TIBOOBURRA-MILPARINKA INLIERS, NORTHWESTERN NEW SOUTH WALES: REGOLITH AND LANDSCAPE EVOLUTION FIELD SITES

S.M.Hill
CRC LEME
School of Earth & Environmental Sciences
University of Adelaide
SA 5005

steven.hill@adelaide.edu.au

Appendix to:
Hill, S.M., Greenfield, J.E., Gilmore, P.G. & Reid, W.J., 2008. A guide for mineral exploration through and within the regolith in the southwestern Thomson Orogen, New South Wales. CRC LEME.

INTRODUCTION

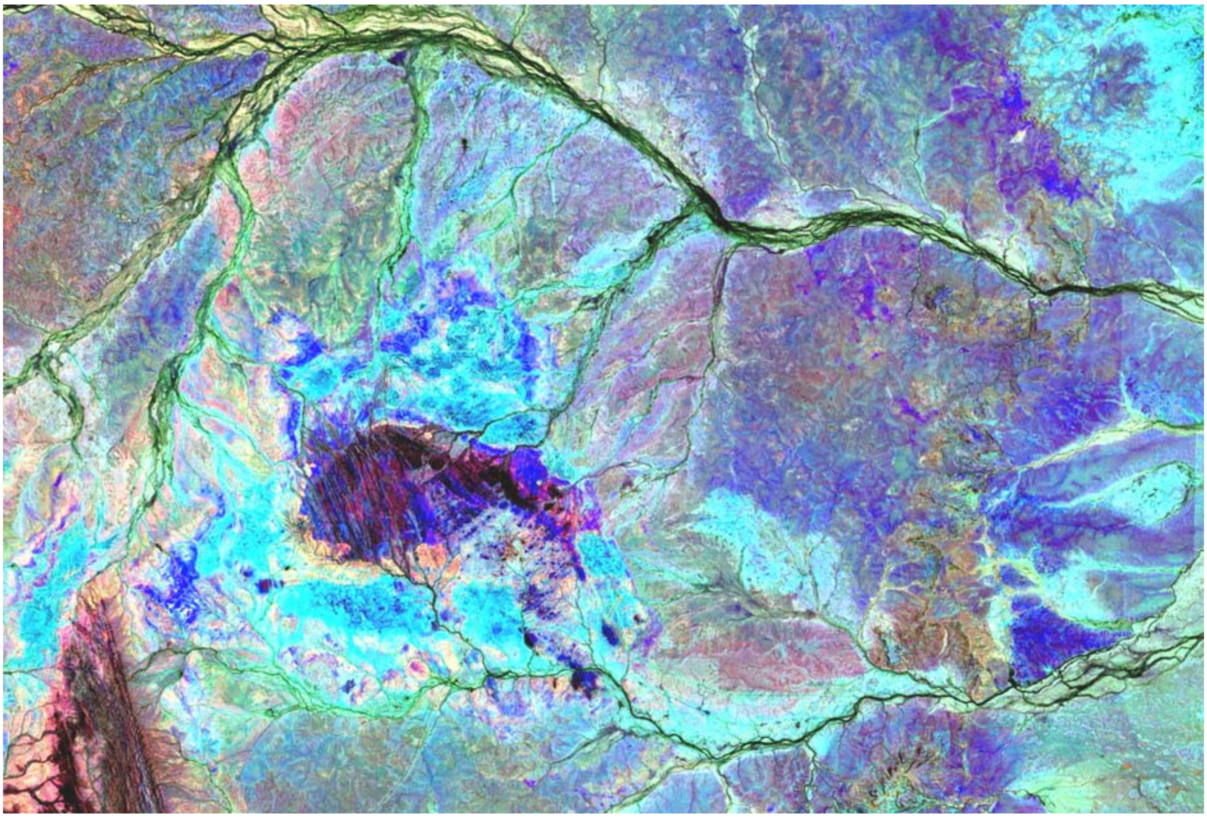
This field guide is a compendium of field sites investigated during CRC LEME regolith and landscape evolution fieldwork focused on the bedrock inliers and immediate margins in the Tibooburra-Milparinka region.

Rather than arranging field sites within a series of field days or journeys, they are presented here as individual field sites. Although providing less structure to the series of field sites this offers greater flexibility for users. Most field sites are relatively easily accessible to 4WD vehicles, however permission for land access is required from land-owners prior to visiting (it is your responsibility to organise this).

Unless otherwsie specified, GPS coordinates given here are according to Australian Map Grid (AMG) 66 datum. This was done in order to be consistent with previously published geological and topographic maps.

THE TIBOOBURRA INLIER

AND MARGINS



Introduction

The town of Tibooburra is centred on the Tibooburra Inlier. The inlier is central to a large dome-structure approximately 50 km in diameter and consists of a major intrusive body (mostly granodiorite) and surrounding Easter Monday Formation metasediments (Stevens & Etheridge, 1989; Greenfield & Reid, 2006). The inlier is overlain and flanked by Mesozoic and Cainozoic sediments, which host placer Au mineralisation.

The Tibooburra Inlier is part of an undulating range of hills and rises on the eastern margins of the Grey Range. Surrounding the inlier are extensive plains, which include the dunefields and alluvial outwash areas of the Strzelecki Desert to the west, and mostly sheetwash and alluvial plains to the north, south and east. The highest topographic relief occurs to the west of Tibooburra where hills reach up to 260 m above sea level. The adjacent plains are generally between 100 to 180 m above sea level. The upland area of the Tibooburra Inlier forms a local drainage divide between the Twelve Mile Creek catchment to the north and Thomsons Creek catchment to the south, which are both within the Bulloo-Bancannia Basin. Twelve Mile Creek and its tributaries drain the western and northern margins of the inlier, before flowing through Mt Wood Gorge and into Caryapundy Swamp (part of the Bulloo Overflow), and Thomsons Creek also flows into Caryapundy Swamp, after draining the southern and eastern margins of the inlier.

The dominant vegetation communities of the Tibooburra Inlier include (Hill *et al.*, 2005):

- mulga (*Acacia anuera*) woodlands and shrublands, with occasional emu bush (*Eremophila spp.*) and chenopod shrubs, mostly restricted to rises and hills with slightly weathered bedrock and lithosols. Sandsheets flanking the inlier also support extensive mulga woodlands and shrublands typically also with sandhill wattle (*Acacia ligulata*), and needlewood (*Hakea leucoptera*);
- open bloodwood (*Corymbia tumescens*) and whitewood (*Atalaya hemiglauca*) woodland with chenopod shrubs (*Atriplex spp.* and *Maireana spp.*), and drainage depressions colonised by prickly wattle (*Acacia victoriae*), mostly on undulating hills and rises composed of granite;
- chenopod shrublands dominated by saltbush (mostly *Atriplex vesicaria*) and bluebush (mostly *Maireana pyramidata*) with occasional prickly wattle trees (*Acacia victoriae*), widespread across the region but particularly on small rises adjacent to the inlier composed of Mesozoic and Cainozoic sediments, and hills and rises composed of weathered metamorphic bedrock;
- eucalypt woodlands dominated by river red gum (*Eucalyptus camaldulensis*), coolibah (*Eucalyptus microtheca*) and occasional thickets of gidgee (*Acacia cambagei*) and beefwood (*Grevillea striata*), along major ephemeral drainage systems; and,
- grasslands dominated by mitchell grass (*Astrebla spp.*), with some neverfail (*Eragrostis setifolia*) on the extensive gibber covered plains flanking the inlier.

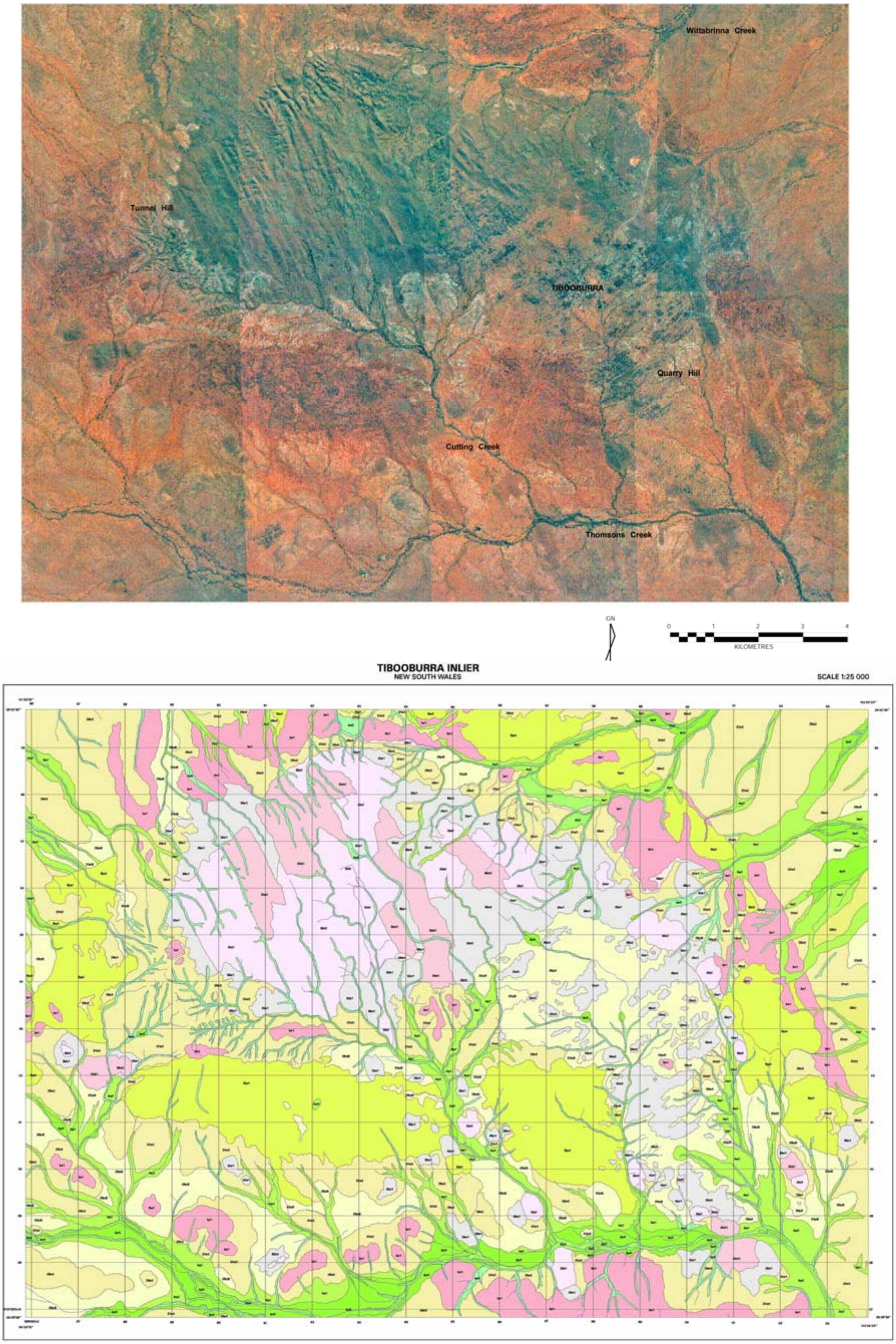


Figure 1: Air photograph mosaic of the Tibooburra Inlier and margins (from Chamberlain, 2001) and reduction of 1:25 k regolith-landform map (Chamberlain & Hill, 2003).

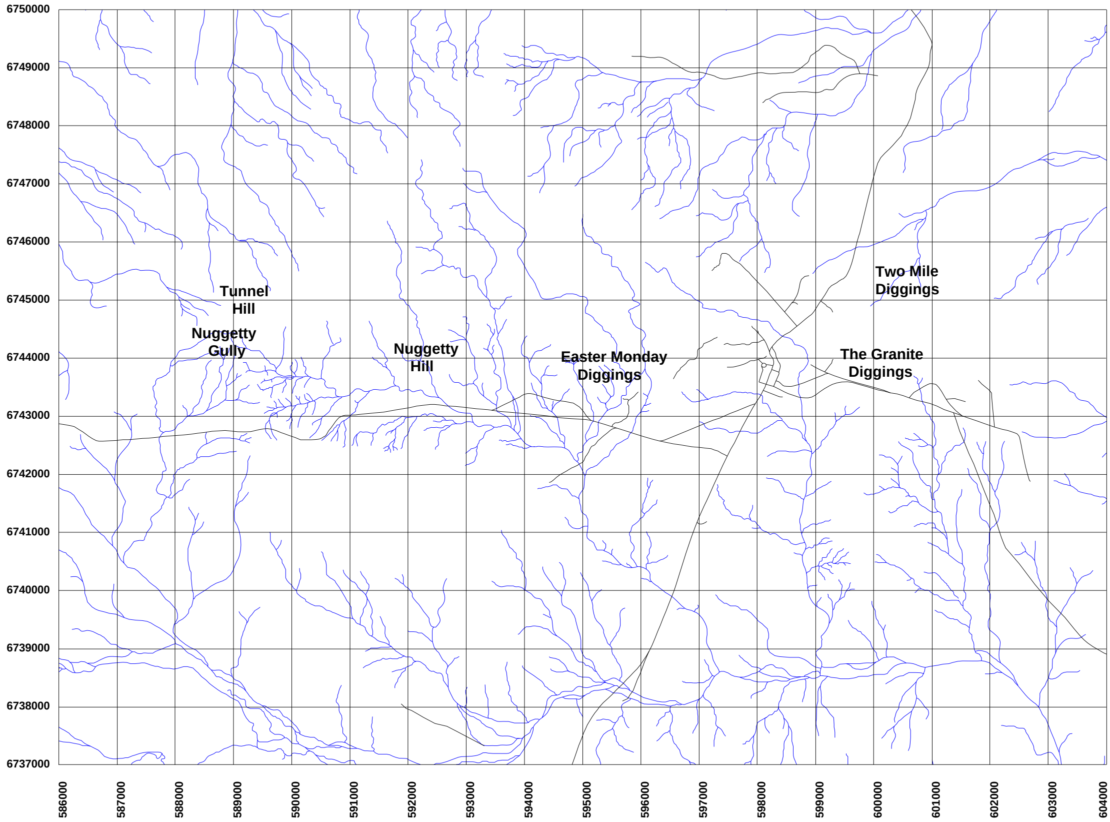


Figure 2: Gold diggings of the Tibooburra Inlier area.

