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Predicting aquifer characteristics and connectivity in Australia's complex regolith landscapes

K.C. Lawrie, J. Clarke and C. Pain

Cooperative Research Centre for Landscape, Environments & Mineral Exploration (CRC LEME), c/o Geoscience Australia, GPO Box 378, ACT 2601. Tel: 02 6249 9847; Fax: 02 6249 9930; e-mail: ken.lawrie@ga.gov.au

Much of the Cainozoic material covering inland Australia consists of variably weathered fluvial, marine, or lacustrine sediments, preserved as a complex mosaic of palimpsest depositional and erosional landscapes. Consequently, datasets that display present day surficial attributes may not adequately describe or predict sub-surface catchment characteristics. This applies particularly in many largely alluviated valleys, where the present-day, rather flat, subdued landscapes may mask a complex palaeotopography that has been largely filled and covered by sediment packages.

Significantly, much of the sediment infill has itself been weathered, and this can radically change the transmissivity of materials. New sedimentary facies models may be required, because the materials being eroded and deposited are often deeply weathered, and do not fit classic terrestrial depositional models. Alluviation of valleys buries geological units in lower landscape positions. These units become unavailable as sources for younger sediments. Thus the composition and texture of materials at depth may be significantly different from surface materials. Transported regolith also masks palaeo-surfaces (disconformities), especially where texture, colour and minerals of both sediments and saprolite are similar.

Overall, present environments are not always a good key to those of the past. Similarly, 'standard' sedimentary facies models, based on examples from elsewhere in the world, may not be particularly applicable in Australia's unique landscapes, while the controls on the nature and extent of weathering of sediments across the continent are very poorly understood. However, the scale and distribution of geomorphic features on

the surface should not be discarded entirely, as these can often provide a guide to the likely distribution, scale and connectivity of aquifers in the shallow sub-surface (top 10-20m). At greater depth, in the top 200m, greater uncertainty is present in model extrapolation, and these issues are often compounded by a paucity of sub-surface spatial data.

Therefore, to model regolith basin architecture and aquifer systems in these landscapes, a multi-scale approach has been developed, utilising a hierarchical approach to recognising landscape units. In addition, where appropriate, either existing models of sedimentary facies, or new models, are used within this hierarchical framework to map groundwater flow and smaller hydrogeomorphic units, while additional methods are used to predict aquifer properties, connectivity and extent in data-rich catchments. In this paper, examples are given from contrasting study areas. It is shown how multi-scale, rules-based approaches can provide greater certainty in mapping regolith architecture, aquifer systems.