WONNAMINTA 1:100 000 MAP SHEET, NEW SOUTH WALES

D.L. Gibson

CRC LEME, Geoscience Australia, PO Box 378, Canberra, ACT 2601
Dave.Gibson@ga.gov.au

INTRODUCTION

The WONNAMINTA 1:100 000 (7336) map sheet area covers part of the northern Koonenberry Belt (previously called the Wonominta Block), between latitude 30°30' and 31°00'S and longitude 142°00' and 142°30'E in northwestern NSW, about 150 km northeast of Broken Hill (Figure 1). The following summary is based on regolith–landform mapping and the interpretation of regolith and landscape history undertaken by Gibson (1999, 2000a, 2001).

PHYSICAL SETTING

Geology

Most of the area lies within the northern part of the Koonenberry Belt, an inlier of dipping late Precambrian to early Palaeozoic low-grade meta-sedimentary and meta-volcanic rocks, and less-deformed Devonian sandstone, northeast of Broken Hill (Mills, 1992, 1997) (Figure 1). Mesozoic sandstone, conglomerate and mudstone of the Eromanga Basin are present as thin sheets in the northeast and northwest, and as isolated outliers over much of the remaining area.

Geomorphology

Much of the area comprises undulating erosional rises and plains developed on the late Precambrian–early Palaeozoic basement rocks (Figures 1, 2). Gently- to moderately-dipping outliers of Devonian sandstone and conglomerate form the Turkaro Range (a broad low range with a planated summit surface) in the southern part of the area, and Koonenberry Mountain (a 200 m high steep ridge) in the northeast. Mesozoic sediments form mesas and undulating plateaux, and three relatively steep 60 m hills in the central part of the area. Dunefields with longitudinal and reticulate dunes dominate low-lying areas in the southwest, and thin aeolian sand sheets are present in the southeast (Figure 1). A well-formed intermittent drainage system characterised by gullies incised into alluvium is present over most of the area, draining to local sumps in sandplains to the north and west.

Climate and vegetation

The climate is hot and dry, with much of the highly variable rainfall falling during the summer and winter storms (Bell, 1972; Macdonald, 2000). Vegetation (Milthorpe, 1972a,b; Walker, 1991) consists mainly of saltbush and bluebush. Erosional plains