1. Southern Mt Wood Hills

(GR: 617708 mE / 6736657 mN)

This site includes a silicifed rise on the northern side of the Tibooburra – Wanaaring Road. Here, Thomsons Creek flows through a narrowly incised valley cut into weathered Mesozoic and Palaeogene sediments. Mesozoic marine sediments (equivalent to the Bulldog Shale) have been weathered to pallid, kaolinitic saprolite, which to the south of the road have been quarried for road base. The weathered Mesozoic sediments are overlain by silicified, quartzose, fluvial sediments. The well-sorted, quartz sands with rounded and highly polished quartz and black chert clasts of these fluvial sediments are typical of the Eyre Formation (Wopfner *et al.*, 1974; Alley, 1998).

The Eyre Formation sediments have been highly indurated by silica (predominantly micro-crystalline quartz cement). Induration morphologies here are composite nodular and columnar silicifications. Nodules are both rounded and elongate 'rods' indicating both transported and *in situ* nodule accretion (e.g. Hill *et al.*, 2003). The nodules contain geopetal overgrowths consisting of micro-crystalline quartz and anatase. The silicifed nodules are set within a silicifed matrix with a columnar morphology. Columns are up to about 2 m high and up to 1 m wide. They have a convex upper surface.

This site shows regolith materials typical of the outer arcuate "ring" of the 'Tibooburra Dome'. The dominance of quartzose clasts within the Eyre Formation sediments suggest derivation from a highly weathered provenance. The rounded and polished nature of pebbles largely reflects polycyclic transport of pebbles within Mesozoic and later Canozoic sedimentary systems. Silicification here must post-date the deposition of the Eyre Formation during the Palaeogene, however there are few chronological constraints on the timing of silicification available at this site, other than "post-Eyre Formation (although transported nodules in a silicified matrix suggest timing may approximate final stages of sedimentation?). Elsewhere from the Lake Eyre Basin, equivalent syles of silicification of the Eyre Formation have been associated with the 'Silcrete of the Cordillo Surface' associated with the mid-Cainozoic (Oligocene) (Alley, 1998).

Eremophila spp. (emu bush) shrubs colonise the silicifed sediments at the crest of the rise.

a)

b)

c)

Figure 3: Photographs of silicified sediments from the Southern Mt Wood Hills; a)silicified quartzose sediments overlying kaolinitic Rolling Downs Group sediments; b) columnar morphology of silicification; c) composite nodular silicification morphology within larger silicified column.

2. **Quarry Hill**

(GR: 0599421 mE / 6742358 mN)

Turn south from the Tibooburra – Wanaaring Road approximately 1 km east of Tibooburra (about 100 east of the TJ's Roadhouse sign). Travel south along a vehicle track towards Quarry Hill. Park near the quarry of the south side of the hill. The quarry here was made to obtain construction stone for buildings such as the Family Hotel in Tibooburra.

The sediments that comprise Quarry Hill have been controversial within previous geological studies in this region. The main discrepancies have regarded the stratigraphic context of these sediments with Kenny (1934) and more recently Hill *et al.* (2005), interpreting these to be from the Jurassic-early Cretaceous, and as such chronologically and lithologically equivalent to the Algebuckina Sandstone and the Cadna-owie Formation. Other studies such as Morton (1981) and Stevens (1989) have interpreted these sediments to be equivalent to the Palaeogene Eyre Formation.

The sediments here are mostly quartzose, although the basal sediments contain quartz with abundant granitic detritus and minerals (e.g. feldspars and micas). Imprints of plant remains including sticks and fern fronds are abundant. A lithological log of the sequence exposed in the main quarry face to the top of the hill is included here. Braided – sandy meandering fluvial sands and gravels dominate the lower part of the sedimentary sequence, with prominent trough cross-bedding, and gravely channels lags. Higher in the sequence, plane laminated and trough and tabular cross-bedded medium sands may relate to a rise in sedimentary baselevel and therefore the transition from fluvial to nearby marine conditions. Palaeo-current indicators, such as cross-bedding measurements, indicate variable transport directions (typically with vector component towards the east and southeast) consistent with a braided stream system depositional setting.

Kenny (1934) reports the presence of Jurassic plant remains, and the abundance of fern impressions is consistent with this. This strongly supports the correlation of these sediments with the Algebuckina Sandstone and Cadna-owie Formation. The lower fluvial-dominated sediments are interpreted here as equivalent to the Algebuckina Sandstone and the overlying sandstone possibly equivalent to the Cadna-owie Formation. The previous arguments for correlation with the Eyre Formation (Morton, 1982; Stevens, 1989) are not clear, however the abundance of rounded quartzose pebbles may provide a lithological basis to these interpretations, however these pebbles are not as well sorted, rounded, and polished as gravels within the Eyre Formation at other sites (such as Site 1, and the Eyre Formation Type Section at Innamincka).

An important implication of the stratigraphic context of these sediments is that is indicates that the exhumed granitic landforms in this area largely pre-date the deposition of the late Jurassic – early Cretaceous sediments. The quartzose composition of the sediments indicates derivation from a highly weathered landscape, with weathered materials derived from along joint sets within the Tibooburra intrusion, and weathered Easter Monday Beds. A NE-SW trending shear zone extends through the granodiorite on the northwestern margins of Quarry Hill and its siliceous composition and hence greater resistance to weathering and erosion meant that this shear zone was a prominent landscape feature in the pre-Mesozoic landscape.

From a mineral exploration perspective this is also important because the basal gravels of these sediments are locally Au-rich and therefore provide a context for regionally significant Au-dispersion.

a)

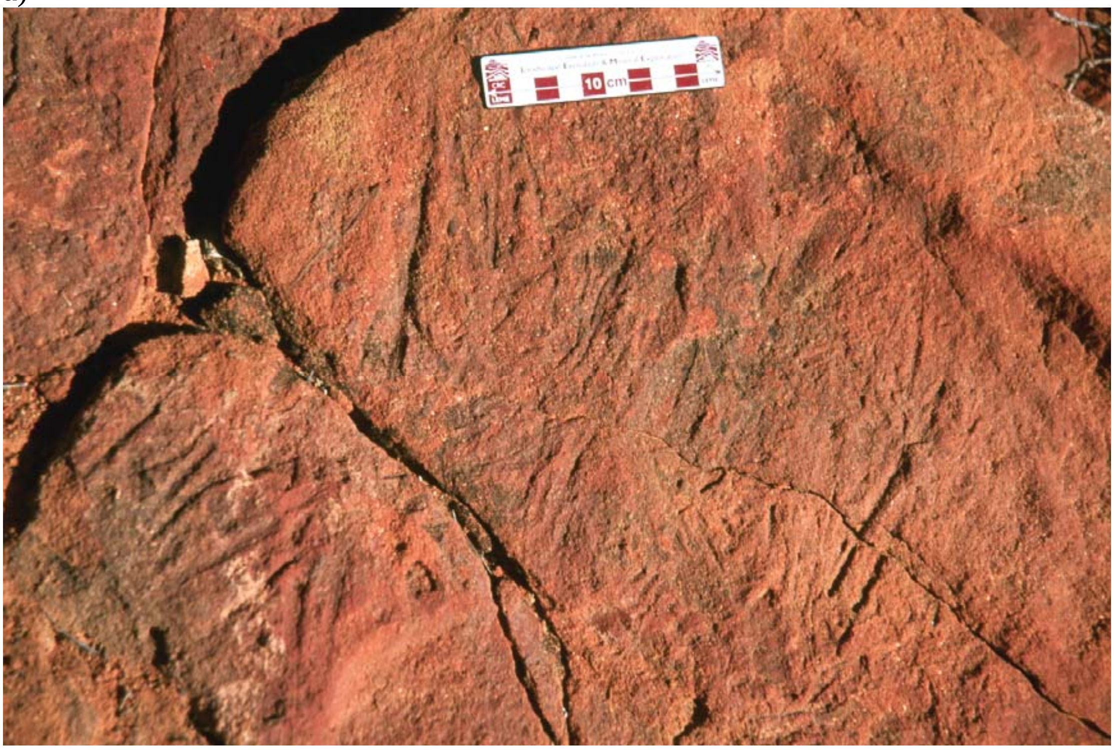


Figure 4: Photographs from Quarry Hill; a) Mesozoic sediments overlying weathered tors of Tibooburra Granodiorite; b) plant fossil impressions from Quarry Hill Mesozoic sediments.

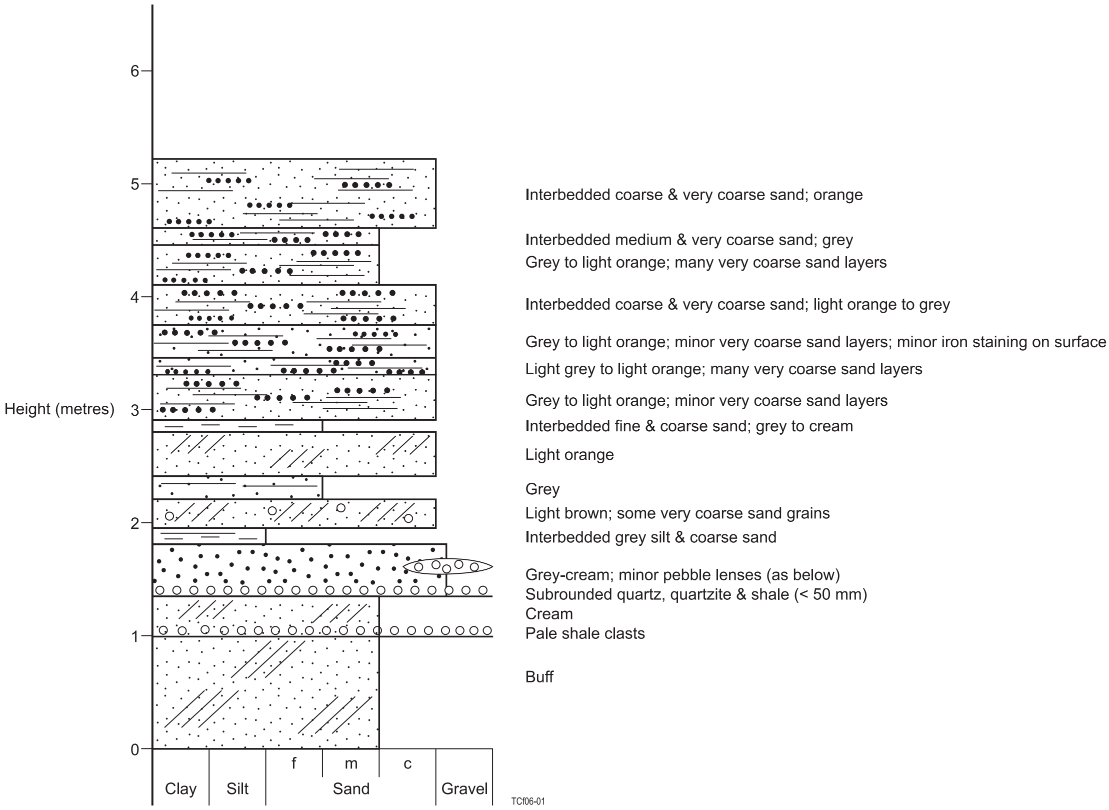


Figure 5: Lithological logs of sections from Quarry Hill. This page: western Quarry Hill quarry (599360 mE / 6742416 mN); Following page: main Quarry Hill quarry (599421 mE / 6742358 mN). For lithological log key, see Appendix 2.

