9075	3577.793	38.4044	26.9037	27.8023
h13ba2_2	5	-16103	21423	0.1321	11.4043	24.0885	26.2021	835.4889	3253.855	12.4005	20.5022	25.1019
h13ba2_3	6	-16001	21423	0.054	12.0319	25.9581	27.8023	881.4246	3507.115	17.801	21.102	21.7014
h13ba3_1	7	-16202	21389	1.251	11.0092	23.8184	104.5328	805.0396	3230.711	37.2042	22.5023	24.3018
h13ba3_2	8	-16102	21389	0	11.4693	24.8195	22.6015	844.5343	3357.174	19.6012	23.5028	25.602
h13ba3_3	9	-16003	21389	0	13.572	30.7204	29.0025	999.1862	4189.604	23.2016	25.5033	32.3033
h13ba4_1	10	-16201	21363	0.863	10.8085	24.053	90.3245	793.1829	3263.950	42.0053	23.3025	27.8024
h13ba4_2	11	-16105	21363	0	11.8075	26.0926	21.8014	869.2609	3534.075	17.2009	24.1027	27.1022
h13ba4_3	12	-16009	21363	0	10.7076	23.9541	26.5021	788.963	3233.770	19.2011	23.7025	25.0019
h13ba5_1	13	-16202	21295	0.9458	11.617	24.8101	77.7181	850.2633	3365.541	25.0019	23.2025	27.6024
h13ba5_2	14	-16093	21295	0	13.4146	30.7832	23.6017	990.4341	4190.219	16.6008	30.5044	34.1035
h13ba5_3	15	-15985	21295	0.1159	12.3362	28.082	28.8025	905.3524	3810.057	16.2008	23.5029	29.1025
h13le1_1	1	-10083	31003	0	16.6265	35.836	29.8027	1226.798	4908.120	28.4024	32.3052	32.1032
h13le1_2	2	-10106	31003	0	16.5454	36.0396	24.4018	1220.250	4931.598	22.0015	32.8056	31.2031
h13le1_3	3	-10129	31003	0	16.1667	35.8232	22.8016	1188.925	4901.015	26.8022	29.6043	33.7035
h13le2_1	4	-10081	30994	0	16.7499	36.1003	27.1022	1231.231	4943.853	24.4018	28.9041	34.9038
h13le2_2	5	-10104	30994	0	16.574	36.1302	24.1017	1220.653	4946.634	26.002	31.7048	35.704
h13le2_3	6	-10127	30994	0	16.4946	36.2006	22.4015	1213.904	4950.135	23.4016	31.3047	31.5031
h13le3_1	7	-10076	30977	0	16.7176	36.2435	30.4028	1229.216	4960.435	24.6018	30.4043	35.8039
h13le3_2	8	-10096	30977	0	16.2428	36.1922	25.1019	1197.688	4955.903	22.2015	32.8054	35.904
h13le3_3	9	-10116	30977	0	16.0725	35.6757	23.0016	1184.393	4885.160	25.2019	30.8047	34.1036
h13lc1_1	1	-9608	27868	0.9624	14.5826	30.8708	85.0217	1066.501	4213.290	31.403	24.9029	31.5031
h13lc1_2	2	-9625	27867	0.7011	13.4713	28.6682	71.8155	990.6354	3903.789	30.8028	27.4034	28.3025
h13lc1_3	3	-9645	27867	0.2246	13.945	29.5352	35.8038	1026.451	4019.388	17.6009	28.1039	32.4033
h13lc2_1	4	-9613	27835	1.104	15.0944	32.4006	85.4219	1105.051	4436.676	25.0019	25.6034	33.0033
h13lc2_2	5	-9627	27835	0.6168	12.7815	26.4856	75.9173	938.8368	3589.440	38.8045	27.3034	27.2023

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h13lc2_3	6	-9645	27834	0.5458	13.9664	29.3777	57.0098	1025.143	3997.983	23.4016	26.9035	31.003
h13lc3_1	7	-9617	27812	0.8733	14.8913	31.9219	80.5194	1092.871	4356.194	31.403	30.0044	33.5035
h13lc3_2	8	-9631	27812	0.5928	13.9482	29.6908	58.5103	1026.954	4035.368	22.8016	31.6051	29.6027
h13lc3_3	9	-9649	27811	0.1837	12.6867	28.2563	33.7034	932.5014	3828.165	17.801	26.9033	27.7024
h13lc4_1	10	-9621	27799	1.0545	14.1376	29.37	86.6225	1035.003	3993.067	28.4024	28.2038	29.0026
h13lc4_2	11	-9632	27799	0.6675	12.1917	25.3381	59.3106	892.5837	3429.423	19.8012	23.9027	25.702
h13lc4_3	12	-9649	27799	0.2625	12.514	27.1989	37.8043	919.5296	3685.503	18.001	25.9032	28.0024
h13lc5_1	13	-9619	27776	0.9962	12.9679	28.305	84.1212	949.7986	3853.540	29.2026	25.4031	30.3029
h13lc5_2	14	-9635	27776	0.8548	14.4923	31.2204	74.0164	1066.702	4256.98	25.802	31.7049	29.0025
h13lc5_3	15	-9651	27776	0.1691	12.1577	28.675	28.9025	897.309	3900.104	14.0006	27.6035	31.303
h13lm1_1	1	-10160	24715	0.9041	14.5517	31.1123	85.0217	1063.884	4241.185	34.4035	25.8033	32.1031
h13lm1_2	2	-10190	24715	0.3029	11.1341	24.0115	46.3064	812.2745	3234.993	24.6018	20.1019	25.302
h13lm1_3	3	-10221	24715	0.0721	12.054	27.0881	28.0024	887.6575	3658.314	17.4009	27.8037	23.9018
h13lm2_1	4	-10169	24693	0.8158	11.8324	25.8451	77.7181	867.351	3497.108	31.603	26.2033	25.4019
h13lm2_2	5	-10196	24693	0.2646	10.7243	23.4073	39.4047	784.8436	3151.211	19.6012	22.0023	25.1019
h13lm2_3	6	-10224	24693	0.0311	10.7519	23.1848	26.7021	784.3412	3114.939	17.801	18.7016	22.9016
h13lm3_1	7	-10177	24666	0.9447	14.9562	32.1536	82.0202	1092.569	4376.311	29.6026	27.3034	28.6025
h13lm3_2	8	-10206	24666	0.2307	10.8638	24.786	41.9053	792.3792	3338.709	24.0017	20.002	25.8021
h13lm3_3	9	-10236	24666	0.1142	11.6561	24.2237	32.4031	850.8664	3258.545	19.4011	20.9023	24.2018
h13lm4_1	10	-10183	24649	1.0484	12.6006	27.0197	80.9196	921.4401	3665.161	23.4016	25.7031	28.0024
h13lm4_2	11	-10208	24649	0.2803	11.2312	24.0124	50.7077	820.5148	3233.974	30.0027	20.9021	23.0016
h13lm4_3	12	-10233	24649	0.0364	12.2035	27.683	30.9029	896.002	3743.473	22.0015	25.2031	26.7021
h13lm5_1	13	-10201	24596	0.9215	13.9175	29.9501	85.2218	1018.905	4077.577	33.8034	26.9037	31.203
h13lm5_2	14	-10218	24596	0.5216	11.1075	24.6261	57.3099	811.5712	3321.98	25.4019	21.2022	20.9013
h13lm5_3	15	-10235	24595	0.3256	13.2276	29.5397	54.809	971.7245	4015.701	32.2031	27.0034	31.9031
h13la1_1	1	-12342	21762	0.7323	13.6824	29.007	59.4106	1000.594	3941.358	17.0009	25.5031	31.503
h13la1_2	2	-12434	21762	0	12.8953	29.1711	23.9017	942.7589	3951.903	18.001	22.3026	29.9028
h13la1_3	3	-12527	21762	0.0283	11.6657	26.0998	24.0017	854.5853	3526.007	15.4007	22.2023	27.8024
h13la2_1	4	-12378	21709	0.5667	13.8546	30.307	57.2098	1017.395	4122.153	23.0016	29.1042	31.9031
h13la2_2	5	-12501	21709	0	13.6163	31.0399	19.6012	999.7898	4216.777	12.6005	26.2036	28.7025
h13la2_3	6	-12624	21709	0	12.1361	25.8873	20.7013	887.6575	3498.333	17.2009	20.9021	28.7026
h13la3_1	7	-12428	21658	0.4859	11.6251	25.8923	49.6074	849.0572	3504.970	19.4011	20.8021	27.4023
h13la3_2	8	-12564	21658	0	11.9861	27.7507	22.1015	879.9166	3758.813	17.2009	23.8029	29.3027
h13la3_3	9	-12700	21658	0	11.7642	25.6504	21.0013	862.5261	3461.169	14.0006	23.0025	25.902
h13la4_1	10	-12534	21594	0.7503	14.2131	31.0545	74.6167	1042.651	4230.416	31.603	28.5039	30.9029
h13la4_2	11	-12663	21594	0	13.5639	31.3764	22.4015	993.7538	4264.981	17.2009	24.4029	31.503
h13la4_3	12	-12792	21594	0	12.4271	29.4444	23.4016	911.2845	3988.561	19.4011	24.1028	26.002
h13la5_1	13	-12578	21485	0.9342	13.3363	28.8386	79.9192	974.038	3914.639	28.0024	25.103	27.3024
h13la5_2	14	-12768	21484	0	11.3542	25.185	26.102	835.1874	3398.499	21.0013	25.603	29.2027
h13la5_3	15	-12959	21482	0	12.9294	30.3931	20.9013	945.5748	4121.641	16.0008	23.0025	30.2028

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h14bel_1	1	10943	6121	0	16.1841	35.9768	25.3019	1187.414	4890.822	22.4015	34.206	32.7033
h14bel_2	2	11012	6121	0	15.9363	36.0329	22.3015	1167.071	4898.853	20.4012	32.3049	35.0038
h14bel_3	3	11081	6121	0	16.3151	35.0917	22.6015	1194.666	4768.452	18.001	31.5047	33.6035
h14be2_1	4	10936	6067	0	16.365	35.7918	25.4019	1197.486	4861.173	19.2011	31.8049	31.8032
h14be2_2	5	10997	6067	0	16.2955	35.7551	23.1016	1194.767	4858.703	22.0015	34.1057	34.5036
h14be2_3	6	11058	6067	0	16.1565	35.1229	19.5011	1181.875	4770.098	19.8012	31.3049	35.4038
h14be3_1	7	10940	6015	0	16.1664	35.8191	24.8018	1182.983	4868.585	20.0012	32.2049	37.6043
h14be3_2	8	10991	6015	0	16.1442	35.3971	19.8012	1182.983	4803.538	20.4012	34.4055	34.7038
h14be3_3	9	11042	6015	0	15.9924	35.2047	21.0013	1169.186	4778.843	21.4014	31.0045	34.8038
h14bc1_1	1	10714	4416	1.3969	13.1248	28.1906	110.5366	950.4021	3808.318	36.604	23.4027	26.5023
h14bc1_2	2	10719	4415	1.2482	13.4255	29.1024	100.03	972.8309	3932.758	33.4033	24.1027	27.9024
h14bc1_3	3	10723	4414	1.1717	13.8977	30.5651	88.8237	1011.258	4138.552	26.002	27.7039	28.8026
h14bc2_1	4	10710	4403	1.3544	11.3948	26.1326	95.5274	822.6251	3523.454	24.6018	19.7018	26.5021
h14bc2_2	5	10716	4403	1.1907	13.9641	30.727	93.7263	1014.78	4163.154	30.0027	26.5035	30.6029
h14bc2_3	6	10721	4403	0.7909	13.1182	30.231	68.5141	953.9221	4088.233	24.4018	25.4029	30.8029
h14bc3_1	7	10703	4385	1.1441	12.0303	26.2247	97.9288	870.4672	3533.973	36.404	21.6022	28.1024
h14bc3_2	8	10710	4389	1.047	13.5316	29.3801	83.8211	983.2921	3975.965	26.8022	25.3031	31.0029
h14bc3_3	9	10716	4388	0.9494	13.8574	30.7524	78.1183	1005.222	4166.434	26.002	23.3026	31.0029
h14bc4_1	10	10701	4380	1.6474	13.0562	27.9271	110.3365	943.1611	3775.483	24.2018	21.5022	25.602
h14bc4_2	11	10704	4379	1.7357	13.4294	29.5196	129.0499	972.6298	4005.562	39.0046	23.7028	31.0029
h14bc4_3	12	10706	4377	1.1287	12.9045	28.0897	91.7252	939.7419	3796.145	30.8028	26.7034	27.4024
h14bc5_1	13	10697	4363	1.4619	13.4717	28.7641	114.4393	976.3514	3891.404	37.2042	23.7027	25.702
h14bc5_2	14	10699	4362	1.2458	13.7026	29.4368	113.1384	993.955	3985.796	46.4065	23.9028	28.9026
h14bc5_3	15	10700	4360	0.7742	13.636	30.1526	74.4166	988.8246	4082.597	30.6028	21.3023	29.1027
h14bm1_1	1	10054	-344	1.3017	14.6638	30.9907	102.4315	1068.011	4202.421	32.8032	29.4042	30.7029
h14bm1_2	2	10063	-350	1.5112	15.1332	31.6252	117.7416	1101.830	4293.499	37.8043	30.1043	31.103
h14bm1_3	3	10071	-356	1.3295	13.7166	29.6981	102.6316	995.6652	4021.949	32.0031	25.3031	29.5027
h14bm2_1	4	10042	-365	1.3046	12.5868	26.2491	92.8258	912.7927	3534.995	23.0016	24.8032	24.9019
h14bm2_2	5	10057	-365	0.7664	13.0596	27.0333	63.212	950.5027	3639.304	19.2011	26.2033	25.802
h14bm2_3	6	10071	-366	1.2993	13.0081	27.2421	100.4303	944.5691	3675.281	30.8028	24.9029	22.8016
h14bm3_1	7	10036	-386	1.2957	12.5921	25.9453	93.4262	913.6977	3497.312	23.8017	24.5028	26.0021
h14bm3_2	8	10054	-386	0.7111	13.2881	28.6335	62.6118	966.9971	3866.843	21.6014	25.403	29.9027
h14bm3_3	9	10072	-386	0.8274	12.3985	26.721	70.615	901.8333	3606.911	24.0017	23.8028	29.703
h14bm4_1	10	10035	-412	1.0698	13.0337	27.4421	77.7181	947.7872	3709.629	19.2011	25.0029	30.2029
h14bm4_2	11	10047	-412	0.8809	13.5637	28.3791	68.5141	985.8068	3836.554	19.0011	24.2029	29.6027
h14bm4_3	12	10058	-412	0.6644	13.7454	28.1294	62.9119	1001.801	3796.349	23.6017	26.4035	27.1023
h14bm5_1	13	10024	-454	0.9765	12.1441	25.7708	80.1193	883.7368	3476.381	26.2021	24.6029	28.8026
h14bm5_2	14	10036	-455	0.5144	13.7621	29.2656	50.8077	1004.115	3957.432	19.0011	26.8035	31.5031
h14bm5_3	15	10048	-456	0.8803	14.5452	29.7341	65.713	1058.953	4024.510	16.0008	26.6034	29.6028
h14ba1_1	1	8958	-4541	1.1193	12.3208	24.8981	93.5262	894.2928	3349.522	32.2031	24.1028	24.7019
h14ba1_2	2	9023	-4541	0.1846	10.9514	23.7158	33.4033	801.1208	3180.663	17.4009	25.1031	27.3023
h14ba1_3	3	9087	-4541	0	11.9532	25.9795	20.4012	870.5677	3487.510	15.6007	22.0023	25.4021
h14ba2_1	4	8950	-4614	1.1968	11.6303	25.0294	88.7236	845.9414	3376.458	24.4018	24.4028	28.0024
h14ba2_2	5	9013	-4614	0.0878	11.9902	26.2815	31.2029	877.1019	3527.437	19.8012	27.0034	25.802
h14ba2_3	6	9075	-4614	0	11.7651	25.0955	18.001	858.0028	3364.010	10.6003	23.4025	25.502
h14ba3_1	7	8950	-4644	1.1507	11.3867	23.7934	92.6257	822.8261	3201.149	30.2027	19.2019	25.202
h14ba3_2	8	9012	-4644	0.2346	11.8109	24.7179	41.005	859.5106	3321.572	22.4015	21.7022	28.7026
h14ba3_3	9	9074	-4644	0.0439	10.3177	22.8452	24.7018	747.5728	3058.508	15.4007	16.4014	26.2021
h14ba4_1	10	8953	-4680	1.1483	13.0708	27.9341	87.7231	947.4855	3778.347	25.602	22.2024	29.5027
h14ba4_2	11	9000	-4680	0.2485	11.333	23.8987	35.4038	831.2679	3210.119	16.2008	27.8037	29.5027
h14ba4_3	12	9046	-4680	0	10.3684	22.8175	18.001	756.2117	3054.434	13.4005	20.9021	25.1019
h14ba5_1	13	8943	-4720	1.3668	11.8576	25.2455	103.6322	859.7116	3406.459	31.0029	22.9025	28.2025
h14ba5_2	14	8996	-4720	0.2522	11.5608	24.5741	33.7034	842.5242	3296.175	14.4006	23.9029	27.5023
h14ba5_3	15	9048	-4720	0	11.2917	24.8347	18.601	823.3286	3326.060	18.001	23.0025	24.8019
h14le1_1	1	-18921	3715	0	16.4211	36.4846	25.3019	1207.357	4992.779	26.002	30.2043	32.2032
h14le1_2	2	-18704	3715	0	16.2207	36.262	20.9013	1192.551	4965.585	22.6015	29.4041	34.3036
h14le1_3	3	-18487	3715	0	16.2221	35.8615	20.6013	1197.587	4911.106	25.0019	33.8057	34.7037
h14le2_1	4	-18842	3639	0	16.5837	36.2625	25.502	1217.833	4966.924	22.6015	28.3038	35.8039
h14le2_2	5	-18665	3639	0	16.4853	36.0629	24.4018	1216.02	4940.146	19.6012	32.505	32.7032
h14le2_3	6	-18489	3639	0	16.0473	35.8715	20.9013	1182.983	4916.151	21.6014	31.9052	38.2046
h14le3_1	7	-18816	3569	0	16.0507	35.6376	22.9016	1181.372	4882.998	24.6018	29.5043	36.104
h14le3_2	8	-18640	3569	0	16.4669	36.6284	20.8013	1214.710	5027.706	24.2018	31.9049	36.8042
h14le3_3	9	-18465	3569	0	16.3022	35.8835	19.7012	1196.982	4917.799	19.2011	26.8036	35.904
h14lc1_1	1	-17939	902	1.3382	11.6113	25.7851	103.232	845.0369	3494.657	32.2031	21.5022	24.4019
h14lc1_2	2	-17926	902	1.2016	12.9212	28.2331	94.927	945.8765	3839.317	30.2027	26.9037	29.2026
h14lc1_3	3	-17914	902	0.7172	12.9914	28.4346	65.4128	949.6981	3865.717	24.0017	23.5026	31.6031
h14lc2_1	4	-17934	892	1.5508	11.6672	26.5335	119.0425	848.9567	3607.831	38.0043	21.1023	27.2023
h14lc2_2	5	-17924	894	1.1472	12.9206	28.2443	93.3261	944.5691	3843.512	31.2029	25.003	30.603

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h14lc2_3	6	-17914	895	0.7655	11.5006	27.2303	78.9187	839.0065	3692.556	36.0039	20.8021	26.0021
h14lc3_1	7	-17927	872	1.1883	12.8644	26.7624	95.9276	940.0436	3632.253	31.2029	25.0029	26.3022
h14lc3_2	8	-17917	872	1.0125	11.7534	26.6542	84.8216	860.2142	3618.049	29.6026	24.0027	25.602
h14lc3_3	9	-17907	872	0.8947	12.1682	26.0012	76.2174	891.7794	3523.454	26.002	25.5032	24.4018
h14lc4_1	10	-17924	857	1.4203	11.9314	25.5577	114.5393	865.9437	3468.928	39.0046	19.4019	28.4024
h14lc4_2	11	-17913	857	1.1873	13.5819	30.4653	102.7317	992.0437	4150.442	39.0046	25.003	27.7023
h14lc4_3	12	-17903	856	0.528	12.1182	27.6899	55.8093	885.4458	3756.358	23.8017	21.6024	27.9024
h14lc5_1	13	-17919	840	1.843	12.7806	26.8083	148.7664	932.8031	3644.312	52.2082	26.0031	24.5019
h14lc5_2	14	-17910	842	1.025	13.593	29.0085	96.9282	994.1563	3944.122	40.4049	25.6032	26.5022
h14lc5_3	15	-17901	843	0.4823	10.2499	26.8607	51.8081	750.3854	3646.458	23.0016	20.0019	28.4025
h14lm1_1	1	-16040	-3696	0.6275	12.2557	26.4627	56.2095	890.6736	3564.922	19.2011	22.6024	27.7024
h14lm1_2	2	-15996	-3696	0.8594	12.315	28.7402	72.1156	895.9015	3887.617	24.8018	24.0028	30.5028
h14lm1_3	3	-15953	-3696	0.2727	11.1673	25.5338	32.4031	808.4561	3432.689	12.6005	17.1014	27.6023
h14lm2_1	4	-16026	-3740	0.7289	13.0236	27.43	64.1123	949.5975	3704.108	22.0015	26.3034	30.5029
h14lm2_2	5	-15971	-3742	0.4825	10.9829	24.0707	48.0069	802.829	3235.095	18.001	24.8029	25.602
h14lm2_3	6	-15917	-3744	0.3495	13.129	30.1964	44.2059	960.2584	4084.749	20.8013	27.7035	30.1029
h14lm3_1	7	-16016	-3768	0.7287	11.588	25.2759	60.9111	840.313	3399.520	19.2011	20.502	24.4018
h14lm3_2	8	-15952	-3768	0.5744	10.9017	24.2303	59.0104	793.8863	3255.793	24.8018	22.7023	26.1021
h14lm3_3	9	-15888	-3769	0.5334	11.4365	25.9739	51.1078	831.1674	3493.943	19.0011	21.4023	24.6019
h14lm4_1	10	-15926	-3817	1.057	11.9978	26.0501	76.3175	872.0756	3514.161	18.8011	23.6027	26.6022
h14lm4_2	11	-15901	-3798	0.6572	10.6064	23.8646	59.8107	772.5865	3207.061	21.8014	22.8025	26.2021
h14lm4_3	12	-15877	-3780	0.6433	11.8209	26.2241	54.909	857.6008	3532.952	17.4009	20.702	28.0024
h14lm5_1	13	-15878	-3837	0.6848	11.8832	25.762	60.3109	866.4464	3471.991	20.6013	24.903	28.9025
h14lm5_2	14	-15863	-3822	0.9462	11.0986	24.4084	76.2174	807.3507	3285.568	24.2018	23.4027	26.7022
h14lm5_3	15	-15849	-3807	0.7697	13.205	30.3767	65.6129	961.767	4114.159	22.4015	25.103	28.7026
h14la1_1	1	-15051	-4843	0.9041	11.8496	25.4965	73.3161	859.209	3424.626	23.2016	23.8028	27.2022
h14la1_2	2	-15015	-4826	0.2924	12.9161	28.8666	41.5052	943.8651	3895.294	20.6013	27.0034	29.0027
h14la1_3	3	-14979	-4809	0.0323	11.8128	26.1177	19.8012	860.3147	3504.970	11.0004	21.9023	23.2016
h14la2_1	4	-15020	-4867	1.2007	13.9155	30.4816	94.1266	1016.389	4132.197	29.8027	30.7047	29.8028
h14la2_2	5	-14986	-4844	0.2385	11.1073	24.5796	41.4051	810.4658	3298.826	23.0016	23.4026	25.902
h14la2_3	6	-14953	-4821	0	13.1995	29.7082	18.201	964.1809	4005.05	12.2004	25.9035	25.602
h14la3_1	7	-14980	-4898	1.0684	11.1747	24.3884	81.5199	810.6667	3281.285	23.6017	22.1021	25.402
h14la3_2	8	-14946	-4874	0.1297	10.637	24.7722	23.4016	775.6005	3323.815	10.4003	22.1022	27.1023
h14la3_3	9	-14913	-4851	0.0281	11.378	25.6296	23.1016	832.0718	3436.874	14.6006	25.2032	24.0018
h14la4_1	10	-14942	-4930	0.9116	10.9765	24.9078	63.6121	794.8911	3349.931	13.6006	19.802	23.9018
h14la4_2	11	-14892	-4909	0.1199	12.923	29.423	29.7026	942.256	3967.467	17.0009	24.7031	27.9024
h14la4_3	12	-14843	-4889	0	11.4341	24.5839	23.3016	833.7804	3295.359	18.601	22.5024	25.502
h14la5_1	13	-14845	-5012	0.8145	11.8355	25.326	62.0115	864.7375	3405.439	16.0008	28.0035	24.3018
h14la5_2	14	-14788	-4970	0.0341	10.2458	23.8158	25.602	746.9702	3188.306	17.0009	20.802	22.8016
h14la5_3	15	-14732	-4928	0	13.2547	30.3977	22.2015	968.3047	4103.707	15.4007	26.0033	27.9024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h15be1_1	1	-9774	4738	0	15.7247	35.3158	23.7017	1148.946	4795.203	20.4012	30.6044	37.6044
h15be1_2	2	-9851	4738	0	15.8508	35.5805	22.2015	1160.123	4833.691	21.2013	31.0045	31.6031
h15be1_3	3	-9929	4738	0	15.3786	34.8446	20.6013	1121.963	4731.007	24.6018	27.5037	35.2038
h15be2_1	4	-9765	4703	0	15.3233	34.9345	26.002	1120.453	4739.339	24.0017	30.5045	33.1033
h15be2_2	5	-9842	4703	0	15.5099	35.6729	21.6014	1134.951	4843.263	23.8017	31.5049	32.6032
h15be2_3	6	-9919	4703	0	15.2699	34.8534	20.9013	1118.440	4727.407	21.8014	31.8052	30.303
h15be3_1	7	-9787	4639	0	15.4951	35.3967	23.4016	1130.118	4808.786	23.2016	28.304	39.6049
h15be3_2	8	-9854	4639	0	15.3368	35.623	20.3012	1122.668	4830.192	20.6013	33.3054	33.6034
h15be3_3	9	-9921	4639	0	15.3017	34.9114	20.4012	1115.822	4732.447	21.2013	28.5041	34.1036
h15bc1_1	1	-9722	2591	0.0536	13.0925	25.8476	18.401	953.017	3467.703	8.0002	23.9028	27.3023
h15bc1_2	2	-9725	2591	0.4734	14.376	30.9398	42.3054	1051.104	4180.377	12.6005	31.3048	29.4027
h15bc1_3	3	-9728	2591	0.6586	14.6939	31.2611	59.6107	1070.627	4227.442	21.0013	28.604	29.5027
h15bc2_1	4	-9721	2586	0.3123	13.4629	27.6005	39.0046	979.4697	3712.390	16.6008	25.503	29.9027
h15bc2_2	5	-9723	2586	0.594	14.7758	31.0588	49.0072	1077.169	4197.089	13.4005	30.1046	32.5032
h15bc2_3	6	-9726	2586	0.8566	14.8822	31.8939	70.9151	1084.215	4315.763	23.0016	30.8043	33.2033
h15bc3_1	7	-9719	2577	0.1905	12.889	26.8556	26.102	937.9318	3601.189	9.6003	25.6032	26.5021
h15bc3_2	8	-9722	2577	0.6149	15.0569	31.579	49.8074	1099.917	4270.006	13.2005	33.2052	34.7039
h15bc3_3	9	-9725	2577	1.0087	14.9815	32.1891	84.5214	1090.556	4353.526	29.4026	31.0046	30.0028
h15bc4_1	10	-9720	2569	0.7058	13.9349	28.8387	53.0084	1017.496	3883.012	12.0004	32.9053	31.7031
h15bc4_2	11	-9721	2569	0.1996	14.1428	29.5916	25.902	1031.482	3977.809	9.0002	30.1043	28.3024
h15bc4_3	12	-9723	2569	1.2087	15.0199	31.7438	92.7258	1093.072	4293.293	27.8023	32.105	32.1031
h15bc5_1	13	-9719	2545	0.7535	13.5759	26.9597	62.9119	986.1086	3622.851	19.2011	27.2037	29.3027
h15bc5_2	14	-9720	2545	0.6542	14.7571	30.1159	54.5089	1071.030	4058.110	15.8007	26.7037	28.6026
h15bc5_3	15	-9722	2545	1.0148	15.1549	31.8415	79.7191	1103.944	4309.401	24.0017	32.1048	34.8037
h15bm1_1	1	-9796	-1481	1.0359	13.9944	28.2882	74.4166	1015.786	3813.535	17.2009	26.8033	29.3026
h15bm1_2	2	-9797	-1483	0.7913	13.1651	27.1447	60.3109	954.0227	3647.786	15.2007	25.003	29.4027
h15bm1_3	3	-9801	-1483	1.0201	14.933	31.3569	83.5209	1080.994	4233.390	27.6023	26.2033	30.5028
h15bm2_1	4	-9797	-1498	0.4762	13.2399	26.5027	43.5057	960.8618	3550.826	13.2005	26.4036	28.6025
h15bm2_2	5	-9801	-1498	0.6906	15.2005	31.6434	58.8104	1102.836	4269.289	18.601	28.2038	32.6033
h15bm2_3	6	-9805	-1498	0.8375	15.4961	32.5054	76.1174	1127.903	4387.705	29.0025	33.0051	31.103
h15bm3_1	7	-9800	-1514	1.0004	14.2764	29.7923	76.7177	1035.506	4017.955	21.6014	26.4034	26.9023
h15bm3_2	8	-9802	-1512	0.73	14.9812	31.7922	65.6129	1087.436	4281.496	23.8017	30.7045	31.7031
h15bm3_3	9	-9805	-1512	0.815	15.9106	32.7038	66.8134	1154.081	4407.518	20.6013	30.5046	28.2025
h15bm4_1	10	-9800	-1518	1.1428	14.1747	28.8363	86.7226	1027.457	3883.114	24.6018	28.804	33.1034
h15bm4_2	11	-9804	-1518	1.1206	15.6563	32.3421	88.9237	1137.871	4371.077	28.0024	32.005	32.2032
h15bm4_3	12	-9808	-1518	0.906	16.0018	32.7339	72.9159	1162.741	4423.944	22.2015	30.7046	30.8029
h15bm5_1	13	-9802	-1526	1.5063	13.644	28.7345	116.2405	991.1383	3874.620	37.0041	30.6047	30.0027
h15bm5_2	14	-9806	-1526	0.6841	14.7834	30.5226	60.8111	1075.760	4115.389	20.8013	30.1043	30.803
h15bm5_3	15	-9810	-1526	0.6843	15.8895	32.9552	64.0123	1158.009	4459.986	24.0017	32.1049	33.8036
h15ba1_1	1	-10271	-5329	1.1883	13.1671	27.5242	83.5209	946.5804	3690.818	19.8012	22.1025	27.0022
h15ba1_2	2	-10282	-5329	0.8578	13.9598	30.5966	71.6154	1007.033	4110.675	24.2018	24.9028	27.8024
h15ba1_3	3	-10293	-5329	0.696	14.0638	30.1429	61.6114	1016.993	4051.349	21.6014	26.5036	31.7031
h15ba2_1	4	-10271	-5346	0.8964	12.9986	26.1121	65.0127	936.725	3493.534	14.8007	23.5028	27.6024
h15ba2_2	5	-10282	-5346	0.7254	13.769	29.7811	57.9101	991.239	3999.212	16.6008	21.9024	29.1028
h15ba2_3	6	-10293	-5346	0.612	13.648	28.8102	53.2085	985.5051	3868.377	17.0009	23.6027	30.4028
h15ba3_1	7	-10267	-5367	0.7019	13.0848	27.8174	52.6083	946.9827	3733.146	12.2004	25.2033	29.0026
h15ba3_2	8	-10278	-5367	0.9284	12.6294	27.4388	64.6125	911.7873	3689.694	13.6006	22.4026	30.8029
h15ba3_3	9	-10289	-5367	0.6584	12.2942	27.091	54.6089	888.3613	3626.939	16.6008	22.8023	22.7016
h15ba4_1	10	-10269	-5384	0.7083	13.1727	26.7504	53.3085	951.1061	3583.106	12.2004	24.2028	30.0028
h15ba4_2	11	-10281	-5384	0.7992	13.9045	29.794	68.9142	1005.624	4003.104	24.0017	26.4035	28.5025
h15ba4_3	12	-10293	-5384	0.4944	12.2525	25.9213	56.4095	885.2448	3464.538	25.802	22.7024	25.402
h15ba5_1	13	-10263	-5398	0.9526	11.5306	23.8389	71.2152	830.5644	3186.268	18.601	20.9022	24.7019
h15ba5_2	14	-10277	-5399	0.8395	14.288	30.8778	70.615	1035.205	4164.486	23.8017	27.1035	32.9033
h15ba5_3	15	-10292	-5400	0.6673	12.7059	27.2866	55.3092	919.5296	3663.117	16.6008	23.8028	28.7025
h15le1_1	1	-18695	3245	0	16.3735	35.2507	23.1016	1188.019	4748.186	22.8016	31.7048	34.2036
h15le1_2	2	-18577	3245	0	16.6206	36.0317	20.2012	1205.745	4864.468	21.8014	30.5046	36.004
h15le1_3	3	-18460	3245	0	16.3908	35.7967	20.4012	1189.832	4830.192	21.6014	30.5044	32.3033
h15le2_1	4	-18661	3191	0	16.0055	35.4925	24.1017	1162.439	4785.017	23.4016	31.3049	32.1031
h15le2_2	5	-18557	3191	0	16.5047	35.8493	22.3015	1200.407	4838.426	21.2013	32.9052	33.2035
h15le2_3	6	-18454	3191	0	16.2996	35.9347	19.8012	1182.681	4851.292	18.001	29.3043	31.503
h15le3_1	7	-18624	3087	0	16.136	35.4975	23.4016	1178.350	4794.895	20.6013	35.6061	31.9031
h15le3_2	8	-18529	3087	0	16.6078	35.9947	21.2013	1207.659	4867.865	21.8014	31.0047	35.0038
h15le3_3	9	-18435	3087	0	16.2316	35.5983	22.9016	1177.746	4812.079	22.0015	28.704	37.3043
h15lc1_1	1	-17650	167	1.154	11.4055	25.55	96.4279	820.8162	3421.666	35.2037	21.1022	25.602
h15lc1_2	2	-17645	167	1.4569	13.4308	28.9169	106.434	967.7012	3888.948	30.2027	24.6029	27.7024
h15lc1_3	3	-17641	167	1.9028	14.056	30.4121	139.6585	1010.856	4103.502	42.0053	23.9027	28.5025
h15lc2_1	4	-17650	165	1.6545	12.2726	26.0067	118.8424	882.832	3495.168	32.8032	22.0024	27.0023
h15lc2_2	5	-17645	165	1.4915	13.008	28.5261	108.3352	938.5351	3846.582	30.6028	24.303	32.7032