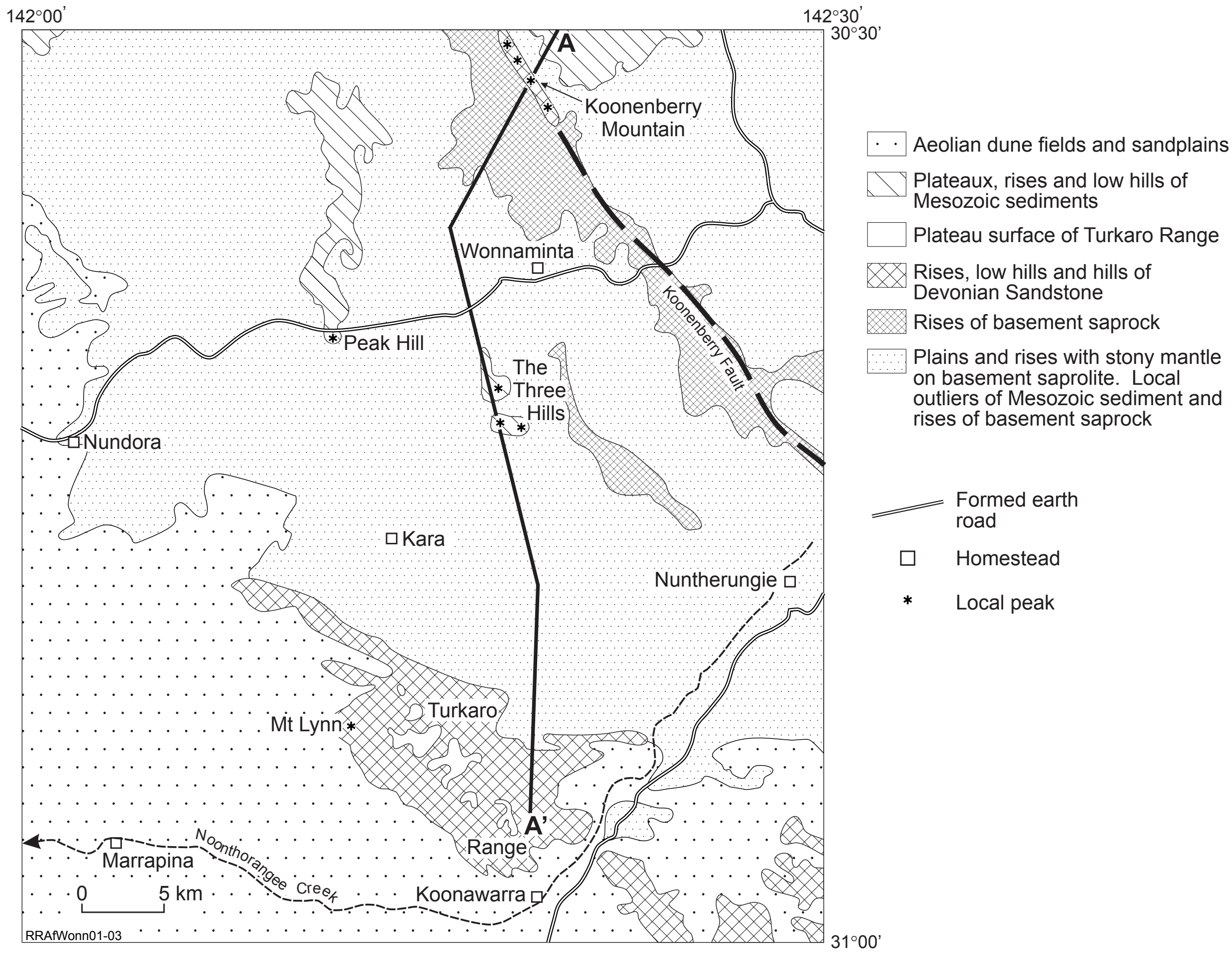

Figure 1. Location and major regolith–landform divisions of the Wonnaminta 1:100 000 map sheet. Section A–A' shown in Figure 2.

and rises are dominated by saltbush, bluebush, grasses, forbs and copperbush, with lesser Mulga (*Acacia aneura)* and other small trees. Belah (*Casuarina cristata*) and white cypress pine (*Callitris columellaris)* are common in areas of aeolian sand, whereas rugged areas of Devonian sandstone are characterised by mulga and grasses with some white cypress pine. River gums (*Eucalyptus camaldulensis*) are present along major drainage lines. All of the area is used for low intensity grazing on pastoral leases. The natural vegetation has been significantly affected by the introduction of domestic animals and rabbits (Bailey, 1972).

REGOLITH–LANDFORM RELATIONSHIPS

The late Precambrian to early Palaeozoic basement rocks are characterised by two contrasting regolith–landform associations (Figures 1, 2). Most of the rocks are highly weathered and form undulating plains and rises underlain by saprolite, with gypseous and calcareous loamy to clayey soils (which may be partly aeolian-derived). The upper part of the saprolite locally merges with gypseous clay. A stony mantle is widespread. This is principally composed of resistant basement-derived clasts (mostly angular fragments of quartz and quartz–iron-oxide veins, ferruginised basement saprolite, and resistant rock fragments, such as quartzite), material derived from a former Mesozoic cover (fragments of silicified[1] and ferruginised sediment, and rounded pebbles reworked from conglomerate), and small rounded magnetic ferruginous clasts (origin unknown). The stony mantle is colluvial, as clasts have been physically dispersed from source areas.

The small-scale topography, soil and vegetation within this association are mostly partitioned into zones roughly parallel to topographic contours (tiger stripe banding or contour gilgai), with a stepped micro-topography of unvegetatated risers with red desert loam soils and stone-free vegetated steps with self-mulching red clays (Macdonald and Melville, 2000; Macdonald *et al*., 1999).