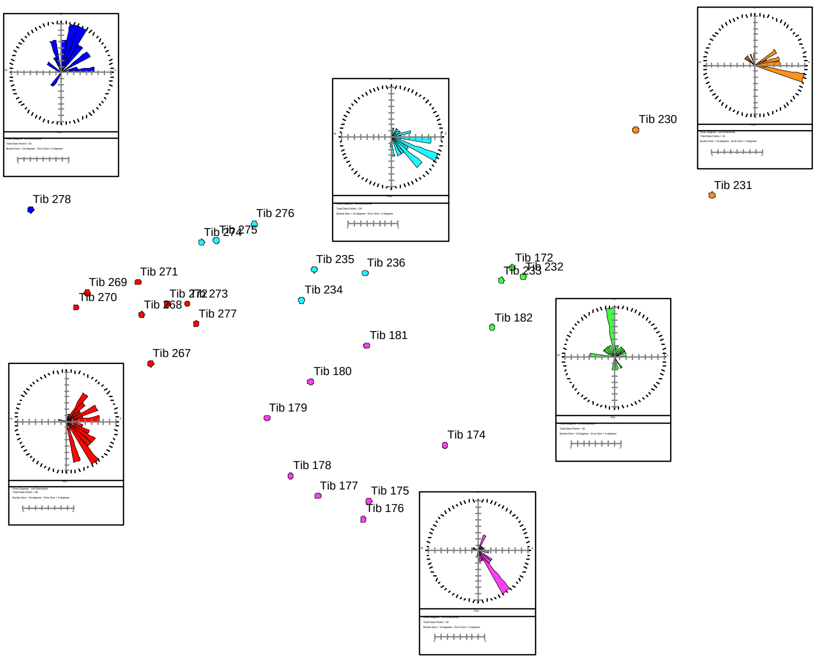


Figure 6: Palaeocurrent rosses (from cross-bedding measurements) for Quarry Hill (from Chamberlain, 2001)

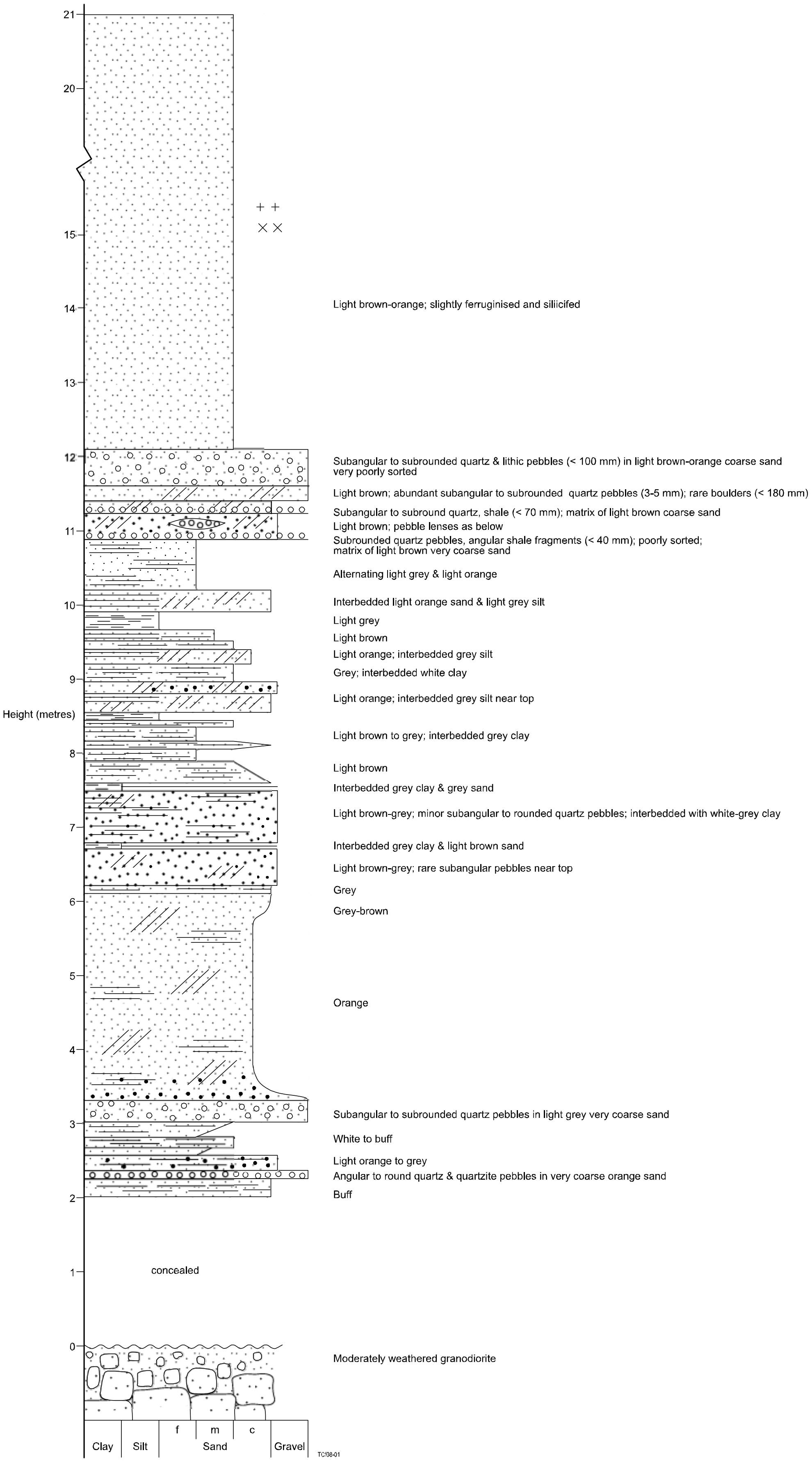


Figure 7: Graphic log of the main Quarry Hill exposure (quarry face) from Chamberlain 2001.

3. Hidden Valley

(GR:0599113 mE / 6741740 mN)

Continue south along the vehicle track, past another outlier rise of sediments equivalent to those at Quarry Hill. The track then follows a bloodwood lined, linear creek towards the west. This valley is Hidden Valley. Approximately 100 m into the valley park the vehicles.

This is a good opportunity to examine the weathering of Tibooburrra Granodiorite and some felsic dykes. A prominent low hill on the southern margins of the valley contain a good example of joint-bound inter-locking granitic tors (Figure 8).
The dominant tree species in this valley is desert bloodwood (*Corymbia tumescens* formerly *Eucalyptus terminalis*).


a)

b)
Figure 8: Photographs from Hidden Valley; view northwards over Hidden Valley towards Quarry Hill; b) Granodiorite tors within Hidden Valley.

c)

d)

Figure 8 (continued): c) moderately weathered granodiorite tors along Hidden Valley near junction with Racecourse Creek; d) granodiorite tors with prominent joint sets at southeastern end of Hidden Valley.

4. Racecourse Creek

(GR: 598500 mE / 6741360 mN)

Continue travelling west along Hidden Valley, until the large sandy channel of Racecourse Creek. Park vehicles on the eastern bank of Racecourse Creek, just south of the creek flowing from Hidden Valley.

Racecourse Creek is one of the major drainage systems flowing south from the Tibooburra Inlier, and eventually into Thomsons Creek. The creek's name is derived from the Tibooburra Racecourse, which used to south of town near this creek. Upstream of this point Racecourse Creek flows through a bedrock controlled constriction.

The dominant tree species colonising the ephemeral channel is river red gum (*Eucalyptus camaldulensis*). The river red gum trees along this channel were initially sampled on an approximate 250 m spacing as a part of a pilot study. Further follow-up sampling of each individual tree along this creek has since been undertaken as a part of Karen Hulme's PhD research. The large tree in the centre of the channel at this point has also been sampled as a part of this PhD study (Hulme & Hill, 2003; 2004).

Only two river red trees have had detectable Au during the sampling program here (although please note that the analyses conducted here as an early part of the research program had higher analytical detection limits for Au than are now available). These trees are located at:

- 5988580 mE / 6741690 mN sampled in summer at head of 'gorge'
- 598496 mE / 6741356 mN at Hidden Valley Creek junction (only from Autumn sample)

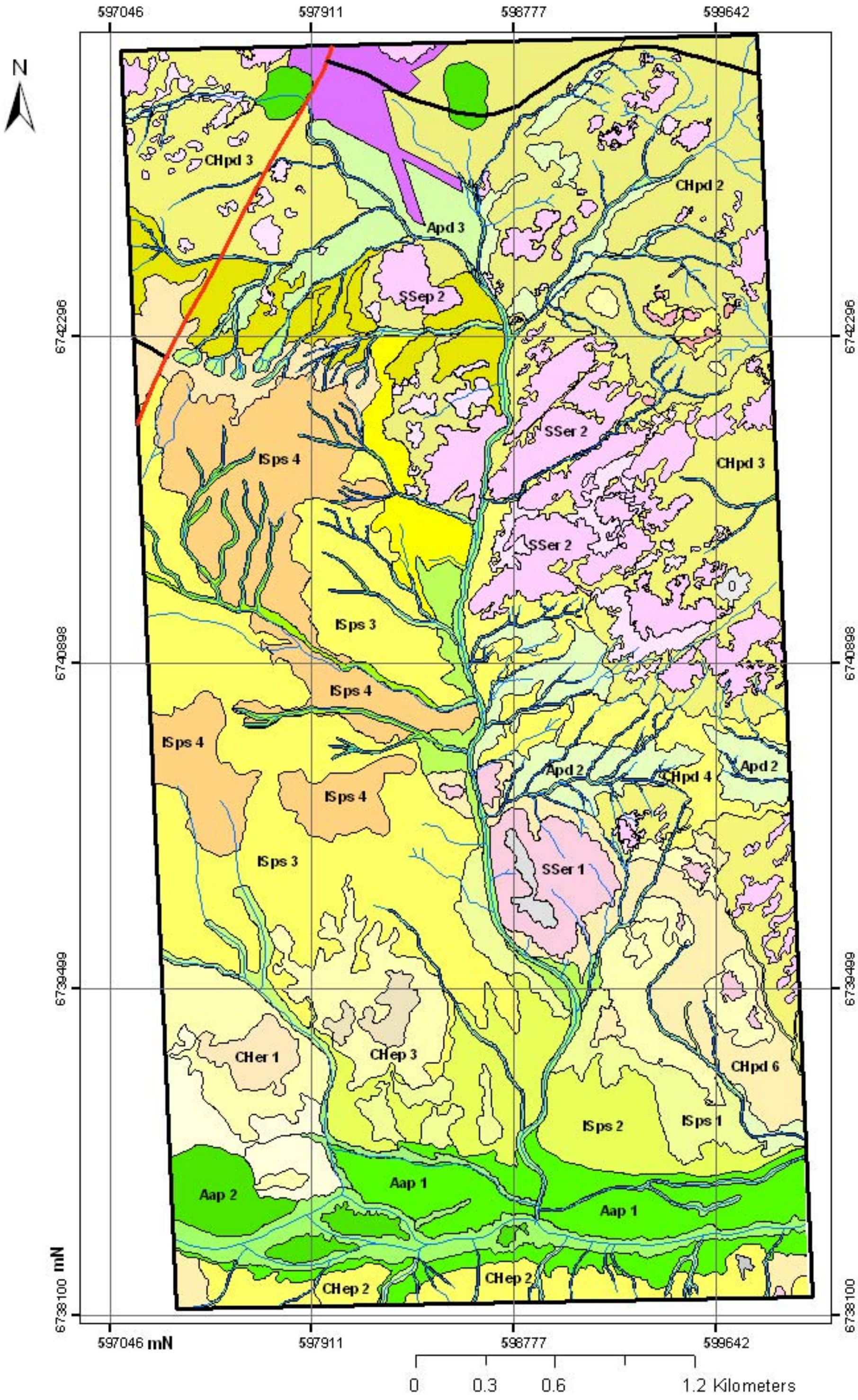


Figure 9: Regolith-Landform map of the Racecourse Creek catchment (Hulme, 2008)

5. Dee Dee Creek

Travel east along the Tibooburra – Wanaaring Road, until crossing the creek immediately west of the airport turnoff. This creek is a headwater tributary of Dee Dee Creek. This site is immediately to the north of the road near the creek crossing. This catchment is one of the study sites where Lea Hill conducted her PhD study (Hill, 2004).

The catchment is underlain by weathered bedrock of contact metamorphosed Easter Monday Formation (contact metamorphosed to hornfels). The Tibooburra Granodiorite mostly occurs in the next catchment to the west, although occasional dykes of granodiorite also extend into parts of this catchment. In the northern and eastern edges of the catchment Mesozoic Algebuckina Sandstone equivalent sediments overlie the weathered metasediments. In this area the Mesozoic sediments consist of quartzose sands and gravels that are highly indurated with hematite. The regolith-landforms of the catchment are shown in Figure 10, and include a central alluvial drainage depression flanked by erosional rises and plains with variable sheetwash cover. The northeastern parts of the catchment are dominated by an aeolian sandplain colonised by mulga (*Acacia aneura*) and bastard mulga (*Acacia stowardii*).

The regolith chemistry and biogeochemical study of Hill (2004), reveals some important characteristics for Au residence and dispersion:

- soil Au contents tend to be greatest within the drainage depression, with some high assays within the area of the aeolian sandplain;
- plant samples taken from autumn had detectable Au contents, whereas spring samples were either had lower Au contents or were below detection limit;
- in the area of the aeolian sandplain mulgas had Au contents below detection limit, whereas adjacent bastard mulga tress had detectable Au contents, particularly within twigs; and,
- black bluebush and velvet potato bush had detectable Au contents for sample sites within the drainage depression originating in the area of the aeolian sandplain.

A follow-up biogeochemistry sampling program is now planned for the area of the aeolian sandplain within the Tibooburra Common area.