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h15lc2_3	6	-17641	165	1.5665	13.2389	28.9427	115.9403	958.2468	3898.774	34.6036	28.204	28.5025
h15lc3_1	7	-17641	144	1.8912	12.5587	25.7325	145.6636	903.0399	3461.067	47.6068	22.8026	28.9026
h15lc3_2	8	-17645	158	1.5866	12.4747	26.9669	120.0432	899.722	3624.486	37.6042	24.5029	26.5022
h15lc3_3	9	-17641	158	1.6264	13.8691	29.3337	124.0461	998.7838	3951.084	39.4047	25.0029	30.903
h15lc4_1	10	-17641	144	1.5153	12.3157	25.3911	122.545	882.6309	3403.092	43.0055	20.6019	29.9028
h15lc4_2	11	-17639	144	1.7128	12.4147	26.8959	136.4558	893.4886	3606.400	48.207	25.1032	25.602
h15lc4_3	12	-17637	144	1.7787	12.7706	28.7929	124.0461	916.9153	3869.401	33.2033	22.6022	24.2018
h15lc5_1	13	-17641	138	1.4412	12.3944	25.808	117.8416	890.0704	3457.494	42.0053	22.1024	27.9023
h15lc5_2	14	-17637	136	1.9962	13.2558	28.5486	145.7637	949.0947	3836.452	43.8058	22.1023	27.7024
h15lc5_3	15	-17634	136	2.2204	13.5918	28.5476	165.4821	976.7538	3835.736	52.2082	26.7035	25.602
h15lm1_1	1	-16317	-2790	1.3994	11.0736	23.2516	110.3365	791.9772	3086.823	37.0041	22.4024	24.9019
h15lm1_2	2	-16280	-2790	0.6965	12.2979	25.9971	62.9119	883.2341	3447.286	23.0016	24.9031	23.4017
h15lm1_3	3	-16243	-2790	0.1948	12.1945	26.3428	34.5036	874.5887	3494.351	18.201	20.902	26.2021
h15lm2_1	4	-16304	-2812	1.325	11.9167	24.1449	111.137	853.9822	3205.838	40.805	24.3029	23.3017
h15lm2_2	5	-16263	-2812	0.425	13.9287	30.3459	50.0075	1000.192	4052.373	23.0016	23.6026	30.803
h15lm2_3	6	-16223	-2812	0.2157	14.0132	30.7375	39.8048	1009.246	4104.628	22.6015	25.9032	31.703
h15lm3_1	7	-16289	-2839	1.6131	11.3919	23.6532	117.0411	818.103	3174.242	32.6032	19.0017	24.1018
h15lm3_2	8	-16251	-2839	0.4371	12.1417	26.3313	51.2079	874.3876	3505.073	23.6017	24.0027	30.0027
h15lm3_3	9	-16213	-2839	0	13.6095	30.0445	28.2024	985.2033	4009.453	22.2015	28.404	28.9025
h15lm4_1	10	-16275	-2864	1.1628	11.6823	24.1714	99.2295	836.5944	3215.624	36.8041	21.2023	24.502
h15lm4_2	11	-16238	-2864	0.4152	11.4403	24.3974	41.5052	823.3286	3237.950	14.8007	22.3026	24.9019
h15lm4_3	12	-16202	-2864	0.091	12.0368	26.0536	21.1013	869.0599	3463.415	9.6003	24.503	29.2026
h15lm5_1	13	-16265	-2889	1.606	11.3963	25.314	118.4421	817.299	3382.274	35.8038	22.8026	27.5023
h15lm5_2	14	-16228	-2889	0.4541	13.4807	30.6494	55.9094	975.4462	4105.756	27.8023	28.304	31.203
h15lm5_3	15	-16192	-2889	0.1702	13.1619	28.0919	28.5024	946.3793	3751.041	13.2005	20.302	29.7027
h15la1_1	1	-14361	-5907	0.9875	11.7507	24.6377	78.0183	847.6501	3303.212	23.8017	21.102	27.1022
h15la1_2	2	-14312	-5907	0.7437	11.2775	24.501	68.6141	812.8775	3279.552	26.4021	19.502	26.1021
h15la1_3	3	-14263	-5907	0.2672	12.1769	26.3344	35.6038	883.7368	3525.599	15.8007	24.0029	25.602
h15la2_1	4	-14276	-5987	1.4156	14.139	30.5775	107.2345	1025.444	4130.250	32.8032	28.5038	27.5023
h15la2_2	5	-14228	-5987	0.6885	12.4943	26.4083	62.9119	904.548	3545.719	23.0016	22.8027	26.9022
h15la2_3	6	-14181	-5987	0.0804	14.1722	30.6676	31.1029	1033.192	4135.785	20.0012	28.3037	32.9033
h15la3_1	7	-14250	-6016	1.4871	12.7361	27.8033	108.1351	919.228	3748.586	30.4028	22.7024	27.2024
h15la3_2	8	-14203	-6016	0.9934	13.9424	30.6153	84.3213	1015.081	4140.397	30.2027	29.8042	32.9033
h15la3_3	9	-14157	-6016	0.2374	12.0668	25.48	33.8034	876.5992	3416.665	15.2007	22.6025	26.3022
h15la4_1	10	-14218	-6052	1.6557	11.9966	25.1711	118.9424	866.949	3393.703	32.4031	23.0027	28.6025
h15la4_2	11	-14173	-6052	0.9142	12.4082	27.3133	79.9192	903.442	3676.916	29.6026	27.6036	26.2021
h15la4_3	12	-14129	-6052	0.3527	13.7498	31.3298	36.9041	996.3694	4230.519	13.4005	22.6027	31.0031
h15la5_1	13	-14160	-6100	1.4881	12.1162	25.0823	104.4327	875.0914	3374.315	25.802	22.1023	23.6017
h15la5_2	14	-14117	-6100	0.9812	12.2191	26.3657	78.7186	884.541	3544.289	25.0019	22.6024	23.8018
h15la5_3	15	-14074	-6100	0.3503	14.3279	31.7542	39.8048	1042.248	4292.370	16.2008	26.5031	31.9031

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h16be1_1	1	-18771	30958	0	16.6758	36.5092	24.1017	1226.093	4982.169	21.6014	33.806	34.1035
h16be1_2	2	-18696	30958	0	16.6581	36.4999	18.501	1224.280	4987.114	21.0013	32.1052	35.5039
h16be1_3	3	-18622	30958	0	16.4153	36.1142	21.9014	1204.234	4932.834	20.2012	29.7045	36.104
h16be2_1	4	-18751	30919	0	16.6425	36.0436	23.4016	1227.604	4921.815	21.6014	36.6063	35.3038
h16be2_2	5	-18687	30919	0	16.6569	36.4188	21.4014	1224.481	4973.928	19.0011	32.4054	33.9035
h16be2_3	6	-18623	30919	0	16.7013	36.5477	22.7015	1227	4995.046	21.8014	31.1049	34.2036
h16be3_1	7	-18724	30774	0	16.7019	36.5427	21.9014	1229.115	4996.797	18.8011	32.0049	31.8031
h16be3_2	8	-18664	30774	0	16.387	36.494	22.8016	1205.141	4991.131	20.4012	30.9047	32.9033
h16be3_3	9	-18605	30774	0	16.3877	36.1297	20.9013	1207.256	4940.969	17.801	33.0051	34.8037
h16bc1_1	1	9032	27578	2.0324	14.2079	31.9907	105.3333	908.7709	4320.483	28.8025	20.6019	15.3007
h16bc1_2	2	9035	27578	1.7519	14.4772	31.8898	84.6215	924.2557	4307.965	18.201	19.0018	18.301
h16bc1_3	3	9037	27578	2.0886	14.2564	32.3943	111.3372	913.2955	4379.288	32.8032	21.9023	17.2009
h16bc2_1	4	9049	27536	1.7737	13.006	30.1333	98.0288	833.5793	4064.974	31.0029	21.2022	17.801
h16bc2_2	5	9052	27536	1.8725	14.2917	32.6845	103.0318	919.228	4420.967	32.4031	25.3031	18.9011
h16bc2_3	6	9054	27536	1.8323	14.6902	33.5961	107.1344	942.7589	4547.812	38.0043	23.7025	20.1012
h16bc3_1	7	9053	27526	1.7856	15.0036	32.7021	94.7269	963.4768	4421.788	27.0022	24.2026	16.1008
h16bc3_2	8	9056	27526	1.9923	14.832	33.5862	107.8349	954.5256	4551.922	32.8032	26.2031	22.9016
h16bc3_3	9	9058	27526	1.9456	15.122	34.3796	115.6401	969.8134	4653.778	42.4054	23.7027	17.801
h16bc4_1	10	9057	27512	1.606	15.2627	32.9148	93.126	976.6532	4444.583	32.0031	22.7026	18.7011
h16bc4_2	11	9061	27512	2.1457	15.2245	34.147	115.2398	979.9726	4628.077	34.6036	27.2036	22.0015
h16bc4_3	12	9065	27512	1.2582	15.7879	34.6998	78.5185	1015.685	4699.330	30.0027	26.9036	21.3014
h16bc5_1	13	9063	27491	1.7504	14.5759	31.7234	86.7226	934.0098	4278.008	20.4012	24.0028	18.201
h16bc5_2	14	9067	27491	1.5747	15.4199	33.5366	88.1233	991.1383	4531.374	28.2024	27.4037	20.5013
h16bc5_3	15	9071	27491	1.6989	15.3496	33.5508	96.0277	985.8068	4538.154	31.603	26.1033	22.5015
h16bm1_1	1	-16761	24056	1.2492	14.8451	31.3703	104.7329	1083.208	4271.032	37.4042	27.7038	32.3033
h16bm1_2	2	-16757	24054	1.0297	14.5201	32.4472	92.4256	1057.343	4415.936	36.404	25.3032	31.503
h16bm1_3	3	-16750	24054	0.382	14.4035	31.6774	46.7065	1054.022	4300.270	21.4014	28.3039	32.4033
h16bm2_1	4	-16754	24024	1.5166	13.1789	29.6284	103.332	957.8445	4023.178	24.0017	23.8028	25.502
h16bm2_2	5	-16747	24024	0.9836	14.5709	32.425	88.2233	1064.186	4412.343	34.4035	28.3039	31.7032
h16bm2_3	6	-16740	24024	0.2152	14.1477	31.3189	43.0055	1035.607	4253.185	25.602	26.3034	31.5031
h16bm3_1	7	-16738	23985	1.4286	15.0569	31.7356	115.8402	1099.112	4321.611	39.8048	29.4041	31.8031
h16bm3_2	8	-16740	23989	1.1106	14.2761	30.9891	90.1244	1040.538	4216.367	29.8027	25.103	30.0028
h16bm3_3	9	-16734	23989	0.714	14.3194	31.2976	65.4128	1048.990	4258.621	24.2018	28.5039	31.603
h16bm4_1	10	-16739	23974	1.1785	13.6705	29.5793	89.6241	994.1563	4016.521	26.002	22.8026	26.7022
h16bm4_2	11	-16729	23971	1.4104	14.435	31.574	103.9324	1052.613	4305.092	29.2026	26.1034	30.9029
h16bm4_3	12	-16720	23967	0.2918	14.1256	30.981	44.1058	1034.198	4211.649	23.0016	25.8031	32.4032
h16bm5_1	13	-16714	23916	1.3405	13.4001	29.9029	105.8336	979.2685	4066.101	34.8036	27.8037	28.4025
h16bm5_2	14	-16707	23916	1.2549	14.2822	32.1351	90.0243	1040.739	4381.136	23.2016	25.103	31.303
h16bm5_3	15	-16700	23916	0.3501	14.5392	32.1495	46.2064	1066.702	4374.361	22.4015	29.004	32.0031
h16ba1_1	1	-15654	21332	1.4006	11.8801	26.6017	98.6292	867.4515	3607.013	24.8018	25.9034	27.9024
h16ba1_2	2	-15637	21332	0.132	12.9182	30.0321	35.0037	949.7986	4076.859	21.8014	28.504	34.2036
h16ba1_3	3	-15620	21332	0.085	11.7468	24.9941	29.9027	856.0931	3370.948	18.401	18.6016	27.2022
h16ba2_1	4	-15654	21312	1.6013	11.859	26.1833	115.6401	861.1188	3556.546	31.803	20.602	28.2025
h16ba2_2	5	-15637	21312	0.338	13.4978	29.9772	38.6045	988.3217	4069.175	15.4007	25.5031	29.9028
h16ba2_3	6	-15621	21312	0.1408	12.271	25.3797	32.5032	898.7166	3423.401	18.201	24.1028	27.5023
h16ba3_1	7	-15653	21243	1.3894	14.0217	31.5281	105.9337	1022.929	4302.014	32.6032	26.1032	33.8035
h16ba3_2	8	-15643	21243	0.5166	13.5736	31.1048	55.8093	995.8664	4230.519	24.4018	28.5038	32.3033
h16ba3_3	9	-15634	21243	0.0543	12.9131	28.9223	29.4026	947.7872	3917.915	19.6012	25.8031	28.1024
h16ba4_1	10	-15656	21218	1.4	10.9212	26.6096	101.5309	794.6901	3606.911	28.8025	20.9021	21.0013
h16ba4_2	11	-15640	21218	0.3608	12.3646	28.8067	37.7043	901.2301	3899.081	13.8006	21.1022	26.3022
h16ba4_3	12	-15625	21218	0.2053	12.2474	28.5394	28.8025	894.9966	3864.080	12.2004	22.8026	30.8029
h16ba5_1	13	-15651	21187	1.529	11.6711	26.3916	106.6341	845.4389	3575.546	26.8022	19.7019	25.502
h16ba5_2	14	-15636	21187	0.6565	12.6541	28.9088	52.6083	920.4346	3916.686	14.6006	20.9021	27.8024
h16ba5_3	15	-15621	21187	0.403	12.4964	27.5263	44.1058	912.5917	3719.035	17.801	23.3027	24.7018
h16le1_1	1	-9206	31091	0	16.3254	35.6057	21.2013	1203.932	4871.365	22.0015	33.105	35.2038
h16le1_2	2	-9316	31091	0	16.4744	36.7158	22.7015	1211.386	5028.737	18.401	30.204	36.404
h16le1_3	3	-9427	31091	0	16.164	35.9209	21.3014	1189.529	4907.605	20.8013	32.1049	33.5034
h16le2_1	4	-9232	31024	0	16.5148	36.3515	20.9013	1214.307	4972.074	25.0019	30.8045	34.3036
h16le2_2	5	-9345	31024	0	16.4715	36.4479	23.6017	1207.458	4979.182	24.6018	29.4042	37.3042
h16le2_3	6	-9458	31024	0	16.4632	35.7643	20.7013	1210.278	4880.218	20.4012	32.305	33.4035
h16le3_1	7	-9262	30965	0	16.7078	36.2833	23.1016	1224.985	4953.637	24.6018	30.4046	37.8044
h16le3_2	8	-9362	30965	0	16.408	36.3926	23.0016	1202.321	4961.156	23.0016	30.6045	34.4036
h16le3_3	9	-9462	30965	0	16.1384	36.0706	22.7015	1183.386	4920.682	23.4016	29.5044	32.4032
h16lc1_1	1	17423	28424	0.8602	14.8724	28.3316	51.8081	951.5084	3809.341	17.0009	22.4024	18.8011
h16lc1_2	2	17419	28424	0.7538	15.3696	30.7435	57.81	986.9134	4144.702	27.0022	25.403	20.3012
h16lc1_3	3	17415	28424	1.1515	15.0046	30.6793	72.4157	965.589	4136.092	27.4023	27.4036	18.9011
h16lc2_1	4	17422	28417	1.2679	15.1857	29.8689	67.2135	974.038	4026.251	17.801	24.1028	18.101
h16lc2_2	5	17419	28416	1.159	15.9467	31.5728	62.3116	1026.048	4271.135	16.8008	25.503	18.9011

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h16lc2_3	6	17415	28415	1.4911	16.3652	33.5384	84.1212	1056.336	4543.702	26.8022	29.9042	20.2012
h16lc3_1	7	17423	28356	1.1461	14.9544	29.069	63.0119	957.8445	3912.899	18.001	23.8027	20.6013
h16lc3_2	8	17420	28356	1.2121	15.4612	31.0232	69.5145	993.955	4191.142	22.2015	25.9032	21.8014
h16lc3_3	9	17416	28356	1.2712	14.9531	32.2721	76.1174	963.3763	4360.710	27.0022	27.6036	19.6012
h16lc4_1	10	17423	28339	1.4431	16.1766	31.7009	78.1183	1038.123	4279.649	22.4015	25.7032	19.2011
h16lc4_2	11	17420	28339	1.4784	14.9374	31.499	91.325	959.6549	4255.749	34.6036	25.003	20.3013
h16lc4_3	12	17416	28339	1.0563	16.5095	32.7022	66.3132	1063.079	4422.302	24.6018	28.2041	20.6013
h16lc5_1	13	17424	28322	0.8445	15.4202	30.0828	57.81	991.1383	4059.339	23.6017	25.0031	19.0011
h16lc5_2	14	17421	28322	1.0898	15.4958	30.3381	67.2135	999.5886	4095.406	24.2018	29.2039	20.5013
h16lc5_3	15	17418	28322	1.3667	14.9546	31.2316	88.1233	962.6722	4217.700	35.4038	27.0033	20.2012
h16lm1_1	1	-10786	23126	0.9095	15.8555	32.7725	87.2228	1162.036	4470.667	36.0039	30.5047	32.7034
h16lm1_2	2	-10788	23125	0.8493	15.2739	30.1729	76.6176	1120.151	4104.321	27.8023	30.4045	31.3031
h16lm1_3	3	-10792	23125	0.9559	15.2875	31.9062	75.1169	1115.218	4346.240	21.8014	25.6031	31.7031
h16lm2_1	4	-10792	23114	1.0758	15.4299	31.7875	81.1197	1129.715	4327.460	21.8014	30.3043	28.5025
h16lm2_2	5	-10794	23114	1.1828	16.2448	32.2917	93.126	1182.48	4397.868	28.2024	25.6032	31.9032
h16lm2_3	6	-10797	23113	0.7632	14.9704	32.1805	69.9147	1099.112	4380.006	26.2021	32.2049	30.703
h16lm3_1	7	-10793	23108	0.6437	14.6232	31.2177	61.3113	1074.854	4247.749	23.2016	31.2047	29.1026
h16lm3_2	8	-10796	23108	0.5798	15.4031	33.0034	55.6093	1126.292	4499.014	20.6013	26.3033	31.7031
h16lm3_3	9	-10800	23108	0.7293	15.3407	32.3868	65.713	1122.467	4414.396	23.4016	27.6035	32.5032
h16lm4_1	10	-10796	23093	0.8959	15.2062	30.4109	75.9173	1112.500	4138.142	25.0019	28.3039	33.0033
h16lm4_2	11	-10799	23093	0.7188	15.5974	32.3254	69.6145	1142.301	4407.518	27.6023	28.3038	32.6033
h16lm4_3	12	-10802	23093	0.7519	15.2052	32.1817	66.8134	1116.024	4391.195	23.4016	30.0045	33.6035
h16lm5_1	13	-10801	23070	1.0384	15.0613	31.2643	88.9237	1103.340	4265.596	31.403	28.4038	32.1032
h16lm5_2	14	-10805	23070	0.7868	15.0183	32.3465	68.1139	1100.118	4413.883	23.2016	27.7035	32.3031
h16lm5_3	15	-10810	23070	0.682	14.8063	31.7433	61.3113	1086.530	4321.714	21.4014	29.7041	28.6026
h16la1_1	1	-12121	20151	0.5916	14.1875	30.0683	50.6077	1035.406	4075.937	15.0007	25.2029	27.3023
h16la1_2	2	-12137	20151	0.3258	11.542	25.1495	46.5065	842.3232	3387.784	23.8017	21.6024	23.9018
h16la1_3	3	-12154	20151	0.2467	13.153	29.0387	35.5038	959.2526	3932.656	16.6008	22.0023	29.8027
h16la2_1	4	-12138	20129	0.9327	13.1952	27.2534	69.8146	962.0687	3684.583	17.6009	25.9032	27.9024
h16la2_2	5	-12158	20129	0.3505	11.5143	25.6978	40.5049	841.9211	3467.703	16.8008	23.2026	27.4023
h16la2_3	6	-12179	20129	0.0531	10.8485	23.402	28.3024	792.3792	3142.142	18.401	21.002	24.5018
h16la3_1	7	-12159	20094	0.8149	13.5229	29.4534	65.0127	987.2151	3994.603	19.0011	25.7032	28.6025
h16la3_2	8	-12181	20094	0.2285	13.9372	31.0205	42.0053	1024.036	4217.597	24.0017	29.5043	35.5038
h16la3_3	9	-12204	20094	0.1398	12.6714	27.3776	26.2021	926.3673	3701.144	12.2004	22.7024	27.7024
h16la4_1	10	-12181	20059	0.8261	12.6569	27.7389	63.7122	923.5518	3756.768	17.2009	23.7027	25.602
h16la4_2	11	-12206	20058	0.2694	11.9182	24.6624	40.0048	870.9698	3322.694	19.6012	22.7025	25.8021
h16la4_3	12	-12231	20057	0.1204	14.2127	30.6949	26.7021	1043.154	4166.434	13.6006	27.9039	29.8028
h16la5_1	13	-12197	20033	0.8732	13.1161	27.8646	67.6137	956.9393	3784.382	18.401	22.9026	30.2028
h16la5_2	14	-12225	20033	0.2528	10.8861	22.8909	38.1044	796.9006	3081.832	18.601	22.1025	25.802
h16la5_3	15	-12254	20033	0.0034	12.6419	26.7466	25.2019	924.9595	3611.305	17.4009	23.0025	27.6024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h17be1_1	1	15600	4625	0.0173	16.4693	36.3669	27.1022	1205.141	4935.923	19.0011	34.4061	33.2034
h17be1_2	2	15346	4625	0	16.2349	36.3323	21.1013	1187.817	4929.435	21.8014	33.9057	31.7031
h17be1_3	3	15091	4625	0	16.3032	35.5798	21.9014	1191.443	4825.046	21.2013	32.105	31.6031
h17be2_1	4	15587	4562	0	16.3606	36.207	27.7023	1193.357	4914.092	20.8013	30.4046	34.2036
h17be2_2	5	15353	4562	0	16.6387	36.267	20.3012	1213.098	4922.330	18.401	30.1043	34.1036
h17be2_3	6	15118	4562	0	15.9209	35.4429	16.6008	1161.029	4807.448	26.6021	29.8041	35.5039
h17be3_1	7	15549	4463	0	15.9759	35.6428	23.4016	1167.172	4836.573	22.0015	31.405	34.0035
h17be3_2	8	15358	4463	0	16.5025	35.9865	22.3015	1204.637	4888.249	22.8016	30.9045	37.3043
h17be3_3	9	15167	4463	0	16.3355	35.2196	19.5011	1189.932	4775.551	20.2012	28.304	33.1034
h17bc1_1	1	16021	1997	1.2488	13.033	26.0031	86.9227	943.1611	3496.495	19.4011	24.7028	26.2022
h17bc1_2	2	16013	1997	1.179	13.5257	29.6462	85.3218	977.5585	3999.519	22.4015	23.8027	28.5025
h17bc1_3	3	16002	1997	0.8255	14.0438	29.8415	58.8104	1018.905	4022.769	12.4005	26.4032	27.6023
h17bc2_1	4	16022	1987	1.1786	14.0159	26.4921	92.2255	1011.359	3561.653	27.4023	22.9025	27.8023
h17bc2_2	5	16013	1987	1.2075	13.7348	30.1632	92.3256	992.7479	4076.859	28.0024	23.1024	29.7028
h17bc2_3	6	16002	1987	0.395	14.3996	31.3732	45.0061	1047.481	4230.416	19.2011	27.8039	27.0023
h17bc3_1	7	16025	1973	0.7317	13.2964	25.5085	66.1131	960.3589	3420.748	23.2016	22.2023	28.4024
h17bc3_2	8	16017	1973	0.6198	13.7209	29.6057	61.5113	995.3634	3991.940	25.0019	24.803	29.8027
h17bc3_3	9	16006	1973	0.8436	14.4266	31.2253	65.1127	1046.575	4219.751	18.001	26.0034	29.4026
h17bc4_1	10	16027	1966	0.7509	13.4091	25.5969	63.7122	969.5117	3432.383	19.8012	22.9026	26.1021
h17bc4_2	11	16019	1968	0.9922	13.6903	29.828	78.7186	990.736	4026.149	24.6018	24.1029	30.3029
h17bc4_3	12	16007	1968	0.4002	14.228	30.8232	41.5052	1033.192	4159.873	15.4007	25.403	31.103
h17bc5_1	13	16030	1959	0.9297	12.562	24.6279	73.3161	907.6649	3292.299	21.2013	25.003	26.0021
h17bc5_2	14	16021	1959	1.0269	13.0516	29.2432	73.4162	945.2731	3939.208	18.001	24.9029	25.402
h17bc5_3	15	16010	1956	0.6772	14.3226	31.4954	55.2091	1038.424	4250.415	16.2008	26.2032	30.4029
h17bm1_1	1	16617	-1416	0.0813	12.7843	23.7037	19.6012	927.4734	3164.560	7.6002	23.6023	27.4023
h17bm1_2	2	16610	-1416	1.1891	14.6412	31.4037	87.7231	1059.758	4251.954	24.0017	25.5034	34.9038
h17bm1_3	3	16603	-1416	0.2465	15.0615	32.4847	28.1024	1099.112	4392.324	9.2003	30.8044	33.5034
h17bm2_1	4	16617	-1422	0.447	13.4669	25.3741	43.8058	979.5703	3398.397	14.4006	27.7038	26.4023
h17bm2_2	5	16612	-1422	0.8633	15.0261	31.9621	69.8146	1090.254	4324.177	21.6014	27.2036	33.2034
h17bm2_3	6	16606	-1422	0.8276	15.2379	32.769	63.9123	1107.064	4429.386	17.6009	30.7047	34.5037
h17bm3_1	7	16618	-1426	0.094	12.7994	25.0292	20.5013	933.7081	3348.605	8.2002	28.2038	27.8024
h17bm3_2	8	16613	-1426	0.7798	14.1166	30.1714	62.9119	1025.746	4068.663	18.8011	29.3044	34.1037
h17bm3_3	9	16606	-1426	0.5095	15.1001	32.2702	48.5071	1097.199	4355.374	17.2009	29.7044	34.1035
h17bm4_1	10	16620	-1441	0.1513	12.6259	23.8867	23.2016	915.7087	3188.816	8.0002	23.4025	25.602
h17bm4_2	11	16614	-1438	0.9299	13.8894	29.8053	71.0151	1005.926	4016.726	19.8012	26.8034	33.0034
h17bm4_3	12	16607	-1437	0.802	13.6813	30.1436	67.0135	991.4401	4060.262	22.2015	27.1037	32.7032
h17bm5_1	13	16622	-1456	0.4214	12.6947	24.7944	40.4049	917.1164	3310.147	12.6005	22.6023	25.602
h17bm5_2	14	16616	-1456	0.5795	13.8382	29.9637	52.9084	1002.807	4032.192	18.401	25.6031	28.7025
h17bm5_3	15	16610	-1456	0.7006	13.4891	29.6951	60.511	982.2861	4002.694	20.4012	29.5042	30.7029
h17ba1_1	1	17230	-3094	0.7293	11.4382	27.207	68.1139	828.2529	3657.496	27.4023	22.1024	27.8025
h17ba1_2	2	17211	-3124	0.5526	12.07	25.9212	49.9075	873.885	3474.850	16.6008	22.4023	26.2021
h17ba1_3	3	17191	-3154	0	11.8803	24.9691	24.2018	861.2194	3339.219	17.4009	21.4023	28.9026
h17ba2_1	4	17306	-3119	0.4538	12.781	29.0979	41.005	927.574	3917.301	12.8005	24.6028	30.803
h17ba2_2	5	17287	-3161	0.5975	11.873	25.2466	54.5089	855.3895	3383.499	19.0011	18.2017	27.0024
h17ba2_3	6	17267	-3203	0	11.3202	24.1946	22.9016	822.1227	3230.508	16.4008	22.3026	26.1021
h17ba3_1	7	17353	-3141	0.467	12.0019	27.6684	38.7045	869.663	3714.639	10.0003	22.9025	27.3022
h17ba3_2	8	17337	-3174	0.7904	11.2247	25.4504	64.4124	808.9585	3411.664	20.4012	19.3018	26.9022
h17ba3_3	9	17320	-3207	0.2561	12.68	26.0701	40.805	917.1164	3486.999	21.2013	22.4025	27.5023
h17ba4_1	10	17423	-3189	0.987	12.2914	26.7474	71.5153	887.2554	3590.257	17.801	23.1028	29.3026
h17ba4_2	11	17401	-3219	0.786	12.1355	25.9976	65.913	876.0966	3480.056	21.6014	22.9024	26.5022
h17ba4_3	12	17378	-3250	0.1402	11.6294	25.1896	29.4026	838.504	3357.786	15.6007	19.9018	26.6021
h17ba5_1	13	17492	-3244	0.2523	11.045	25.5304	29.6026	795.7953	3407.990	11.0004	19.0018	27.9023
h17ba5_2	14	17470	-3263	0.8726	11.9031	26.1424	68.7142	857.9023	3497.823	20.6013	22.3023	26.3021
h17ba5_3	15	17447	-3283	0.2003	13.7593	28.9773	29.2026	994.0556	3881.375	12.4005	23.7027	29.4026
h17le1_1	1	7618	4142	0	16.6588	36.4983	20.7013	1214.912	4949.518	20.2012	32.2048	35.8041
h17le1_2	2	8308	4142	0	16.3881	35.5847	23.6017	1193.054	4816.916	23.4016	29.9043	32.3032
h17le1_3	3	8998	4142	0	15.9579	35.2883	20.2012	1161.432	4775.654	17.4009	29.804	35.0037
h17le2_1	4	7610	4032	0	16.9104	36.8211	20.6013	1234.051	4993.913	19.6012	33.2055	34.6037
h17le2_2	5	8326	4032	0	16.4193	35.7413	21.8014	1197.788	4841.308	18.601	31.805	32.2033
h17le2_3	6	9042	4032	0	15.9743	35.1451	20.9013	1166.064	4755.386	21.2013	32.7052	32.6033
h17le3_1	7	7650	3942	0	16.7801	36.6052	22.6015	1223.575	4959.714	22.2015	33.3053	35.804
h17le3_2	8	8330	3942	0	16.388	35.8347	22.3015	1190.839	4844.293	22.6015	29.4043	31.5031
h17le3_3	9	9009	3942	0	16.0863	34.5886	21.0013	1166.669	4662.723	22.6015	28.704	32.3033
h17lc1_1	1	10516	-2154	2.6157	11.6962	25.903	194.7137	834.7854	3477.708	63.4121	20.6021	24.4018
h17lc1_2	2	10530	-2156	2.2536	12.2431	27.648	150.8683	874.3876	3713.923	37.4042	20.0018	24.702
h17lc1_3	3	10542	-2156	1.6715	12.0645	27.6334	115.1398	862.8276	3707.789	29.8027	19.7019	28.4025
h17lc2_1	4	10519	-2162	2.3426	12.1184	26.3174	169.4861	865.1396	3523.658	51.4079	23.2026	29.3026
h17lc2_2	5	10534	-2164	2.1599	11.95	27.5071	144.8629	851.8715	3695.828	36.2039	17.5014	24.5019

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h17lc2_3	6	10549	-2164	1.541	11.3895	26.0049	108.2351	812.777	3482.813	29.0025	16.5014	24.5018
h17lc3_1	7	10529	-2193	2.3545	11.1677	24.3114	171.4882	796.2977	3259.259	52.4082	18.3016	22.9016
h17lc3_2	8	10544	-2195	1.9924	11.1488	25.5152	132.6528	796.1973	3419.523	32.0031	18.8017	24.6019
h17lc3_3	9	10559	-2195	1.7268	11.8545	26.5497	125.7474	848.9567	3554.401	37.4042	20.7021	21.7016
h17lc4_1	10	10547	-2241	2.5779	10.8041	25.5491	185.1027	770.5773	3428.504	57.0098	19.1017	21.6014
h17lc4_2	11	10565	-2241	1.8653	12.2449	27.7308	137.1564	875.795	3718.831	42.4054	20.5021	24.2018
h17lc4_3	12	10583	-2241	1.2689	12.8054	28.0845	82.7205	918.7252	3765.767	15.8007	20.502	24.7019
h17lc5_1	13	10550	-2250	2.6229	10.8697	23.8997	169.8865	771.4814	3204.513	38.0043	15.4012	21.2013
h17lc5_2	14	10567	-2247	1.7918	12.8449	28.0993	136.9563	922.7473	3775.279	45.0061	23.4026	26.3022
h17lc5_3	15	10584	-2244	0.8828	13.192	29.1291	85.1217	948.3907	3910.238	36.604	21.7022	31.7031
h17lm1_1	1	10922	-4480	1.5997	11.4942	25.6422	112.2378	818.2034	3415.440	30.2027	19.1017	26.1021
h17lm1_2	2	10938	-4480	1.2975	11.7156	27.2769	103.332	836.1924	3632.968	36.2039	21.0021	27.2022
h17lm1_3	3	10953	-4480	1.636	12.8194	29.0698	130.0507	917.3175	3879.942	46.6065	25.6031	27.9024
h17lm2_1	4	10923	-4494	2.2019	10.703	25.5443	151.5689	759.4263	3403.602	42.2053	18.7015	23.9017
h17lm2_2	5	10939	-4495	1.5704	12.3786	28.5298	114.7395	883.0331	3806.886	34.6036	21.8025	27.1022
h17lm2_3	6	10955	-4496	1.6907	13.3262	30.8811	132.2525	955.0284	4126.048	46.6065	28.3037	28.4025
h17lm3_1	7	10924	-4519	1.9708	11.1597	24.3749	130.2509	788.963	3239.479	30.4028	16.4012	24.9019
h17lm3_2	8	10942	-4519	1.4418	12.5152	28.3192	101.8311	894.3934	3782.029	27.4023	21.9024	27.4023
h17lm3_3	9	10960	-4519	1.1845	11.9713	28.3511	104.933	855.49	3785.711	43.2056	20.5021	28.7025
h17lm4_1	10	10929	-4549	1.6909	11.4703	24.1398	121.7444	815.9927	3211.954	34.4035	18.5016	23.6017
h17lm4_2	11	10947	-4549	1.7609	12.7966	29.4106	125.3471	914.5021	3934.601	36.0039	22.9025	26.3021
h17lm4_3	12	10964	-4549	1.8018	13.1272	32.1023	138.1572	939.3397	4312.274	47.8069	23.9027	30.903
h17lm5_1	13	10936	-4564	1.92	11.5143	26.3011	129.6504	820.5148	3515.795	32.6032	19.6018	27.4024
h17lm5_2	14	10951	-4560	1.7469	12.8925	30.7391	134.5543	928.2779	4131.788	46.2064	27.3036	29.7026
h17lm5_3	15	10966	-4557	1.2908	12.1943	30.2431	103.332	874.5887	4060.671	37.0041	21.7024	31.5031
h17la1_1	1	11284	-6102	2.0945	11.0907	24.0497	141.3599	790.872	3203.086	35.2037	21.7024	23.4017
h17la1_2	2	11328	-6102	1.2052	11.9544	26.7016	91.0248	857.6008	3557.261	27.6023	23.8028	24.9019
h17la1_3	3	11372	-6102	0.1617	12.203	26.2965	30.4028	872.6787	3494.351	15.6007	17.0013	27.8023
h17la2_1	4	11308	-6139	2.1891	11.4962	25.3253	145.2633	819.9118	3385.029	34.6036	20.6021	24.3018
h17la2_2	5	11343	-6139	1.0467	11.6844	26.2157	79.9192	837.3984	3488.939	24.0017	21.8022	22.9016
h17la2_3	6	11378	-6139	0.6499	13.2735	28.7751	65.4128	953.6204	3840.033	27.8023	23.5026	27.8023
h17la3_1	7	11319	-6161	1.4894	11.7217	26.1379	109.1357	834.5844	3487.306	32.2031	17.8015	26.7022
h17la3_2	8	11350	-6161	1.2294	11.1474	25.2783	88.4234	793.9868	3366.561	24.0017	16.6013	23.9018
h17la3_3	9	11380	-6161	1.0567	12.8576	28.9241	83.8211	920.8368	3868.685	27.4023	21.502	30.2028
h17la4_1	10	11332	-6193	1.9368	10.9761	23.6919	136.0555	784.2408	3158.854	37.2042	21.2022	23.1016
h17la4_2	11	11359	-6187	0.9901	11.3286	26.0193	80.6195	812.1741	3466.988	27.6023	21.1022	26.2022
h17la4_3	12	11386	-6185	1.0547	12.9591	29.3576	85.0217	924.2557	3922.624	28.8025	18.1016	26.4021
h17la5_1	13	11341	-6203	1.6458	12.5784	27.8962	122.8453	902.1349	3727.420	38.4044	25.5031	27.0022
h17la5_2	14	11366	-6203	1.2554	11.5689	26.4618	91.5251	827.7504	3525.497	26.002	20.9021	22.9016
h17la5_3	15	11393	-6203	1.1882	13.8412	31.6338	95.0271	996.1682	4244.056	32.6032	27.6037	32.3032

