DETAILED REGOLITH-LANDFORM MAPPING FOR MINERAL EXPLORATION: THE WAHRATTA 1:25,000 REGOLITH-LANDFORM MAP

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INTRODUCTION

The Wahratta 1:25,000 scale regolith-landform map sheet area, 25 km to the east of Broken Hill, in western New South Wales, contains some of the eastern-most exposures of Broken Hill-type rocks and is dominated by regolith cover. Less than 5% of the area has exposed bedrock. The Wahratta 1:25,000 regolith-landform map characterises the distribution of regolith materials and their associated landforms, previously mapped as uniform "Cainozoic cover" in an area where prospective rocks are likely to exist at depth.

REGOLITH MAPPING AND BROKEN HILL

Regolith-dominated terrains in the Broken Hill region have traditionally been mapped uniformly as 'Cainozoic rock units', limiting an understanding of the landscape as a whole. Traditional geology maps published for the region show where bedrock is exposed at the surface. These areas tend to correspond with known mineralisation. However, contrary to the geological mapping, highly prospective rocks also exist in regolith-dominated terrains adjacent to these exposed bedrock areas, buried at variable depth by transported sediments and weathered materials. Surface expressions of mineralisation are identified when metals are dispersed through the landscape mechanically (sediment and seed transport), hydromorphically (regolith and groundwaters) and biochemically (interaction with plants).

Regolith-landform mapping at 1:25,000 scale in the Broken Hill region was initiated during the work of Hill (2000). While mapping regolith-landforms at the regional 1:100,000 scale (Hill 2001), the need for more detailed mapping was identified. The purpose of the Broken Hill 1:25,000 regolith-landform mapping project is to characterise regolith materials and their associated landforms, and to identify surface dispersion pathways. This work complements the existing 1:25,000 scale geology map series, published in the late 1970s and early 1980s.

Detailed regolith-landform maps are a useful tool for realising the potential of a regolith-dominated area by providing a systematic framework in which to carry out mineral exploration. For mineral explorers, tenement-scale regolith-landform maps help locate, identify and characterise regolith sampling media. Furthermore, they provide a context in which to place the sampling media by identifying geochemical dispersion pathways within the contemporary landscape.

Land managers and pastoralists also find these maps useful for developing land management practices. At an individual property scale, the distribution of soil and vegetation types together with areas of erosion and deposition were identified. Scientists and students working in western New South Wales can also use these maps to contribute to understanding of wider regolith and landscape evolution research.

THE WAHRATTA AREA

The Wahratta 1:25,000 scale regolith-landform map addresses the following aims:

- To produce a 1:25,000 scale regolith-landform map by identifying, characterising and correlating components of the landscape and regolith within the Wahratta sheet area,
- To consider models for the genesis of regolith materials and the landscapes encountered in the Wahratta region, and relate these findings to processes of regional landscape evolution and regolith formation,
- To sample and map the distribution of regolith sampling materials in the Wahratta sheet area,
- To provide a geochemical framework in areas of poorly known mineral exploration potential, and
- To consider the implications of the above points for scientific research, mineral exploration and land management.

METHODOLOGY

After recognising that the regolith-landforms of Wahratta map sheet needed to be mapped, previous mapping and geophysics for the area were examined and the best possible aerial photographs for the area were acquired. The 1:25,000 regolith-landform map production methodologies will be detailed in Foster (in prep.).

In: Roach I.C. ed. 2003. *Advances in Regolith*, pp. 133-136. CRC LEME.

The system used to map the Broken Hill 1:25,000 regolith-landform map series is based largely on the RTMAP unit scheme described in Pain *et al.* (2000). This approach takes into account the purpose of the mapping program and the end-users of the map product, while maintaining the integrity of a systematic division of materials and landforms. This scheme is used because it is independent of an interpreted chronology or stratigraphy (Hill 2002).