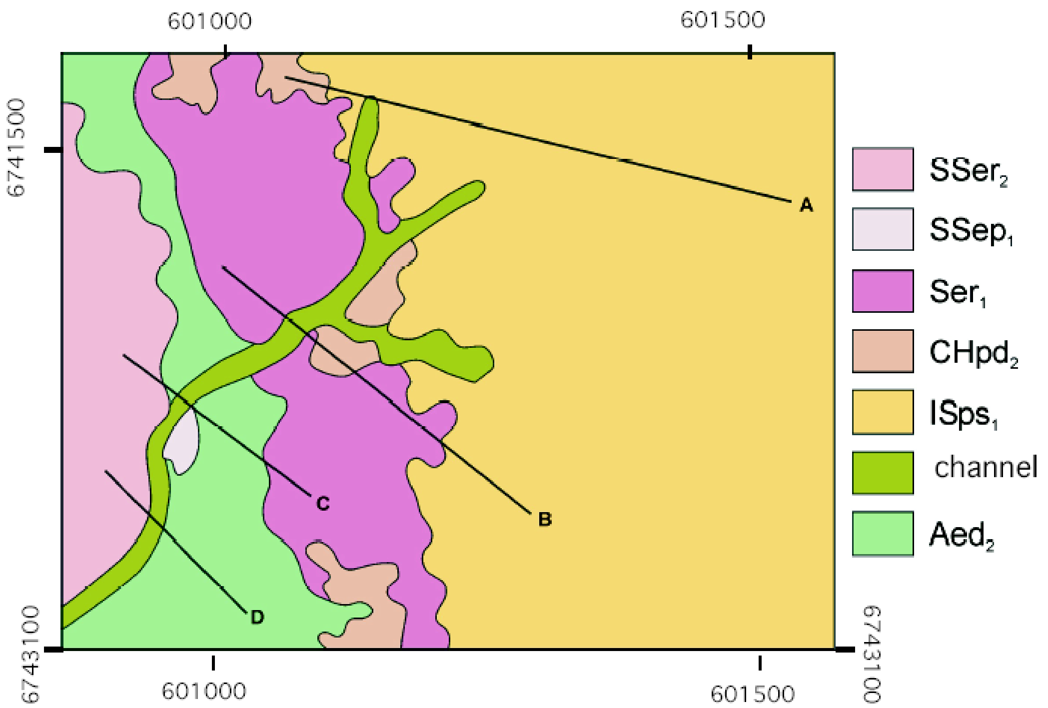
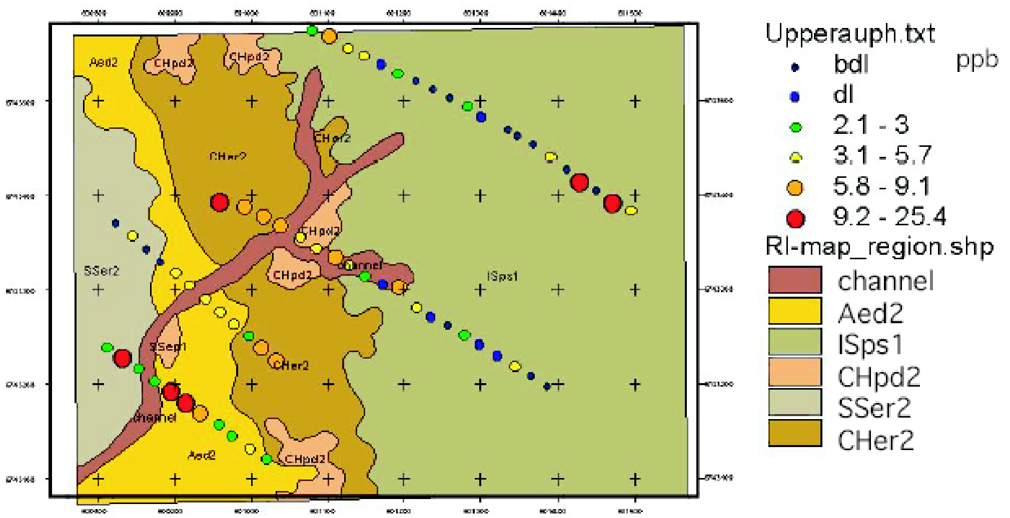
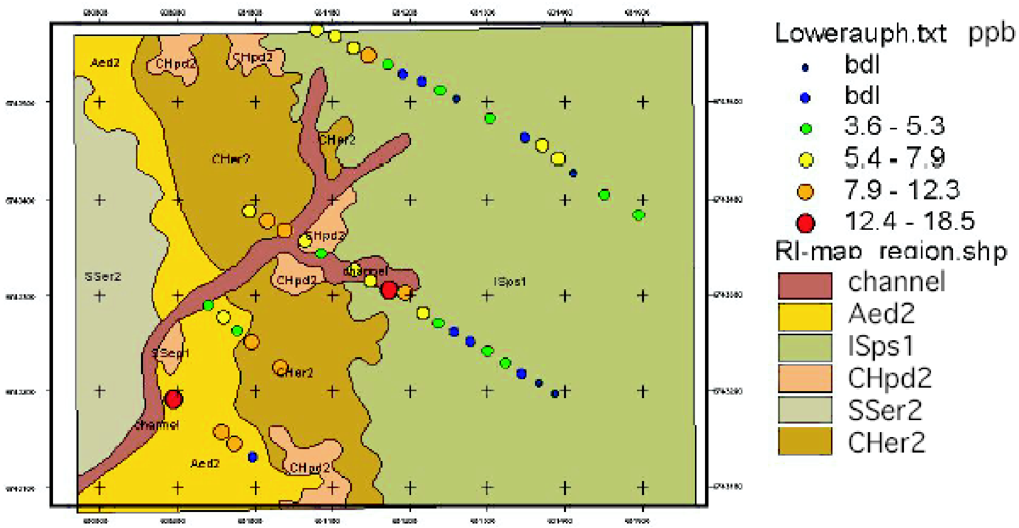


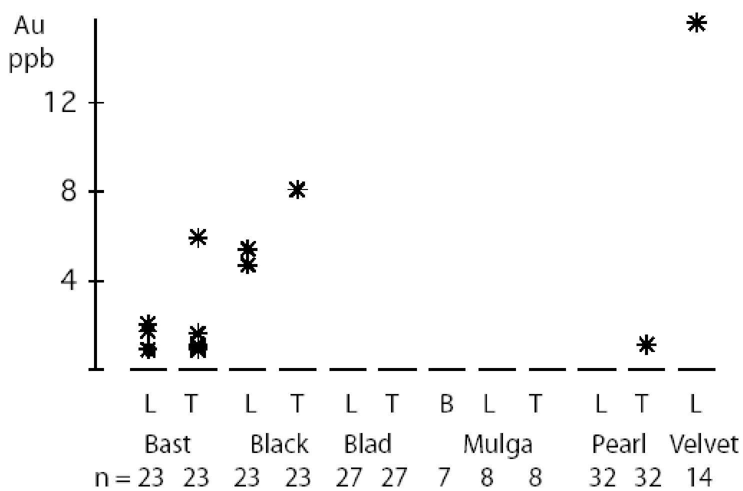
Figure 10: Regolith-Landform map of Upper Dee Dee Creek catchment, also showing the location of soil and vegetation sampling transects (Hill, 2004)



a)



b)



c)

Figure 11: Regolith chemistry and biogeochemistry maps of upper Dee Dee Creek catchment (Hill, 2004); a) Au assays from surface soils; b) Au assays from lower regolith layer; c) Au assays for leaves (L) and twigs (T) and bark (B) from bastard mulga (Bast); Black bluebush (“Black), Bladder saltbush (“Blad”), mulga, Pearl Bluebush (“Pearl”); and, Velvet Potato Bush (“Velvet).

6. The Granites Diggings
(GR: 599998 mE / 6744713 mN)

In this area, contemporary alluvium has been worked for Au. There are also some examples of large quartz veins within the Eastern Monday Formation, and the sub-Mesozoic unconformity. A low rise immediately downstream from the drainage knickpoint has reported risen within the lifetime of some residents of Tibooburra (as has a similar rise near Nuggety Gully to the west). The extent and cause of this uplift is unknown, however one possibility is that it has arisen due to unloading following denudational unloading in this part of the landscape.

Figure 12: “Pop-up” rise from The Granites diggings.

7. Tibooburra Inlier Northern Margin

(GR: 602004 mE / 6745601 mN)

On the north-eastern margin of the Tibooburra Inlier, a fault has disrupted coarse-grained Mesozoic conglomerates. Quartz pebble layers have an aligned, fractured fabric, sub-parallel to the fault trend. Calcite veins have also formed within these sediments.

a)

b)

c)

Figure 13: a) and b) calcite veins within Mesozoic conglomerates; c) fractured and stretched quartz clasts within Mesozoic conglomerates.

8. Old Airstrip Pit

(GR: 597510 mE / 6744165 mN)

A small pit has been excavated through a thin remnant of Mesozoic conglomerate and into the underlying weathered granodiorite. Fragmented hardpan regolith carbonate has developed overlying slightly to moderately weathered granodiorite corestones and along sub-vertical joint sets. Assays of this carbonate returned one of the highest Au contents from carbonate in the area of the Tibooburra Inlier (69 ppb).

Figure 14: Weathered granodiorite corestones and regolith carbonate accumulations from small pit northwest of Tibooburra township margins.

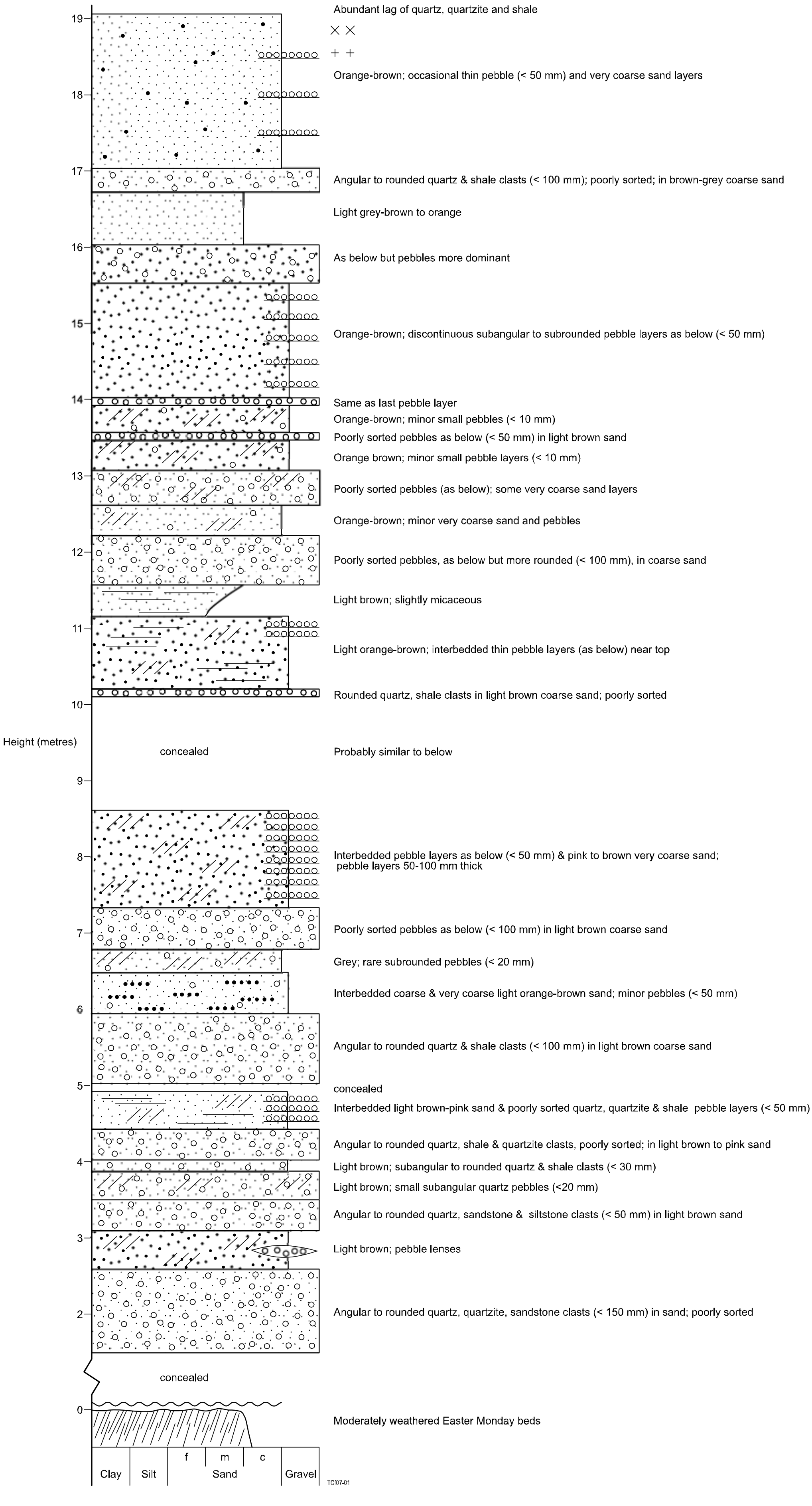
9. Tunnel Hill – Nuggety Gully

(GR: 589437 mE / 6744767 mN)

Sampling from an audit within the basal 0.6 m of Mesozoic conglomerate at Tunnel Hill assayed at 11 g/t over a length of 4.6 m (Kenny, 1934b). Sampling of the basal conglomerate at Tunnel Hill obtained assays of 0.25 to 0.8 g/t Au (Warne, 1983, cited in Marston, 1984). In the mid-1970s, Whim Creek Consolidated .L. sampled rock chips and stream sediments associated with Mesozoic conglomerates at Tunnel Hill, and gained a best assay of 0.1 g/t (Alexander, 1976). Recent prospecting by metal detectors and dryblowers has focussed on creeks (such as Nugget Creek) and old dry blown areas. Marston (1984) estimated Au tonnages available at Nugget Creek are of the order of 10,000 t of about 1 g/t grade. Wilkinson (1889) reports the discovery of a 15 oz Au nugget with quartz attached, as well as smaller samples of Au in quartz. ‘Scaly” Au is also reported by Wilkinson (1889).

Tunnel Hill contains the most extensive exposure of Algebuckina Sandstone sediments near the Tibooburra Inlier. The sediments are dominated by angular to sub-rounded lithic and milky quartz gravels (mostly 50-150 mm diameter), and light brown to orange, coarse and very coarse quartz sand. The sediments are generally coarser grained than those at Quarry Hill. Palaeocurrent indicators, such as cross-bedding measurements are variable but generally suggest sediment transport was towards the east. Recent NSW DMR mapping has interpreted these sediments to be part of the Namur Sandstone, however the broad stratigraphic context for these sedimentary units at this site has led to the more general stratigraphic correlation with Algebuckina Sandstone being adopted in this study.

Figure 15: Algebuckina Sandstone equivalent sediments from Tunnel Hill: a) basal sediments overlying sub-Mesozoic unconformity; b) close-up of quartzose sediments.