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h18be1_1	1	8775	29925	0	16.7754	36.4156	21.9014	1215.617	4907.502	20.0012	31.6048	34.7036
h18be1_2	2	8811	29925	0	16.4123	35.9307	20.2012	1184.997	4837.293	18.401	27.0032	32.5032
h18be1_3	3	8847	29925	0	15.8586	35.0452	17.7009	1147.738	4708.997	21.0013	30.5046	32.9034
h18be2_1	4	8775	29906	0	16.832	36.0671	21.6014	1220.452	4855.409	19.2011	33.6058	36.5041
h18be2_2	5	8811	29906	0	16.3702	35.7783	19.6012	1189.127	4813.829	20.6013	35.3064	35.2038
h18be2_3	6	8847	29906	0	16.1306	34.6185	19.2011	1163.345	4653.675	19.8012	25.6031	32.9034
h18be3_1	7	8780	29872	0	16.8858	36.0289	20.6013	1224.985	4855.718	20.2012	33.1053	37.4042
h18be3_2	8	8812	29872	0	16.3382	35.3407	19.6012	1185.299	4760.942	20.0012	31.5046	34.3036
h18be3_3	9	8843	29872	0	16.0809	35.0668	19.6012	1166.064	4724.219	20.6013	30.7046	35.904
h18bc1_1	1	8831	28482	1.2023	12.9763	29.0218	89.6241	935.116	3890.074	26.2021	25.7031	26.0021
h18bc1_2	2	8842	28484	1.3854	13.858	32.5305	108.5353	997.9789	4391.606	37.0041	25.403	36.5042
h18bc1_3	3	8852	28485	0.7774	14.8132	33.4134	74.3166	1070.124	4500.144	31.0029	27.5038	30.4028
h18bc2_1	4	8832	28476	1.0262	13.427	29.1036	71.9155	966.6954	3904.096	16.4008	23.8027	27.7024
h18bc2_2	5	8839	28476	0.9395	11.2824	27.9061	79.2188	809.8629	3743.883	29.2026	18.5016	28.8026
h18bc2_3	6	8846	28476	1.1497	13.1736	31.3069	93.126	951.0055	4216.674	32.8032	25.6032	29.9028
h18bc3_1	7	8829	28458	1.9068	13.6921	29.2394	143.1615	985.1027	3938.901	45.2061	25.3032	30.4028
h18bc3_2	8	8838	28458	1.5981	12.2553	29.2505	118.0418	884.0384	3938.286	36.604	25.1031	28.5026
h18bc3_3	9	8846	28458	0.8181	13.0265	30.8919	68.314	938.2335	4151.775	23.6017	23.2026	31.0029
h18bc4_1	10	8828	28433	1.3055	12.6793	27.8109	92.0254	907.3632	3728.749	23.4016	18.7018	26.7022
h18bc4_2	11	8837	28433	1.6522	12.8329	29.4076	119.2426	921.4401	3953.746	34.8036	23.5027	30.6029
h18bc4_3	12	8845	28433	0.8918	13.8745	31.6388	73.9164	1000.795	4249.390	25.4019	26.6033	29.1026
h18bc5_1	13	8829	28427	1.2367	12.7523	29.2119	95.6274	914.5021	3908.600	31.0029	22.8025	25.1019
h18bc5_2	14	8836	28427	1.3511	13.1017	30.3432	99.9299	939.8425	4072.864	30.0027	23.1025	29.9027
h18bc5_3	15	8843	28427	1.1368	14.1196	32.2147	99.2295	1018.301	4330.641	39.2046	28.4039	31.7031
h18bm1_1	1	8644	25524	0.9351	13.6871	30.5424	79.519	989.1264	4096.636	28.6025	28.0037	27.0022
h18bm1_2	2	8644	25523	1.6	13.0684	28.5991	107.6347	935.116	3831.848	25.0019	21.8021	28.5025
h18bm1_3	3	8648	25523	1.2354	13.2798	30.5477	95.0271	951.8101	4099.915	30.4028	22.4024	33.3033
h18bm2_1	4	8643	25506	0.8801	13.0964	28.5856	73.3161	944.3679	3829.290	24.8018	25.8034	32.5032
h18bm2_2	5	8643	25511	1.5007	13.3896	29.8459	106.1338	960.0572	3996.344	28.6025	24.803	28.1024
h18bm2_3	6	8647	25511	1.3608	12.9194	28.1889	112.9383	924.7584	3771.802	41.6052	20.4021	23.8017
h18bm3_1	7	8640	25498	1.2156	13.4422	28.056	100.03	966.5948	3758.199	35.0037	24.3029	29.3026
h18bm3_2	8	8646	25498	1.4192	13.1024	29.2131	106.0337	943.4628	3918.427	32.2031	26.1032	28.4025
h18bm3_3	9	8651	25498	1.4582	14.0859	32.1389	110.4366	1017.395	4331.565	35.0037	29.3042	34.0035
h18bm4_1	10	8641	25481	0.8539	13.3492	28.8519	63.212	962.4711	3864.796	15.8007	24.4027	26.2021
h18bm4_2	11	8644	25481	1.3268	13.3512	30.0522	95.0271	961.1635	4041.207	25.602	24.3028	30.4028
h18bm4_3	12	8647	25481	1.3298	11.4878	26.5822	98.329	823.7306	3558.385	29.2026	20.0019	25.9021
h18bm5_1	13	8643	25444	1.571	13.1442	29.689	117.0411	948.2901	3996.139	36.0039	26.5034	30.603
h18bm5_2	14	8646	25444	1.4169	13.6048	29.7769	113.3385	981.7832	4006.893	39.2046	26.8035	31.8031
h18bm5_3	15	8649	25444	1.7182	14.2851	31.9647	125.247	1031.381	4315.865	37.0041	28.5039	33.7035
h18ba1_1	1	8159	21442	0	12.9249	29.4489	1.3	937.8312	3940.539	0.4	27.1035	29.2026
h18ba1_2	2	8191	21442	0	12.3601	28.6522	0.3	894.3934	3835.634	0.6	23.9028	34.1036
h18ba1_3	3	8223	21442	0	11.9686	27.0972	0.5	865.2401	3613.042	0.4	22.7024	25.602
h18ba2_1	4	8164	21421	0	12.3304	26.1834	0.5	888.1602	3488.633	0.2	20.0019	27.0022
h18ba2_2	5	8198	21421	0	11.3541	25.9212	0.5	820.8162	3454.636	0.2	21.6023	26.6022
h18ba2_3	6	8231	21421	0	11.2707	28.3711	0.5	818.103	3796.963	0.8	24.6027	31.6031
h18ba3_1	7	8170	21402	0	11.487	25.0428	0.6	832.4739	3333.710	0.8	23.5027	24.5019
h18ba3_2	8	8207	21402	0	12.0456	26.7472	0.4	874.8903	3575.853	0.8	24.8033	27.8023
h18ba3_3	9	8243	21402	0	12.4005	28.4857	0.6	899.5209	3816.911	0.4	24.0027	29.0026
h18ba4_1	10	8171	21371	0	12.0621	25.9703	0.6	875.594	3468.418	0.4	24.4029	27.3023
h18ba4_2	11	8208	21371	0	12.181	26.6937	0.7	881.5251	3568.497	0.6	21.8024	27.9024
h18ba4_3	12	8245	21371	0	11.7518	26.7996	0.1	853.8818	3586.273	1	24.7031	30.8029
h18ba5_1	13	8180	21332	0	12.1115	28.1495	0.6	878.2076	3771.188	1	23.3024	29.6028
h18ba5_2	14	8223	21332	0	12.771	29.4611	0.9	927.1718	3956.306	0.8	24.7029	31.5031
h18ba5_3	15	8266	21332	0	12.6437	28.4184	0.6	916.0103	3805.147	1	23.6028	28.6025
h18le1_1	1	17234	29652	0	16.5012	36.5736	23.3016	1199.299	4943.853	25.2019	31.405	34.0035
h18le1_2	2	17059	29652	0	16.2681	36.1573	21.8014	1181.775	4883.307	22.0015	31.2048	34.5036
h18le1_3	3	16883	29652	0	16.0869	35.8846	22.9016	1166.467	4843.160	23.4016	28.9039	32.7033
h18le2_1	4	17192	29597	0	16.2973	36.9484	21.2013	1186.508	4998.754	23.0016	33.2052	35.804
h18le2_2	5	17049	29597	0	16.1799	36.0098	21.6014	1177.746	4870.850	23.4016	31.805	35.6038
h18le2_3	6	16906	29597	0	16.3177	36.0828	21.3014	1187.414	4882.174	22.2015	31.0047	34.3036
h18le3_1	7	17094	29475	0	16.339	36.3087	21.5014	1190.537	4918.52	20.4012	32.0053	36.304
h18le3_2	8	17000	29475	0	16.1986	36.3616	21.0013	1184.695	4926.037	18.8011	35.1059	31.4033
h18le3_3	9	16905	29475	0	16.2416	36.0156	24.6018	1181.674	4870.438	19.8012	31.3047	34.4036
h18lc1_1	1	16699	27379	1.2965	12.9522	27.1023	91.325	935.6188	3647.378	22.2015	23.7028	27.7023
h18lc1_2	2	16694	27379	1.4102	12.9523	28.9392	96.628	931.3953	3900.514	23.0016	20.3019	28.1024
h18lc1_3	3	16689	27379	0.981	13.7944	31.2885	67.4136	997.3754	4220.776	14.4006	25.4033	31.4031
h18lc2_1	4	16696	27375	1.6491	12.8196	28.0674	112.3378	921.7418	3771.495	27.2022	23.3026	26.6022
h18lc2_2	5	16692	27375	1.2082	13.8108	31.1311	93.7263	994.2568	4191.245	30.0027	23.8029	29.4026

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h18lc2_3	6	16687	27375	0.7697	15.043	32.5047	64.8126	1087.738	4378.262	21.4014	27.8037	31.7031
h18lc3_1	7	16694	27366	1.4954	12.9051	29.3165	103.0318	925.3618	3941.767	25.802	20.5019	27.4023
h18lc3_2	8	16690	27366	1.0928	13.2777	31.0904	78.6185	956.0342	4184.786	20.8013	23.1026	29.1026
h18lc3_3	9	16685	27366	0.7535	14.35	32.7788	55.5092	1037.418	4415.217	13.4005	26.8035	29.6027
h18lc4_1	10	16689	27332	1.1377	12.2594	26.7007	84.7215	882.5304	3572.073	24.0017	23.3025	24.5018
h18lc4_2	11	16684	27332	1.1295	12.1603	27.7355	81.0197	875.2924	3718.013	21.2013	22.4021	25.702
h18lc4_3	12	16679	27332	0.5872	12.7024	28.3477	49.1072	915.5076	3799.316	14.6006	21.8024	28.3025
h18lc5_1	13	16685	27309	1.1901	13.5602	28.9545	87.9232	975.5468	3888.846	24.4018	23.3025	29.5026
h18lc5_2	14	16681	27308	1.1019	12.7061	28.4037	89.0238	911.4856	3812.103	30.2027	18.8017	24.9019
h18lc5_3	15	16676	27307	0.7413	12.8534	28.8661	61.7114	924.6579	3874.825	20.0012	20.2019	28.3025
h18lm1_1	1	16106	23770	1.2655	13.6718	27.736	98.4291	984.3986	3718.217	30.6028	25.6032	31.503
h18lm1_2	2	16096	23770	0.9893	13.6686	29.9927	77.9182	981.4814	4027.173	24.2018	21.002	29.2026
h18lm1_3	3	16085	23769	0.549	14.6721	32.1748	64.1123	1064.689	4329.513	31.2029	30.9045	34.5037
h18lm2_1	4	16105	23746	0.8678	13.3045	28.2538	68.5141	960.5601	3783.973	20.2012	25.4031	26.0021
h18lm2_2	5	16098	23744	0.9459	13.1808	30.1966	78.8186	945.8765	4059.442	27.6023	19.4016	30.9029
h18lm2_3	6	16091	23741	0.7037	11.8502	27.9902	69.1143	854.5853	3750.018	29.6026	21.7022	26.6021
h18lm3_1	7	16105	23723	1.3831	13.2726	28.165	98.5291	954.3244	3778.143	25.602	23.2028	26.4022
h18lm3_2	8	16097	23723	0.9448	12.9514	29.23	81.1197	932.9036	3924.671	29.8027	22.9024	30.0028
h18lm3_3	9	16088	23723	0.9003	13.1189	30.0095	76.7177	951.2067	4036.187	27.6023	27.6036	28.2025
h18lm4_1	10	16103	23711	0.9813	14.0223	29.8307	81.62	1014.075	4016.623	27.8023	26.0033	31.9031
h18lm4_2	11	16097	23711	1.1878	14.0133	31.7579	87.8231	1012.969	4281.598	25.0019	27.3036	31.803
h18lm4_3	12	16091	23711	0.8891	13.5219	32.1187	76.0173	982.1855	4335.362	27.8023	29.5042	33.8037
h18lm5_1	13	16102	23690	0.9706	13.0335	26.784	80.0192	942.7589	3588.316	26.4021	26.6033	28.1024
h18lm5_2	14	16093	23690	1.1218	13.6416	30.5548	88.8237	983.8956	4111.700	29.0025	24.7029	29.9027
h18lm5_3	15	16084	23690	0.9217	13.8416	30.388	76.5176	999.5886	4083.929	26.002	25.5031	28.1024
h18la1_1	1	15512	20641	1.6711	12.066	25.9171	120.7437	863.7323	3473.114	34.2035	19.6019	26.1021
h18la1_2	2	15464	20642	0.3843	12.5778	29.316	42.7055	905.855	3925.695	18.001	21.4021	29.9027
h18la1_3	3	15416	20642	0	12.2428	27.7937	18.101	884.4405	3705.131	12.0004	23.1024	26.5021
h18la2_1	4	15506	20608	1.0393	12.7187	27.7199	76.5176	913.4966	3712.799	20.4012	21.5025	29.3026
h18la2_2	5	15467	20608	0.6098	12.4141	28.5625	58.7103	895.4993	3823.254	23.4016	23.5026	28.4025
h18la2_3	6	15427	20608	0	13.3169	29.5897	19.8012	957.1405	3957.125	14.6006	19.3017	31.403
h18la3_1	7	15492	20540	1.0586	13.1371	28.3772	74.9168	944.2674	3801.362	17.801	23.0027	29.4026
h18la3_2	8	15453	20552	0.7344	12.4256	28.6182	58.9104	894.494	3830.211	17.801	22.5023	27.9024
h18la3_3	9	15414	20563	0.1095	11.912	26.6643	18.001	859.008	3555.933	5.8001	21.2022	29.0026
h18la4_1	10	15473	20479	1.2095	11.5065	25.7902	96.4279	826.8459	3447.592	32.6032	21.6022	25.6021
h18la4_2	11	15411	20479	0.1268	11.8072	26.4095	33.8034	854.8869	3520.288	20.8013	24.6027	28.0025
h18la4_3	12	15348	20479	0.076	12.3641	28.0025	19.2011	892.9859	3743.064	8.6002	22.4025	31.0029
h18la5_1	13	15466	20422	1.3572	11.9514	26.0939	101.2307	855.49	3493.738	30.0027	18.8016	27.4023
h18la5_2	14	15406	20422	0.1035	11.795	26.0747	25.602	855.2889	3475.054	13.6006	25.003	25.602
h18la5_3	15	15346	20422	0	13.2289	29.9325	25.802	960.9624	4012.936	19.2011	27.5036	31.8031

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h19be1_1	1	9584	6187	0	16.4442	35.5389	21.4014	1198.594	4794.071	25.802	35.3058	33.7035
h19be1_2	2	9635	6187	0	16.1057	35.3036	19.8012	1167.575	4761.970	19.8012	29.7045	39.2047
h19be1_3	3	9685	6187	0	15.8988	35.1464	20.7013	1151.061	4731.213	22.4015	28.0036	30.4028
h19be2_1	4	9588	6130	0	16.5454	35.4865	23.4016	1196.680	4781.313	20.8013	27.3036	33.1035
h19be2_2	5	9633	6130	0	15.5841	34.2617	20.6013	1130.319	4612.144	24.2018	29.3041	33.0034
h19be2_3	6	9677	6130	0	15.5736	34.7173	19.5011	1128.407	4675.678	20.2012	28.1038	32.6032
h19be3_1	7	9594	6084	0	16.2374	35.2077	21.0013	1180.969	4747.157	20.0012	33.1054	35.6039
h19be3_2	8	9634	6084	0	16.1093	34.8584	22.0015	1171.1	4692.131	19.6012	33.0054	31.9031
h19be3_3	9	9673	6084	0	15.7574	34.658	22.6015	1142.200	4666.630	21.2013	29.3042	34.3035
h19bc1_1	1	9624	2599	1.1228	12.7486	29.0319	80.8196	914.4016	3891.097	21.4014	21.3021	28.1024
h19bc1_2	2	9631	2602	1.0301	14.3731	31.5255	81.8201	1033.494	4228.672	26.4021	25.9032	29.5026
h19bc1_3	3	9638	2604	0.8357	14.1332	31.8457	74.9168	1018.905	4268.878	29.0025	28.1039	29.3027
h19bc2_1	4	9628	2588	0.6801	13.3102	28.5965	61.9115	960.0572	3825.71	22.8016	26.2035	31.2029
h19bc2_2	5	9635	2593	1.0859	14.358	31.287	82.8206	1034.802	4202.626	24.6018	27.0036	29.7027
h19bc2_3	6	9641	2597	0.773	14.1206	31.4605	72.2156	1020.615	4225.596	29.0025	27.6035	27.8023
h19bc3_1	7	9633	2567	1.1097	13.4243	30.201	75.8172	963.7786	4055.959	16.8008	21.6023	28.2025
h19bc3_2	8	9641	2570	1.0317	14.6812	31.811	84.5214	1058.651	4273.289	28.8025	27.6037	28.5025
h19bc3_3	9	9648	2572	1.1138	14.2483	31.3659	76.0173	1023.734	4214.521	16.6008	23.8024	30.1028
h19bc4_1	10	9632	2565	0.8146	14.2977	32.0419	73.9164	1031.381	4311.659	28.8025	25.8033	32.5034
h19bc4_2	11	9642	2566	1.0643	14.9509	32.7681	83.4209	1078.377	4413.883	26.2021	26.5035	29.0025
h19bc4_3	12	9651	2567	0.8214	13.7978	31.3643	72.1156	997.0735	4215.341	26.8022	26.7036	27.8023
h19bc5_1	13	9638	2548	1.0183	12.3662	27.343	82.1202	887.8586	3663.731	27.2022	20.102	27.4023
h19bc5_2	14	9644	2548	1.0838	13.8403	30.7792	81.8201	996.47	4140.602	23.8017	23.1026	27.3023
h19bc5_3	15	9649	2548	0.9671	14.4171	31.8011	81.1197	1041.946	4280.778	28.6025	27.4035	29.3026
h19bm1_1	1	7999	-2114	0.8766	11.8519	26.7068	67.5137	855.691	3576.057	19.4011	23.5026	27.5023
h19bm1_2	2	8003	-2115	0.8199	14.228	32.291	71.1152	1030.576	4342.340	25.802	29.8043	29.3027
h19bm1_3	3	8014	-2111	0.7593	13.4076	30.7946	69.2144	964.7844	4122.358	27.0022	25.2029	29.7028
h19bm2_1	4	7993	-2128	1.0964	13.8431	31.3573	82.3203	996.3694	4212.265	24.0017	25.5031	31.7031
h19bm2_2	5	7999	-2130	0.7983	12.1547	29.3367	60.611	870.8693	3926.207	17.0009	19.0017	27.1023
h19bm2_3	6	8008	-2130	0.838	13.1749	30.1561	69.0143	948.8936	4046.431	23.0016	24.3028	32.9033
h19bm3_1	7	7986	-2152	0.971	12.6608	27.8517	83.9211	907.3632	3725.886	31.2029	20.102	28.6026
h19bm3_2	8	7995	-2152	0.8577	13.6496	30.724	72.3157	986.7122	4120.821	25.2019	28.4039	28.9027
h19bm3_3	9	8003	-2152	0.3578	13.3652	30.5406	42.8055	963.678	4088.233	19.2011	23.5026	25.9021
h19bm4_1	10	7979	-2175	0.7764	12.4264	28.2576	84.4214	893.0864	3780.495	41.2051	20.8021	25.6021
h19bm4_2	11	7985	-2177	0.9671	12.6386	29.3348	82.4204	909.0725	3935.113	30.4028	22.2024	29.0026
h19bm4_3	12	7991	-2180	0.8807	13.6524	30.8263	74.6167	986.3098	4140.295	26.4021	26.9036	29.8027
h19bm5_1	13	7973	-2199	1.3534	13.0547	28.5336	117.4414	941.1498	3828.881	46.4065	26.2035	29.8027
h19bm5_2	14	7979	-2201	1.2578	13.7525	31.193	107.4346	991.4401	4197.499	41.4051	26.1033	31.503
h19bm5_3	15	7985	-2203	0.764	14.4895	32.1834	79.3189	1044.865	4333.002	36.404	24.8031	33.9035
h19ba1_1	1	7806	-4065	0	11.5388	25.3668	0.2	835.1874	3374.928	0.2	22.8026	23.8018
h19ba1_2	2	7839	-4065	0	10.8946	22.6297	0.2	785.3459	3001.587	0.2	19.3017	25.002
h19ba1_3	3	7872	-4065	0	12.6106	28.5127	0.5	908.8714	3808.932	1	20.9021	29.6027
h19ba2_1	4	7812	-4087	0	11.1849	23.9086	0.8	806.2454	3176.076	1.4	19.5018	25.602
h19ba2_2	5	7848	-4087	0	11.366	23.1261	0.2	821.3187	3066.554	0.4	22.2025	24.3018
h19ba2_3	6	7883	-4087	0	10.9498	23.4799	0.8	791.3744	3115.346	1	22.1025	26.2021
h19ba3_1	7	7825	-4108	0	13.063	28.3825	0.5	945.4742	3789.496	1.2	25.8032	30.3028
h19ba3_2	8	7857	-4108	0	11.1474	23.4328	0.5	808.657	3109.641	1.2	25.0031	25.5021
h19ba3_3	9	7888	-4108	0	11.6799	24.6553	0.2	842.3232	3273.637	0.8	20.8019	23.2016
h19ba4_1	10	7832	-4162	0	13.2964	29.0608	0.5	961.767	3885.775	0.4	24.5029	29.3026
h19ba4_2	11	7865	-4162	0	10.6649	22.6891	0.4	769.9745	3009.528	1	20.202	24.7019
h19ba4_3	12	7897	-4162	0	11.2483	23.3663	0.7	813.2794	3102.204	0.6	21.3022	22.6016
h19ba5_1	13	7842	-4208	0	11.3757	24.331	0.8	821.1177	3238.867	0.4	20.4021	29.3027
h19ba5_2	14	7867	-4208	0	11.3571	23.3802	0.4	818.9069	3107.094	0.2	19.6018	27.2023
h19ba5_3	15	7891	-4208	0	12.7814	28.3423	0.7	921.6412	3790.110	1	20.2021	28.8025
h19le1_1	1	18448	5176	0	15.4037	35.3016	22.7015	1119.648	4763.514	19.8012	30.9047	35.9041
h19le1_2	2	18238	5176	0	16.6394	36.5095	19.4011	1208.163	4935.202	21.8014	30.2045	35.7039
h19le1_3	3	18028	5176	0	15.9232	35.4618	21.9014	1158.009	4784.399	21.8014	31.5051	32.2033
h19le2_1	4	18373	5059	0	16.1505	35.6613	23.3016	1173.315	4814.755	26.4021	30.5043	34.6037
h19le2_2	5	18177	5059	0	16.5206	36.6029	20.0012	1202.724	4952.195	20.0012	32.7052	37.0042
h19le2_3	6	17980	5059	0	16.2647	35.6644	21.0013	1181.674	4816.401	19.2011	30.1041	33.5035
h19le3_1	7	18315	4971	0	16.1741	35.9563	23.1016	1176.739	4855.718	19.0011	32.2053	34.0037
h19le3_2	8	18131	4971	0	16.2386	36.4293	20.1012	1181.170	4926.552	24.0017	31.4047	35.7039
h19le3_3	9	17947	4971	0	16.2533	35.6556	20.6013	1179.559	4815.064	21.2013	28.804	33.4034
h19lc1_1	1	17430	2245	1.2028	13.7358	29.1921	87.523	990.4341	3919.041	23.2016	25.1028	25.902
h19lc1_2	2	17427	2247	0.9939	13.3239	28.5529	79.0187	960.8618	3827.04	24.8018	24.7029	26.2021
h19lc1_3	3	17423	2249	0.5925	14.1192	32.241	47.4067	1026.048	4334.644	12.8005	31.8047	29.2027
h19lc2_1	4	17428	2237	0.8368	13.6167	29.8565	73.8163	979.0673	4003.001	27.4023	22.7026	29.7027
h19lc2_2	5	17425	2237	0.4994	12.3489	26.1547	66.0131	891.7794	3486.183	35.2037	24.4031	24.4018

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h19lc2_3	6	17421	2237	0.7032	15.0096	32.0954	56.4095	1085.423	4317.918	16.0008	28.1038	32.5034
h19lc3_1	7	17425	2218	0.9763	13.3807	29.5603	84.4214	965.6896	3966.442	31.403	25.7032	28.2025
h19lc3_2	8	17421	2218	0.5854	14.6068	31.7017	56.5096	1057.041	4255.646	21.8014	28.1039	26.1021
h19lc3_3	9	17417	2218	0.6063	14.673	32.4046	53.5086	1061.570	4356.502	18.001	28.9038	33.0033
h19lc4_1	10	17424	2207	0.8633	12.153	26.6076	67.5137	874.1866	3552.562	19.8012	21.9023	23.6017
h19lc4_2	11	17419	2207	0.7855	13.1828	29.8189	56.5096	946.8821	3996.754	12.8005	20.702	26.7022
h19lc4_3	12	17414	2207	0.8375	14.6714	31.9252	64.4124	1059.054	4294.730	17.801	25.8032	28.9026
h19lc5_1	13	17421	2198	0.8135	13.1393	28.1822	72.0156	948.5918	3775.381	26.4021	24.5029	25.9021
h19lc5_2	14	17416	2198	0.6252	13.2286	29.0287	53.7087	954.2238	3891.916	17.2009	23.0026	27.7024
h19lc5_3	15	17411	2198	0.7758	14.2503	32.0511	60.611	1028.564	4316.378	17.2009	24.1028	28.9026
h19lm1_1	1	16795	-1861	0.984	13.6141	29.1244	78.1183	982.2861	3904.608	24.4018	26.3035	29.0026
h19lm1_2	2	16793	-1861	0.7364	14.72	29.8009	65.3128	1062.375	3997.778	22.8016	26.2033	30.9029
h19lm1_3	3	16790	-1861	0.8534	14.8226	30.9626	65.6129	1069.923	4162.846	17.801	25.6031	29.2027
h19lm2_1	4	16794	-1865	0.9027	14.0541	30.2933	76.2174	1012.365	4070.712	26.4021	23.1025	28.6025
h19lm2_2	5	16791	-1865	0.7222	14.8687	31.5303	59.8107	1072.439	4241.800	18.401	24.8032	32.7033
h19lm2_3	6	16788	-1865	0.6895	14.8696	32.1766	62.7118	1076.364	4331.359	23.0016	27.4038	28.2025
h19lm3_1	7	16795	-1873	0.9206	13.734	29.1488	72.9159	988.2211	3916.686	22.0015	21.1022	29.0026
h19lm3_2	8	16792	-1873	0.7743	14.0628	30.1158	67.8138	1014.276	4047.148	24.0017	23.5025	29.3026
h19lm3_3	9	16788	-1873	0.8149	14.7201	31.2658	63.4121	1065.897	4209.496	17.6009	28.704	33.9035
h19lm4_1	10	16793	-1878	0.8457	13.4766	29.5808	69.7146	971.6239	3974.122	22.8016	23.4026	30.9029
h19lm4_2	11	16790	-1878	0.7959	14.6337	31.6208	68.9142	1058.249	4253.697	24.2018	27.6037	30.8029
h19lm4_3	12	16787	-1878	0.776	15.5267	32.0494	70.4149	1121.863	4310.735	26.2021	27.9038	31.503
h19lm5_1	13	16792	-1889	0.5023	13.9758	29.4818	49.4073	1010.252	3945.453	18.401	26.8037	26.7022
h19lm5_2	14	16789	-1889	0.7256	13.7684	30.7197	66.2132	993.955	4121.231	25.2019	26.3034	29.7027
h19lm5_3	15	16786	-1889	0.8073	13.6558	30.2774	70.715	987.014	4061.286	25.802	27.7036	30.0028
h19la1_1	1	15830	-5407	0.3428	12.6414	28.4988	37.4042	914.7032	3810.568	14.4006	25.7033	28.4025
h19la1_2	2	15788	-5407	0	11.5606	23.8122	24.1017	834.5844	3160.382	21.4014	21.2023	23.3017
h19la1_3	3	15746	-5407	0	11.9401	25.2784	22.8016	863.4308	3362.174	15.4007	23.8027	28.4025
h19la2_1	4	15821	-5434	0.9197	11.8842	24.8369	78.0183	853.1782	3308.72	27.2022	21.3022	25.0019
h19la2_2	5	15776	-5434	0	13.1906	28.2055	18.601	956.1348	3762.904	11.6004	27.4035	28.2025
h19la2_3	6	15731	-5434	0	11.4708	24.3105	16.9009	829.7604	3226.124	16.8008	23.5026	24.2019
h19la3_1	7	15804	-5482	0.7341	12.0131	25.0499	65.4128	866.3458	3339.423	23.4016	24.2029	27.4023
h19la3_2	8	15759	-5482	0	11.2801	23.7089	23.3016	814.6863	3147.033	17.0009	21.6022	25.402
h19la3_3	9	15714	-5482	0	11.8645	25.3242	19.6012	860.8173	3372.173	18.401	25.3034	27.1022
h19la4_1	10	15787	-5528	0.5699	11.5653	24.0387	49.3073	831.7704	3202.168	15.0007	19.702	25.1019
h19la4_2	11	15741	-5528	0	11.8865	24.3502	22.5015	860.1136	3242.334	15.2007	22.3023	27.3023
h19la4_3	12	15694	-5528	0	11.4427	24.2315	19.0011	829.9614	3226.226	15.6007	24.103	28.7025
h19la5_1	13	15764	-5585	0.6213	12.1048	24.783	59.5106	873.1813	3307.088	22.6015	22.5024	26.6022
h19la5_2	14	15716	-5585	0	11.764	25.8879	13.3005	850.9669	3456.882	12.8005	21.3021	29.4027
h19la5_3	15	15667	-5585	0	11.4499	23.9918	16.0008	828.3534	3192.485	15.8007	22.0023	27.7024