The second regolith–landform association occurs where the late Precambrian to early Palaeozoic basement rocks are more resistant and less weathered, as in the case of where they are more siliceous (Figures 1, 2). Here, the topography is steeper and the regolith comprises skeletal soils with a mantle of fragments of local rock types overlying saprock.

The Devonian sandstones are mostly slightly weathered, forming rocky rises and hills with skeletal soils, and in many places a mantle of sandstone fragments (Figures 1, 2). Colluvial scree is locally present (Figure 2). The planated summit surfaces of the Turkaro Range are characterised by loamy calcareous soils with a mantle of fragments of silicified sediment, and rounded clasts of quartz and sandstone, some with adhering silcrete matrix, indicating derivation from sediment. The composition of the mantle suggests that Mesozoic sediments once overlay the Devonian sediments forming the Turkaro Range.

Surviving Mesozoic sediments are highly weathered and host to bodies of silicified and ferruginised sediment at various stratigraphic and topographic levels (Figures 1, 2). These resistant regolith types are reflected by the presence of local steep low peaks, scarps and breakaways. Most areas of Mesozoic sediments are characterised by a mantle of fragments of silicified and ferruginised sediment, and rounded clasts (mostly milky quartz, but also detrital clasts of Devonian sandstone) reworked from the sediment (Figure 2).

Some scree slopes beneath silcrete outcrops have been partly cemented to form a thin hardpan with a red earthy matrix enclosing clasts. The hardpan protects the slope from erosion. However, where it has been breached, the underlying highly weathered materials are easily eroded.

Alluvial sediments (and local source-bordering dunes) occupy

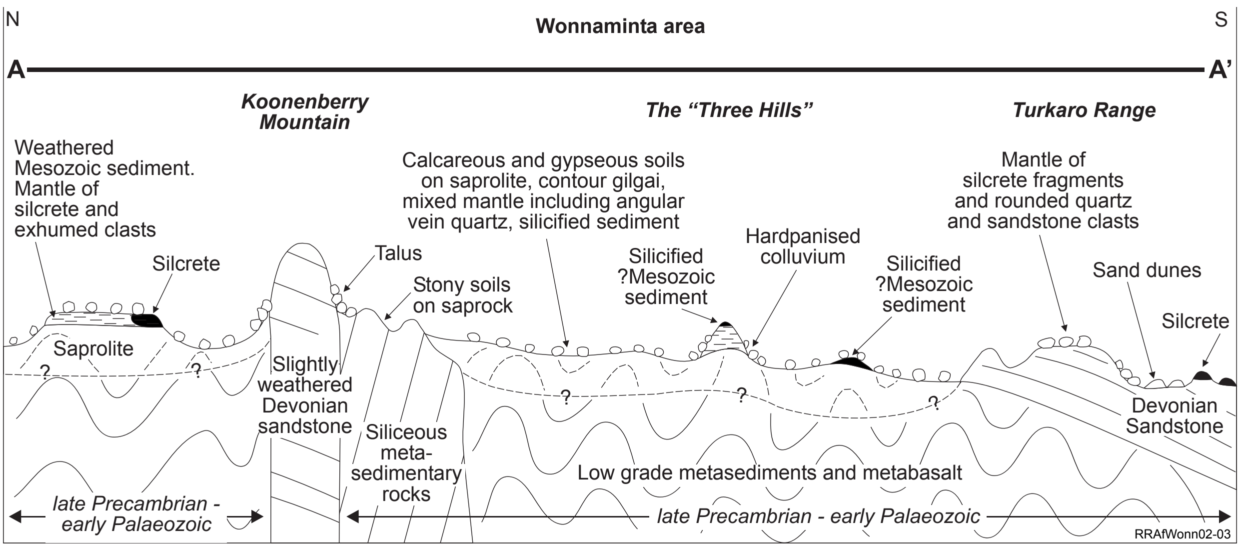

Figure 2. Schematic regolith–landform relationships in N–S zone across the Wonnaminta 1:100 000 sheet. See Figure 1 for location.