Abundant lag of quartz, quartzite and shale
Orange-brown; occasional thin pebble (< 50 mm) and very coarse sand layers
Angular to rounded quartz & shale clasts (< 100 mm); poorly sorted; in brown-grey coarse sand
Light grey-brown to orange
As below but pebbles more dominant
Orange-brown; discontinuous subangular to subrounded pebble layers as below (< 50 mm)
Same as last pebble layer
Orange-brown; minor small pebbles (< 10 mm)
Poorly sorted pebbles as below (< 50 mm) in light brown sand
Orange brown; minor small pebble layers (< 10 mm)
Poorly sorted pebbles (as below); some very coarse sand layers
Orange-brown; minor very coarse sand and pebbles
Poorly sorted pebbles, as below but more rounded (< 100 mm), in coarse sand
Light brown; slightly micaceous
Light orange-brown; interbedded thin pebble layers (as below) near top
Rounded quartz, shale clasts in light brown coarse sand; poorly sorted
Height (metres)
concealed
Probably similar to below
Interbedded pebble layers as below (< 50 mm) & pink to brown very coarse sand; pebble layers 50-100 mm thick
Poorly sorted pebbles as below (< 100 mm) in light brown coarse sand
Grey; rare subrounded pebbles (< 20 mm)
Interbedded coarse & very coarse light orange-brown sand; minor pebbles (< 50 mm)
Angular to rounded quartz & shale clasts (< 100 mm) in light brown coarse sand
concealed
Interbedded light brown-pink sand & poorly sorted quartz, quartzite & shale pebble layers (< 50 mm)
Angular to rounded quartz, shale & quartzite clasts, poorly sorted; in light brown to pink sand
Light brown; subangular to rounded quartz & shale clasts (< 30 mm)
Light brown; small subangular quartz pebbles (<20 mm)
Angular to rounded quartz, sandstone & siltstone clasts (< 50 mm) in light brown sand
Light brown; pebble lenses
Angular to rounded quartz, quartzite, sandstone clasts (< 150 mm) in sand; poorly sorted
concealed
Moderately weathered Easter Monday beds
0
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
f
m
c
Clay
Silt
Sand
Gravel
TC07-01

10. Black Stump Dam

Morton (1982) described the fine sandstones here as the type section for the Mokely Creek Sandstone Member, which is in the upper part of the Gum Vale Formation. This is equivalent to the transgressive marine, Cadna-owie Formation of the Eromanga Basin. The unit is dominated by fine sandstone with occasional quartz and metasediment derived cobbles and boulders. Beds of symmetrical sand ripples, as well as sections showing herring-bone cross-stratification, are consistent with interpretations of a marginal marine depositional environment (Morton, 1982). The exposed sandstones here are overlain by mudstones of the Bulldog Shale equivalent marine sediments (Wittabrenna Shale) and near here contain occasional beds with cone-in-cone and large spherical concretion calcite structures.

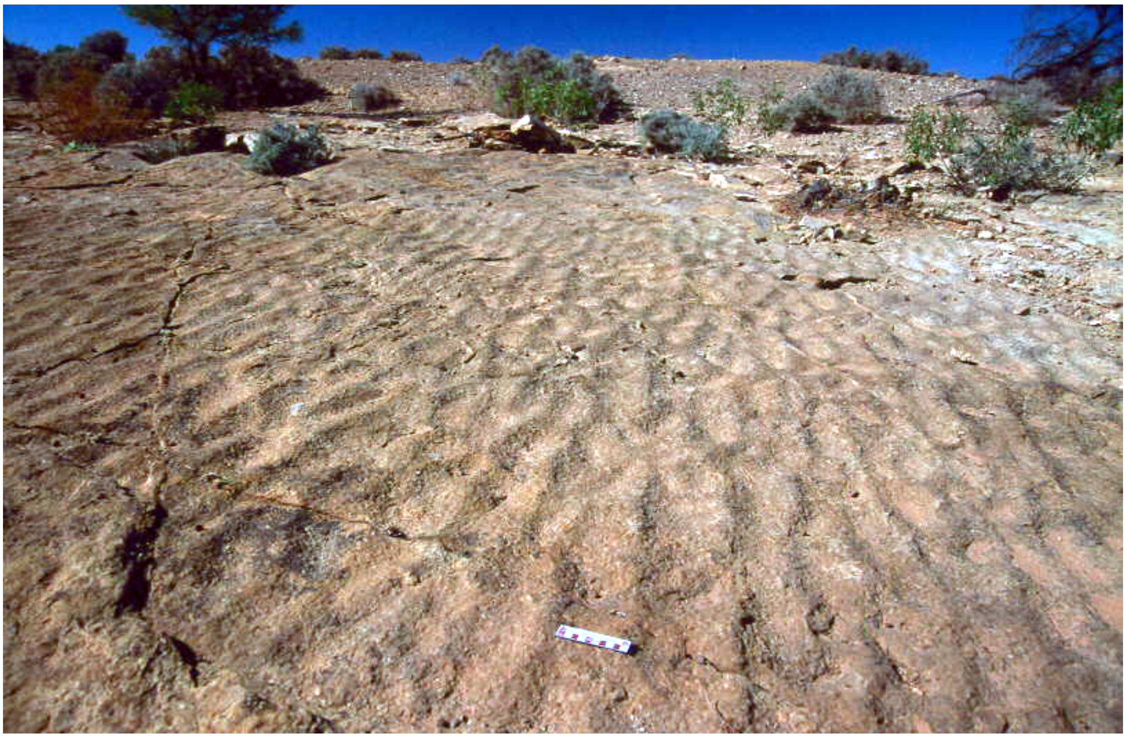
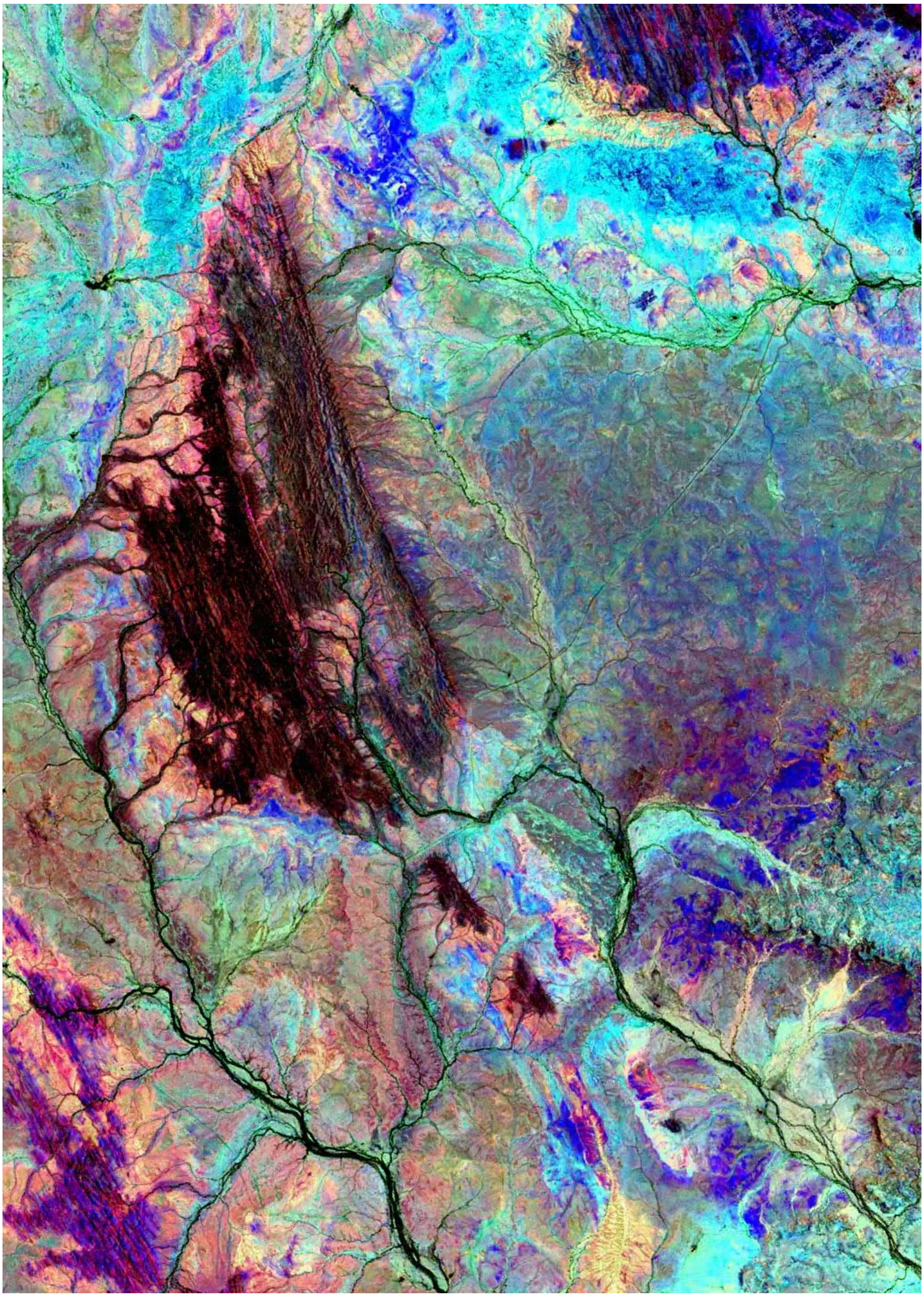


Figure 17: Symmetrical ripples from the Mokely Creek Sandstone exposed within the Black Stump Dam overflow channel

THE WARRATTA INLIER, WARRATTA SOUTH INLIER, NEW BENDIGO INLIER AND MARGINS



Introduction

The Warratta Inlier is a NNW trending area of bedrock exposure, bounded on its eastern margins by the Warratta Fault (Stevens & Etheridge, 1989). Smaller inliers occur to the south of the main Warratta Inlier, mostly along the southward trend of the New Bendigo Fault (Rode *et al.*, 1967; Stevens & Etheridge, 1989), but also exposed with incised gullies along the southern trend of the Warratta Fault. The inlier is mostly composed of metasediments of the Jeffereys Flat Formation. The western margins of the inlier are overlain by Mesozoic and Cainozoic sediments. The inlier conforms to a fault-bounded, half-dome set within the larger Tibooburra Dome. Smaller inliers to the south, particularly immediately west of the New Bendigo Fault, include: the Warratta South Inlier immediately to the south of the Silver City Highway; the New Bendigo Inlier further south; and, a series of previous poorly constrained inliers further south towards Milparinka as well as along parts of the Warratta Fault. Mapping by McAvaney & Hill (2006) found further small bedrock inliers than had been previously mapped, as well as strong indications that the Mesozoic sediment cover was relatively thin (<10 m in mnay parts). Tucker & Hill (2006) conducted a biogeochemical and soil sampling program along a mineralised alteration zone at the New Bendigo Inlier. This showed that when the transported regolith is >1 m thick soil geochemistry had a limited ability to express the underlying bedrock, however bluebush biogeochemistry was more effective.

The Warratta Inlier landscape is dominated by the Warratta Hills, and includes the local drainage divides within the Bulloo-Bancannia Basin, between Thomson Creek (including Andrews Creek tributary, also known as North Warratta Creek), Twelve Mile Creek (includes Evans Gully tributary), and the Evelyn Creek - Warratta Creek drainage systems. The Warratta Hills are asymmetric in east-west section with steep and deeply incised hills along the NW-SE trending Warratta range-front which forms the eastern margin of the inlier. The highest elevations occur in the central-east of the inlier, rising to 295 m at "Warratta Trig". Elevations gradually decrease to the north, south and west of this upland area largely reflecting the tilted and folded block controlled by uplift along the Warratta Fault.

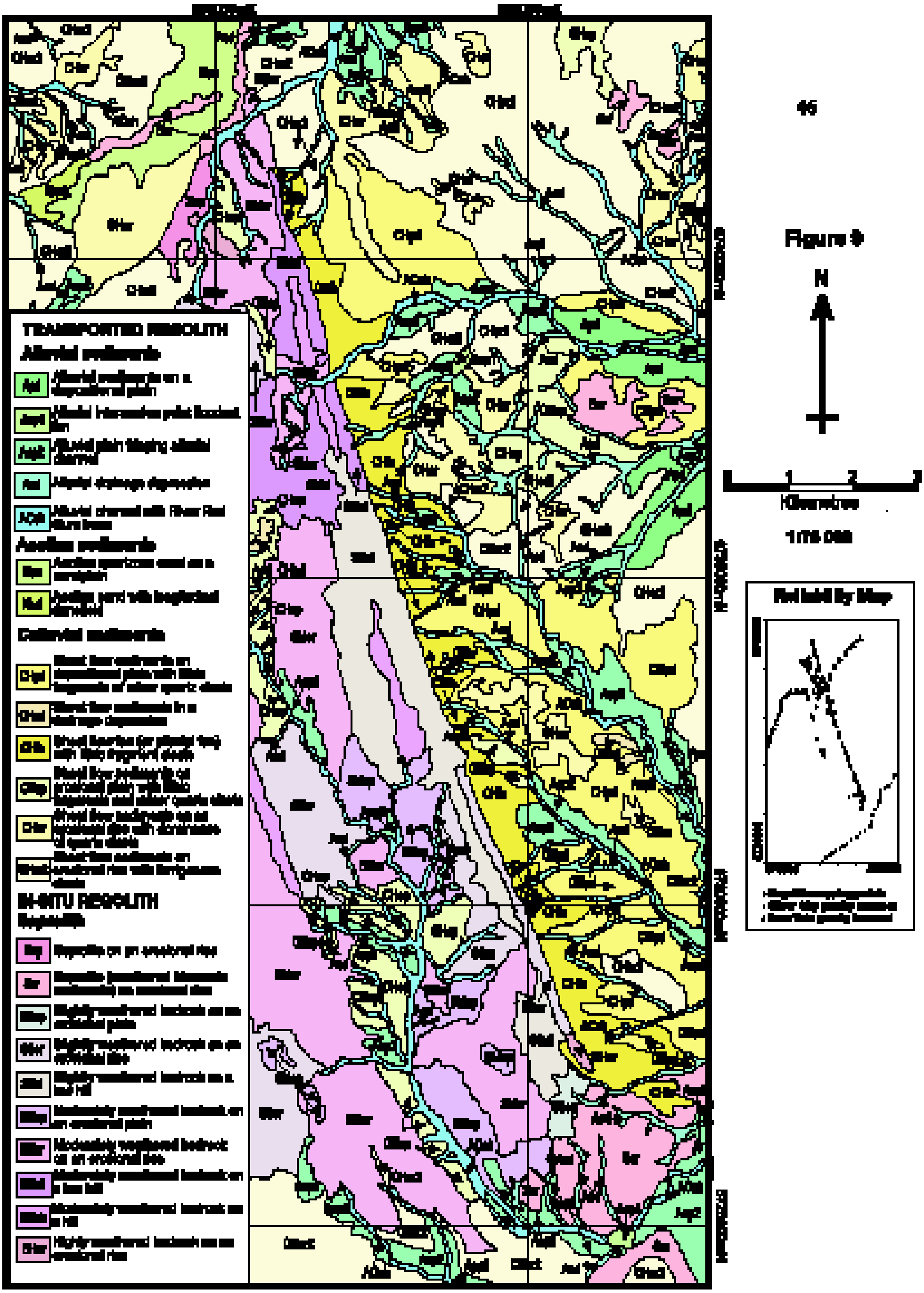


Figure 18: Regolith-landform map of the northeastern Warratta Inlier (after Anderson *et al.* 2004)