The RTMAP system divides regolith materials into transported and *in situ* categories, and then further subdivides each of these. For example, transported materials are divided into aeolian, alluvial, colluvial and lacustrine sediments, and *in situ* materials are divided according to weathering grade. The RTMAP scheme also provides a comprehensive list of landforms, hierarchically divided according to type. A combination of regolith materials and landforms are represented on each map unit polygon as a 3 to 4 letter code, together with a numerical modifier to further subdivide broadly similar units. For example, ACar1 is alluvial sediments ('AC') within an alluvial tract ('ar') and has the specific characteristics ('1').

A map unit table (database) was developed specifically for the 1:25,000 scale mapping project. Under the headings of *regolith lithology, landform, surface form, minor attributes* and *vegetation*, a series of descriptive unit characterisations were assembled with little genetic interpretation. This database of units can be used and modified for future 1:25,000 scale mapping projects.

WAHRATTA REGOLITH-LANDFORM UNITS

The major regolith landform units of the southern Broken Hill Block and northern Murray Basin margins are made up of low hills and rises comprising variably weathered bedrock and indurated regolith materials as well as broad alluvial and colluvial systems in the lower parts of the landscape. A significant aeolian component contributes to the regolith materials across the entire landscape. The low relief Wahratta area, between 140 m and 200 m in elevation, lies to the east of the north-south trending Barrier Ranges. Yancowinna Creek, Twenty Five Mile Creek and their tributaries drain to the south east. Wahratta is within the Stevens Creek Catchment and the Yancowinna Creek Catchment, both draining to the Murray Basin.

A brief, general description of the major regolith and landform types in the Wahratta area are provided below.

Alluvial

Alluvial regolith-landform associations in the Wahratta area comprise alluvial sediments within channels (ACar), swampy channels (ACaw), alluvial (Aap) and depositional (Apd) plains, alluvial fans (Afa), drainage depressions (Aed) and swamps (Aaw). Older alluvial materials are also preserved in the contemporary landscape where they are indurated by silica or iron oxides (Aer). The two major channels in the Wahratta area are Yalcowinna Creek in the north east and Stephens Creek in the south west. These ACar1 units grade upstream into smaller channels (ACar2) with slightly different stream sediment composition and vegetation. The ACar units tend to be bordered by depositional alluvial units, such as Apd and Aap units. The Apd units are dominantly depositional while the Aap units are more active areas of erosion and deposition and host prickly wattle vegetation. Within the channels in the southeast, elongate Apd units occur. These alluvial sediments are dominated by quartzose and lithic sands and gravels, with minor silts and clays. The large alluvial channels tend to be dominated by an open woodland of river red gums (*Eucalyptus camaldulensis*), whilst other alluvial units, such as plains, swamps, drainage depressions and fans, are likely to host a chenopod shrubland. Aed units are gently sloping drainage depressions, including an erosional alluvial channel (typically with no sediment, bedrock exposure occurs), sections of colluvial sheetflow and alluvial deposition.

Colluvial

Broad colluvial units dominate the margins of the southern Broken Hill block and northern Murray Basin area, including the Wahratta area to the east. These regolith-landform units usually comprise sub-rounded to sub-angular lithic and quartzose sands and gravels, associated with landforms including rises (CHer), depositional (CHpd) and erosional (CHep) plains, sheet flow fans (CHfs) and drainage depressions (CHed). They are vegetated by chenopod shrublands, containing mostly species of bladder saltbush (*Atriplex vesicaria*) and bluebush (*Maireana sp.*), with minor grasslands or open woodlands of casuarina (*Casuarina pauper)* and mulga (*Acacia aneura*). In some cases colluvial landforms display a distinctive contour banding pattern. Like most of the southern and eastern flanks of the Barrier Ranges, the Wahratta area is dominated by large (10 m to 15 km at the longest axis) depositional plains of variable thickness (0.5 m to 10 m) which are principally the result of sheet flow. During mapping these can be separated into lobes and subdivided according to differences in vegetation and surface lag lithology. On the eastern side of the mapping area are slightly elevated (less than 5 m about surrounding plains) erosional plains (CHep), dominated by sheet flow surface processes. It is important to distinguish these units as regolith carbonate accumulations that prefer these sites to the surrounding plains.