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h20be1_1	1	-7666	30034	0	16.3836	36.0192	21.8014	1182.681	4842.852	19.8012	29.604	37.6044
h20be1_2	2	-7766	30034	0	16.2757	35.8243	24.7018	1176.236	4814.961	21.8014	30.3046	34.6036
h20be1_3	3	-7866	30034	0	15.8152	36.0961	21.1013	1145.321	4851.601	21.0013	32.205	32.8033
h20be2_1	4	-7725	29941	0	16.3841	36.0269	23.2016	1183.889	4842.234	24.6018	30.2044	33.5035
h20be2_2	5	-7819	29941	0	16.4465	36.1381	18.701	1189.731	4859.012	22.6015	31.0047	32.3034
h20be2_3	6	-7914	29941	0	15.8254	34.7494	24.1017	1142.502	4668.995	19.8012	27.1035	32.0031
h20be3_1	7	-7804	29837	0	16.4144	36.4521	23.7017	1188.220	4908.532	21.0013	30.6044	32.8033
h20be3_2	8	-7875	29837	0	16.3366	35.937	20.6013	1180.667	4831.736	21.2013	29.8043	33.2034
h20be3_3	9	-7946	29837	0	15.9728	35.1047	22.8016	1155.491	4715.168	20.8013	30.1043	30.8029
h20bc1_1	1	-8993	27176	0.7134	13.3954	28.0079	72.4157	962.6722	3731.203	31.603	25.8033	28.7025
h20bc1_2	2	-8995	27176	0.8431	14.8532	31.031	70.815	1069.721	4150.853	23.8017	28.5041	27.4024
h20bc1_3	3	-8998	27176	0.4557	15.4457	31.6968	48.307	1114.514	4246.005	19.4011	29.2042	33.3034
h20bc2_1	4	-8995	27173	0.9023	15.0658	30.9735	77.6181	1085.725	4149.930	27.6023	29.1041	32.0033
h20bc2_2	5	-8997	27173	0.8237	15.5195	32.1504	74.0164	1119.950	4313.300	27.8023	30.6045	33.3034
h20bc2_3	6	-8999	27173	0.663	15.9478	32.8964	64.7126	1155.088	4422.712	26.002	32.9054	34.6036
h20bc3_1	7	-8998	27164	0.9648	15.4867	31.9885	77.8182	1118.037	4297.294	24.8018	29.9043	31.8031
h20bc3_2	8	-9001	27164	0.5036	15.7657	32.8345	49.7074	1141.999	4413.164	18.601	31.7048	33.2033
h20bc3_3	9	-9004	27164	0.6585	16.0459	33.0545	56.3095	1160.929	4445.918	17.801	31.7051	35.904
h20bc4_1	10	-9004	27155	0.8631	14.6417	30.6977	68.214	1055.23	4119.898	20.2012	27.1036	34.0035
h20bc4_2	11	-9006	27155	0.8106	15.15	31.4556	66.0131	1092.569	4220.878	20.4012	28.504	33.0033
h20bc4_3	12	-9008	27155	0.6829	15.2613	31.4701	64.6125	1097.099	4217.085	25.0019	25.203	30.903
h20bc5_1	13	-9012	27138	0.9559	14.5164	30.3877	76.7177	1044.160	4064.155	24.4018	28.404	32.1032
h20bc5_2	14	-9012	27140	0.9196	14.5641	30.7549	78.1183	1049.594	4117.542	27.6023	29.204	31.1029
h20bc5_3	15	-9015	27140	0.8896	14.4582	29.9025	68.1139	1038.726	3999.724	18.8011	25.9033	31.5031
h20bm1_1	1	-10712	22725	0.6533	15.3926	31.6228	60.8111	1111.292	4234.518	22.6015	31.0046	31.8031
h20bm1_2	2	-10715	22725	0.6108	14.3931	30.0438	54.0088	1033.293	4009.863	18.001	25.103	29.3026
h20bm1_3	3	-10719	22725	0.1951	14.9347	30.7348	26.6021	1075.961	4100.120	10.0003	28.3038	31.7031
h20bm2_1	4	-10713	22720	0.7285	13.7043	29.2562	54.709	984.9016	3899.899	13.4005	26.5035	27.7023
h20bm2_2	5	-10717	22720	0.2767	13.5107	29.6295	34.4035	975.6473	3949.344	14.4006	28.404	27.3023
h20bm2_3	6	-10722	22720	0.3086	15.3023	31.2496	36.0039	1102.434	4178.531	14.0006	27.4038	31.603
h20bm3_1	7	-10721	22691	0.6097	13.2649	27.9149	46.9066	952.2124	3717.706	11.0004	23.3028	25.4021
h20bm3_2	8	-10725	22691	0.3453	12.8577	26.6157	34.6036	920.0324	3536.220	11.0004	19.2017	25.1019
h20bm3_3	9	-10729	22691	0.461	12.8868	26.178	44.606	924.4568	3479.546	15.4007	21.6023	25.2019
h20bm4_1	10	-10725	22674	0.6196	13.7088	28.9305	63.6121	987.6175	3863.977	27.2022	25.7032	26.5021
h20bm4_2	11	-10730	22674	0.6087	14.0888	29.311	57.2098	1017.597	3918.119	21.2013	29.1039	30.6029
h20bm4_3	12	-10735	22673	0.4311	14.4507	29.451	45.8063	1042.047	3930.711	18.001	27.2035	26.4021
h20bm5_1	13	-10727	22664	0.5439	13.4341	29.2073	46.2064	968.2041	3905.120	13.6006	25.0031	28.1024
h20bm5_2	14	-10732	22664	0.4459	14.0203	29.0664	38.4044	1008.844	3885.878	10.0003	23.2025	28.3024
h20bm5_3	15	-10737	22664	0.5972	14.4698	30.2173	45.5062	1044.160	4048.890	10.0003	26.4033	28.6026
h20ba1_1	1	-12189	19184	1.0129	14.0361	30.7839	84.3213	1008.039	4121.026	29.8027	25.9033	30.7029
h20ba1_2	2	-12274	19264	0	13.9347	31.5154	20.9013	1006.027	4211.752	22.4015	27.1033	30.9029
h20ba1_3	3	-12359	19343	0.1199	13.1954	30.2184	25.3019	952.8158	4032.192	12.8005	26.4034	26.7022
h20ba2_1	4	-12153	19222	1.0156	13.6538	30.3008	79.0187	982.6885	4060.262	24.4018	25.8032	28.2024
h20ba2_2	5	-12289	19240	0	13.3438	30.2539	20.3012	965.2873	4041.924	18.201	27.0037	29.3026
h20ba2_3	6	-12425	19258	0	13.9474	31.2349	24.0017	1009.950	4185.606	17.6009	27.7036	33.3034
h20ba3_1	7	-12274	19106	1.1001	13.8878	29.5528	80.8196	999.0856	3963.575	21.6014	24.1027	26.7021
h20ba3_2	8	-12414	19107	0	13.1139	30.2164	17.4009	948.8936	4048.275	13.2005	25.103	32.7034
h20ba3_3	9	-12555	19107	0	13.6141	31.301	21.5014	986.8128	4196.576	18.601	27.8037	32.8034
h20ba4_1	10	-12387	19003	0.8876	11.7389	25.3558	78.9187	845.2379	3386.458	30.0027	22.7027	27.7023
h20ba4_2	11	-12534	19003	0	12.2799	27.8125	15.0007	888.1602	3710.856	9.2003	24.3029	28.8026
h20ba4_3	12	-12682	19003	0	12.9388	30.6316	19.7012	935.116	4101.964	16.4008	24.2029	30.7029
h20ba5_1	13	-12498	18868	0.9403	14.2712	30.9089	84.5214	1031.985	4147.265	33.2033	30.4044	30.6029
h20ba5_2	14	-12665	18868	0	12.4357	29.5921	15.4007	895.7004	3948.115	9.2003	22.8023	30.303
h20ba5_3	15	-12833	18868	0.0957	12.5903	30.4354	21.7014	906.9611	4068.560	10.6003	22.9026	30.9031
h20le1_1	1	-16506	31549	0	16.7366	36.6128	23.0016	1217.933	4951.165	21.2013	32.4051	34.7038
h20le1_2	2	-16410	31549	0	16.2897	36.2086	23.0016	1181.775	4891.131	21.4014	29.5039	36.3041
h20le1_3	3	-16314	31549	0	16.2725	36.0219	22.0015	1178.653	4862.923	25.802	28.204	36.8042
h20le2_1	4	-16503	31497	0	16.5799	35.2967	25.702	1204.436	4756.313	25.2019	32.6051	34.8038
h20le2_2	5	-16414	31497	0	16.4277	35.9451	20.7013	1195.069	4851.601	22.0015	33.5056	36.4041
h20le2_3	6	-16326	31497	0	16.1051	35.7103	22.5015	1167.474	4815.064	22.2015	29.6044	35.1039
h20le3_1	7	-16496	31435	0	16.4886	36.0978	26.3021	1197.788	4868.276	21.0013	33.0051	36.4041
h20le3_2	8	-16420	31435	0	16.341	36.1602	18.601	1185.199	4877.953	20.2012	30.4045	34.8038
h20le3_3	9	-16344	31435	0	16.3669	35.4224	23.3016	1187.213	4771.950	19.6012	31.2049	35.0037
h20lc1_1	1	-16736	28221	1.3393	13.2071	29.776	102.2313	950.3015	4007.712	32.2031	23.3028	32.9033
h20lc1_2	2	-16731	28221	1.2627	12.7235	28.2012	93.3261	914.8037	3778.654	26.8022	23.1026	26.0021
h20lc1_3	3	-16726	28221	1.1361	12.0925	28.8432	85.8221	866.949	3866.945	26.2021	19.8018	27.7024
h20lc2_1	4	-16737	28210	1.0106	14.5894	31.6359	89.2239	1052.714	4251.954	34.4035	27.5039	30.6029
h20lc2_2	5	-16732	28209	1.4077	13.2815	30.0523	106.1338	956.8387	4041.412	33.0033	26.1034	33.5034

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h20lc2_3	6	-16727	28208	1.2288	13.461	31.1896	103.9324	967.0977	4191.347	39.6047	23.3025	29.8027
h20lc3_1	7	-16742	28184	1.2492	11.7904	27.1451	96.4279	845.7404	3624.691	31.2029	22.3025	25.202
h20lc3_2	8	-16737	28183	1.0056	12.131	27.2269	71.0151	866.1448	3629.902	17.0009	18.3017	24.6019
h20lc3_3	9	-16732	28182	0.7891	11.439	27.5093	64.3124	817.8015	3664.139	21.2013	18.4015	23.5017
h20lc4_1	10	-16744	28174	1.0534	12.2345	26.5322	76.3175	876.5992	3539.284	19.6012	20.9022	25.502
h20lc4_2	11	-16738	28174	1.0805	12.655	27.1916	84.1212	907.3632	3631.639	26.002	21.9023	27.6023
h20lc4_3	12	-16732	28174	1.1834	11.3962	26.875	88.9237	815.0883	3595.059	27.0022	18.1015	27.4023
h20lc5_1	13	-16745	28145	1.1458	12.6976	28.0274	92.8258	916.2114	3752.984	31.803	26.0035	25.702
h20lc5_2	14	-16737	28145	1.1803	12.9694	29.1615	91.325	931.6969	3906.041	29.0025	23.9027	29.6026
h20lc5_3	15	-16733	28145	1.327	12.2908	27.8883	99.2295	877.504	3726.193	30.2027	19.7017	28.1024
h20lm1_1	1	-17823	24097	1.4934	13.5554	30.9949	115.6401	976.1503	4161.411	38.8045	27.6038	27.1022
h20lm1_2	2	-17819	24097	1.3837	12.9365	31.1433	107.3345	927.7751	4182.222	36.404	23.1025	29.4026
h20lm1_3	3	-17816	24097	1.6329	10.6574	28.2566	115.9403	762.0381	3793.383	34.6036	18.6017	28.4025
h20lm2_1	4	-17824	24096	1.26	12.2732	31.504	102.1313	879.6151	4229.698	37.8043	21.8025	29.0027
h20lm2_2	5	-17820	24096	0.9859	12.7175	32.033	83.4209	912.29	4302.732	31.603	22.2024	32.9033
h20lm2_3	6	-17817	24096	1.3513	11.2574	30.5333	107.7348	807.0493	4101.350	39.8048	20.9022	30.0028
h20lm3_1	7	-17824	24090	1.5757	12.0096	27.2349	126.448	859.7116	3646.560	45.6062	21.1021	26.8022
h20lm3_2	8	-17820	24090	1.2646	12.0529	27.5946	104.833	866.3458	3694.908	38.8045	23.2026	27.5023
h20lm3_3	9	-17817	24090	1.1986	11.5383	27.3247	114.9396	829.0569	3658.007	52.4082	21.7022	25.8021
h20lm4_1	10	-17825	24069	1.266	12.1433	28.6584	92.1255	868.5573	3840.340	26.4021	18.8017	26.1021
h20lm4_2	11	-17821	24069	1.1909	12.5079	29.891	87.9232	895.4993	4013.550	25.802	18.6017	26.2021
h20lm4_3	12	-17818	24069	1.6025	11.1399	28.5747	122.3449	798.6088	3843.103	41.8052	19.5018	28.2025
h20lm5_1	13	-17830	24021	1.1644	13.3512	31.0931	94.0265	961.4653	4183.760	32.8032	24.0028	29.0025
h20lm5_2	14	-17826	24021	0.9957	13.7558	31.5804	88.2233	993.1503	4247.646	34.8036	26.8035	29.8027
h20lm5_3	15	-17822	24021	1.4577	12.1821	29.3247	114.1391	874.9908	3937.775	39.6047	22.5023	27.0022
h20la1_1	1	-18346	20590	0	14.2047	30.8392	0.8	1024.941	4122.563	1.2	24.9029	27.4023
h20la1_2	2	-18128	20590	0	12.1985	28.7056	0.4	883.3347	3831.541	1	25.6033	28.2024
h20la1_3	3	-17911	20590	0	13.3299	29.6172	1.2	963.1751	3960.197	0.4	25.0031	31.7031
h20la2_1	4	-18321	20488	0	13.9183	31.0383	0.1	1008.039	4158.130	0.2	26.9036	29.0026
h20la2_2	5	-18114	20488	0	12.6822	29.2433	0.1	917.3175	3906.246	1	25.2029	29.0025
h20la2_3	6	-17907	20488	0	13.07	30.009	0.4	946.1782	4011.707	1	26.9034	30.8029
h20la3_1	7	-18333	20800	0	13.7717	30.4242	0.1	994.1563	4076.655	1	24.0028	34.7037
h20la3_2	8	-18135	20800	0	13.3611	31.4523	0.5	964.6838	4214.315	0.4	24.603	33.5035
h20la3_3	9	-17938	20800	0	12.0316	27.5087	17.0009	866.4464	3665.468	11.6004	21.5023	30.5029
h20la4_1	10	-18343	20877	0	11.9447	24.7109	0.5	860.3147	3276.696	0.8	22.2023	26.2021
h20la4_2	11	-18131	20877	0	12.2167	27.5776	9.6003	879.414	3670.374	4.4001	22.2025	29.7027
h20la4_3	12	-17920	20877	0	13.6202	30.1732	16.9009	982.085	4023.690	13.6006	25.6033	28.4024
h20la5_1	13	-18350	21142	0.5092	10.9874	23.1751	56.3095	789.5658	3071.341	25.2019	21.9025	25.2019
h20la5_2	14	-18155	21142	0.0593	13.4382	30.2998	23.4016	969.8134	4041.514	13.6006	26.9033	29.8027
h20la5_3	15	-17961	21142	0.0219	13.164	30.3825	19.8012	944.5691	4054.524	11.8004	20.502	29.7027

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h2lbe1_1	1	-19918	2612	0	16.3945	35.7652	23.6017	1188.119	4820.827	19.2011	30.1043	35.7039
h2lbe1_2	2	-19834	2612	0	16.2214	35.5831	20.8013	1173.718	4792.836	25.0019	28.1039	33.2034
h2lbe1_3	3	-19751	2612	0	16.0648	35.5383	20.5013	1167.273	4791.396	24.6018	32.3053	35.6041
h2lbe2_1	4	-19890	2523	0	15.9354	34.8557	22.5015	1158.009	4701.078	21.2013	31.8046	38.8047
h2lbe2_2	5	-19800	2523	0	16.0188	35.6694	19.4011	1167.776	4819.077	20.8013	34.406	37.7043
h2lbe2_3	6	-19711	2523	0	15.7989	35.2345	21.1013	1147.436	4760.222	20.8013	29.3043	37.6043
h2lbe3_1	7	-19819	2417	0	16.3229	35.683	27.2022	1189.227	4818.357	24.8018	32.905	30.5029
h2lbe3_2	8	-19745	2417	0	16.3079	35.0501	20.7013	1181.976	4726.893	21.2013	28.5042	35.2038
h2lbe3_3	9	-19672	2417	0	15.5762	34.6278	18.001	1131.326	4669.303	21.4014	29.2039	31.9031
h2lbc1_1	1	-18751	28187	1.2105	14.3787	30.5395	68.9142	929.7863	4160.693	21.4014	21.2021	17.3009
h2lbc1_2	2	-18743	28187	0.9286	12.9353	30.6276	58.5103	839.2075	4171.868	21.6014	21.9024	15.8008
h2lbc1_3	3	-18736	28186	1.2087	14.5144	32.5126	70.615	943.9656	4439.141	23.4016	26.1033	18.201
h2lbc2_1	4	-18751	28187	1.2347	14.698	31.0142	80.4194	954.9279	4229.596	32.0031	25.8033	19.2011
h2lbc2_2	5	-18740	28177	0.9088	11.6065	27.7373	56.8097	750.7872	3773.949	20.6013	18.2017	20.4012
h2lbc2_3	6	-18729	28166	0.5441	12.3797	28.5024	36.8041	802.829	3877.793	13.6006	20.7022	18.9011
h2lbc3_1	7	-18750	28144	1.2373	13.0108	26.1882	68.7142	843.5292	3550.009	20.0012	24.2028	17.3009
h2lbc3_2	8	-18742	28142	1.3888	12.2683	27.917	80.7195	790.3696	3792.360	27.0022	17.4015	17.801
h2lbc3_3	9	-18743	28144	1.2584	11.535	28.2987	68.1139	746.5684	3849.754	19.4011	19.202	19.4011
h2lbc4_1	10	-18745	28064	1.0263	14.9242	31.2067	64.3124	971.0204	4259.852	23.4016	26.3032	19.0011
h2lbc4_2	11	-18737	28065	1.8164	13.3316	28.4284	92.9259	862.0235	3869.401	23.2016	21.1019	18.601
h2lbc4_3	12	-18727	28065	0.834	13.5496	30.8537	51.2079	880.3188	4203.549	17.6009	24.3029	18.501
h2lbc5_1	13	-18743	28031	1.01	14.7142	30.1762	65.5129	953.9221	4108.010	25.2019	25.0028	21.1013
h2lbc5_2	14	-18732	28031	1.0765	12.9731	31.7008	68.7142	842.1221	4325.716	26.6021	22.4025	19.1011
h2lbc5_3	15	-18721	28031	0.5711	14.4746	33.3769	37.9043	937.7306	4557.779	13.8006	21.9022	18.6011
h2lbn1_1	1	-18391	25540	0.7764	15.0159	31.736	48.407	962.5717	4278.418	17.0009	23.7026	18.8011
h2lbn1_2	2	-18367	25540	0.1576	13.4358	29.3776	22.4015	861.4204	3948.422	13.0005	22.1022	17.7009
h2lbn1_3	3	-18343	25540	0.0294	14.3755	30.1004	18.8011	923.2501	4048.480	13.8006	24.5026	18.101
h2lbn2_1	4	-18388	25513	0.7389	15.5844	32.669	51.3079	1003.009	4410.905	21.2013	27.3035	18.701
h2lbn2_2	5	-18360	25513	0	12.1952	26.6715	15.9008	780.1215	3574.116	14.4006	19.7019	19.0011
h2lbn2_3	6	-18333	25513	0.0004	14.1727	29.8929	17.2009	907.866	4021.027	13.2005	21.5021	17.6009
h2lbn3_1	7	-18383	25483	0.8242	14.4651	30.839	42.1053	926.4679	4156.593	9.0002	22.3024	19.9012
h2lbn3_2	8	-18351	25488	0.0121	12.1258	25.6298	21.8014	779.3177	3426.463	17.4009	24.2028	16.9009
h2lbn3_3	9	-18319	25476	0.0588	12.7522	27.1785	21.2013	820.6153	3642.574	15.2007	25.2031	17.4009
h2lbn4_1	10	-18370	25447	0.6964	13.738	29.7331	44.906	881.9272	4000.543	16.4008	23.9027	18.301
h2lbn4_2	11	-18340	25447	0	14.0743	30.3335	16.8008	903.3414	4084.339	14.0006	22.9023	19.3011
h2lbn4_3	12	-18311	25447	0	14.4923	29.8913	20.2012	930.4902	4019.286	19.8012	24.5028	18.301
h2lbn5_1	13	-18358	25406	1.0021	13.3111	31.3326	55.3092	850.0623	4224.058	16.2008	18.6015	18.601
h2lbn5_2	14	-18330	25406	0	12.1004	25.1264	22.0015	776.8061	3361.867	19.8012	22.8026	18.401
h2lbn5_3	15	-18303	25406	0.0416	12.6677	30.8793	18.301	811.5712	4161.923	13.2005	19.1018	19.3011
h2lba1_1	1	-16067	-8527	0.5566	12.6943	26.9021	49.9075	913.5971	3593.220	16.4008	21.8024	28.4025
h2lba1_2	2	-16052	-8526	0.2336	12.4436	29.0873	35.3037	900.3252	3894.782	17.6009	24.5029	30.7029
h2lba1_3	3	-16038	-8525	0	11.3499	23.722	28.3024	824.3336	3146.524	21.0013	25.9032	21.6015
h2lba2_1	4	-16054	-8545	0.6084	13.1565	29.8501	54.0088	952.5141	4005.971	18.601	26.7035	29.9027
h2lba2_2	5	-16043	-8545	0.5352	12.2302	28.7778	51.708	883.4352	3858.758	20.0012	22.5025	27.3022
h2lba2_3	6	-16032	-8545	0.1507	11.4972	24.1418	32.5032	832.2729	3212.464	18.001	22.7024	23.6017
h2lba3_1	7	-16027	-8581	0.8261	11.8317	24.8977	66.8134	850.6653	3326.876	20.4012	20.102	27.7024
h2lba3_2	8	-16014	-8580	0.296	11.1768	23.9147	38.8045	811.9731	3187.185	17.6009	25.3031	25.502
h2lba3_3	9	-16002	-8580	0.2204	11.3359	23.7034	34.4035	820.5148	3156.714	16.6008	22.3025	25.102
h2lba4_1	10	-16014	-8595	0.64	12.419	29.3617	55.1091	897.1079	3938.286	18.601	24.3029	30.5028
h2lba4_2	11	-16002	-8595	0.317	11.9933	25.8352	35.9039	867.8536	3445.244	13.8006	25.103	29.3026
h2lba4_3	12	-15991	-8595	0	10.9614	23.5217	29.0025	792.3792	3121.459	22.6015	21.9025	25.1019
h2lba5_1	13	-15996	-8618	0.6079	12.6302	29.0501	56.8097	909.173	3889.562	21.6014	22.2023	29.5027
h2lba5_2	14	-15981	-8618	0.1172	11.311	24.207	30.8028	817.902	3216.541	18.001	23.0026	25.402
h2lba5_3	15	-15967	-8618	0.1219	12.0847	25.5187	29.1025	871.774	3392.682	16.0008	22.3023	24.5018
h2lle1_1	1	-10121	5740	0	15.5345	34.6474	24.3018	1127.803	4665.087	20.0012	30.3044	31.8033
h2lle1_2	2	-10218	5740	0	16.1143	35.8448	25.3019	1167.474	4835.750	23.8017	27.8038	32.1032
h2lle1_3	3	-10316	5740	0	15.8581	35.1418	25.802	1150.557	4736.562	19.6012	29.3039	31.7031
h2lle2_1	4	-10115	5675	0	16.0456	35.8494	20.9013	1164.353	4839.043	22.4015	29.6043	34.7039
h2lle2_2	5	-10196	5675	0	15.8549	35.5771	22.7015	1149.651	4790.881	21.4014	29.7041	29.5026
h2lle2_3	6	-10277	5675	0	15.9435	34.999	19.3011	1153.981	4707.454	20.0012	28.304	29.7027
h2lle3_1	7	-10112	5594	0	15.7631	35.2802	21.2013	1143.811	4754.152	24.4018	31.0046	36.8041
h2lle3_2	8	-10175	5594	0	16.0603	35.9506	19.9012	1165.36	4841.822	17.4009	31.8049	32.8034
h2lle3_3	9	-10238	5594	0	15.5583	35.5152	20.9013	1126.796	4775.962	20.8013	29.7041	30.2028
h2llc1_1	1	-9677	3976	0.4798	11.5595	25.313	43.2056	833.6799	3376.662	13.6006	22.3024	29.6027
h2llc1_2	2	-9683	3975	0.1586	12.1563	26.1476	26.9022	875.3929	3480.669	12.2004	20.9023	25.9021
h2llc1_3	3	-9689	3974	0.2676	13.0214	28.016	32.6032	939.7419	3735.804	12.8005	24.0028	23.5017
h2llc2_1	4	-9670	3957	0.0553	12.5094	25.5953	25.2019	903.1404	3403.908	15.0007	22.4024	23.1017
h2llc2_2	5	-9674	3955	0.3155	13.124	28.4675	34.8036	946.8821	3806.681	12.8005	23.5026	29.7027

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h21lc2_3	6	-9678	3952	0.3818	13.089	28.4186	35.5038	941.6526	3795.940	10.4003	21.0021	24.8019
h21lc3_1	7	-9661	3943	0.6037	10.9286	24.7397	55.9094	786.7526	3295.359	20.8013	20.9019	25.902
h21lc3_2	8	-9670	3941	0.371	12.7834	27.238	36.504	919.7307	3633.172	11.8004	21.8023	28.2024
h21lc3_3	9	-9679	3938	0.1919	13.3567	29.4581	24.7018	962.0687	3935.727	8.6002	23.0026	29.5027
h21lc4_1	10	-9650	3916	0.5553	11.4861	24.1299	49.4073	822.1227	3201.863	16.0008	18.4016	23.5017
h21lc4_2	11	-9654	3914	0.2387	12.1056	27.1902	31.503	872.6787	3613.757	13.4005	24.903	27.2022
h21lc4_3	12	-9659	3912	0.2385	11.9818	27.2625	30.2027	861.1188	3620.501	12.2004	22.5026	25.702
h21lc5_1	13	-9639	3899	0.5981	11.9117	25.6417	56.8097	852.173	3408.092	21.6014	18.7018	25.0019
h21lc5_2	14	-9645	3897	0.4793	12.9346	28.3275	38.1044	928.7807	3772.722	8.6002	22.6023	25.802
h21lc5_3	15	-9652	3895	0.3185	13.5234	28.4186	34.7036	971.2216	3786.939	12.4005	22.3023	28.3024
h21lm1_1	1	-8658	25030	0.5643	12.4145	24.6021	39.9048	802.3265	3318.307	15.6007	22.6025	15.6007
h21lm1_2	2	-8667	25030	0.4136	12.3696	25.4024	28.6025	799.0107	3430.035	9.8003	21.1021	14.9007
h21lm1_3	3	-8677	25030	0.2147	12.6444	24.7791	23.8017	814.3848	3339.321	12.0004	19.8019	13.6006
h21lm2_1	4	-8657	25006	0.6999	11.5126	24.2994	44.2059	743.1531	3281.693	15.2007	20.0019	18.101
h21lm2_2	5	-8663	25005	0.5521	11.2999	24.5751	37.6042	726.3795	3316.675	14.0006	16.3013	15.2007
h21lm2_3	6	-8670	25003	0.2886	12.4219	24.8099	25.0019	805.0396	3348.910	10.6003	24.1027	16.8009
h21lm3_1	7	-8658	24984	0.8289	12.3459	25.1465	46.4065	795.3934	3400.642	12.6005	18.7016	16.1008
h21lm3_2	8	-8663	24984	0.5693	12.3752	25.5905	42.0053	798.6088	3462.088	17.6009	19.2016	15.0007
h21lm3_3	9	-8669	24984	0.6112	12.9199	25.6934	35.8038	834.7854	3475.156	9.8003	21.8024	17.4009
h21lm4_1	10	-8661	24965	0.6052	13.2313	26.9133	39.3046	854.2838	3645.231	13.6006	21.302	19.1011
h21lm4_2	11	-8668	24965	0.3771	13.0114	25.6511	33.2033	840.6146	3465.151	15.6007	22.1023	16.0008
h21lm4_3	12	-8676	24965	0.1426	12.9059	24.5882	18.9011	831.4689	3315.961	9.6003	20.1018	15.6007
h21lm5_1	13	-8665	24932	0.4626	12.8187	27.5652	35.4038	828.1524	3730.078	15.0007	21.5021	16.6008
h21lm5_2	14	-8672	24932	0.2336	13.8869	26.8683	26.5021	899.2192	3634.092	14.0006	25.003	18.001
h21lm5_3	15	-8684	24936	0.2136	13.2145	24.6236	24.7018	854.3843	3323.918	12.8005	22.8024	15.3007
h21la1_1	1	-8305	-2992	0.6437	12.0434	25.524	50.3076	869.1604	3399.418	12.8005	25.003	24.5018
h21la1_2	2	-8355	-2992	0	10.6476	22.3912	19.4011	769.5726	2968.808	21.4014	21.9023	26.7021
h21la1_3	3	-8406	-2992	0.148	12.7155	28.7708	24.7018	919.6302	3845.968	10.8004	24.803	28.1024
h21la2_1	4	-8313	-3032	0.4155	11.7871	24.9423	50.6077	847.449	3320.144	23.8017	19.902	24.2018
h21la2_2	5	-8363	-3032	0	11.0703	23.9859	28.0024	801.0203	3189.428	24.4018	22.5025	27.6024
h21la2_3	6	-8414	-3032	0	12.0699	24.4905	27.0022	875.2924	3257.322	21.0013	25.8033	27.3023
h21la3_1	7	-8324	-3086	0.5822	11.6188	24.1783	61.2112	842.2227	3220.109	26.4021	26.9036	24.7018
h21la3_2	8	-8369	-3086	0	10.8309	22.4841	22.1015	782.8342	2977.256	17.4009	21.8024	21.2013
h21la3_3	9	-8414	-3086	0.0271	12.0749	25.0453	28.8025	872.3771	3332.282	20.0012	23.0024	27.7024
h21la4_1	10	-8327	-3132	0.5724	13.5865	28.8789	54.2088	980.4755	3867.661	20.0012	24.7028	28.2025
h21la4_2	11	-8380	-3132	0.1211	12.3995	28.3802	23.4016	895.7004	3796.452	10.8004	22.4024	28.9025
h21la4_3	12	-8433	-3132	0.0333	11.8314	24.0142	26.8022	854.7864	3188.306	17.6009	22.4024	22.7015
h21la5_1	13	-8329	-3181	0.4446	12.1087	23.7542	50.6077	874.4882	3161.197	21.8014	23.6028	24.5018
h21la5_2	14	-8377	-3181	0	11.1034	22.7333	25.3019	803.7333	3018.488	21.0013	22.6024	25.802
h21la5_3	15	-8425	-3181	0.0428	11.5986	23.7032	19.8012	838.705	3152.332	10.2003	22.5025	27.3023

Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h22be1_1	1	18732	31543	0	16.0425	36.0345	24.8018	1153.175	4815.064	19.6012	29.9043	32.6032
h22be1_2	2	18659	31543	0	15.7001	35.5645	20.0012	1129.212	4747.260	24.0017	30.8047	32.5032
h22be1_3	3	18585	31543	0	15.7068	35.3551	19.8012	1129.313	4717.842	19.2011	31.0046	34.6037
h22be2_1	4	18736	31486	0	16.3055	36.2442	25.3019	1172.812	4839.352	19.6012	32.005	32.6032
h22be2_2	5	18670	31486	0	15.7952	35.5869	21.2013	1134.649	4749.523	22.2015	29.5042	31.7032
h22be2_3	6	18604	31486	0	15.8297	35.4697	20.2012	1139.582	4733.373	18.401	32.0048	31.9031
h22be3_1	7	18720	31439	0	16.1703	35.8785	20.4012	1161.332	4795.512	23.6017	29.0041	34.9037
h22be3_2	8	18672	31439	0	15.8834	35.7141	19.8012	1143.509	4769.892	21.0013	32.1051	34.4037
h22be3_3	9	18624	31439	0	15.545	35.9294	21.6014	1119.144	4801.892	22.6015	30.6045	31.403
h22bc1_1	1	18344	27452	0.6984	13.444	30.0697	58.7103	966.8965	4015.087	19.2011	27.0035	33.6035
h22bc1_2	2	18344	27452	0.7945	13.5168	29.2276	66.3132	968.9082	3892.735	22.0015	24.803	28.2025
h22bc1_3	3	18342	27452	0.6765	14.5193	30.7164	56.4095	1041.644	4106.678	17.4009	25.5034	37.5043
h22bc2_1	4	18346	27450	0.8774	12.261	30.2992	66.4132	876.1971	4040.080	19.6012	21.6022	28.8026
h22bc2_2	5	18345	27450	0.9249	14.5565	32.0728	78.6185	1044.160	4285.394	28.4024	27.5039	31.8032
h22bc2_3	6	18343	27450	0.8389	15.1913	31.8557	70.1147	1088.442	4256.467	23.4016	26.1033	32.7032
h22bc3_1	7	18346	27445	0.6956	12.2867	30.0619	63.9123	879.7156	4004.435	25.4019	22.8024	28.4024
h22bc3_2	8	18343	27445	0.5522	14.0727	30.6253	44.706	1008.341	4085.159	11.8004	23.9027	31.6031
h22bc3_3	9	18340	27445	0.4001	14.3128	31.4583	33.9034	1027.859	4192.168	8.2002	26.8034	29.8027
h22bc4_1	10	18342	27428	0.505	13.061	28.2346	48.5071	937.0267	3748.484	17.801	25.2031	27.2023
h22bc4_2	11	18340	27428	0.3755	14.3821	29.4484	41.5052	1032.79	3917.710	16.4008	26.0032	28.9025
h22bc4_3	12	18337	27428	0.5698	15.2308	31.3096	61.0112	1093.978	4177.404	26.8022	28.0039	32.4033
h22bc5_1	13	18339	27403	0.4242	13.1603	31.1543	40.705	945.2731	4160.283	14.4006	24.4028	32.2032
h22bc5_2	14	18338	27403	0.4502	13.6766	31.1343	46.2064	986.4104	4156.900	18.401	29.104	31.8031
h22bc5_3	15	18336	27403	0.7697	15.5909	32.9793	60.0108	1123.775	4416.347	16.6008	31.605	33.6035
h22bm1_1	1	-9345	-1874	0.723	13.3343	25.7881	53.3085	869.0599	3508.647	23.0016	25.003	17.0009
h22bm1_2	2	-9397	-1874	0.0195	12.1886	28.5419	17.1009	795.4939	3897.750	12.6005	21.6023	18.301
h22bm1_3	3	-9449	-1874	0	12.4439	25.4344	25.0019	813.9828	3456.984	22.0015	26.0032	17.2009
h22bm2_1	4	-9365	-1902	0.243	12.9199	29.4967	26.7021	840.313	4030.348	14.2006	20.402	19.2011
h22bm2_2	5	-9416	-1902	0.107	12.7455	28.3794	15.9008	826.1425	3867.661	8.2002	18.6015	18.8011
h22bm2_3	6	-9468	-1902	0.0918	14.3119	29.8173	22.7015	931.7975	4067.433	15.4007	24.3029	18.501
h22bm3_1	7	-9384	-1939	0.3118	12.6109	28.3323	27.6023	819.0074	3864.387	12.6005	19.8019	19.3011
h22bm3_2	8	-9432	-1939	0.2078	14.1519	30.1856	24.4018	924.2557	4125.740	13.0005	25.5031	18.001
h22bm3_3	9	-9481	-1939	0.0867	12.1771	29.3859	16.2008	792.4796	4013.755	9.4003	19.7018	18.401
h22bm4_1	10	-9431	-2016	0.329	13.1324	29.8942	30.6028	855.3895	4090.282	15.0007	21.002	18.6011
h22bm4_2	11	-9472	-2016	0	11.8779	23.762	22.9016	776.2032	3225.818	21.0013	24.7028	18.001
h22bm4_3	12	-9514	-2016	0	12.4196	28.835	17.5009	808.2551	3939.925	16.2008	19.902	21.2013
h22bm5_1	13	-9454	-2054	0.4416	12.4893	28.7256	32.2031	813.9828	3922.316	12.6005	22.0024	19.1011
h22bm5_2	14	-9489	-2054	0	11.8493	23.2694	25.0019	769.2712	3149.784	21.6014	21.0021	15.3007
h22bm5_3	15	-9524	-2054	0.1149	12.303	29.6636	17.4009	797.403	4051.451	9.6003	16.9013	18.7011
h22ba1_1	1	-10757	-5450	0.7969	13.1728	26.1564	54.709	854.9874	3559.100	21.8014	21.0022	15.3007
h22ba1_2	2	-10767	-5450	0.6992	12.9347	26.0998	50.5077	842.7252	3552.256	21.2013	23.8028	16.6008
h22ba1_3	3	-10777	-5450	0.4431	13.7609	27.9841	38.4044	893.4886	3817.218	18.401	20.7021	17.901
h22ba2_1	4	-10763	-5468	0.7354	12.7759	27.2161	45.9063	835.5894	3715.457	15.4007	24.5029	15.2007
h22ba2_2	5	-10773	-5468	0.5378	13.8371	30.5601	38.4044	901.4312	4187.451	15.2007	21.5021	18.8011
h22ba2_3	6	-10784	-5468	0.6636	12.3998	25.3205	48.207	805.542	3446.061	20.2012	20.2019	16.1008
h22ba3_1	7	-10766	-5492	1.3585	13.1422	26.2489	74.9168	853.0776	3580.552	21.4014	20.202	16.3008
h22ba3_2	8	-10779	-5492	0.7273	12.432	25.7491	39.7047	810.9682	3511.710	9.4003	22.6026	17.901
h22ba3_3	9	-10792	-5492	0.7407	13.1467	26.9418	42.4054	856.3946	3678.143	11.6004	22.3023	18.701
h22ba4_1	10	-10773	-5517	0.7773	12.5961	25.2012	47.6068	820.3138	3429.423	15.4007	22.7023	15.9008
h22ba4_2	11	-10786	-5517	0.8399	12.3608	24.942	56.7096	805.0396	3398.091	22.2015	21.4021	15.5007
h22ba4_3	12	-10800	-5517	0.3817	13.1173	24.9809	40.4049	850.9669	3398.397	22.4015	19.702	16.1008
h22ba5_1	13	-10785	-5545	1.3768	12.825	26.5183	80.8196	833.8809	3616.312	26.8022	21.4023	15.5007
h22ba5_2	14	-10797	-5545	0.8725	13.8596	26.8794	59.6107	903.9447	3669.557	23.8017	24.2026	17.2009
h22ba5_3	15	-10810	-5545	0.4744	13.193	27.352	32.5032	856.7966	3734.373	11.4004	19.7019	20.0012
h22le1_1	1	8582	31749	0	15.6424	35.3636	27.8023	1127.400	4724.219	24.8018	32.005	32.7033
h22le1_2	2	8616	31749	0	16.0557	35.7255	20.0012	1155.088	4771.744	22.6015	30.9047	32.4033
h22le1_3	3	8649	31749	0	15.8013	35.1041	19.9012	1136.260	4695.422	23.0016	28.5039	35.5039
h22le2_1	4	8592	31714	0	15.995	35.5494	25.2019	1150.054	4756.724	19.4011	28.5042	34.8037
h22le2_2	5	8622	31714	0	16.1191	35.2504	24.2018	1158.009	4710.54	21.8014	28.8039	35.1038
h22le2_3	6	8651	31714	0	15.7036	34.887	18.701	1127.198	4662.620	24.4018	26.4031	32.9033
h22le3_1	7	8625	31691	0	15.7474	35.4401	24.1017	1135.354	4734.916	18.201	32.5053	32.8033
h22le3_2	8	8620	31681	0	15.8784	35.2681	23.9017	1143.006	4719.487	20.4012	29.2041	34.4036
h22le3_3	9	8625	31759	0	15.6736	35.2752	21.4014	1128.608	4708.689	24.0017	32.1048	34.2035
h22lc1_1	1	-18692	483	0.9346	14.4132	31.5364	58.4102	943.3622	4327.768	20.8013	26.4034	18.9011
h22lc1_2	2	-18686	483	0.6703	13.9028	28.8364	49.0072	906.3578	3945.043	20.8013	22.9025	18.701
h22lc1_3	3	-18680	483	0.8999	12.5551	29.0187	50.6077	820.1128	3976.682	14.4006	22.2024	20.4013
h22lc2_1	4	-18691	472	1.2681	14.806	30.9321	78.2184	965.1867	4246.107	28.2024	22.8024	18.301
h22lc2_2	5	-18683	472	0.8127	14.067	30.8336	50.8077	917.5186	4231.236	17.6009	22.1023	18.601