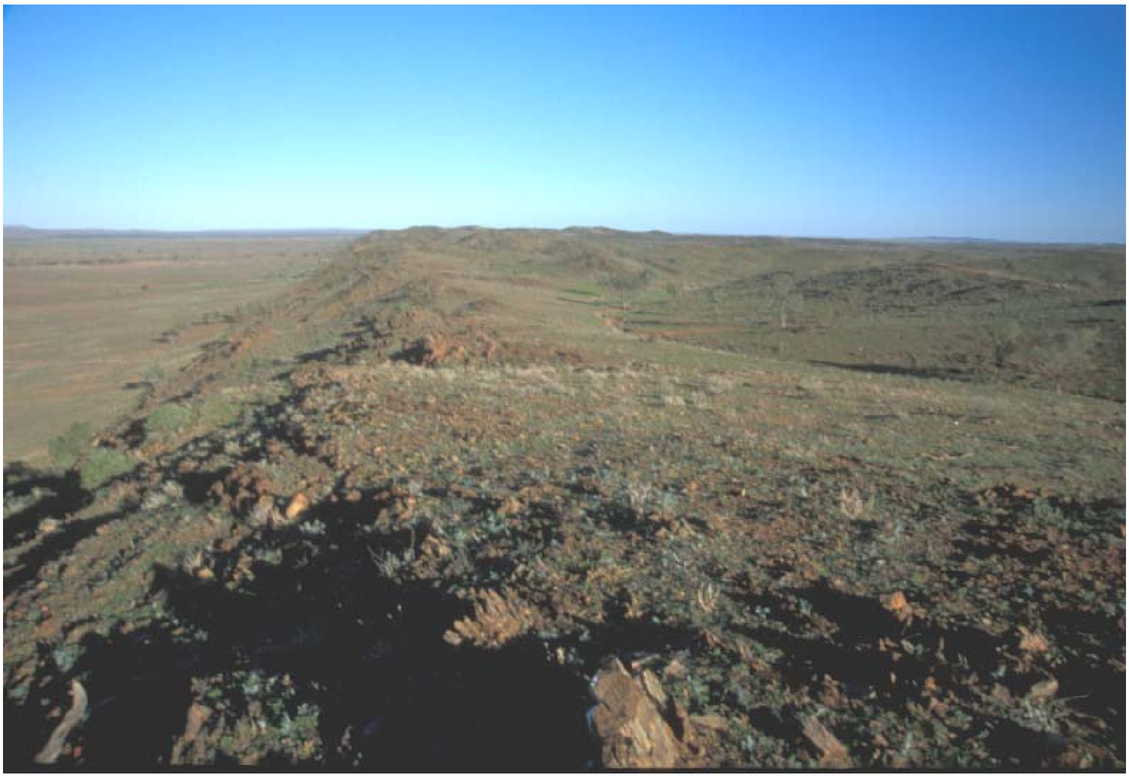
11. Warratta Fault

Stevens (1991b) showed the Warratta Fault to be part of the major, regional Olepoloko Fault. Stevens & Etheridge (1989) describe the slightly overturned Mesozoic sediments along the Warratta Fault. These were mapped by Anderson *et al.* (2004), and have been mapped and described in more detail within ongoing fieldwork. The fault and the overturned Mesozoic sediments dip at approximately >80 degrees to the west, and at some sites the Jeffereys Flat Formation metasediments have been faulted over the Mesozoic. The post-Mesozoic fault movement is therefore of a reverse nature.

Prominent stream knickpoint up to 10 metres high occur along many of the creeks crossing the fault.

a)

b)



c)

d)

Figure 19: Warratta Rangefront photographs: a) stream knickpoint from central rangefront; b) Easter Monday Beds metasediments thrust over overturned Mesozoic sediments; c) view southwards along Warratta Rangefrot from Warratta Trig; d) Warratta rangefront showing Mesozoic sediments along base of slope.

12. Gum Vale Gorge

(GR: 581687 mE / 6738003 mN)

The road towards Gum Vale and Mt Sturt stations follows the bed of Burtons Creek across the Warratta Fault range-front and into the Warratta Hills. Strath terraces cutting across bedrock structures (such as well-developed cleavage) along the valley have been surveyed with a DGPS and reveal two main terrace types:

- Upper terrace (or palaeosurface) including a surface lag dominated by angular and rounded quartz pebbles (interpreted as the sub-Mesozoic palaeosurface);
- Lower terrace with a thin red-brown lithosol and regolith-carbonate accumulations typically less than 5 m above the contemporary stream bed.

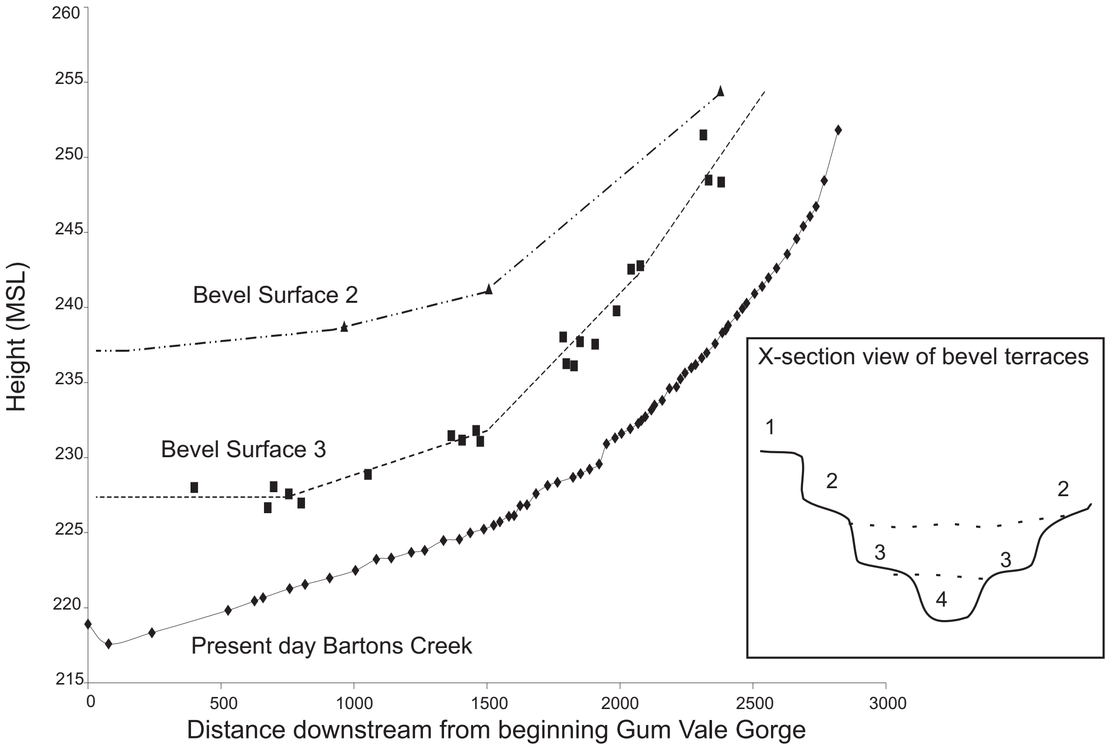
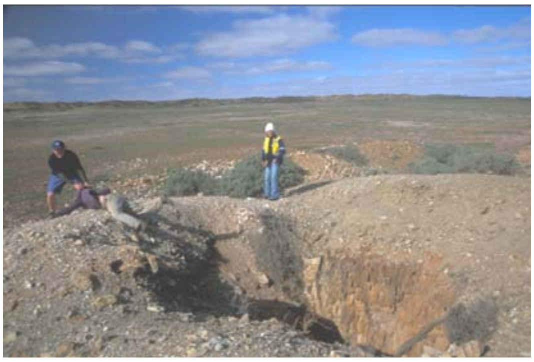


Figure 20: DGPS measurements from Burtons Creek and two terraces through Gum Vale Gorge (Anderson et al., 2004).

13. “The Reefs” (Pioneer and Phoenix Mines)
(GR: 580308 mE / 6734906 mN)

This area was originally know as “the Reefs”. The Wittabreena Mining Company had a 16 hp boiler and a 12-headed stamper battery erected. This company gained rich Au assays of several ounces per tonne, but were unable to recover the fines (unfortunately their engineer knew very little about mining). Gold grades of > 15 oz/t were gained from the workings (Jackaman & Koneck, 1974). Total production from the ‘reefs’ was about 750 oz (Stevens & Etheridge, 1989). These “reefs” were particularly favoured by miners from Tibooburra during drought periods when there was no water available for puddling. In 1899, the Bourke Syndicate put 100 tonnes of old tailings through an improvised cyanide plant for a return of 54 ounces (Gerritsen, 1980). The battery was sold by the government to local graziers in 1895 (Jackaman & Koneck, 1974). Five lines of auriferous veins were recognised in the area: Phoenix; Elizabeth; Pioneer; Rosemount; and, Warratta (Jackaman & Koneck, 1974). The Pioneer Reef is the largest in the Warratta Inlier and is up to 5 m thick.

Regolith carbonates have been sampled from the vicinity of the Pioneer and Pheonix reefs and assays reveal high Au contents (typically 10s of ppb and up to 280 ppb)



a)

b)

c)

Figure 21: Regolith-landforms near The Reefs: a) shafts along the Phoenix Pit (Jeffery’s Flat); b) sub-Mesozoic palaeosurface with pre-Mesozoic rises in background; c) Warratta Creek valley with pre-Mesozoic palaeosurface remnants along valley margin

d)

e)

Figure 21 (continued): d) lower terrace remnant near Pioneer Reef battery; e) quartz veins on pre-Mesozoic palaeosurface between Phoenix and Pioneer reefs.

14. Warratta Creek valley

The track travels southwards from the Pioneer Battery and into the lower Warratta Creek valley. This area is underlain by highly weathered Easter Monday Beds with extensive quartz veins (possible continuation from Pioneer Reef and other systems to the north). Regolith carbonates are also extensive throughout this valley. Eve studies as early as Wilkinson (1889) urged that this area is highly prospective and "should be explored in detail". A present study by Gibbons (in prep. 2005) proposes to sample regolith carbonates extensively within this area.

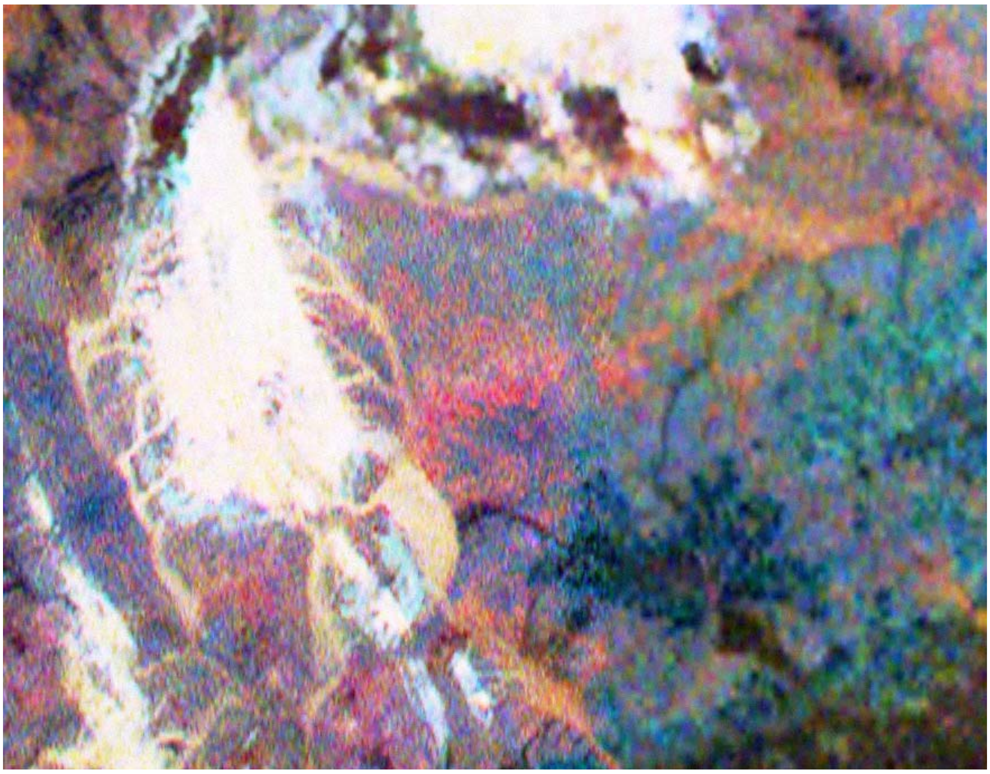


Figure 22 : Radiometrics image of the main Warratta Inlier area. Note, large fan associated with Warratta Creek as it leaves the Warratta Inlier (Data: NSW DMR, Koonenberry Geoscience Data CD).

15. Good Friday

(GR: 0578089 mE / 6725010 mN)

The western margins of the Warratta Inlier include the alluvial Good Friday diggings. The bedrock of this area consists of moderately to highly weathered metasediments of the Jeffereys Flat Formation metasediments that contain wide (over 1 m wide) and extensive quartz veins. The Jeffereys Flat Formation metasediments also contain abundant iron oxide, cubic pseudomorphs of sulphides (pyrite?). Mesozoic conglomerates and sandstones of the Algebuckina Sandstone equivalent sediments overlie these weathered sediments.