[1] Silicification of the Mesozoic sediments has been intense leading to the formation of silcrete.

valley floors. Outcrops of basement saprolite in gullies suggest that the sediments are mostly only a maximum of a few metres thick. Aeolian sand in dunefields (Figure 1) has been derived from Cenozoic depocentres to the west of the area. Longitudinal dunes predominate over part of the dunefields, but irregular reticulate networks of dune ridges are also present. Sand sheets in the southeast have originated by deflation of residual soils over Devonian sandstone in the local area, and are mostly devoid of dunes.

REGOLITH AND LANDSCAPE EVOLUTION

Because the ages of weathering and post-Mesozoic deposition have not been directly determined, the stages in regolith and landscape development reported on here are only relative and based on field relationships.

Sediments of the Eromanga Basin were deposited over the area in the Late Jurassic to Early Cretaceous, covering the existing landscape with a blanket of sandstone and conglomerate (with rounded pebbles to boulders), and then mudstone (which contains scattered rounded quartzite and quartz boulders, indicating possible ice-rafting). Field relationships between the Mesozoic sediments and the Devonian sediments of the Turkaro Range and Koonenberry Mountain indicate that these topographic features were present prior to sedimentation, and were subsequently buried (Turkaro Range) or at least partly buried (Koonenberry Mountain) by the Mesozoic sediment (Gibson, 2001). Boulder conglomerates with locally-derived clasts of sandstone up to 2 m in diameter, mixed with rounded quartz pebbles were locally deposited as part of the Mesozoic sediment around the margins of the palaeo-Turkaro Range.

It is not known whether the late Precambrian to early Palaeozoic basement rocks were already weathered at the time of Mesozoic deposition. However, the dominantly low relief on the Palaeozoic–Mesozoic unconformity preserved in outliers away from the palaeo-highs indicates a gentle palaeo-topography.

Following Mesozoic sedimentation, most of the Eromanga Basin sediments were eroded, at least partly as a result of lowered base levels produced by regional warping. Weathering occurred intermittently both during and after erosion, with silica and iron oxides being precipitated in favourable sites within the sediment, probably mostly in the subsurface. The underlying late Precambrian to early Palaeozoic basement rocks and Devonian rocks were generally not affected by cementation, although outside of the map sheet area there is evidence of both silica and iron oxide cementation of basement saprolite immediately below the unconformity. Silica has also impregnated fractures in some Devonian sandstones near the crest of the Turkaro Range. Some of the cemented Mesozoic sediment was then exposed by further erosion, and resistant cemented fragments were dispersed downslope to form a stony mantle (Figure 2). The contrast in erodibiliy of the cemented materials with the surrounding weathered sediment most likely resulted in the formation of scarps and breakaways, and local plateau surfaces.

Over most of the area, erosion has proceeded past the unconfomity (i.e., past the landsurface at the time of onset of Mesozoic sedimentation) to re-expose the late Precambrian–early Palaeozoic basement rocks. In most outliers of Mesozoic sediment, the unconformity is preserved only a few metres to a maximum of a few tens of metres above the surrounding low relief areas. Thus it is probable that a maximum of a few tens of metres of basement materials have been eroded since exhumation of the pre-sedimentation land surface. This implies very low rates of net erosion, and has resulted in the unusual situation where the stony mantle over weathered basement rocks includes not only basement-derived material, but also resistant material derived from the previously-overlying Eromanga Basin sediment. Erosion has also exhumed the palaeo-Turkaro Range and Koonenberry Mountain. There has probably been little erosion of the resistant Devonian sandstone since removal of the surrounding Mesozoic sediment.

Increasing aridity during the Quaternary has resulted in the aeolian reworking of sediment deposited in local depocentres to form dunefields downwind of the depocentres, and aeolian reworking of sandy residual soils. In addition, it is probable that finer sediment has been deposited as dust throughout the area, adding fine sediment and possibly salts to soils, and indirectly to alluvium derived by erosion of the soils. Regolith carbonate is common in many soils across the area, some of which overlie calcium deficient rocks. The calcium has most probably been blown into the area as a component of the dust, or introduced as part of the dissolved salt load of rainwater.