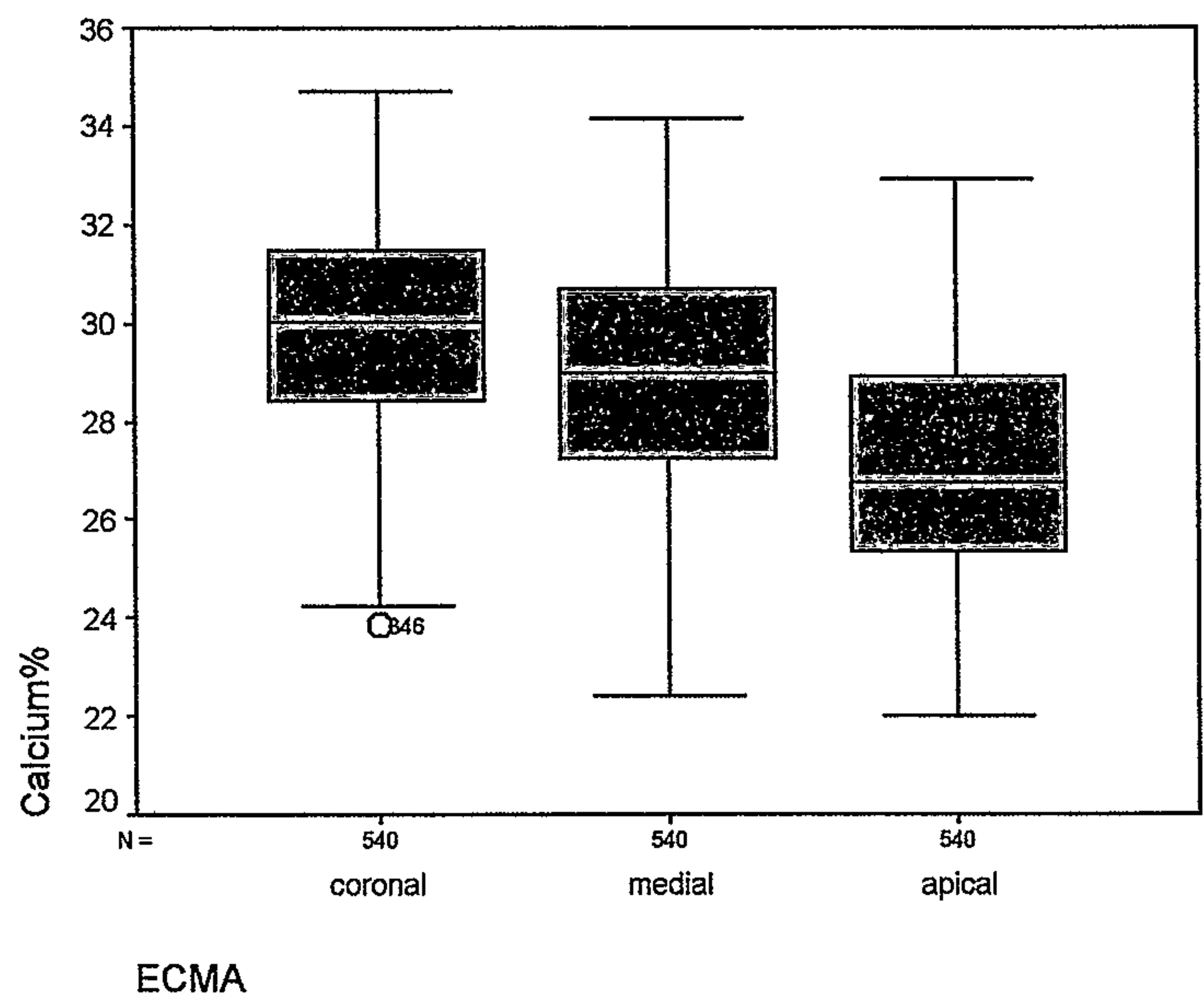
Label	No	X	Y	W%(F)	W%(P)	W%(Ca)	Pk(F)	Pk(P)	Pk(Ca)	Bg(F)	Bg(P)	Bg(Ca)
h22lc2_3	6	-18675	472	0.7146	13.9884	31.7603	48.307	915.407	4360.094	18.8011	25.3031	19.8012
h22lc3_1	7	-18690	460	0.7059	13.8709	30.3758	48.5071	905.1512	4160.181	19.2011	23.3026	17.1009
h22lc3_2	8	-18680	462	0.7932	14.4435	31.2717	53.3085	942.6583	4290.729	20.8013	23.8027	20.2012
h22lc3_3	9	-18670	463	0.3721	13.5399	32.5628	33.8034	882.832	4472.823	16.8008	20.7021	18.9011
h22lc4_1	10	-18689	453	1.0197	14.9107	32.0424	65.0127	974.2391	4406.799	24.2018	24.3029	21.5014
h22lc4_2	11	-18681	453	0.7491	15.0273	31.7946	51.8081	981.6826	4365.432	20.8013	24.2032	16.7008
h22lc4_3	12	-18673	453	0.7803	13.5285	30.8249	54.709	883.7368	4231.031	22.8016	22.7024	19.3011
h22lc5_1	13	-18688	430	1.0646	15.0598	32.3327	66.0131	981.9844	4442.940	23.6017	23.3026	20.4013
h22lc5_2	14	-18681	436	0.6815	13.6405	29.401	44.3059	890.4725	4025.842	15.8007	23.0024	17.2009
h22lc5_3	15	-18673	436	0.6398	14.816	32.5755	46.5065	967.9023	4479.088	19.6012	23.9027	21.1013
h22lm1_1	1	-18356	-2328	1.3173	14.4312	31.7101	79.0187	942.256	4350.550	27.4023	24.703	19.0011
h22lm1_2	2	-18329	-2328	0.2953	12.8856	28.4601	22.9016	842.2227	3887.720	8.4002	23.8027	18.6011
h22lm1_3	3	-18303	-2328	0.4538	13.1542	30.1402	34.7036	859.7116	4126.048	14.6006	23.4026	18.301
h22lm2_1	4	-18358	-2345	0.9566	14.8131	31.9946	61.3113	964.4826	4392.324	22.8016	21.6024	19.8012
h22lm2_2	5	-18332	-2342	0.0879	13.8494	31.3037	22.2015	903.8442	4286.933	15.2007	22.7023	17.801
h22lm2_3	6	-18306	-2339	0.1396	14.0718	29.7832	21.4014	916.0103	4068.868	12.4005	22.0023	17.801
h22lm3_1	7	-18360	-2361	1.2721	14.3702	31.962	67.3136	937.9318	4386.473	17.4009	24.1027	19.1011
h22lm3_2	8	-18333	-2361	0.247	13.7169	30.8163	25.702	890.3719	4220.161	13.0005	18.5016	21.7014
h22lm3_3	9	-18306	-2361	0.1531	14.2818	31.2993	22.6015	932.0992	4287.548	13.2005	23.4025	19.1011
h22lm4_1	10	-18358	-2371	1.108	15.106	32.8411	68.0139	984.7003	4512.779	24.0017	22.7025	18.9011
h22lm4_2	11	-18331	-2371	0.2304	13.7578	31.1053	23.1016	896.002	4262.724	11.0004	20.5022	19.1011
h22lm4_3	12	-18304	-2371	0.3507	14.7171	28.8821	37.8043	960.7612	3946.989	21.0013	25.4032	19.3011
h22lm5_1	13	-18360	-2384	0.9222	13.2499	30.0946	51.3079	863.1292	4122.461	14.2006	20.702	17.3009
h22lm5_2	14	-18331	-2385	0.2	14.7375	32.0371	27.3022	962.0687	4397.252	16.2008	23.4025	21.6014
h22lm5_3	15	-18302	-2386	0.197	12.59	29.8738	25.802	823.3286	4089.565	15.0007	22.5025	18.301
h22la1_1	1	-16533	-6967	0.4514	13.3105	28.4889	36.504	866.2453	3878.611	16.4008	24.3029	19.0011
h22la1_2	2	-16479	-6962	0.2304	13.1903	25.8536	20.0012	857.0982	3505.277	7.6002	24.6028	18.301
h22la1_3	3	-16425	-6958	0.0363	11.6018	25.6413	23.4016	754.8054	3469.643	18.201	23.3028	15.4007
h22la2_1	4	-16526	-6986	0.6631	12.2807	25.3253	45.4062	795.5944	3429.729	17.6009	22.0024	17.5009
h22la2_2	5	-16473	-6983	0.007	12.4489	26.0312	20.1012	807.9536	3526.007	15.8007	22.4025	16.3008
h22la2_3	6	-16438	-6986	0.1308	12.5392	28.1486	21.1013	813.179	3821.924	12.6005	21.6023	18.501
h22la3_1	7	-16498	-7050	0.2066	14.1451	30.219	19.9012	919.228	4110.470	8.6002	25.3028	18.201
h22la3_2	8	-16442	-7050	0.0176	12.7094	28.5293	14.7006	824.032	3870.424	10.2003	21.8023	16.0008
h22la3_3	9	-16387	-7050	0	14.0701	32.0966	10.9004	917.3175	4374.156	8.4002	27.4035	19.0011
h22la4_1	10	-16470	-7107	0	13.6474	28.1451	2.2	882.5304	3821.822	2.2	19.9021	16.5008
h22la4_2	11	-16414	-7107	0	12.6977	30.2889	3.6	820.9167	4121.641	2.8	18.5017	19.3011
h22la4_3	12	-16359	-7107	0.0525	12.3316	26.8281	8.2002	800.7189	3634.910	2.4	23.3027	18.7011
h22la5_1	13	-16440	-7192	0	12.7941	26.8634	0.2	830.9664	3638.078	0.2	24.3025	17.5009
h22la5_2	14	-16373	-7192	0	13.3497	30.3285	0.6	865.7427	4127.278	0.6	21.6024	17.801
h22la5_3	15	-16307	-7192	0	12.4505	24.8605	1.2	806.7478	3362.786	0.6	21.8024	16.6008

6.4 Graphs and Statistical Data

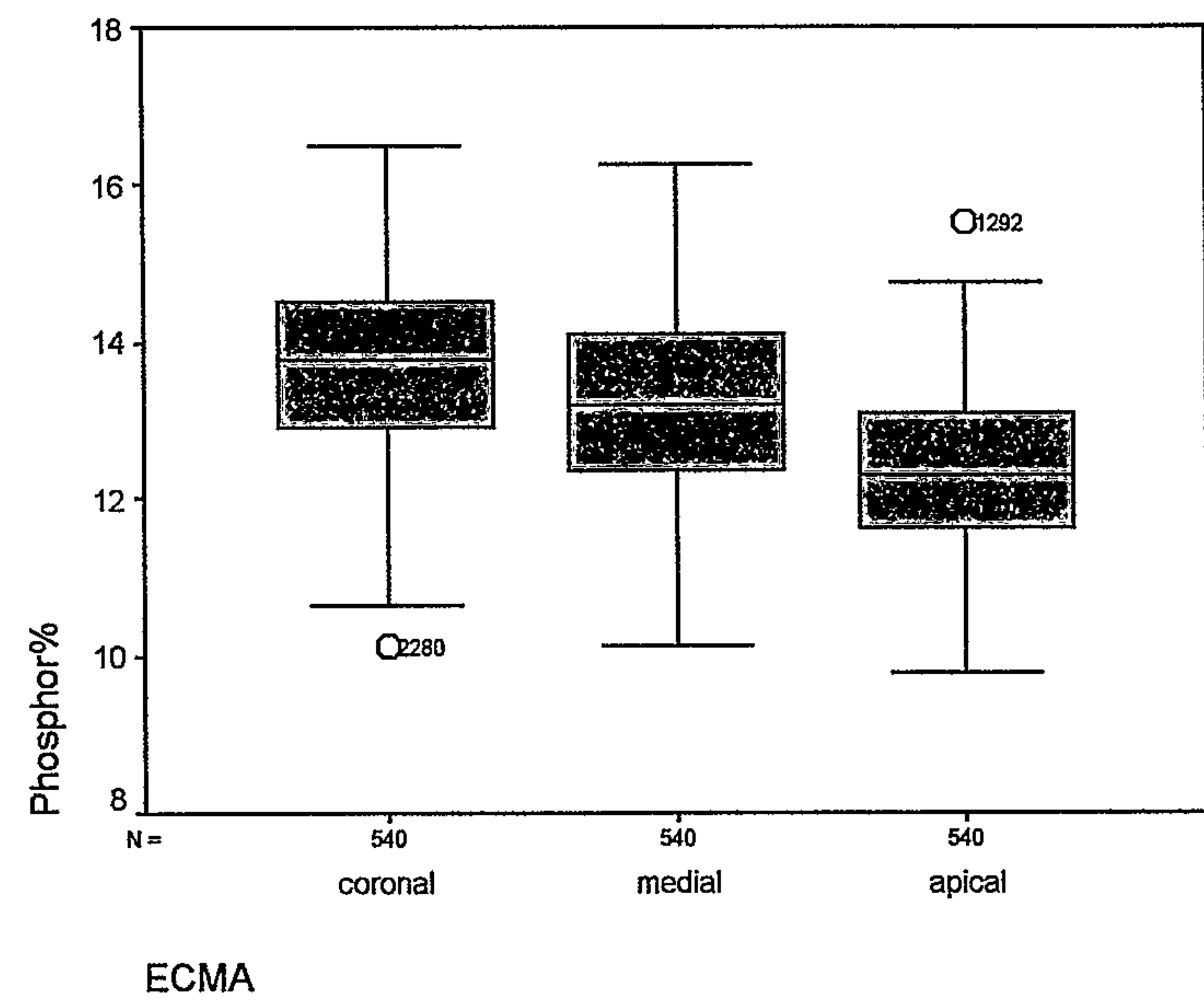
6.4.1 Graphs derived from control data

Boxplots constructed from raw unadjusted data.

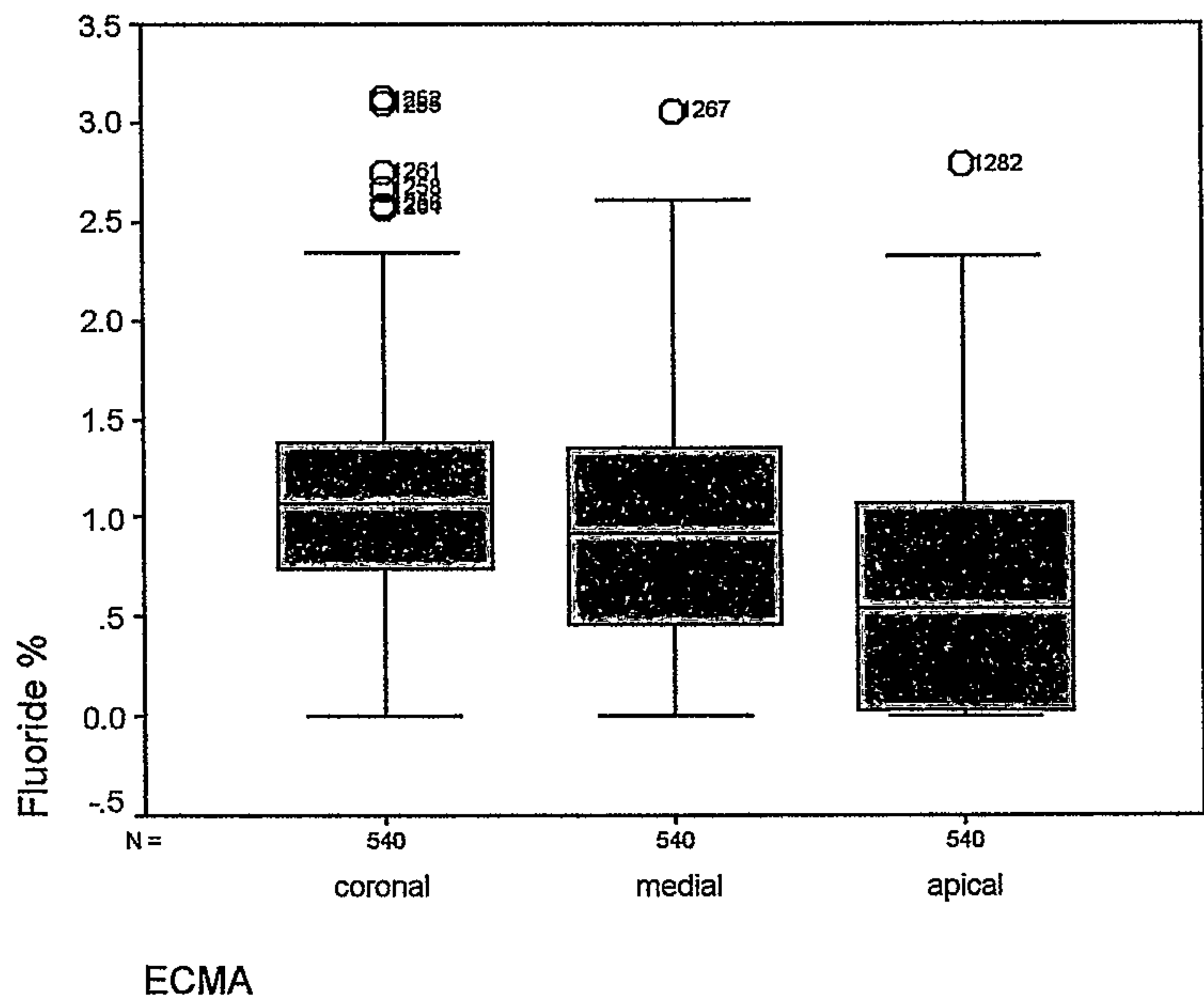
1. Ca% (controls) at the cervical, middle and apical third.



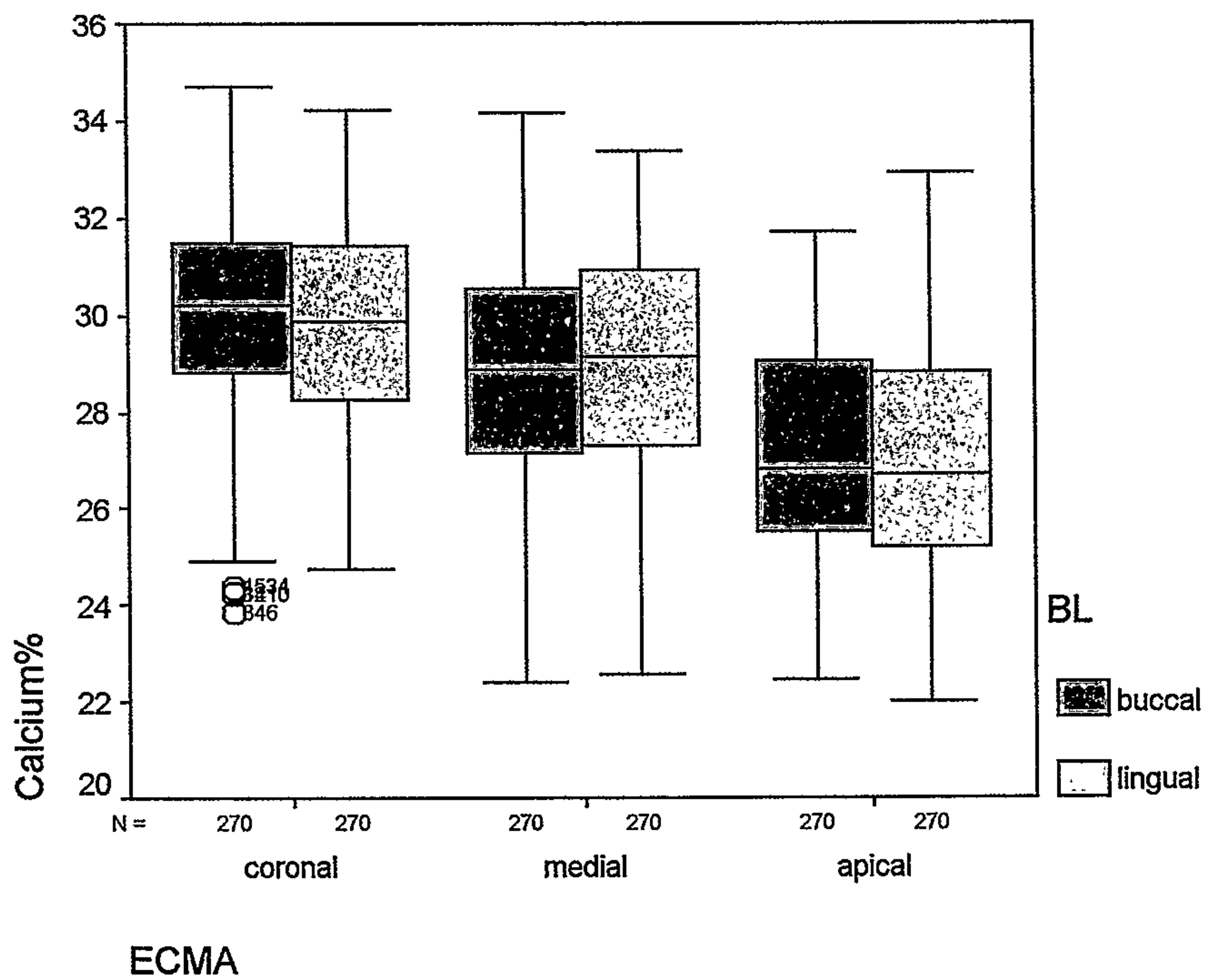
2. P% (controls) at the cervical, middle and apical third.



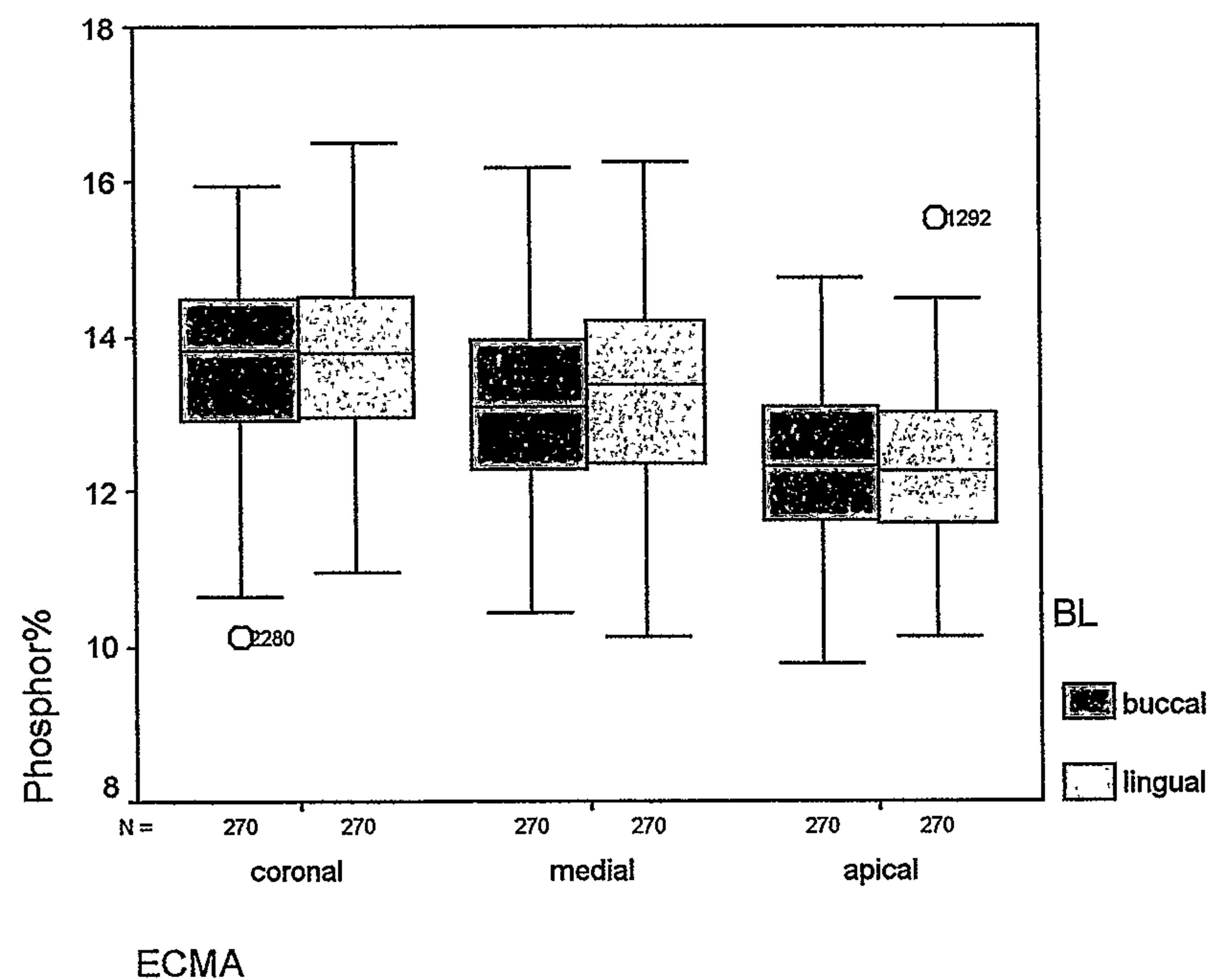
3. F% (controls) at the cervical, middle and apical third.



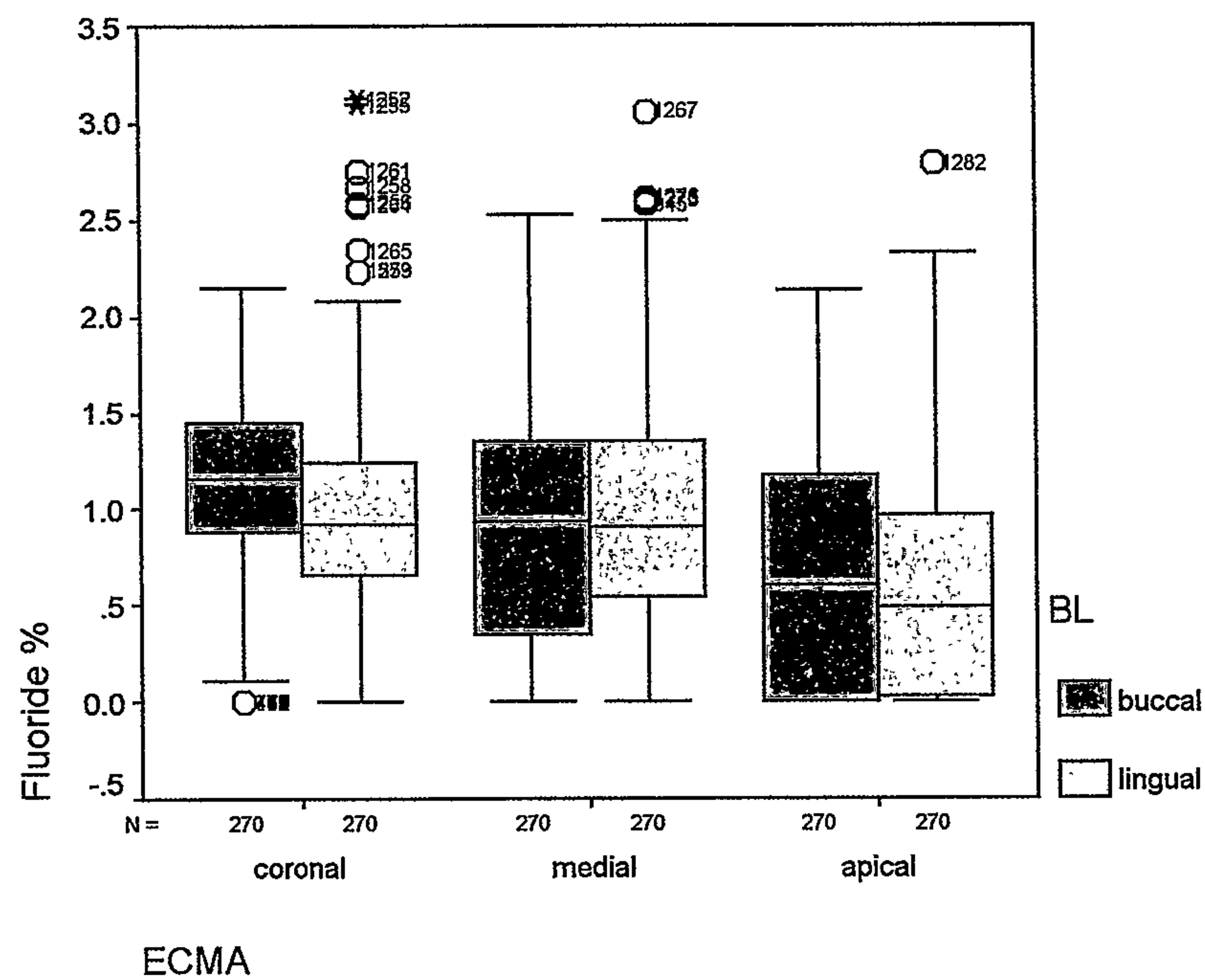
1. Ca% (controls) on the buccal and lingual surface at the cervical, middle and apical third.



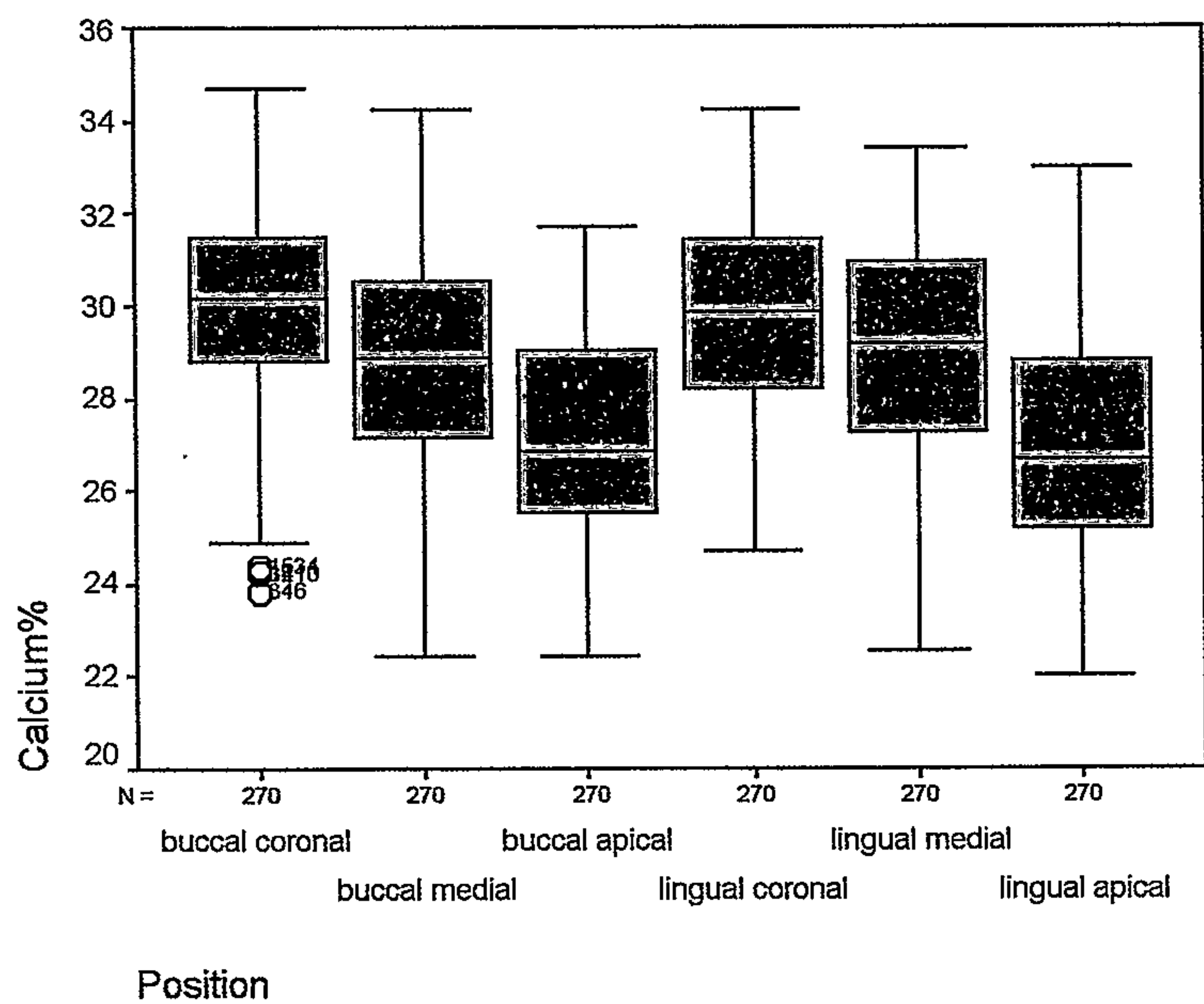
2. P% (controls) on the buccal and lingual surface at the cervical, middle and apical third.



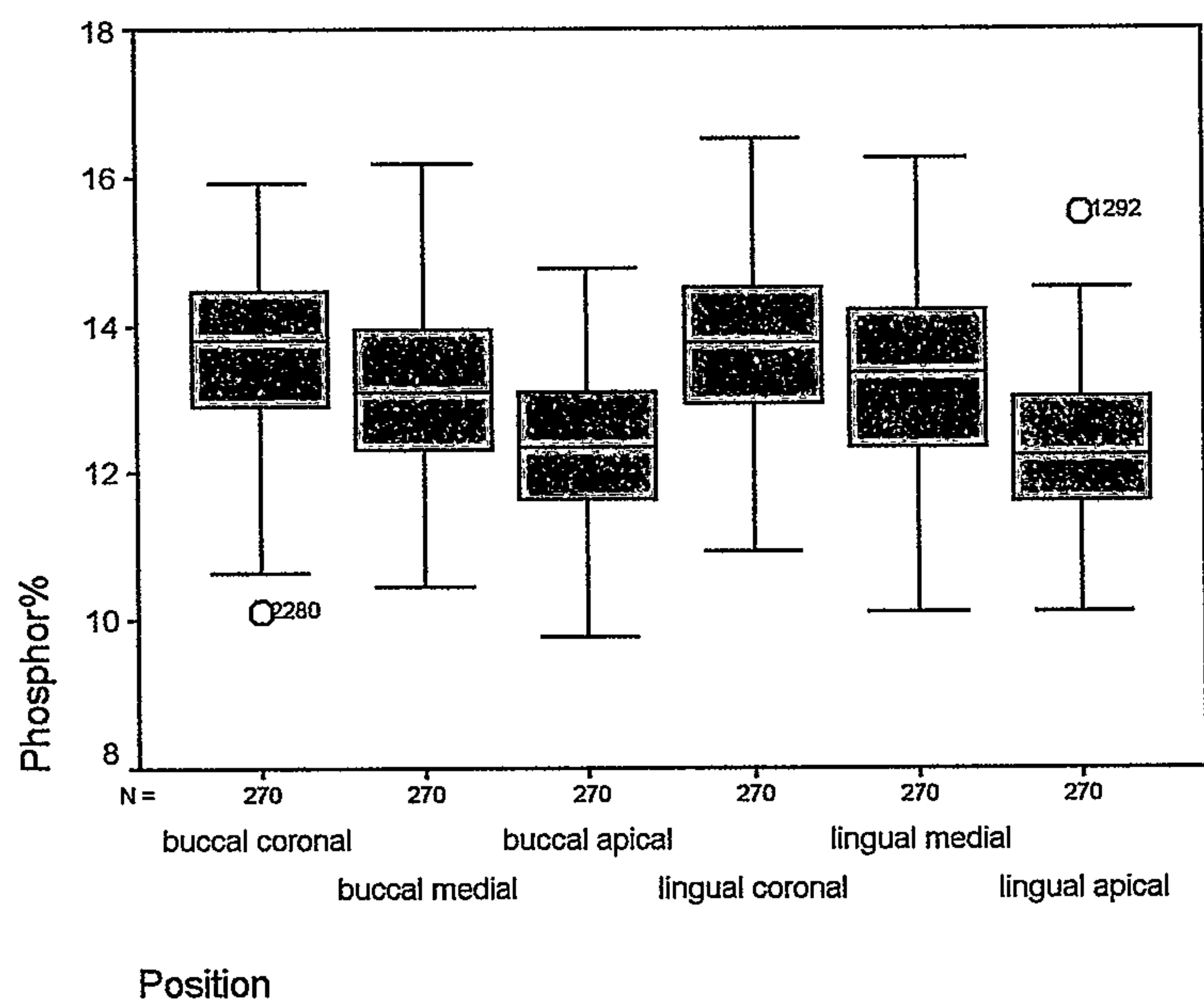
3. F% (controls) on the buccal and lingual surface at the cervical, middle and apical third.