Where the contemporary drainage channels passes over the sub-Mesozoic unconformity, alluvial Au-diggings are extensive. An RCA sample from upstream of here (GR: 0578353 mE / 6725341 mN) had a Au assay of 9 ppb.

Figure 23: Good Friday alluvial diggings.

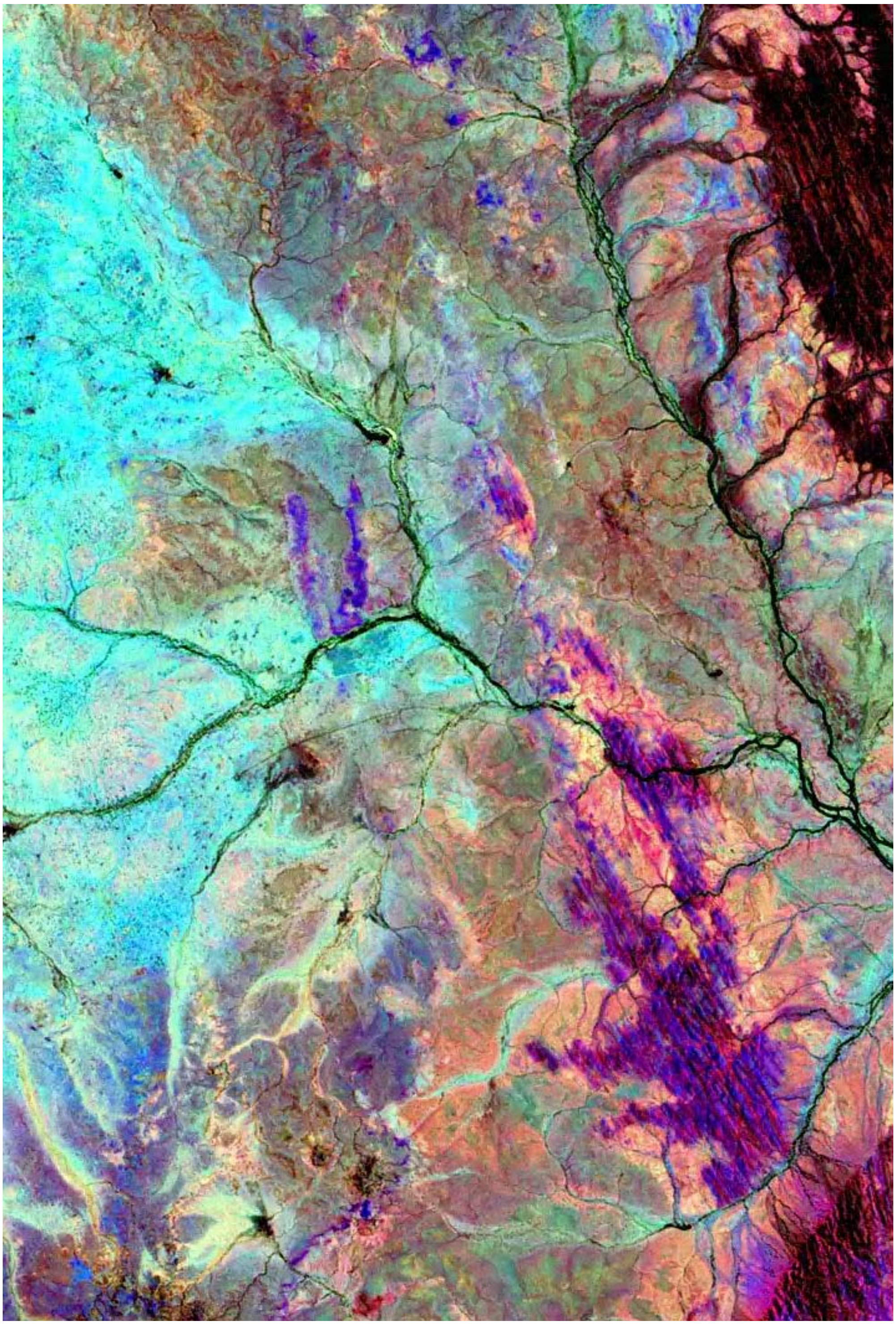
16. South Warratta Fault (Gum Vale Beds Type Section)

(GR: 588650 mE / 6720016 mN)

Surface exposures of the 'Gum Vale Beds' (Morton 1982) (local stratigraphic name for sediments equivalent to the Algebuckina Sandstone and the Cadna-owie Formation) typically include sandstones, calcareous sandstones, siltstones, shales, and quartz pebble conglomerate with silicified wood. These are well exposed and tilted along the Warratta Fault (as well as the New Bendigo Fault, such as along the eastern margins of the New Bendigo Inlier). The faultline escarpment exposes light brown, micaceous fine sandstone with conglomerate interbeds. One of the conglomerate beds contains large boulders of weathered granodiorite. Weathered Jeffereys Flat Formation metasediments are exposed in the erosional plain at the foot of the escarpment.

Figure 24: a) 'Gum Vale Beds' type section exposed along the Warratta Fault; b) weathered granodiotite boulder exposed within the section.

THE MT POOLE INLIER
AND MARGINS



Introduction
The Mt Poole Inlier mostly consists of metasediments of the Depot Glen Formation (Greenfield & Reid, 2006), although it also includes an altered diorite intrusion, approximately 1 km north-west of Mt Poole homestead (Morton, 1982). The Mt Poole Fault forms the eastern margins of the NNW trending inlier. The southern margin of the inlier closely approximates the Mt Browne Fault.

The inlier is a low relief area of erosional rises up to a little over 150 m above sea level. This inlier is mostly drained within the Evelyn Creek catchment, and the tributary Preservation Creek. A regolith-landform map and landscape evolution study of this inlier is reported within Davey (2005); Davey & Hill (2005) and a subsequent PhD study by Jessie Davey (University of Adelaide).

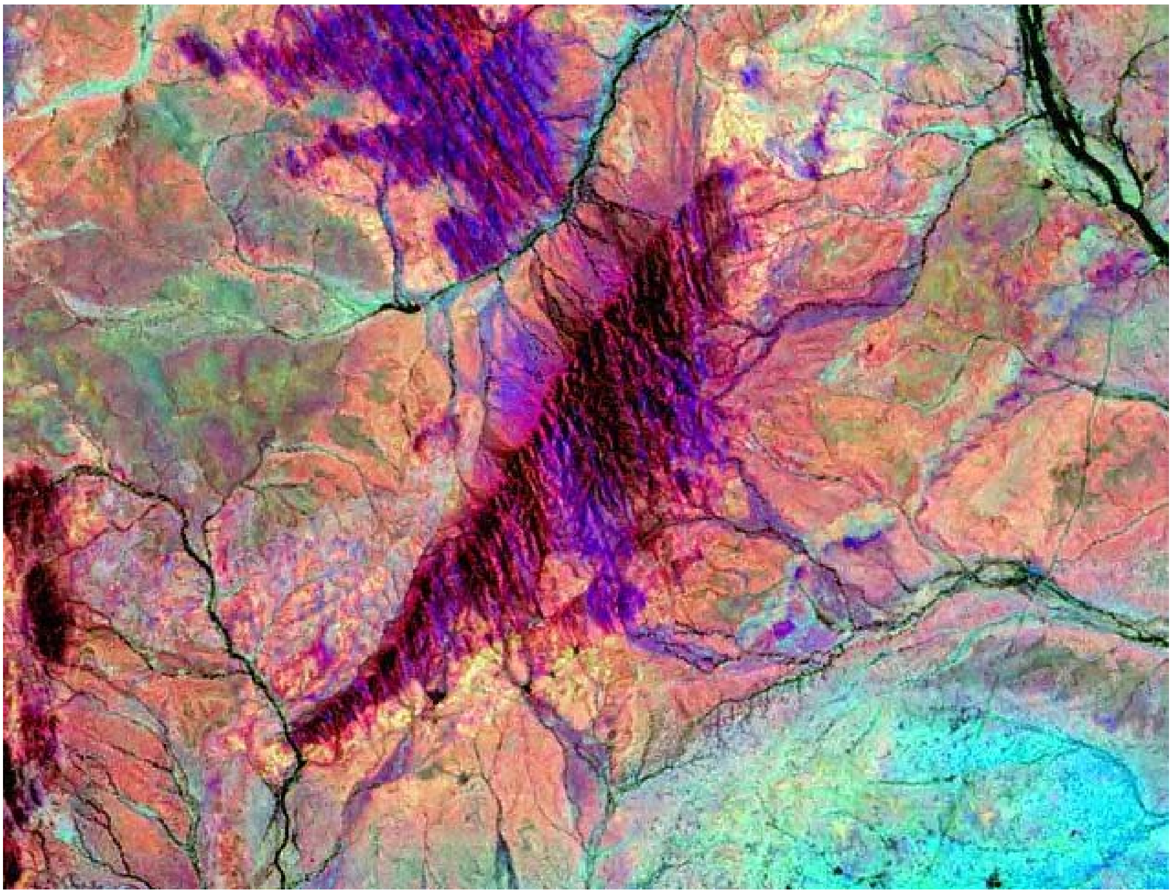
17. Depot Glen

(Poole's Tree GR: 576690 mE / 6718202 mN)

Sturt's party set up camp on 27 January 1845. A small settlement with a post office was established at this site in 1879. Preservation Creek flows across the Mt Poole Inlier here. Time permitting we will visit Depot Glen and Poole's Grave.

Figure 25: Depot Glen

MT BROWNE INLIER
AND MARGINS



Introduction
The Mt Browne Inlier broadly trends NE-SW, and is bounded on its NW side by the Mt Browne Fault. The SE margins are covered by Mesozoic and Cainozoic sediments.

The Mt Browne Inlier is dominated by the NE-SW trending Mt Browne Ridge, which includes erosional low hills and rises. It is drained within the Evelyn Creek and Mt Browne Creek catchments. The Mt Browne Ridge is asymmetric in an east-west section with steep and deeply incised low hills along the NE-SW trending Mt Browne rangefront.

The richest Au-workings near the inlier include Billygoat Hill, The One Mile, Stringers Gully, and The Four Mile, although Kenny (1934) reports that Au workings were “more or less continuously from The Four Mile to Billygoat Hill, payable gold being found in most instances at an average depth approximating 6 feet”.

Figure 26: Mt Browne Inlier: a) slightly weathered Easter Monday Beds; b)looking west from Mt Browne summit.

18. Mt Browne (Billy Goat Hill)

(GR: 573895 mE / 6702594 mN)

Mt Browne hosted some of the richest gold diggings in the region. A small village was also estrablished here during the early 1880s and included a "coffee palace" owned by 'Frank the Pieman', whose coffee, pies and tarts were eagerly sought. As well as a coffee palace, the settlement at Mt Browne had several stores, a butcher, a baker, a hotel and several houses. Original water shortages here were overcome by drawing water the Golden Lake Shaft, where the groundwater impeded further shaft sinking.

Mining including surface workings and shallow shafts into the basal Mesozoic sediments, surface workings of Recent alluvial deposits, and deeper shaft mining (up to 60 m deep, until groundwater flooding inhibited further mining) within Mesozoic sediments.

The Mount Browne Prospecting Co. sank a 73.5 m deep shaft at Billy Goat Hill, which exposed 0.3 to 1.5 m of sediment with 4.6 to 18.4 g of Au per load (one cubic yard, approximately 1 t) (Barnes, 1975). Water was removed at 200,000 litres per day, but could not be controlled, and was eventually converted into a public well.


Figure 27: Billygoat Hill Diggings

19. Milparinka

(Courthouse GR: 585451 mE / 6709651 mN)

'Milparina' is thought to be a local aboriginal word for "water may be found here". In the early 1880s Milparinka was focus of the gold rush of the Albert Goldfields. Gold was discovered in 1881. By March 1881 there were 800 people in the Albert goldfields. By June there were 2000 people on the fields, and severe food shortages were a major problem. Reliable water supply however was the major set-back for the development of the goldfields. Milparinka serviced the goldfields and the site of the settlement was chosen because of its proximity to a waterhole on Evelyn Creek. A journalist named J.Johnson visited the town in 1881 and described it as "a good place for grog, and I consider that a good number of its inhabitants would never know whether the creek has run or was dry unless someone told them" (cited in Gerritsen, 1980, p.25). To the east of Milparinka the "Cut Line" stock route was used to move stock from this region to the railhead at Bourke.

Today the population of Milparinka varies between numbers less than 10 (based at the Albert Hotel and the kangaroo shooters camp across the road), plus one ghost at the Albert Hotel (reportedly a small lady with a white blouse, black skirt and high boots). Ruins in the town area include the remains of the courthouse, police station and post and telegraph office. The cellar of Baker's shop (named after the store owner) and the foundations of other building are also visible. The Albert Hotel was built in April 1882 by George Blore.

On the western side of Evelyn Creek, north of Milparinka, a small quarry exposing cross-bedded sandstones can be seen on the south side of the road. Morton (1982) and later Stevens (1988) interpret these sediments to be from the Eyre Formation.

Figure 28: Milparinka Courthouse.

20. Peak Hill

Just north of Peak Hill homestead the Silver City Highway passes over the base of a slope of a low hill to the east of the highway. This hill has a distinctive E-W asymmetry, with a steep escarpment on its western slope and a gentle (backslope) towards the east. The escarpment crest is composed of silicified quartzose sediments of the Palaeogene Eyre Formation. The silicification includes columnar (pedogenic silcrete) and massive tabular (groundwater silcrete) silicification. The lower slopes consist of highly weathered, kaolinitic Mesozoic sediments of the Rolling Downs Group, overlain by colluvial (predominantly rockfall) sediments.

The backslope here is covered by a surface lag consisting of pebbles and boulders of silicified sediments. Importantly, although this backslope is covered with silicified detritus, it must be stressed that the silicification here does not conform to the tilted "sheet" as described in many previous studies of silicified regolith from inland Australia.