Neef (1998) suggested that Tertiary continental sediments of the Palaeogene Eyre Formation (Wopfner *et al*., 1974) may have been deposited over part of the area. However, there is increasing evidence that many of the rocks previously mapped as Eyre Formation in northwest NSW area are in fact of Mesozoic age (e.g. Gibson, 2000b; S.M. Hill, pers. comm. 2001). Neef (1998) and Neef *et al*. (1995) have also suggested that most silcrete in the general area was generated at an Oligocene land surface (the 'Cordillo Surface' of Wopfner, 1974). However, silcrete in the area clearly occurs at various levels within the Mesozoic sediment, locally with silcrete bodies one above the other. This situation could not have arisen from silicification at a Tertiary 'palaeosurface'.

REFERENCES

Bailey, P.T., 1972. Fauna of the Fowlers Gap-Calindary areas. I. Marsupial fauna. Fowlers Gap Arid Zone Research Station, University of New South Wales, Research Series 4: 153-159.

Bell, F.C., 1972. Climate of the Fowlers Gap-Calindary area. Fowlers Gap Arid Zone Research Station, University of New South Wales, Research Series 4: 41-67.

Gibson, D.L., 1999. Explanatory notes for the Broken Hill and Curnamona Province 1:500 000 regolith landform maps. CRC LEME, Perth. Open File Report 77. 59 pp.

Gibson, D.L., 2000a. Regolith, landform history and sampling strategies in the Wonnaminta area, Koonenberry Belt. In: Broken Hill Exploration Initiative, Abstracts from 2000 Annual Meeting. Australian Geological Survey Organisation (Geoscience Australia), Canberra. Record 2000/10. pp 41-44.

Gibson, D.L., 2000b. Post–Early Cretaceous landform evolution along the western margin of the Bancannia Trough, western NSW. The Rangeland Journal, 22: 32-43.

Gibson, D.L., 2001. Wonnaminta regolith landforms. CRC LEME, Perth. Open File Report 114. 41 pp.

Macdonald, B.C.T., 2000. University of New South Wales Fowlers Gap Arid Zone Research Station – nearly 50 years of research. Journal of Arid Environment, 41: 5-31.

Macdonald, B.C.T. and Melville, M.D., 2000. The impact of contour pattern furrowing on chenopod patterned ground at Fowlers Gap, western New South Wales. Journal of Arid Environment, 41: 345-357.

Macdonald, B.C.T, Melville, M.D. and White, I., 1999. The distribution of soluble cations within chenopod-patterned ground, Western New South Wales, Australia. Catena, 37: 89-105.

Mills, K.J., 1992. Geological evolution of the Wonominta Block. Tectonophysics, 214: 57-68.

Mills, K.J., 1997. Koonenberry Pre-Permian 1:250 000 geological sheet. Version 1. Geological Survey of New South Wales, Sydney.

Milthorpe, P.L., 1972a. Vegetation of the Fowlers Gap-Calindary area. Fowlers Gap Arid Zone Research Station, University of New South Wales. Research Series 4: 119-134.

Milthorpe, P.L., 1972b. Pasture and pasture lands of the Fowlers Gap–Calindary area. Fowlers Gap Arid Zone Research Station, University of New South Wales, Research Series 4: 135-151.

Neef, G., 1998. Early Cretaceous-Recent landscape evolution of the Copper Mine Range and adjacent areas far west New South Wales. Journal and Proceedings of the Royal Society of New South Wales, 131: 77-84.

Neef, G., Bottrill, R.S. and Ritchie, A., 1995. Phanerozoic stratigraphy and structure of the northern Barrier Ranges, western New South Wales. Australian Journal of Earth Sciences, 42: 557-570.

Walker, P.J., 1991. Land systems of western New South Wales. Soil Conservation Service of NSW. Technical Report 25.

Wopfner, H., 1974. Post Eocene history and stratigraphy of northeastern South Australia. Transactions of the Royal Society of South Australia, 98: 1-12.

Wopfner, H., Callen, R.A. and Harris, W.K., 1974. The lower Tertiary Eyre Formation of the southwestern Great Artesian Basin. Journal of the Geological Society of Australia, 21: 17-51.