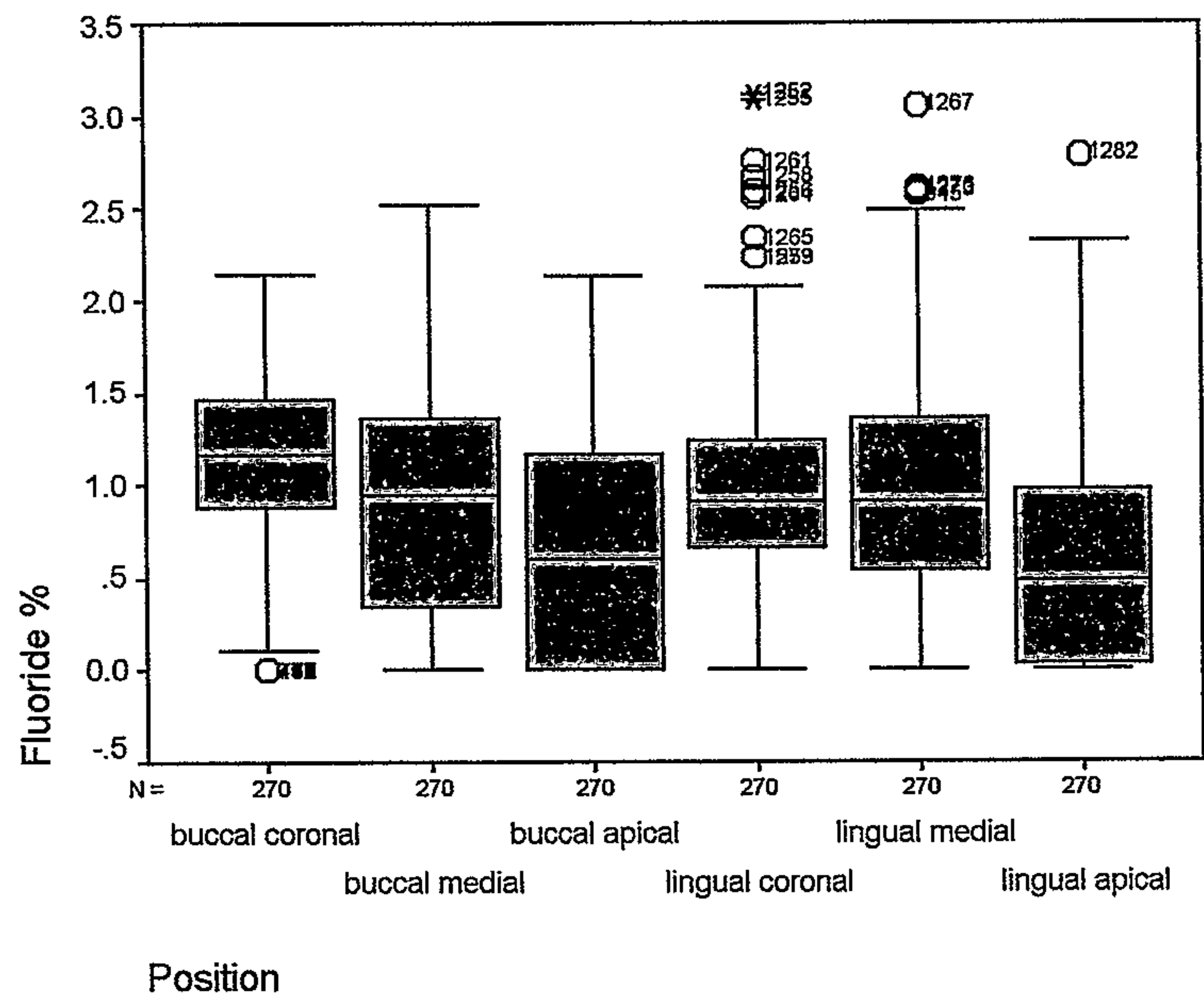
1. **Ca% (controls) on the buccal and lingual surface at the cervical, middle and apical third.**



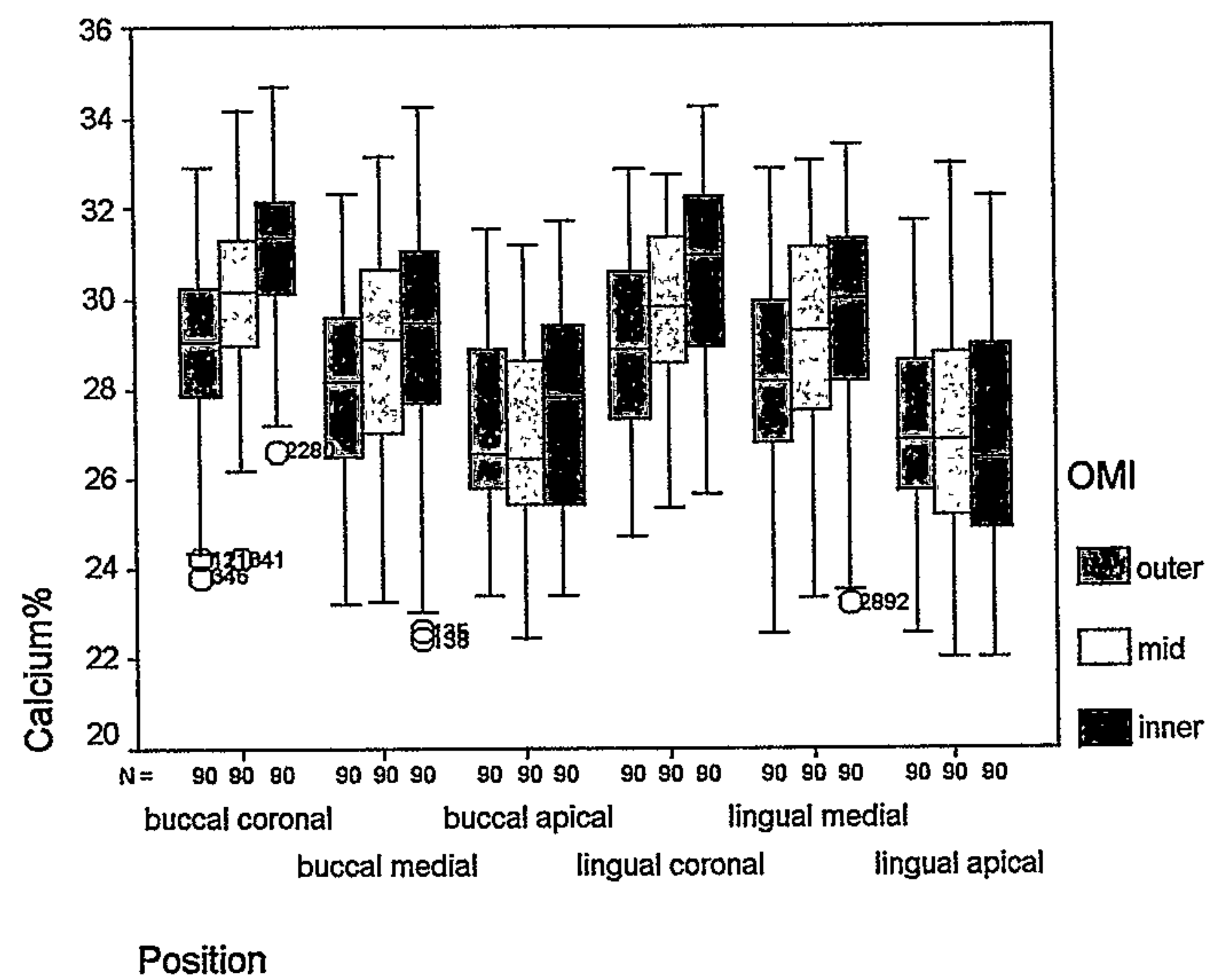
2. **P% (controls) on the buccal and lingual surface at the cervical, middle and apical third.**



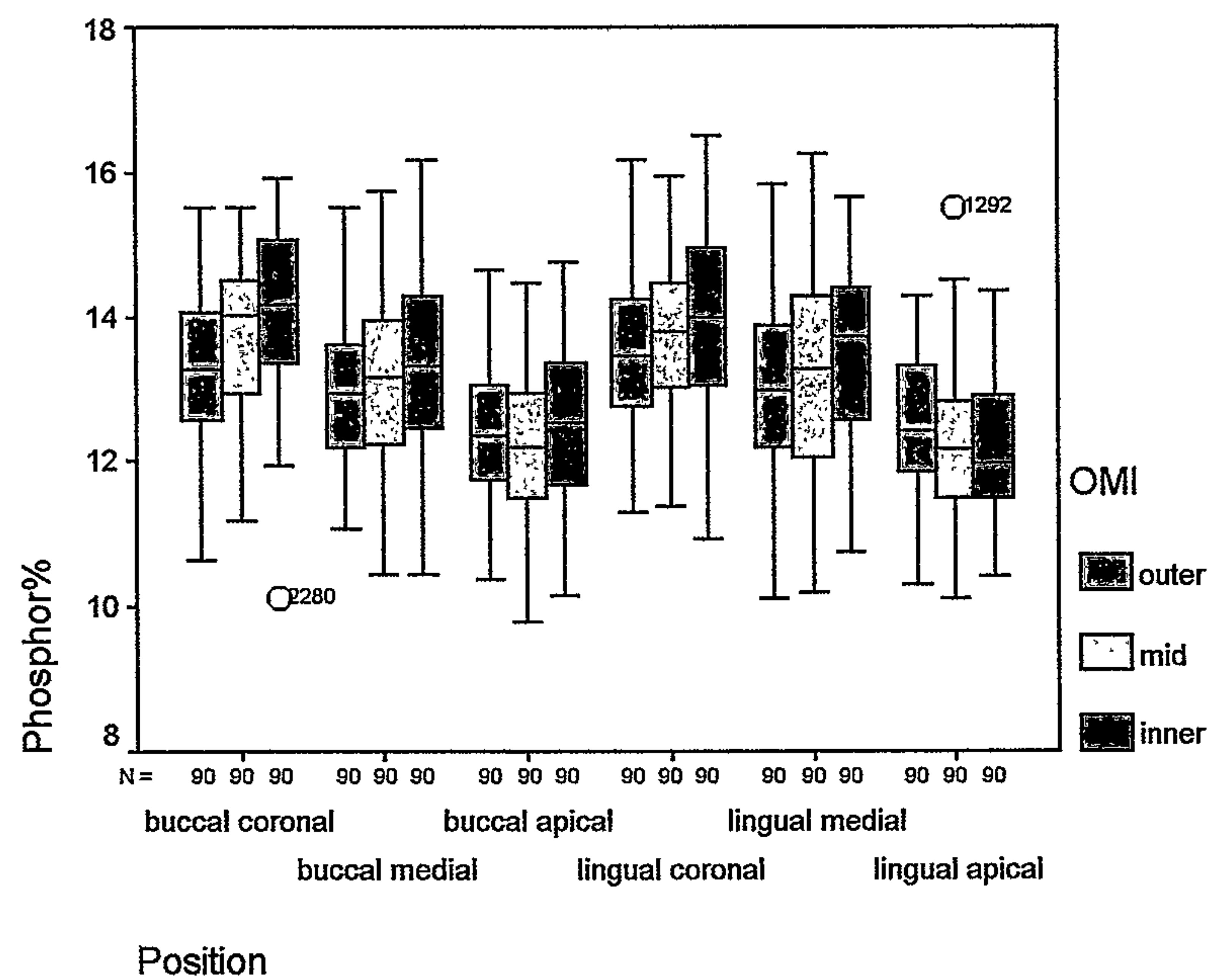
3. F% (controls) on the buccal and lingual surface at the cervical, middle and apical third.



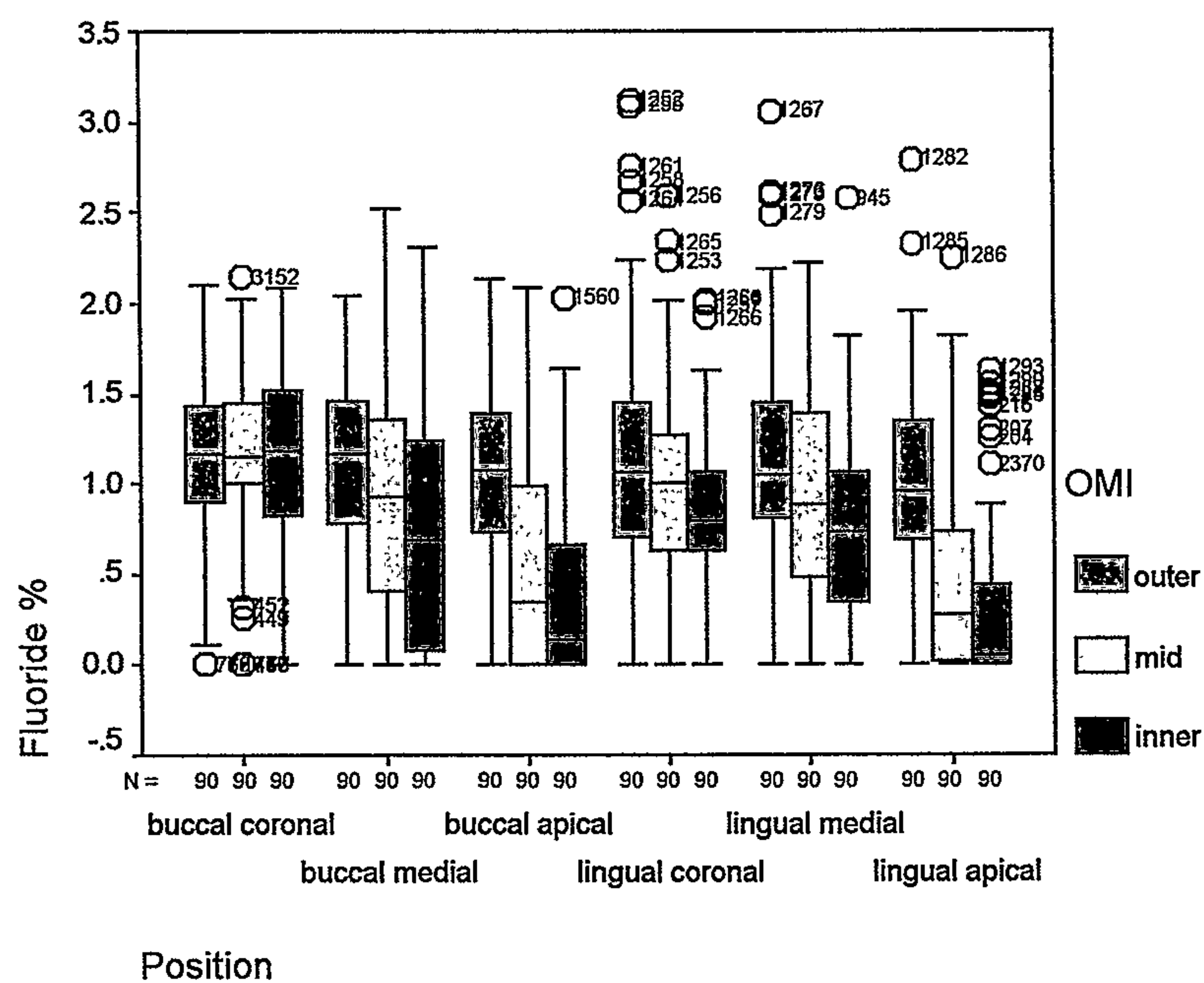
1. Ca% (controls) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third



2. P% (controls) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third



3. F% (controls) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third



6.4.2 Control Data

Univariant Analysis of Variance (UNIANOVA), using control values only.

Between-Subjects Factors			
		Value Label	N
Position	11	buccal coronal	270
	12	buccal medial	270
	13	buccal apical	270
	21	lingual coronal	270
	22	lingual medial	270
	23	lingual apical	270
OMI	1	outer	540
	2	mid	540
	3	inner	540
Subject	1		90
	2		90
	3		90
	4		90
	5		180
	6		180
	7		90
	8		90
	9		90
	10		90
	11		90
	12		90
	13		90
	14		90
	15		90
	16		90

6.4.2.1 Calcium (Ca%)

Tests of Between-Subjects Effects

Dependent Variable: Calcium%

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1253199.825	1	1253199.825	14234.773	.000
	Error	1324.497	15.045	88.038 ^a		
SUBJ	Hypothesis	1382.708	15	92.181	3.211	.000
	Error	2153.133	75	28.708 ^b		
POS	Hypothesis	2078.476	5	415.695	15.112	.000
	Error	2082.850	75.717	27.508 ^c		
POS * SUBJ	Hypothesis	2153.133	75	28.708	10.187	.000
	Error	4260.892	1512	2.818 ^d		
OMI(POS)	Hypothesis	506.383	12	42.199	14.974	.000
	Error	4260.892	1512	2.818 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(POS * SUBJ)
- c. .954 MS(POS * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Expected Mean Squares^{a,b}

Source	Variance Component			
	Var(SUBJ)	Var(POS * SUBJ)	Var(Error)	Quadratic Term
Intercept	96.000	16.000	1.000	Intercept, POS, OMI(POS)
SUBJ	100.667	16.778	1.000	
POS	.000	16.000	1.000	POS, OMI(POS)
POS * SUBJ	.000	16.778	1.000	
OMI(POS)	.000	.000	1.000	OMI(POS)
Error	.000	.000	1.000	

- a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.
- b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Subject

Dependent Variable: Calcium%

Subject	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	27.167	.177	26.820	27.514
2	27.341	.177	26.994	27.688
3	27.157	.177	26.810	27.504
4	29.081	.177	28.734	29.429
5	28.696	.125	28.451	28.941
6	29.026	.125	28.780	29.271
7	28.209	.177	27.862	28.556
8	28.128	.177	27.781	28.475
9	28.132	.177	27.785	28.479
10	27.941	.177	27.594	28.288
11	30.399	.177	30.051	30.746
12	29.663	.177	29.316	30.010
13	28.114	.177	27.767	28.461
14	30.404	.177	30.057	30.751
15	28.985	.177	28.638	29.332
16	28.576	.177	28.229	28.923

2. Position

Dependent Variable: Calcium%

Position	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
buccal coronal	30.047	.105	29.841	30.253
buccal medial	28.629	.105	28.423	28.834
buccal apical	27.158	.105	26.952	27.364
lingual coronal	29.688	.105	29.482	29.894
lingual medial	28.898	.105	28.693	29.104
lingual apical	26.963	.105	26.757	27.168

Pairwise Comparisons

Dependent Variable: Calcium%

(I) Position	(J) Position	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
buccal coronal	buccal medial	1.418*	.148	.000	.982	1.854
	buccal apical	2.889*	.148	.000	2.453	3.325
	lingual coronal	.359	.148	.235	-7.734E-02	.795
	lingual medial	1.148*	.148	.000	.712	1.585
	lingual apical	3.084*	.148	.000	2.648	3.520
buccal medial	buccal coronal	-1.418*	.148	.000	-1.854	-.982
	buccal apical	1.471*	.148	.000	1.034	1.907
	lingual coronal	-1.059*	.148	.000	-1.496	-.623
	lingual medial	-.270	.148	1.000	-.706	.166
	lingual apical	1.666*	.148	.000	1.230	2.102
buccal apical	buccal coronal	-2.889*	.148	.000	-3.325	-2.453
	buccal medial	-1.471*	.148	.000	-1.907	-1.034
	lingual coronal	-2.530*	.148	.000	-2.966	-2.094
	lingual medial	-1.740*	.148	.000	-2.177	-1.304
	lingual apical	.195	.148	1.000	-.241	.632
lingual coronal	buccal coronal	-.359	.148	.235	-.795	7.734E-02
	buccal medial	1.059*	.148	.000	.623	1.496
	buccal apical	2.530*	.148	.000	2.094	2.966
	lingual medial	.789*	.148	.000	.353	1.226
	lingual apical	2.725*	.148	.000	2.289	3.162
lingual medial	buccal coronal	-1.148*	.148	.000	-1.585	-.712
	buccal medial	.270	.148	1.000	-.166	.706
	buccal apical	1.740*	.148	.000	1.304	2.177
	lingual coronal	-.789*	.148	.000	-1.226	-.353
	lingual apical	1.936*	.148	.000	1.500	2.372
lingual apical	buccal coronal	-3.084*	.148	.000	-3.520	-2.648
	buccal medial	-1.666*	.148	.000	-2.102	-1.230
	buccal apical	-.195	.148	1.000	-.632	.241
	lingual coronal	-2.725*	.148	.000	-3.162	-2.289
	lingual medial	-1.936*	.148	.000	-2.372	-1.500

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

3. Position * OMI

Dependent Variable: Calcium%

Position	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
buccal coronal	outer	28.892	.179	28.541	29.242
	mid	30.048	.179	29.698	30.398
	inner	31.201	.179	30.850	31.551
buccal medial	outer	28.058	.179	27.708	28.408
	mid	28.690	.179	28.340	29.040
	inner	29.138	.179	28.788	29.488
buccal apical	outer	27.086	.179	26.736	27.436
	mid	26.821	.179	26.471	27.171
	inner	27.567	.179	27.217	27.918
lingual coronal	outer	28.931	.179	28.581	29.281
	mid	29.706	.179	29.356	30.057
	inner	30.426	.179	30.076	30.777
lingual medial	outer	28.255	.179	27.904	28.605
	mid	28.837	.179	28.487	29.187
	inner	29.603	.179	29.253	29.954
lingual apical	outer	27.137	.179	26.787	27.487
	mid	26.930	.179	26.580	27.280
	inner	26.820	.179	26.470	27.171

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: Calcium%

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1253199.825	1	1253199.825	14230.577	.000
	Error	1325.669	15.053	88.064 ^a		
SUBJ	Hypothesis	1382.708	15	92.181	2.316	.024
	Error	1193.933	30	39.798 ^b		
ECMA	Hypothesis	2047.777	2	1023.888	26.867	.000
	Error	1152.737	30.248	38.109 ^c		
ECMA * SUBJ	Hypothesis	1193.933	30	39.798	11.781	.000
	Error	5289.980	1566	3.378 ^d		
OMI(ECMA)	Hypothesis	468.207	6	78.035	23.101	.000
	Error	5289.980	1566	3.378 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(ECMA * SUBJ)
- c. .954 MS(ECMA * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Estimated Marginal Means

ECMA

Estimates

Dependent Variable: Calcium%

ECMA	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
coronal	29.867	.081	29.708	30.027
medial	28.764	.081	28.604	28.923
apical	27.060	.081	26.901	27.220

Pairwise Comparisons

Dependent Variable: Calcium%

(I) ECMA	(J) ECMA	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
coronal	medial	1.104*	.115	.000	.829	1.379
	apical	2.807*	.115	.000	2.532	3.082
medial	coronal	-1.104*	.115	.000	-1.379	-.829
	apical	1.703*	.115	.000	1.428	1.979
apical	coronal	-2.807*	.115	.000	-3.082	-2.532
	medial	-1.703*	.115	.000	-1.979	-1.428

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: Calcium%

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	2047.777	2	1023.888	303.103	.000
Error	5289.980	1566	3.378		

The F tests the effect of ECMA. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. ECMA * OMI

Dependent Variable: Calcium%

ECMA	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
coronal	outer	28.911	.138	28.640	29.182
	mid	29.877	.138	29.606	30.148
	inner	30.813	.138	30.542	31.085
medial	outer	28.156	.138	27.885	28.427
	mid	28.764	.138	28.492	29.035
	inner	29.371	.138	29.099	29.642
apical	outer	27.112	.138	26.840	27.383
	mid	26.875	.138	26.604	27.147
	inner	27.194	.138	26.923	27.465

CMA * OMI

Dependent Variable: Calcium%

CMA/OMI 1				CMA/OMI 2				Mean Diff (1-2)	SED	Sig. p<0.01
CMA	OMI	Mean	SE	CMA	OMI	Mean	SE			
cervical	O	28.911	.138	cervical	M	29.877	.138	-0.966	.503	*
	M	29.877	.138		I	30.813	.138	-0.936	.503	*
	I	30.813	.138		O	28.911	.138	1.902	.503	*
middle	O	28.156	.138	middle	M	28.764	.138	-0.608	.503	*
	M	28.764	.138		I	29.371	.138	-0.607	.503	*
	I	29.371	.138		O	28.156	.138	1.215	.503	*
apical	O	27.112	.138	apical	M	26.875	.138	0.237	.503	NS
	M	26.875	.138		I	27.194	.138	-0.319	.503	NS
	I	27.194	.138		O	27.112	.138	0.082	.503	NS

CMA – cervical, middle, apical third

OMI – outer, middle, inner third

SE – standard error

Mean diff (1-2) – mean difference between CMA/OMI 1 and CMA/OMI 2

SED – standard error of the difference

Sig. p<0.01 - significant at the 0.01 level, to allow for multiple comparisons.

* - p<0.01

NS – not significant

6.4.2.2 Phosphorus (P%)

Tests of Between-Subjects Effects

Dependent Variable: Phosphor%

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	262687.370	1	262687.370	12366.047	.000
	Error	319.484	15.040	21.243 ^a		
SUBJ	Hypothesis	333.687	15	22.246	2.463	.005
	Error	677.425	75	9.032 ^b		
POS	Hypothesis	512.246	5	102.449	11.855	.000
	Error	652.360	75.490	8.642 ^c		
POS * SUBJ	Hypothesis	677.425	75	9.032	14.911	.000
	Error	915.921	1512	.606 ^d		
OMI(POS)	Hypothesis	65.608	12	5.467	9.026	.000
	Error	915.921	1512	.606 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(POS * SUBJ)
- c. .954 MS(POS * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Expected Mean Squares^{a,b}

Source	Variance Component			
	Var(SUBJ)	Var(POS * SUBJ)	Var(Error)	Quadratic Term
Intercept	96.000	16.000	1.000	Intercept, POS, OMI(POS)
SUBJ	100.667	16.778	1.000	
POS	.000	16.000	1.000	POS, OMI(POS)
POS * SUBJ	.000	16.778	1.000	
OMI(POS)	.000	.000	1.000	OMI(POS)
Error	.000	.000	1.000	

- a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.
- b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Subject

Dependent Variable: Phosphor%

Subject	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	12.968	.082	12.807	13.129
2	12.719	.082	12.558	12.880
3	12.479	.082	12.318	12.640
4	13.462	.082	13.302	13.623
5	13.171	.058	13.057	13.285
6	13.310	.058	13.196	13.424
7	12.997	.082	12.836	13.157
8	12.876	.082	12.715	13.037
9	12.613	.082	12.452	12.774
10	12.426	.082	12.265	12.587
11	13.904	.082	13.743	14.065
12	13.506	.082	13.346	13.667
13	12.608	.082	12.447	12.769
14	14.147	.082	13.986	14.308
15	12.936	.082	12.775	13.096
16	13.118	.082	12.957	13.278

2. Position

Dependent Variable: Phosphor%

Position	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
buccal coronal	13.696	.049	13.601	13.792
buccal medial	13.155	.049	13.059	13.250
buccal apical	12.347	.049	12.251	12.442
lingual coronal	13.719	.049	13.624	13.815
lingual medial	13.265	.049	13.170	13.360
lingual apical	12.283	.049	12.188	12.379

Pairwise Comparisons

Dependent Variable: Phosphor%

		Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
(I) Position	(J) Position				Lower Bound	Upper Bound
buccal coronal	buccal medial	.541*	.069	.000	.339	.744
	buccal apical	1.350*	.069	.000	1.147	1.552
	lingual coronal	-2.299E-02	.069	1.000	-.225	.179
	lingual medial	.431*	.069	.000	.229	.633
	lingual apical	1.413*	.069	.000	1.211	1.615
buccal medial	buccal coronal	-.541*	.069	.000	-.744	-.339
	buccal apical	.808*	.069	.000	.606	1.010
	lingual coronal	-.564*	.069	.000	-.767	-.362
	lingual medial	-.110	.069	1.000	-.312	9.204E-02
	lingual apical	.872*	.069	.000	.669	1.074
buccal apical	buccal coronal	-1.350*	.069	.000	-1.552	-1.147
	buccal medial	-.808*	.069	.000	-1.010	-.606
	lingual coronal	-1.373*	.069	.000	-1.575	-1.170
	lingual medial	-.918*	.069	.000	-1.121	-.716
	lingual apical	6.341E-02	.069	1.000	-.139	.266
lingual coronal	buccal coronal	2.299E-02	.069	1.000	-.179	.225
	buccal medial	.564*	.069	.000	.362	.767
	buccal apical	1.373*	.069	.000	1.170	1.575
	lingual medial	.454*	.069	.000	.252	.656
	lingual apical	1.436*	.069	.000	1.234	1.638
lingual medial	buccal coronal	-.431*	.069	.000	-.633	-.229
	buccal medial	.110	.069	1.000	-9.204E-02	.312
	buccal apical	.918*	.069	.000	.716	1.121
	lingual coronal	-.454*	.069	.000	-.656	-.252
	lingual apical	.982*	.069	.000	.780	1.184
lingual apical	buccal coronal	-1.413*	.069	.000	-1.615	-1.211
	buccal medial	-.872*	.069	.000	-1.074	-.669
	buccal apical	-6.341E-02	.069	1.000	-.266	.139
	lingual coronal	-1.436*	.069	.000	-1.638	-1.234
	lingual medial	-.982*	.069	.000	-1.184	-.780

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

3. Position * OMI

Dependent Variable: Phosphor%

Position	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
buccal coronal	outer	13.255	.083	13.092	13.417
	mid	13.765	.083	13.602	13.927
	inner	14.069	.083	13.907	14.232
buccal medial	outer	12.960	.083	12.797	13.122
	mid	13.147	.083	12.984	13.309
	inner	13.358	.083	13.196	13.520
buccal apical	outer	12.342	.083	12.180	12.504
	mid	12.224	.083	12.062	12.387
	inner	12.473	.083	12.311	12.636
lingual coronal	outer	13.485	.083	13.322	13.647
	mid	13.746	.083	13.583	13.908
	inner	13.927	.083	13.764	14.089
lingual medial	outer	13.077	.083	12.915	13.240
	mid	13.184	.083	13.022	13.347
	inner	13.533	.083	13.371	13.696
lingual apical	outer	12.495	.083	12.333	12.657
	mid	12.188	.083	12.026	12.351
	inner	12.166	.083	12.004	12.328

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: Phosphor%

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	262687.370	1	262687.370	12359.383	.000
	Error	320.001	15.056	21.254 ^a		
SUBJ	Hypothesis	333.687	15	22.246	2.479	.017
	Error	269.205	30	8.974 ^b		
ECMA	Hypothesis	510.109	2	255.055	29.668	.000
	Error	260.300	30.278	8.597 ^c		
ECMA * SUBJ	Hypothesis	269.205	30	8.974	10.522	.000
	Error	1335.546	1566	.853 ^d		
OMI(ECMA)	Hypothesis	57.119	6	9.520	11.163	.000
	Error	1335.546	1566	.853 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(ECMA * SUBJ)
- c. .954 MS(ECMA * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Estimated Marginal Means

ECMA

Estimates

Dependent Variable: Phosphor%

ECMA	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
coronal	13.708	.041	13.628	13.788
medial	13.210	.041	13.130	13.290
apical	12.315	.041	12.235	12.395

Pairwise Comparisons

Dependent Variable: Phosphor%

(I) ECMA	(J) ECMA	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
coronal	medial	.498*	.058	.000	.359	.636
	apical	1.393*	.058	.000	1.255	1.531
medial	coronal	-.498*	.058	.000	-.636	-.359
	apical	.895*	.058	.000	.757	1.033
apical	coronal	-1.393*	.058	.000	-1.531	-1.255
	medial	-.895*	.058	.000	-1.033	-.757

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: Phosphor%

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	510.109	2	255.055	299.065	.000
Error	1335.546	1566	.853		

The F tests the effect of ECMA. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. ECMA * OMI

Dependent Variable: Phosphor%

ECMA	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
coronal	outer	13.370	.069	13.234	13.506
	mid	13.755	.069	13.619	13.892
	inner	13.998	.069	13.862	14.134
medial	outer	13.019	.069	12.882	13.155
	mid	13.166	.069	13.029	13.302
	inner	13.446	.069	13.309	13.582
apical	outer	12.418	.069	12.282	12.555
	mid	12.206	.069	12.070	12.343
	inner	12.320	.069	12.183	12.456

CMA * OMI

Dependent Variable: Phosphor%

CMA/OMI 1				CMA/OMI 2				Mean Diff (1-2)	SED	Sig. p<0.01
CMA	OMI	Mean	SE	CMA	OMI	Mean	SE			
cervical	O	13.370	.069	cervical	M	13.755	.069	-0.385	0.25	*
	M	13.755	.069		I	13.998	.069	-0.243	0.25	NS
	I	13.998	.069		O	13.370	.069	0.628	0.25	*
middle	O	13.019	.069	middle	M	13.166	.069	-0.147	0.25	NS
	M	13.166	.069		I	13.446	.069	-0.280	0.25	*
	I	13.446	.069		O	13.019	.069	0.427	0.25	*
apical	O	12.418	.069	apical	M	12.206	.069	0.212	0.25	NS
	M	12.206	.069		I	12.320	.069	-0.114	0.25	NS
	I	12.320	.069		O	12.418	.069	-0.098	0.25	NS

CMA – cervical, middle, apical third

OMI – outer, middle, inner third

SE – standard error

Mean diff (1-2) – mean difference between CMA/OMI 1 and CMA/OMI 2

SED – standard error of the difference

Sig. p<0.01 - significant at the 0.01 level, to allow for multiple comparisons.

* - p<0.01

NS – not significant

6.4.2.3 Fluoride (F%)

Tests of Between-Subjects Effects

Dependent Variable: Fluoride %

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1109.083	1	1109.083	104.382	.000
	Error	159.509	15.012	10.625 ^a		
SUBJ	Hypothesis	167.058	15	11.137	5.531	.000
	Error	151.016	75	2.014 ^b		
POS	Hypothesis	59.888	5	11.978	6.224	.000
	Error	144.994	75.340	1.925 ^c		
POS * SUBJ	Hypothesis	151.016	75	2.014	21.496	.000
	Error	141.630	1512	9.367E-02 ^d		
OMI(POS)	Hypothesis	61.854	12	5.155	55.028	.000
	Error	141.630	1512	9.367E-02 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(POS * SUBJ)
- c. .954 MS(POS * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Expected Mean Squares^{a,b}

Source	Variance Component			
	Var(SUBJ)	Var(POS * SUBJ)	Var(Error)	Quadratic Term
Intercept	96.000	16.000	1.000	Intercept, POS, OMI(POS)
SUBJ	100.667	16.778	1.000	POS, OMI(POS)
POS	.000	16.000	1.000	
POS * SUBJ	.000	16.778	1.000	OMI(POS)
OMI(POS)	.000	.000	1.000	
Error	.000	.000	1.000	

- a. For each source, the expected mean square equals the sum of the coefficients in the cells times the variance components, plus a quadratic term involving effects in the Quadratic Term cell.
- b. Expected Mean Squares are based on the Type III Sums of Squares.