Aeolian

Well-sorted, red-brown fine sands and silts contribute to most regolith materials over western New South Wales. It is considered as a minor component of most regolith landform units, but occurs in a significant enough quantity to warrant being named an aeolian unit. In the Wahratta area, only one type of aeolian regolith-landform unit was identified while mapping—a depositional plain made up of dominantly aeolian materials (ISps). These sediments accumulate as undulating sand plains and are colonised by closed shrublands dominated by weeds (*Cassia sp*. and *Dodonaua sp*).

Saprolith

Slightly and moderately weathered bedrock exposures are associated with low hills, rises and erosional plains in the north-west and south-west of the Wahratta area. The original lithology and texture of the rock is identifiable and primary minerals are replaced, to varying degrees, by clays and iron oxides on the surface and in open fractures. Numerous sites have been identified in the Wahratta area where bedrock is near to the surface and has not been previously mapped. The vegetation that mainly colonises these regolith-landform units is a chenopod shrubland dominated by bluebush (*Maireana sp*.) and bladder saltbush (*Atriplex vesicaria*), with open woodlands featuring casuarinas (*Casuarina pauper*) and mulgas (*Acacia aneura*).

Indurated regolith materials

Traditional geology maps for this region have represented the location of silcretes, ferricretes and calcretes with limited descriptions and general outlines. This is particularly true for the Wahratta area, where several previously unidentified and unmapped silcretes were located and mapped. The new 1:25,000 scale series refines their location and landscape boundaries and maps the material more specifically. For example, silcretes are classified according to the material that has been silicified (e.g. alluvial sediments or highly weathered bedrock) and the associated landform, with an overprint pattern (on the polygon) to show siliceous induration. Iron-oxide indurated regolith is represented in the same way. Regolith carbonate accumulation (RCA or 'calcretes') occurrences are often too small to map at 1:25,000 scale so their occurrence is described in the minor attributes section of the regolith-landform unit description. The morphology of the RCA is also recorded.

EXPLORATION STRATEGIES FOR THE WAHRATTA AREA

In transported regimes, stream sediment sampling can be a reliable vector for mineralisation, provided the sediment type, sediment source and the likelihood that these materials have travelled considerable distances is considered. Vegetation may also be a reliable sampling media in these areas. Elsewhere in the Stephens Creek catchment, groundwater and river red gum chemistry have been used successfully as sampling media to identify mineralisation (Dann 2001). In sheetflow areas, one must consider sediment type and source, the distance travelled by the material and vectors to its source. Aeolian sediments will display a diluted response and it must be considered that these sediments have travelled a significant distance.

In *in situ* regimes, traditional bedrock sampling programs can be used in these areas if the type of weathering, the degree of weathering, and the secondary mineral development is taken into account. Sampling of materials such as regolith carbonate accumulations and silcretes are showing promising initial results.

CONCLUSION

The competitive advantage for mineral explorers in the regolith-dominated terrains surrounding the outcropping riches of Broken Hill will go to the exploration company brave enough to explore within 'the dirt'. These companies will be armed with tenement-scale regolith landform maps, such as the Wahratta 1:25,000 scale regolith-landform map, which characterises all the elements of the landscape and its materials. By recognising and understanding these materials and their place in the landscape, explorers can realise the mineral potential of the regolith-dominated margins at Broken Hill and beyond.

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Acknowledgments: The author gratefully acknowledges the support of the Cooperative Research Centre for Landscape, Environments, and Mineral Exploration and the New South Wales Department of Mineral Resources and Geoscience Australia, and co-workers and contractors within these organisations. In particular the author wishes to acknowledge Steve Hill, for sharing his knowledge and passion for the Broken Hill region and for his invaluable collaboration, inspiration and support. The cooperation of Broken Hill landholders is also appreciated. Kylie Foster publishes with the permission of the CEO, Geoscience Australia.