

Are sand dunes of the lower Lachlan floodplain a graveyard for parna?

A.L. Ryan

Faculty of Agriculture, Food and Natural Resources, The University of Sydney, NSW 2006, Australia

Abstract

Æolian dust deposits are widespread in southeastern Australia, and are thought to have had a significant influence on soil properties and landscape evolution. However, the characteristics of pure æolian materials and the true extent of their distribution in this region remain unclear. This is due largely to the comparatively low rate of deposition, which has allowed for incorporation of dust into the receiving solum, thus obscuring its origin and particular properties. The dominant model for æolian dust deposits in southeastern Australia is 'parna,' an aggregated material comprised of clay, carbonate and silt-sized quartz, and thought to have been deposited across the Riverine Plain. On the lower Lachlan floodplain at Hillston, the western border of the proposed zone of parna deposition, source-bordering sand dunes occur as a repeated feature. A number of these sand dunes have been found to contain a distinct component of fine material that is possibly æolian in origin. To ascertain the likely provenance of this fine material, and to assess whether it conforms to the notional model for parna, three source-bordering sand dunes were studied. Soil was sampled from each of three distinct phases identified within the three dunes: (1) an upper-slope phase of coarse brown sand, (2) a mid-slope layer of red, possibly clay-enriched, sand and discrete clayey lamellae and (3) a lower slope phase of coarse sand dominated by an accumulation of carbonate 'glaebule' structures. Granulometric properties of the material in each phase were assessed by particle-size analysis, the clay mineral suite was determined by x-ray diffraction, micromorphological features examined in thin section, and grain morphology assessed using scanning electron microscopy. The clay-enriched phase of each dune revealed a distinctly bimodal particle-size distribution, with one conspicuous particle population in the 30–60 µm range, and another in the fine-silt/clay range (<10 µm). Such bimodality is considered characteristic of southeastern Australian æolian dust deposits. The abundance of illite and kaolinite in the clay mineral suite of the upper two dune phases, coupled with a conspicuous absence of smectite, further suggests an allochthonous æolian origin, as the surrounding floodplain is smectite-rich, and inherently low in illite. Micromorphological features within the clay-enriched phase, including abundant anisotropic argillans (clay-coatings), and a laminated arrangement of 30–60 µm particles indicate that this clay is a depositional feature, illuviated from surface horizons and re-deposited at depth. A similar illuvial origin is suggested by the fine crystalline nature of the calcium carbonate accumulation, ubiquitously coating the matrix

mineral grains of the lower dune phase. No discrete ‘parna’ aggregates were identified, however all the necessary components (30–60 μm quartz grains, clay, and carbonate) were identified as separate entities, spatially separated within each dune. The consistency of these features between the three dunes further supports the hypothesis of an analogous æolian dust accession. This dust would have been spread uniformly across the landscape, potentially playing an important role in pedogenesis of the agriculturally important regional soils.

Keywords: Æolian dust; Parna; Source-bordering dunes; Micromorphology; Clay mineralogy; Granulometry