Estimated Marginal Means

1. Subject

Dependent Variable: Fluoride %

Subject	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	.925	.032	.861	.988
2	.969	.032	.906	1.032
3	.594	.032	.530	.657
4	.369	.032	.306	.432
5	1.487	.023	1.442	1.531
6	.548	.023	.503	.593
7	1.129	.032	1.066	1.193
8	1.352	.032	1.289	1.415
9	.573	.032	.510	.637
10	.730	.032	.667	.794
11	1.012	.032	.948	1.075
12	.743	.032	.680	.806
13	.716	.032	.652	.779
14	.977	.032	.914	1.041
15	.865	.032	.802	.928
16	.607	.032	.544	.671

2. Position

Dependent Variable: Fluoride %

Position	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
buccal coronal	1.131	.019	1.094	1.169
buccal medial	.913	.019	.876	.951
buccal apical	.616	.019	.578	.653
lingual coronal	.961	.019	.923	.998
lingual medial	.911	.019	.873	.948
lingual apical	.567	.019	.530	.605

Pairwise Comparisons

Dependent Variable: Fluoride %

(I) Position	(J) Position	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
buccal coronal	buccal medial	.218*	.027	.000	.138	.297
	buccal apical	.516*	.027	.000	.436	.595
	lingual coronal	.170*	.027	.000	9.092E-02	.250
	lingual medial	.221*	.027	.000	.141	.300
	lingual apical	.564*	.027	.000	.484	.643
buccal medial	buccal coronal	-.218*	.027	.000	-.297	-.138
	buccal apical	.298*	.027	.000	.218	.377
	lingual coronal	-4.721E-02	.027	1.000	-.127	3.231E-02
	lingual medial	2.847E-03	.027	1.000	-7.668E-02	8.238E-02
	lingual apical	.346*	.027	.000	.267	.426
buccal apical	buccal coronal	-.516*	.027	.000	-.595	-.436
	buccal medial	-.298*	.027	.000	-.377	-.218
	lingual coronal	-.345*	.027	.000	-.425	-.266
	lingual medial	-.295*	.027	.000	-.375	-.216
	lingual apical	4.840E-02	.027	1.000	-3.113E-02	.128
lingual coronal	buccal coronal	-.170*	.027	.000	-.250	-9.092E-02
	buccal medial	4.721E-02	.027	1.000	-3.231E-02	.127
	buccal apical	.345*	.027	.000	.266	.425
	lingual medial	5.006E-02	.027	.966	-2.947E-02	.130
	lingual apical	.394*	.027	.000	.314	.473
lingual medial	buccal coronal	-.221*	.027	.000	-.300	-.141
	buccal medial	-2.847E-03	.027	1.000	-8.238E-02	7.668E-02
	buccal apical	.295*	.027	.000	.216	.375
	lingual coronal	-5.006E-02	.027	.966	-.130	2.947E-02
	lingual apical	.343*	.027	.000	.264	.423
lingual apical	buccal coronal	-.564*	.027	.000	-.643	-.484
	buccal medial	-.346*	.027	.000	-.426	-.267
	buccal apical	-4.840E-02	.027	1.000	-.128	3.113E-02
	lingual coronal	-.394*	.027	.000	-.473	-.314
	lingual medial	-.343*	.027	.000	-.423	-.264

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

3. Position * OMI

Dependent Variable: Fluoride %

Position	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
buccal coronal	outer	1.131	.033	1.067	1.195
	mid	1.142	.033	1.078	1.205
	inner	1.121	.033	1.057	1.185
buccal medial	outer	1.096	.033	1.032	1.160
	mid	.912	.033	.848	.976
	inner	.733	.033	.669	.796
buccal apical	outer	1.000	.033	.936	1.064
	mid	.519	.033	.455	.583
	inner	.327	.033	.263	.391
lingual coronal	outer	1.084	.033	1.020	1.147
	mid	.971	.033	.907	1.035
	inner	.827	.033	.763	.891
lingual medial	outer	1.102	.033	1.038	1.166
	mid	.905	.033	.841	.969
	inner	.725	.033	.661	.788
lingual apical	outer	.984	.033	.920	1.047
	mid	.448	.033	.385	.512
	inner	.269	.033	.205	.333

Univariate Analysis of Variance

Tests of Between-Subjects Effects

Dependent Variable: Fluoride %

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	1109.083	1	1109.083	104.358	.000
	Error	159.620	15.019	10.628 ^a		
SUBJ	Hypothesis	167.058	15	11.137	4.936	.000
	Error	67.693	30	2.256 ^b		
ECMA	Hypothesis	55.869	2	27.934	12.941	.000
	Error	65.169	30.190	2.159 ^c		
ECMA * SUBJ	Hypothesis	67.693	30	2.256	15.373	.000
	Error	229.853	1566	.147 ^d		
OMI(ECMA)	Hypothesis	60.411	6	10.068	68.597	.000
	Error	229.853	1566	.147 ^d		

- a. .954 MS(SUBJ) + 4.636E-02 MS(Error)
- b. MS(ECMA * SUBJ)
- c. .954 MS(ECMA * SUBJ) + 4.636E-02 MS(Error)
- d. MS(Error)

Estimated Marginal Means

ECMA

Estimates

Dependent Variable: Fluoride %

ECMA	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
coronal	1.046	.017	1.013	1.079
medial	.912	.017	.879	.945
apical	.591	.017	.558	.625

Pairwise Comparisons

Dependent Variable: Fluoride %

(I) ECMA	(J) ECMA	Mean Difference (I-J)	Std. Error	Sig. ^a	95% Confidence Interval for Difference ^a	
					Lower Bound	Upper Bound
coronal	medial	.134*	.024	.000	7.648E-02	.191
	apical	.455*	.024	.000	.397	.512
medial	coronal	-.134*	.024	.000	-.191	-7.648E-02
	apical	.321*	.024	.000	.263	.378
apical	coronal	-.455*	.024	.000	-.512	-.397
	medial	-.321*	.024	.000	-.378	-.263

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Bonferroni.

Univariate Tests

Dependent Variable: Fluoride %

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	55.869	2	27.934	190.318	.000
Error	229.853	1566	.147		

The F tests the effect of ECMA. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. ECMA * OMI

Dependent Variable: Fluoride %

ECMA	OMI	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
coronal	outer	1.107	.029	1.051	1.164
	mid	1.056	.029	1.000	1.113
	inner	.974	.029	.917	1.030
medial	outer	1.099	.029	1.043	1.156
	mid	.908	.029	.852	.965
	inner	.729	.029	.672	.785
apical	outer	.992	.029	.935	1.048
	mid	.484	.029	.427	.540
	inner	.298	.029	.242	.355

CMA * OMI

Dependent Variable: Fluoride %

CMA/OMI 1				CMA/OMI 2				Mean Diff (1-2)	SED	Sig. p<0.01
CMA	OMI	Mean	SE	CMA	OMI	Mean	SE			
cervical	O	1.107	.029	cervical	M	1.056	.029	0.051	.106	NS
	M	1.056	.029		I	.974	.029	0.082	.106	NS
	I	.974	.029		O	1.107	.029	-0.133	.106	*
middle	O	1.099	.029	middle	M	.908	.029	0.191	.106	*
	M	.908	.029		I	.729	.029	0.879	.106	*
	I	.729	.029		O	1.099	.029	-0.370	.106	*
apical	O	.992	.029	apical	M	.484	.029	0.245	.106	*
	M	.484	.029		I	.298	.029	0.195	.106	*
	I	.298	.029		O	.992	.029	-0.694	.106	*

CMA – cervical, middle, apical third

OMI – outer, middle, inner third

SE – standard error

Mean diff (1-2) – mean difference between CMA/OMI 1 and CMA/OMI 2

SED – standard error of the difference

Sig. p<0.01 - significant at the 0.01 level, to allow for multiple comparisons.

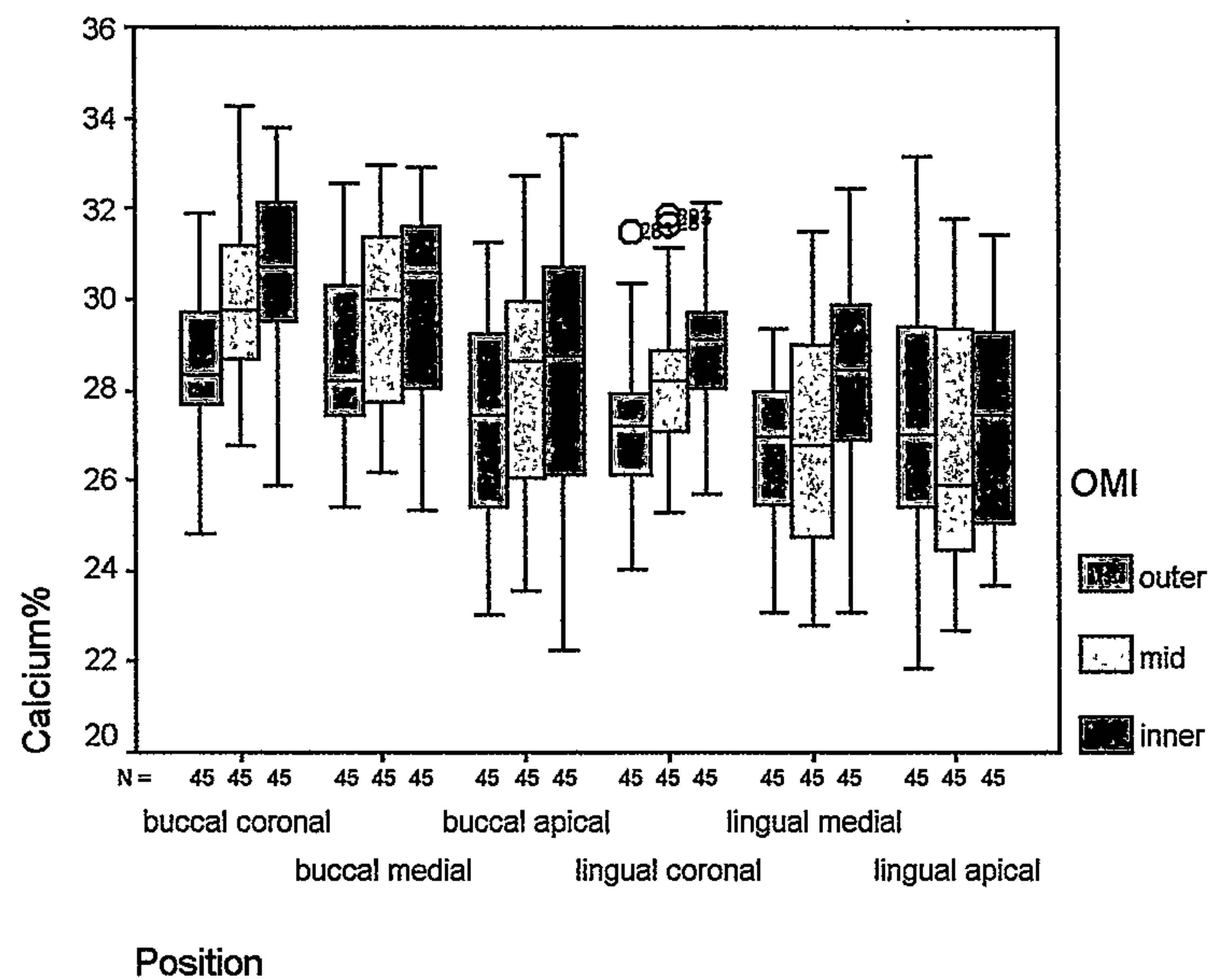
* - p<0.01

NS – not significant

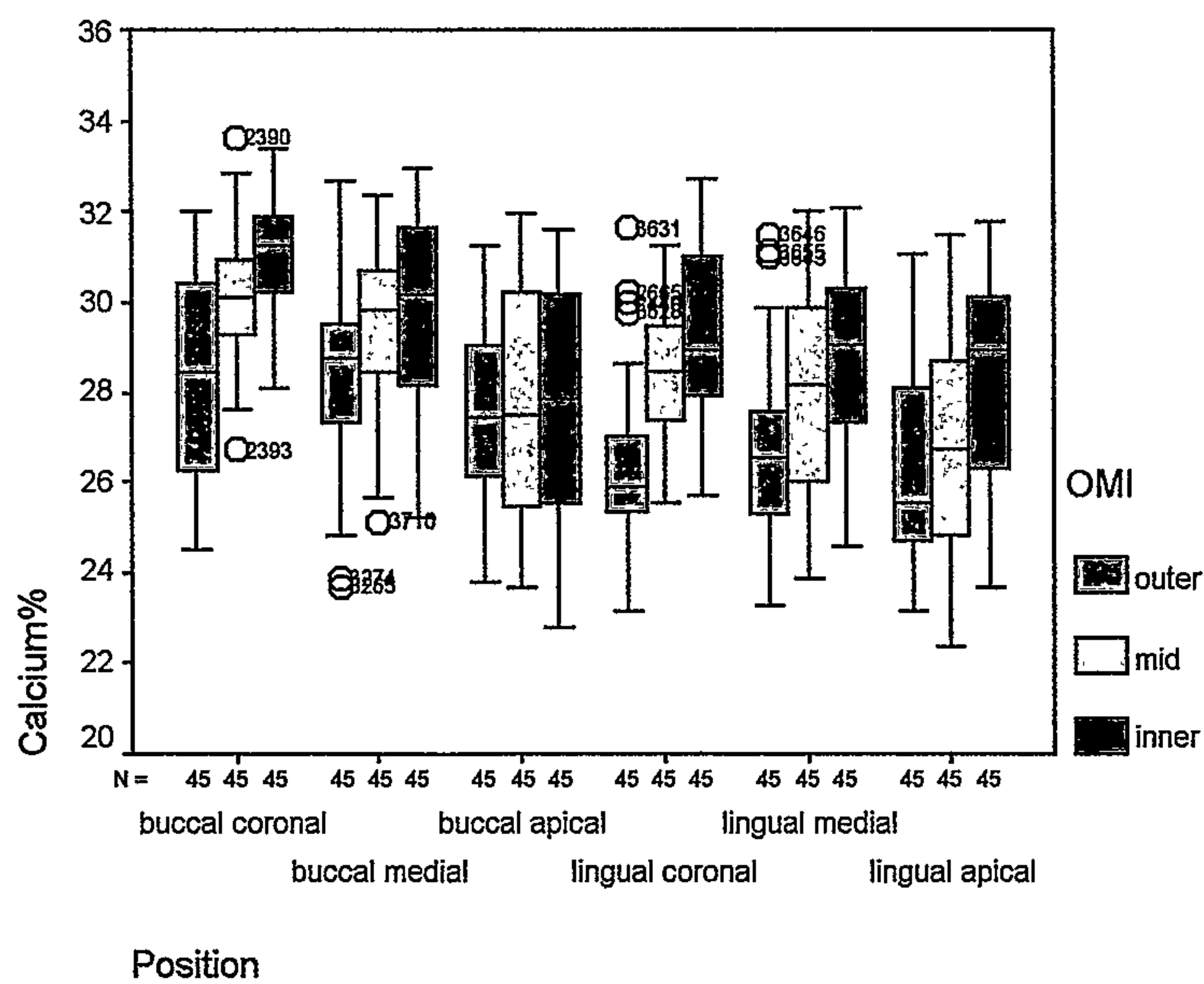
6.4.3 Graphs derived from control and experimental data.

Boxplots constructed from raw unadjusted data.

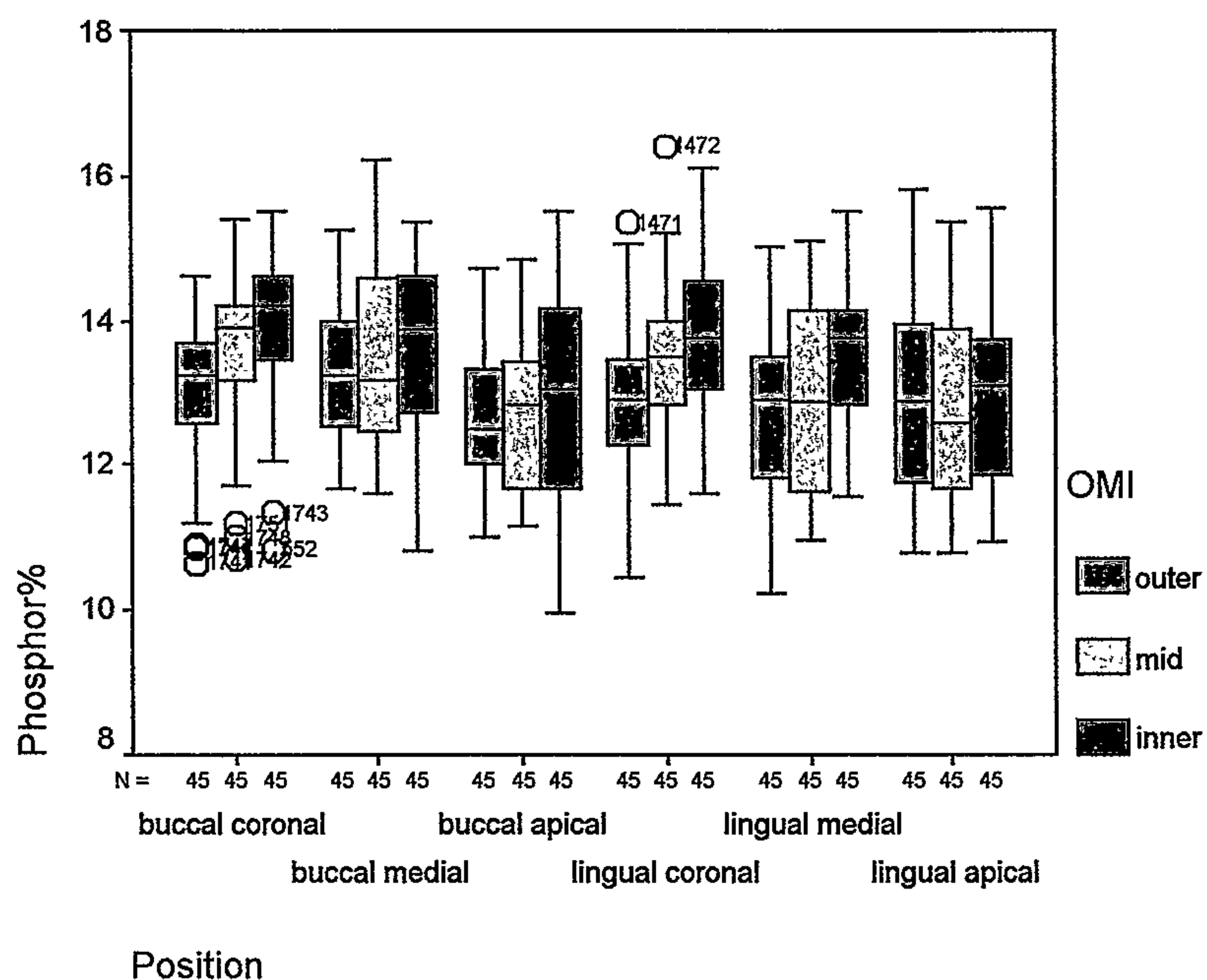
1a. Ca% (light force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



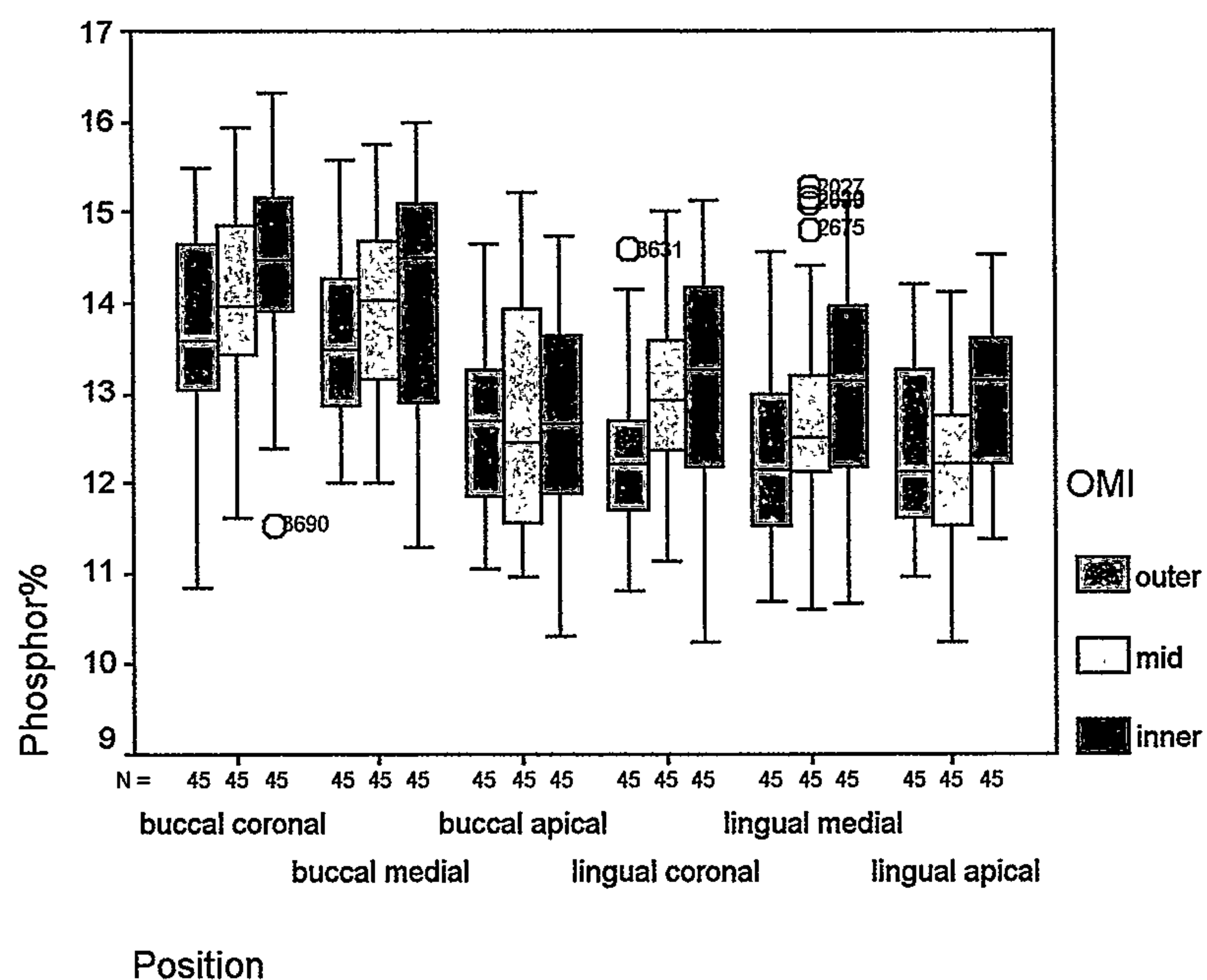
1b. Ca% (heavy force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



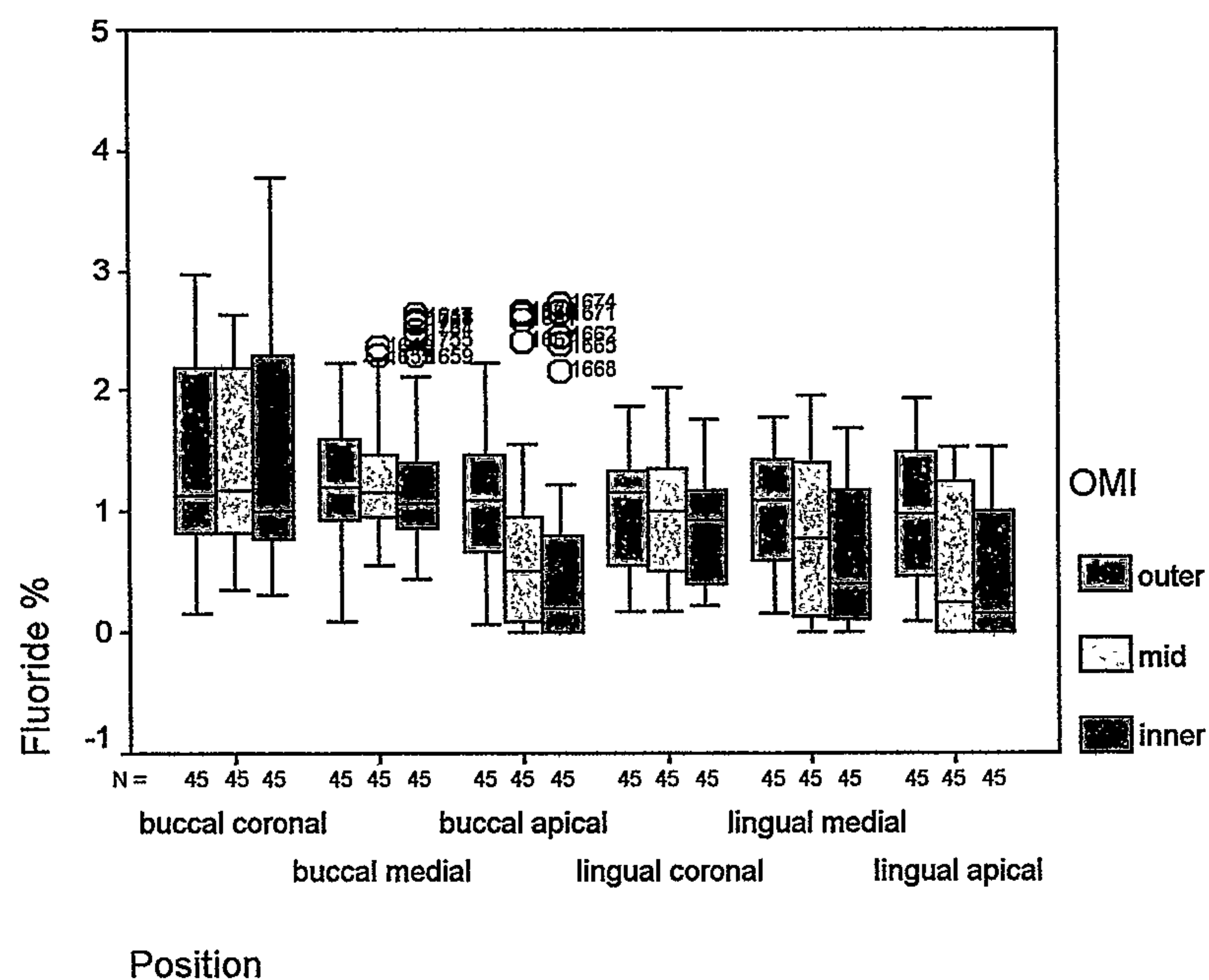
- 2a. P% (light force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



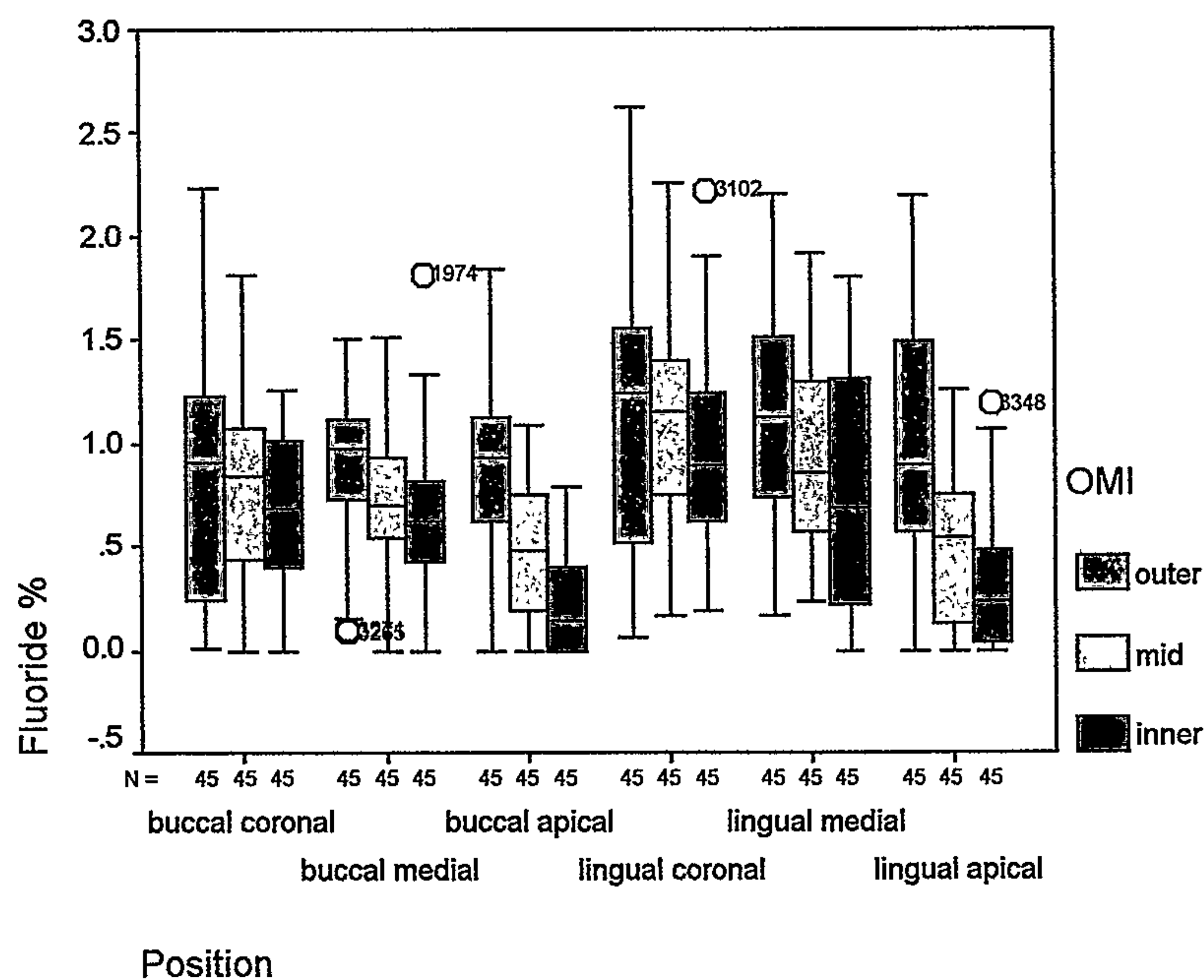
- 2b. P% (heavy force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



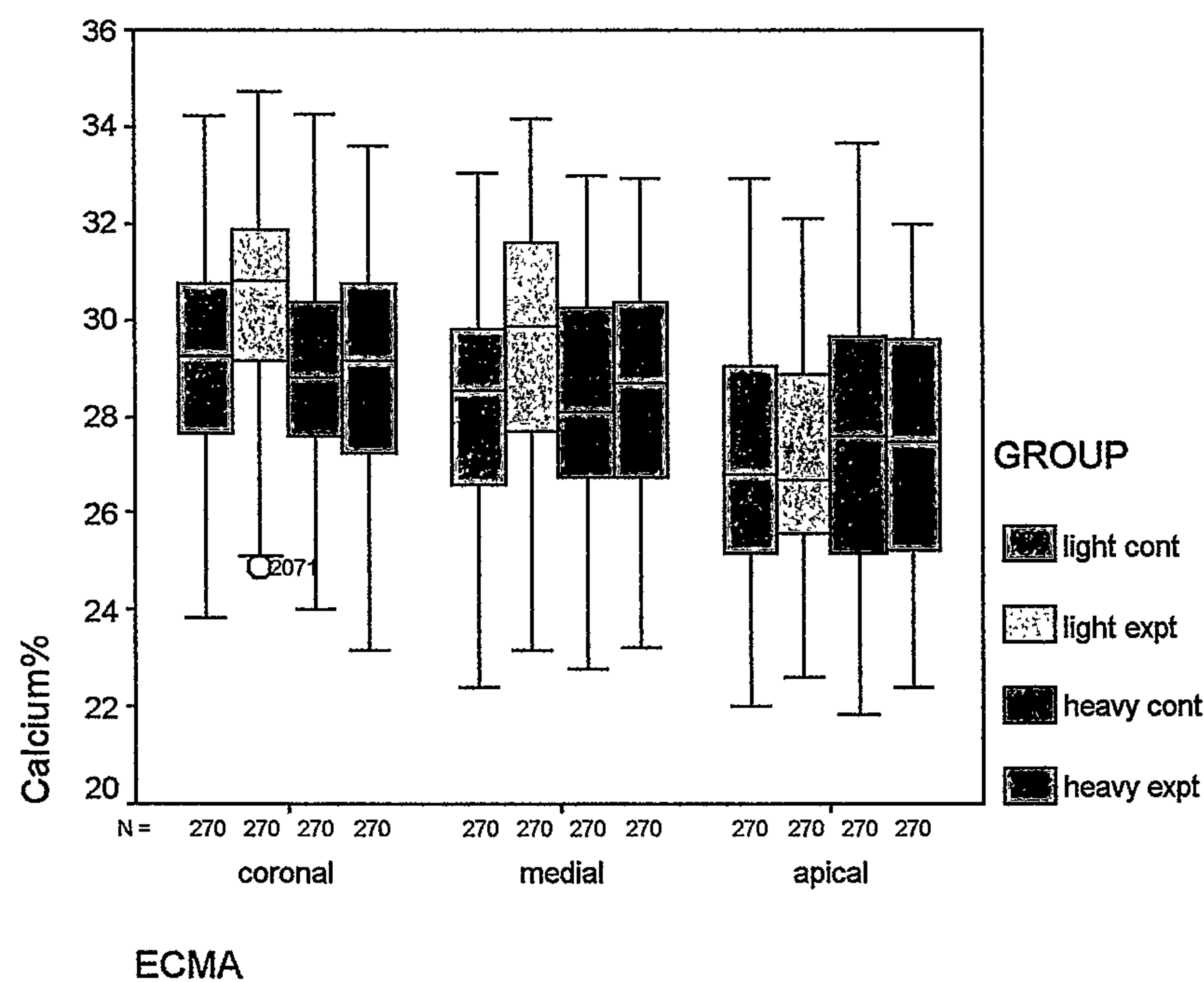
3a. F% (light force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



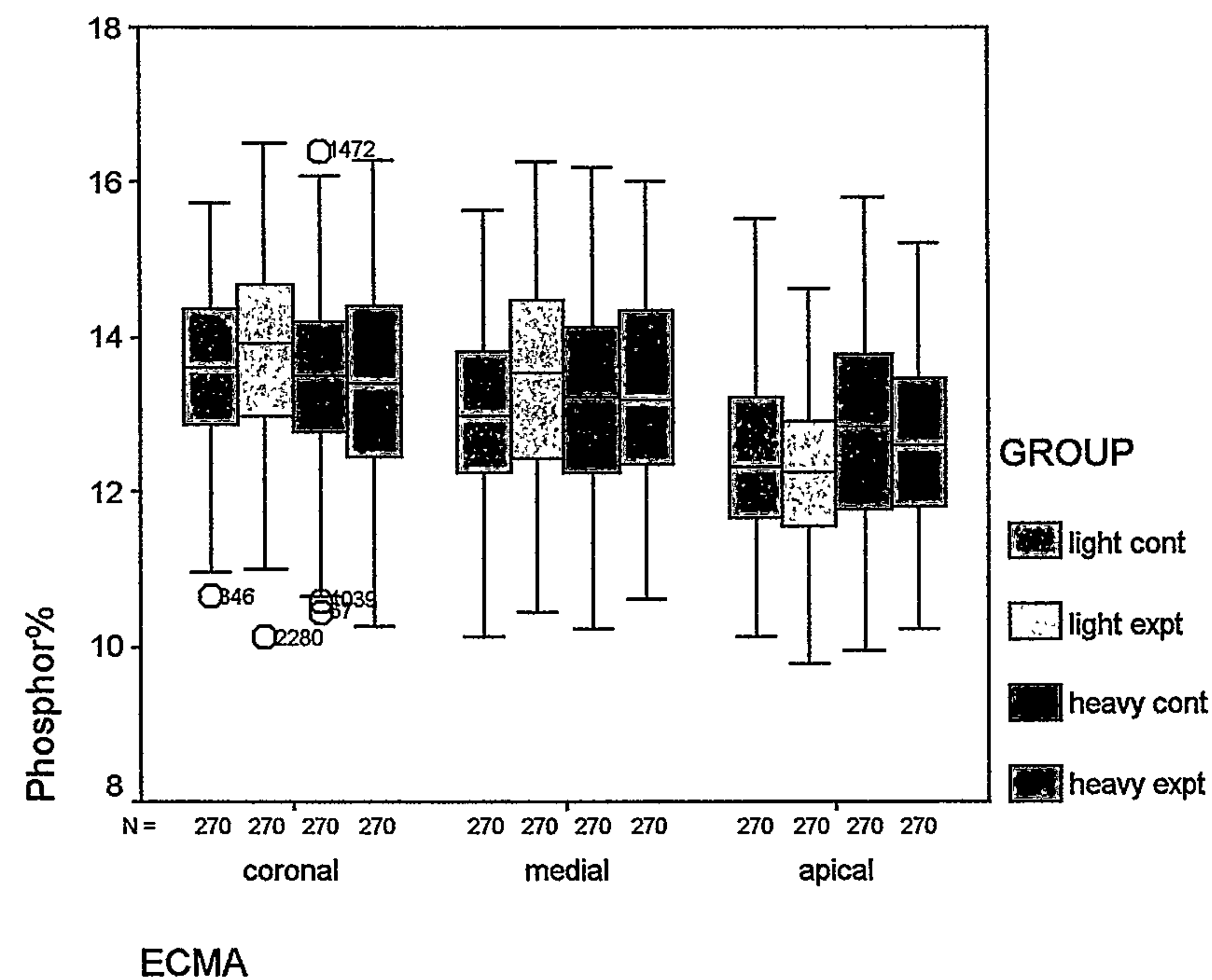
3b. F% (heavy force group) on the buccal and lingual surface at the cervical, middle and apical third at the outer, middle and inner third.



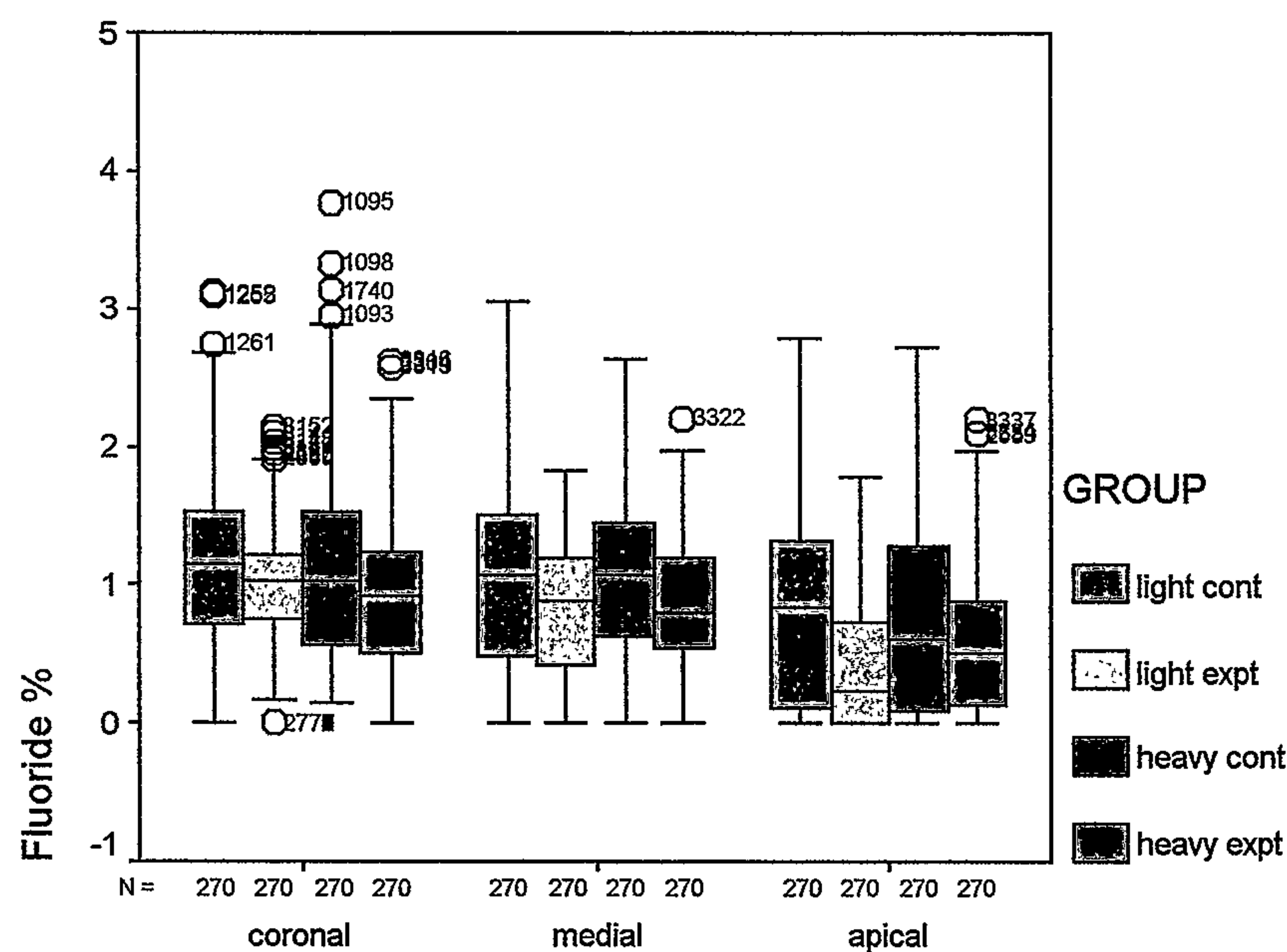
1. Ca% in the 4 groups at the cervical, middle, and apical third.



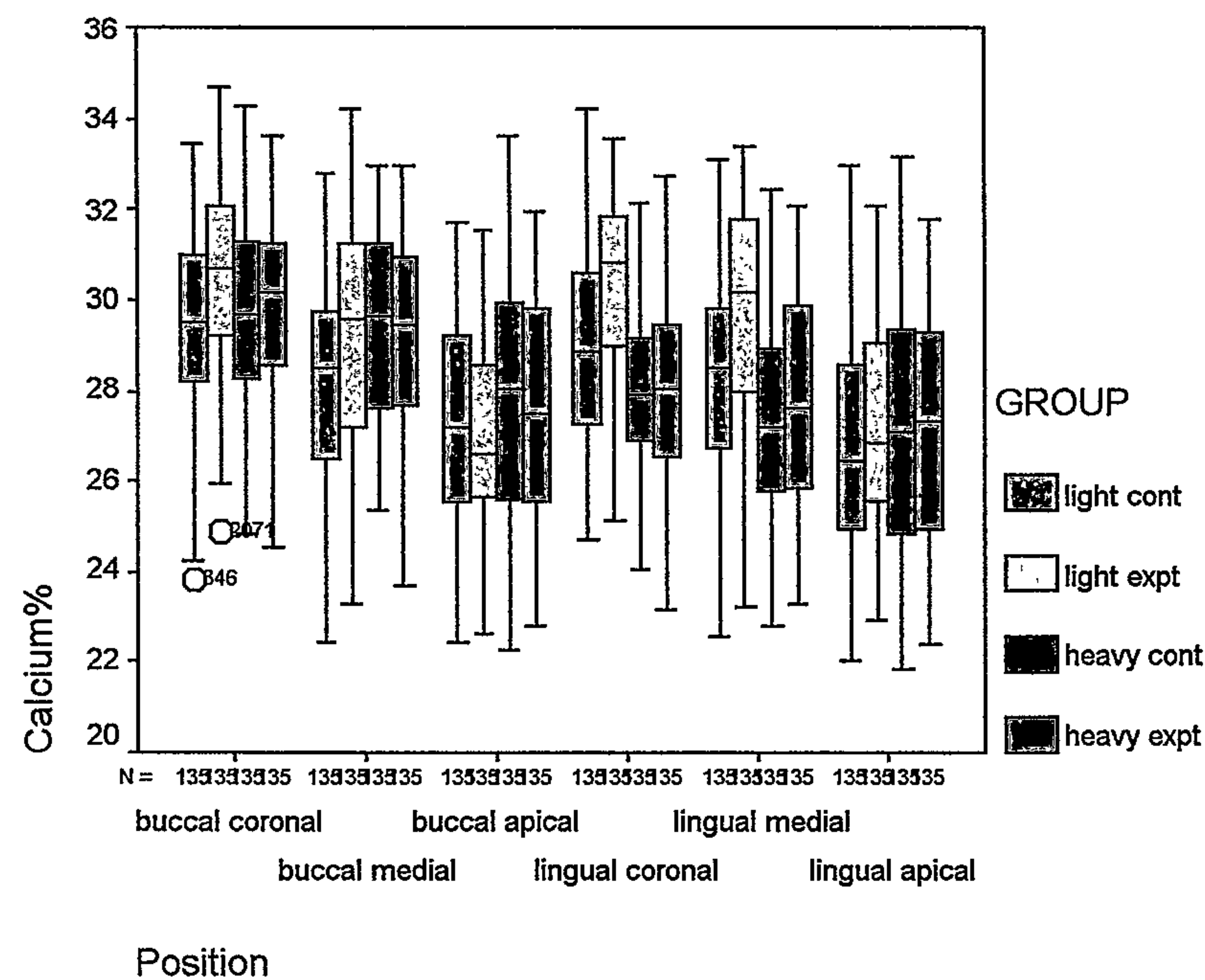
2. P% in the 4 groups at the cervical, middle, and apical third.



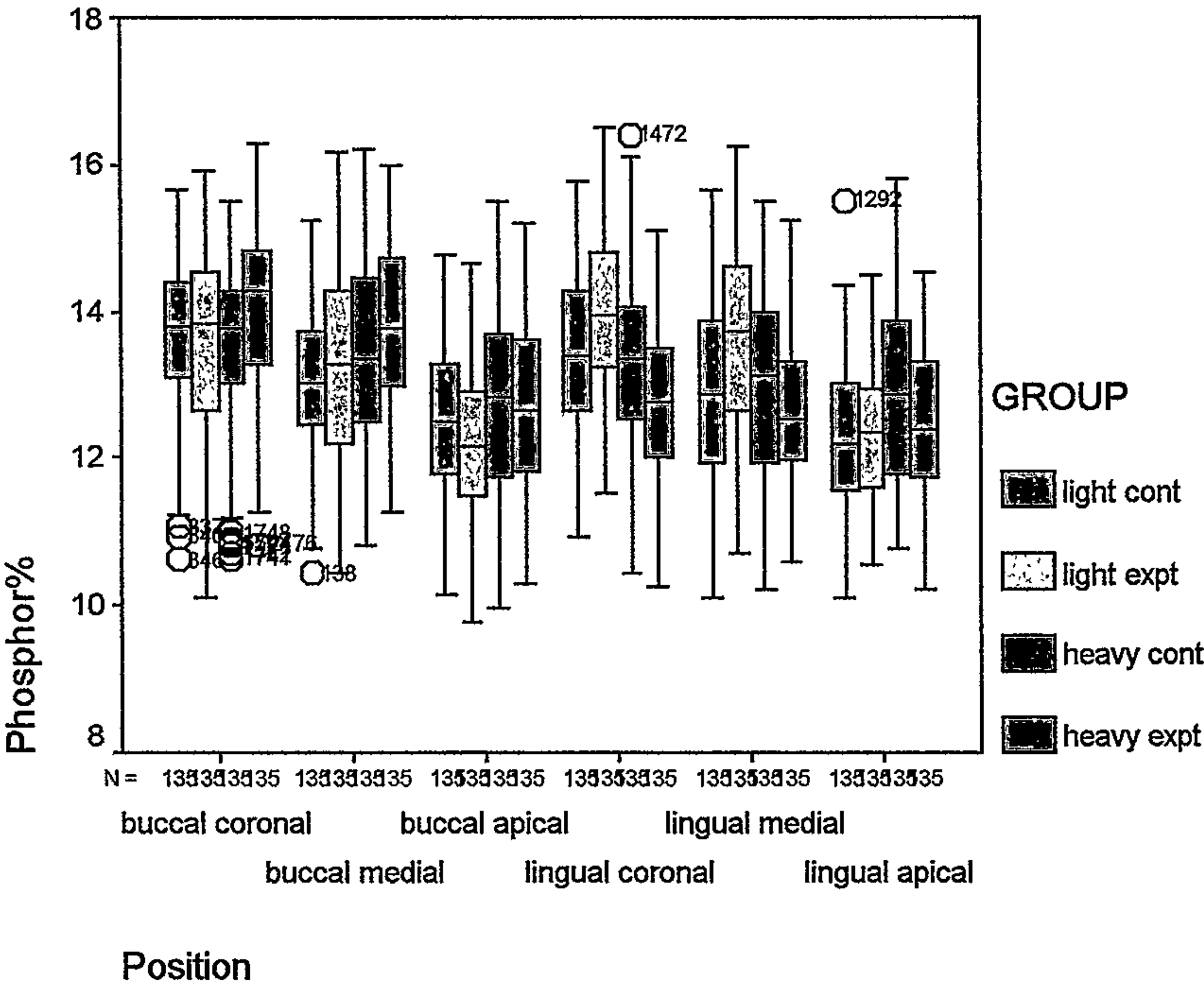
3. F% in the 4 groups at the cervical, middle, and apical third.



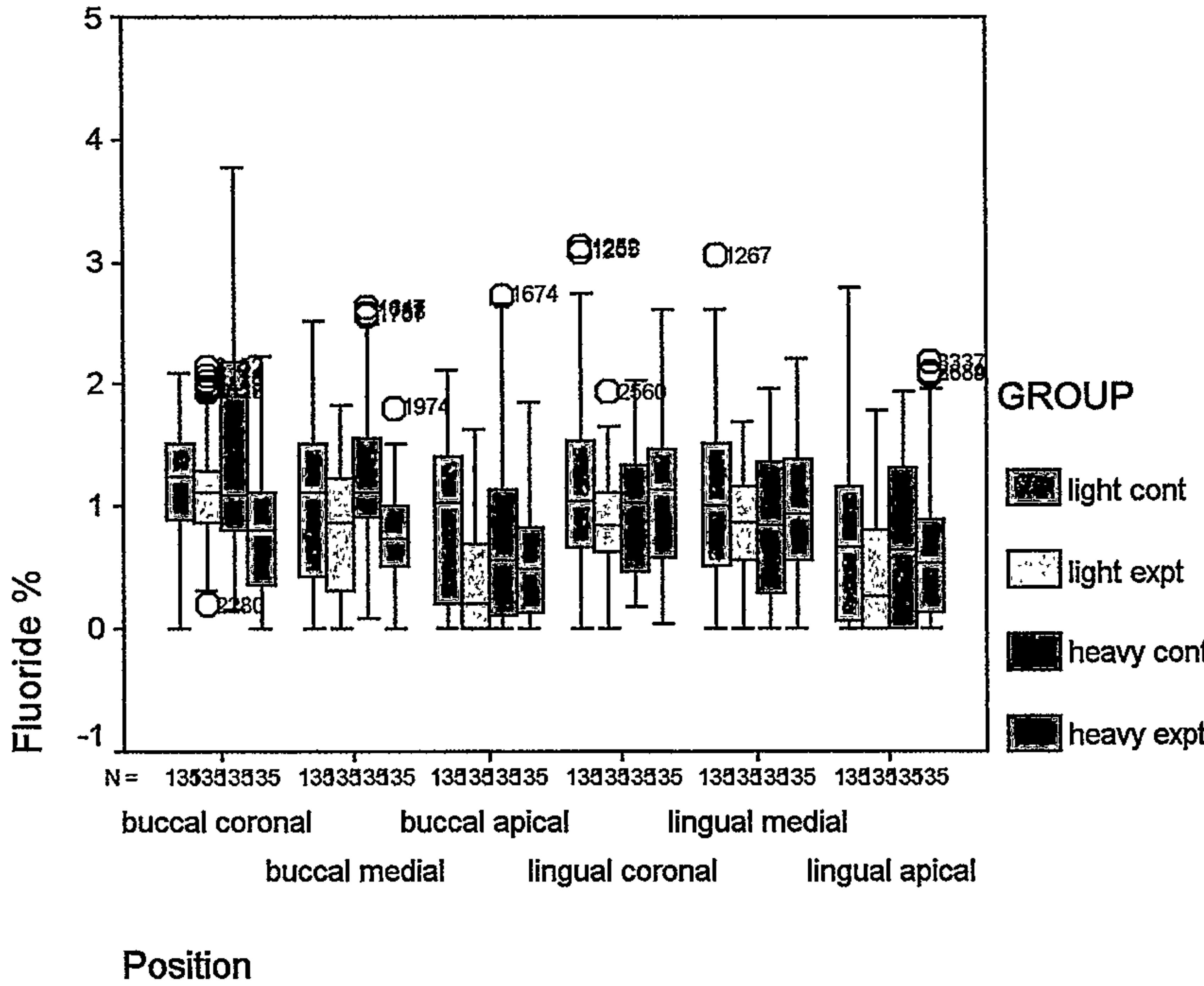
1. Ca% in the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.



2. P% in the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.



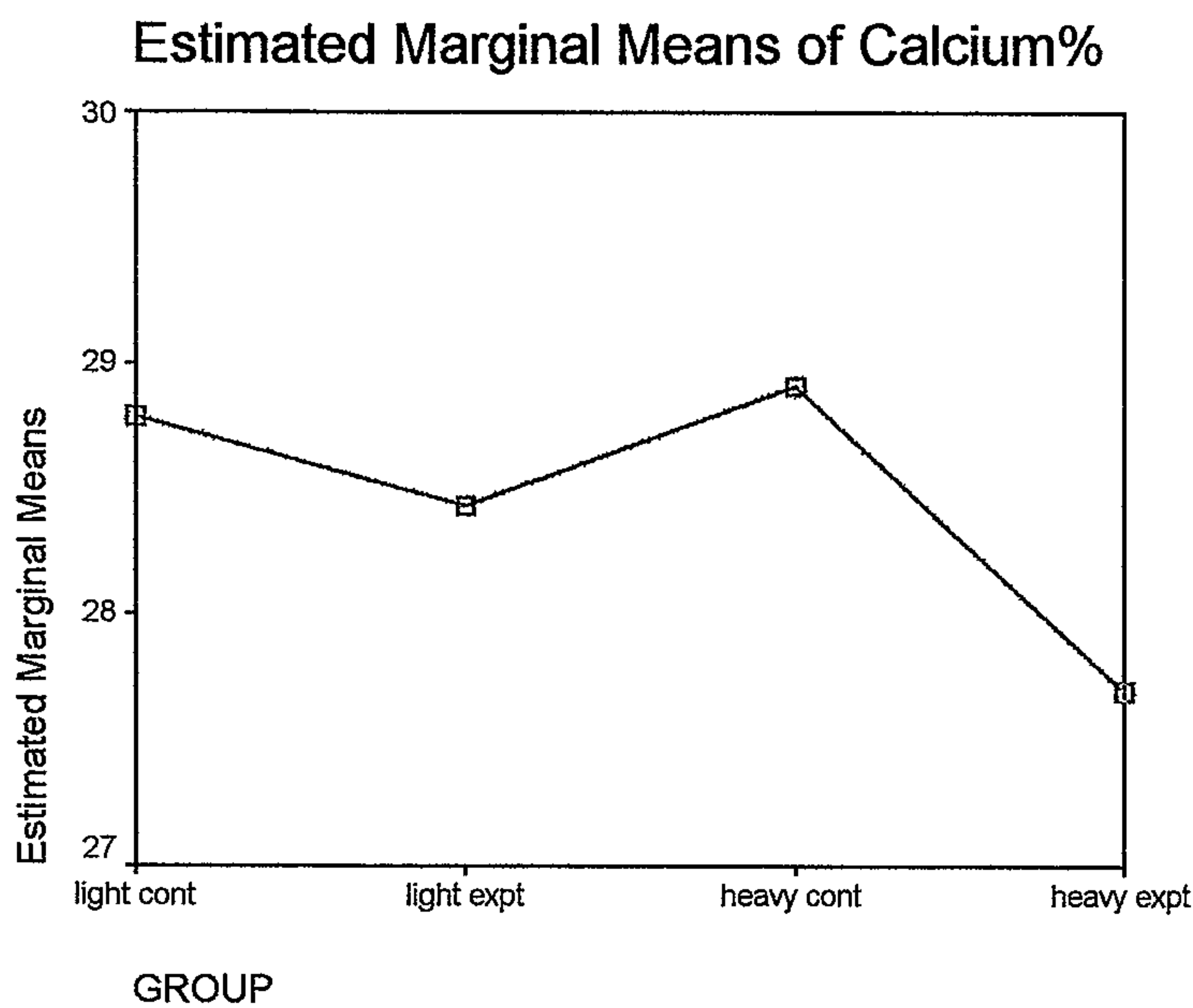
3. F% in the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.



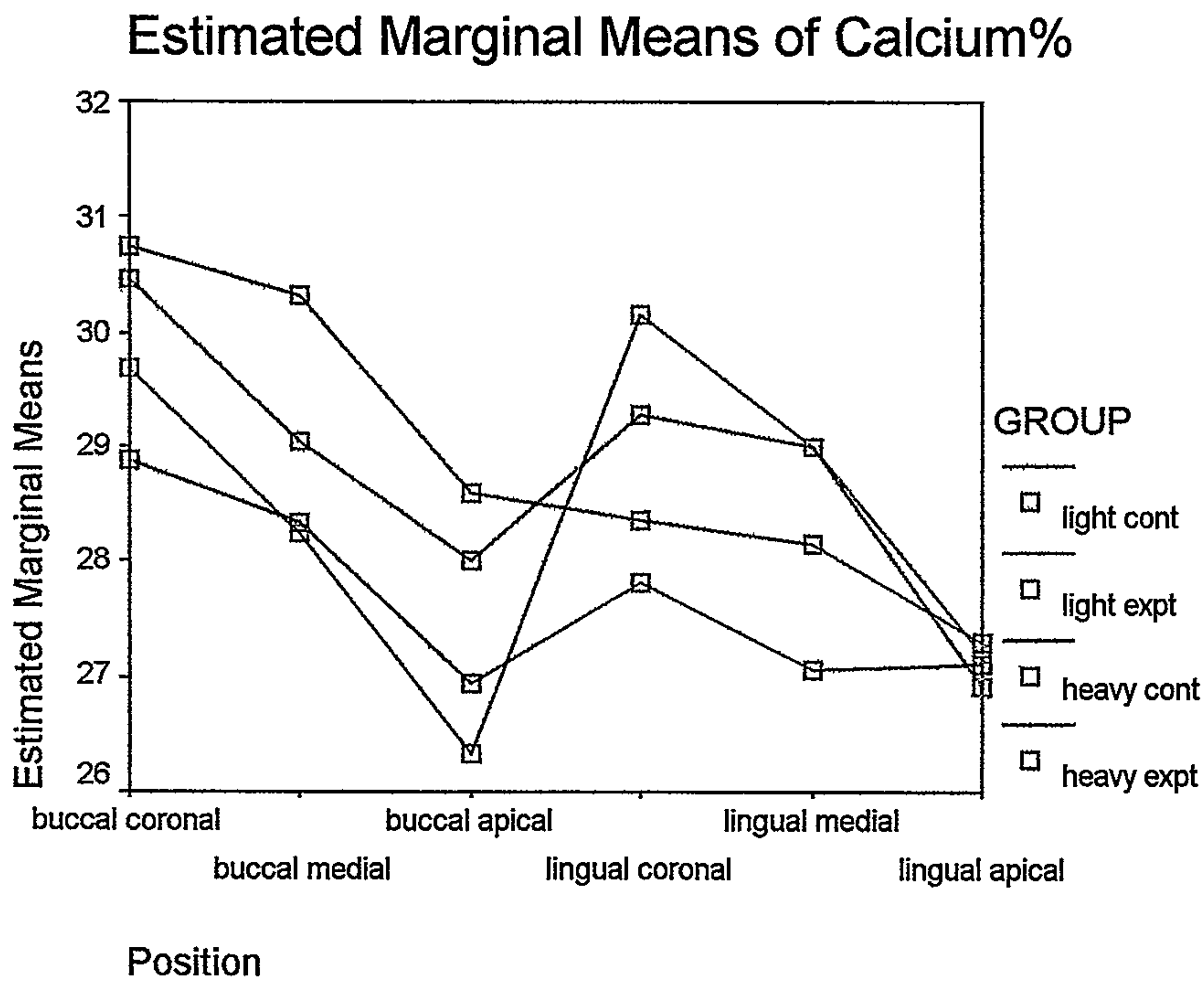
Profile Plots

Plots constructed from estimated marginal means derived from the UNIANOVA model.

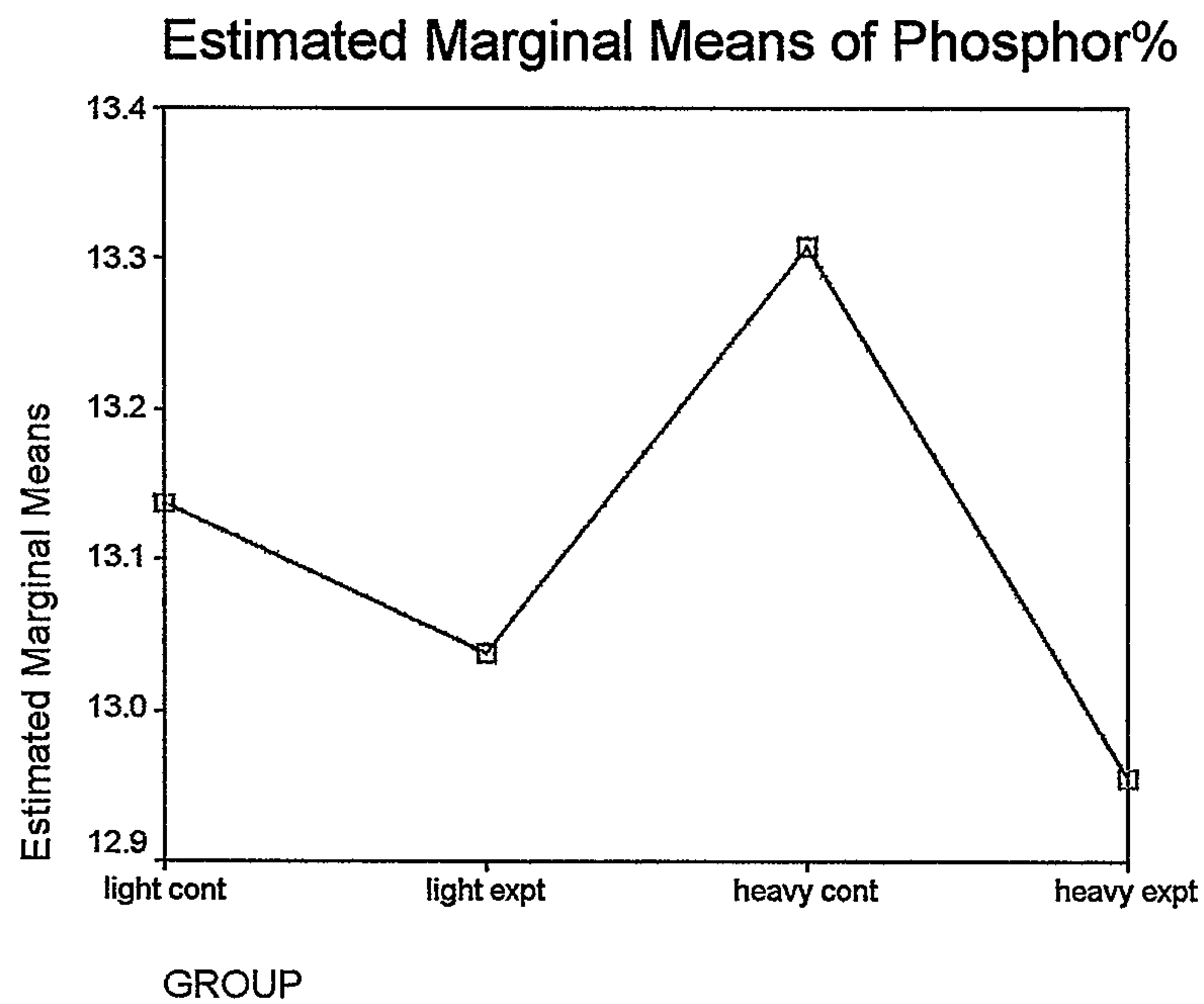
1a. Ca(%) for the 4 groups.



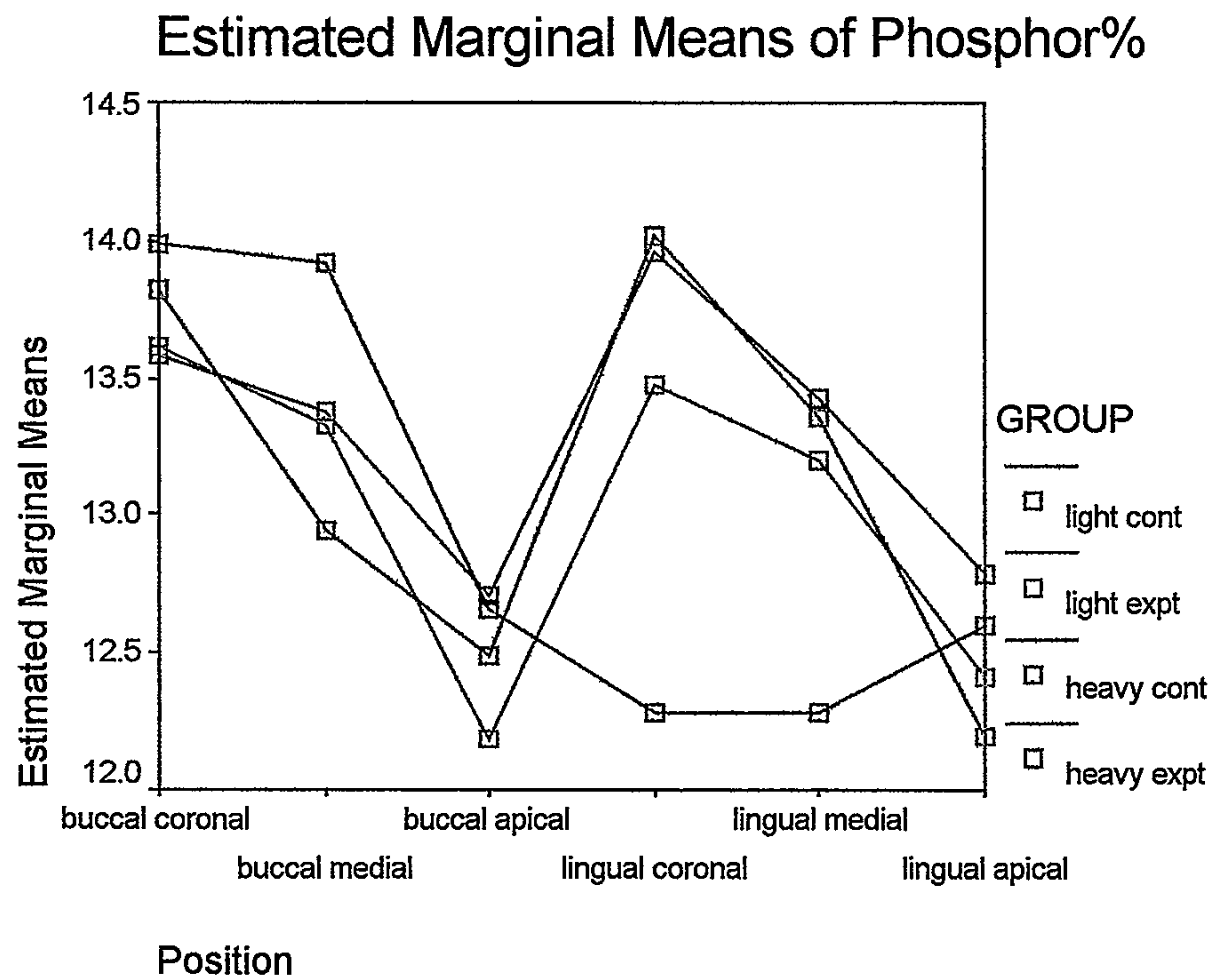
1b. Ca(%) in the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.



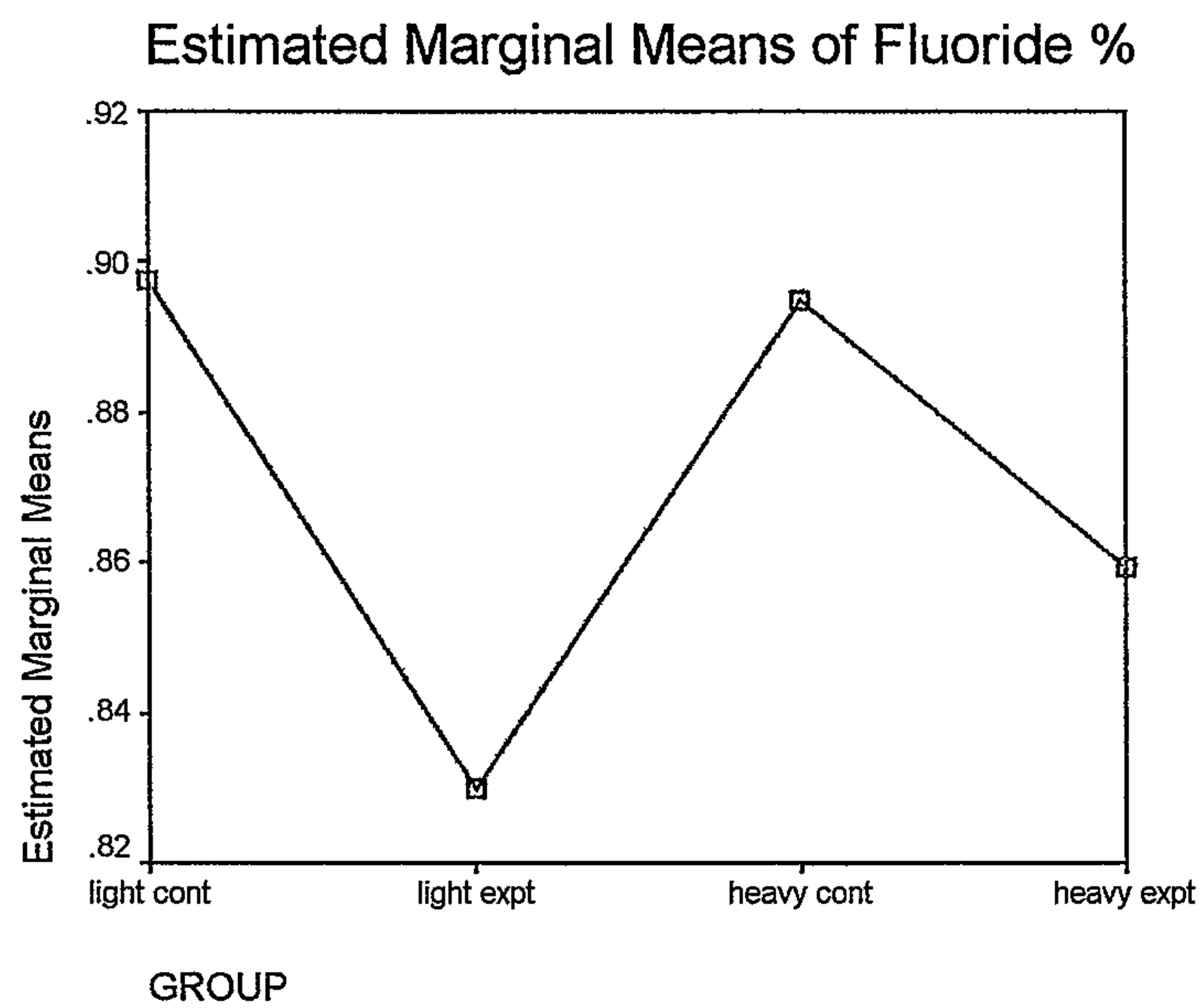
2a. P(%) for the 4 groups.



2b. P(%) for the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.



3a.. F(%) for the 4 groups.



3b. F(%) for the 4 groups on the buccal and lingual surface at the cervical, middle and apical third.