Figure 29: Looking south from Silver City Highway to Peak Hill.

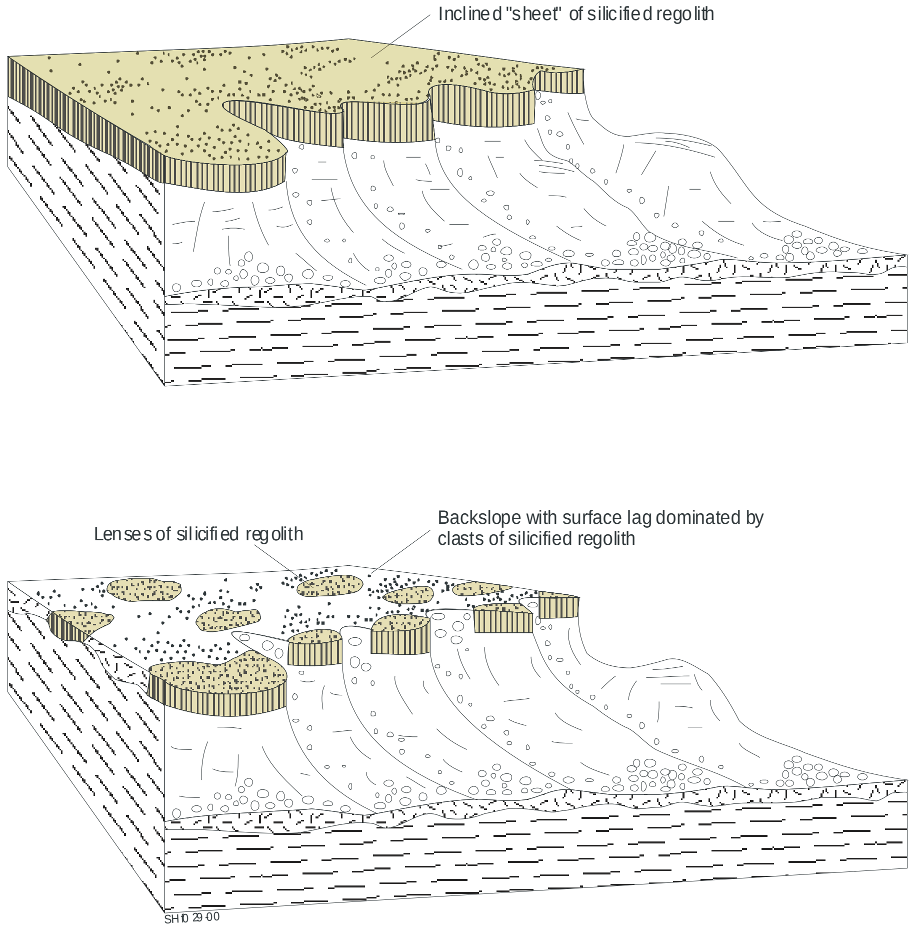


Figure 30: Two different interpretations accounting for silcrete pebble lag covering a slope: a) tilted silcrete sheet; b) slope cut across silcrete pods shedding detritus. The later interpretation is proposed here to account for many of the silcified regolith occurrences in the region.

THE GORGE & MT SHANON INLIERS

These inliers will not be visited on this field trip, however a brief description of them is given here. Access via, Mt Shannon station, is poorly defined.

The Gorge Inlier

The Gorge Inlier is approximately 7 x 2 km^2, and occurs west of Mt Brown. It mostly consists of metasediments, with minor volcanics or volcaniclastics (Stevens & Etheridge, 1989). The Gorge Inlier is within a ridge between the Tibooburra Dome and the Theldarpa Dome.

The Gorge Inlier is a low relief bedrock inlier consisting of erosional rises steeply incised by the south-easterly flowing Gorge Creek, which is a tributary of Mt Browne Creek within the Bulloo-Bancannia drainage basin (flows into Coally Swamp).

Mt Shannon Inlier

The Mt Shannon Inlier is named after Mt Shannon, which forms the highest peak in the region. Mt Shannon was named during Sturt's expedition, however some controversy exists as to whether the peak shown on most topographic and previous geological maps is in fact Mt Shannon, or Mt Blackwood, which was also named by Sturt. Mt Shannon station landowners refer to the high peak with the tower (shown on maps as Mt Shannon) as Mt Blackwood, with a peak several kilometres east being Mt Shannon.

The Mt Shannon Inlier is a small exposure of metasediments, west of the inferred extension of the Koonenberry Fault. The eastern margin of the inlier has been mapped as fault-bound (Rose *et al.*, 1967), although Stevens & Etheridge (1989) later found this boundary to be an unconformity. Mesozoic sediments flanking the inlier are extensively folded and faulted. The Mt Shannon Inlier is within the Theldarpa Dome (Morton, 1982).

The Mt Shannon Inlier is a low relief inlier consisting of erosional rises and plains at the western base of the escarpment on the western side of Mt Blackwood ('Mt Shannon' on topographic maps). The inlier is mostly drained within the Lake Wallace Creek catchment, which is a part of the Lake Eyre Basin.

REFERENCES

Alexander, P., 1976. Report on E.L. 861, Tibooburra District. Whim Creek Consolidated unpublished report. [GS 1976/205]

Alley, N.F., 1998. Cainozoic stratigraphy, palaeoenvironments and geological evolution of the Lake Eyre Basin. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 144, 239-263.

Anderson, N., Direen, N. and Hill, S.M., 2004.

Barnes, R.G., 1975. The Tibooburra-Wonominta Block. In: Markham, N.L. & Basden, H. (eds), *The mineral deposits of New South Wales*, p..92-101. New South Wales Geological Survey, Sydney.

Barratt, R.M. & Hill, S.M., 2003. BHEI 2003 Mineral Deposits Excursion Guide, Broken Hill. *Geological Survey of New South Wales Report*, GS 2003/223.

Bowler, J.M. and Magee, J.W., 1978. Geomorphology of the Mallee region in semi-arid northern Victoria and western New South Wales. *Royal Society of Victoria, Proceedings*, 90, 5-21.

Brewster, D.C., 1989a. First six monthly report for the period ending 6th January, 1989 for EL3118 (Lignum), Tibooburra, north-western NSW. *CRA Exploration Pty Ltd, Report*, 15598. [GS 1989/047]

Brewster, D.C., 1989b. Second six monthly report for the period ending 6th January, 1989 for EL3118 (Lignum), Tibooburra, north-western NSW. *CRA Exploration Pty Ltd, Report*, 15994. [GS 1989/047]

Brown, H.Y.L., 1881. Report on Albert Goldfield, NSW. *New South Wales Legeslative Assembly Notes and Proceedings*, 3 (2), 1-7.

Brunker, R.L., Offenberg, A., & Rose, G., 1967. *Koonenberry 1:500,000 Geological Series.* Geological Survey of New South Wales, mapsheet.

Callen, R.A., Alley, N.F and Greenwood, D.R., 1995. Lake Eyre Basin. In: Drexel, J.F. and Priess, W.V. (eds), The geology of South Australia. Vol.2 The Phanerozoic. *South Australia Geological Survey Bulletin*, 54, 188-194.

Chamberlain, T., 2001. *Regolith Geology and Landscape Evolution of the Tibooburra Inlier, north-west New South Wales.* B.App.Sci.(Hons) thesis, University of Canberra, 133pp.

Chamberlain, T. & Hill, S.M., 2002. *Tibooburra Inlier Regolith-Landform Map (1:25,000).* CRC LEME, Perth.

Chartres, C.J., 1985. A preliminary investigation of hardpan horizons in north-west New South Wales. *Australian Journal of Soil Research*, 23, 325-337.

Chartres, C.J., 1982. The pedogenesis of desert loam soils in the Barrier Range, western New South Wales. 1. Soil parent materials. *Australian Journal of Soil Research*, 20, 269-281.

Chartres, C.J., 1983. The pedogenesis of desert loam soils in the Barrier Range, western New South Wales. 2. Weathering and soil formation. *Australian Journal of Soil Research*, 21, 1-13.

Chen, X.Y., 1992. *Lakes Menindee, Cawndilla and Victoria in western NSW: their geomorphology, stratigraphy and shoreline erosion.* National Parks and Wildlife Service Report, 190pp.

Cunningham, G.M., Mulham, W.E., Milthorpe, P.L., & Leigh, J.H., 1992. *Plants of Western New South Wales.* Inkata press, 766 pp.

Dart, R.C., Wittwer, P.D., Barovich, K.M., Chittleborough, D., & Hill, S.M., 2004. Strontium isotopes as an indicator of the source of calcium for regolith carbonates. In: Roach, I.C. (ed.) *Regolith 2004*, CRC LEME, pp.67-70.

Davey, J. (2005). *Palaeosurfaces and long-term landscape evolution of basin inliers: the regolith and landforms of the Mt Browne and Mt Poole inliers, NW NSW*. B.Sc(Hons) thesis, The University of Adelaide.

Davey, J.E. & Hill, S.M., 2005. Regolith geology and long-term landscape evolution of the Mt Browne and Mt Poole inliers, northwestern New South Wales. In: Roach, I.C. (ed.), *Regolith 2005 – 10 years of CRC LEME*. pp.67-72, CRC LEME, Perth.

Dunkerly, D.L. and Brown, K.J., 1995. Runoff and runon areas in a patterned chenopod shrubland, arid western New South Wales, Australia: characteristics and origin. *Journal of Arid Environments,* 30, 41-55.

Eldridge, D.J., 1988. Soil-landform and vegetation relations in the chenopod shrublands of western New South Wales. *Earth Science Reviews,* 25, 493-499.

Fanning, P.C., 1999. Recent landscape history in arid western New South Wales, Australia: a model for regional change. *Geomorphology,* 29, 191-209.

Fleming, G., 1995. Preliminary Koonenberry 1:500,000 sheet mineral deposit compilation: summary notes. Geological Survey Report GS 1995/212, 30 pp.

Gerritsen, J., 1980. *Tibooburra, Corner Country.* Tibooburra Press, 149pp.

Gibbons, S. (2005). *Regional calcrete sampling and gold nuggets from the Tibooburra-Milparinka goldfields, NW NSW.* B.Sc(Hons) thesis, The University of Adelaide.

Gibbons, S. & Hill, S.M., 2005. Regolith carbonates of the Tibooburra-Milparinka Inliers, northwest NSW: characteristics, regional geochemistry and minerals exploration implications. In: Roach, I.C. (ed.), *Regolith 2005 – Ten Years of CRC LEME,* pp.107-111.

Gibson, D.L., 1997. Recent tectonics and landscape evolution in the Broken Hill region. *AGSO Research Newsletter,* 26, 17-20.

Gibson, D.L., 2001. Wonnaminta regolith-landforms, CRC LEME open file report.

Gibson, D.L. and Wilford, J., 1995. *Broken Hill Regolith-Landforms (1:500,000 map).* CRC LEME, AGSO, Canberra.

Greenfield, J.E. & Reid, W.J., 2006. Orogenic gold in the Tibooburra area of northwestern NSW: a ~440 Ma ore system with comparison to the Victorian goldfields. *Australian Earth Sciences Convention 2006 Abstracts.* Geological Society of Australia.

Greenwood, D.R., Rowlett, A.I., Alley, N.F., and Hill, S.M., 1997. Palaeobotanical evidence for the initiation of the drying of the Australian interior. *In* Price, D. & Nanson, G. (Eds), *Quaternary Deserts and Climate Change Program and Abstracts, ICGP 349*. University of Wollongong School of Geosciences.

Hallsworth, E.G., Beattie, J.A. and Darley, W.E., 1982. Formation of soils in an aridic environment, western New South Wales, Australia. *Catena Supplement,* 1, 83-102.

Hanlon, F.N., 1966. Clarence Oil Binerah Downs No.1 Well NSW. Final Well Report. 19 pp. [WCR122]

Hill, L.J., 2002. Branching out into biogeochemical surveys: a guide to vegetation sampling. In: Roach, I.C. (ed.) *Regolith and Landscapes in Eastern Australia*, pp.50-53, CRC LEME.

Hill, L.J., 2004. *Geochemical and biogeochemical dispersion and residence in landscapes of western New South Wales.* PhD Thesis, The Australian National University, Earth and Marine Sciences, unpublished.

Hill, S.M., 2000. The regolith and landscape evolution of the Broken Hill Block, western NSW, Australia. PhD Thesis, The Australian National University, Department of Geology, unpublished.
Hill, S.M., 2002. Some issues and challenges for regolith-landform mapping with particular reference to the Broken Hill region. In: Roach, I.C. (ed), *Regolith and Landscapes in Eastern Australia*, pp.63-67, CRC LEME.
Hill, S.M., 2003. Regolith mapping and landscape evolution models in gold exploration. *Minfo Quaterly,* 79, pp. 34-5.
Hill, S.M., 2004. Biogeochemical sampling media for regional- to prospect-scale mineral exploration in regolith-dominated terrains of the Curnamona Province and adjacent areas in western NSW and eastern SA. In: Roach, I.C. (ed.) ***Regolith 2004***, CRC LEME, pp. 128-133.
Hill, S.M. 2005a. Teilta, western NSW. In: Anand, R.R. & deBroekert, P. (eds.). *Landscape Evolution Across Australia*. pp.110-117. CRC LEME Monograph, Perth.
Hill, S.M. 2005b. Western New South Wales. In: Anand, R.R. & deBroekert, P. (eds.). *Landscape Evolution Across Australia*. pp.130-145. CRC LEME Monograph, Perth.
Hill, S.M., Hill, L.J., & Chamberlain, T., 2003. Towards a regolith and landscape evolution framework for mineral exploration programs near the Tibooburra Goldfields, NW NSW. *Geoscience Australia Record, 2003/13*, pp. 77-78.
Hill, S.M., Chamberlain, T., & Hill, L.J., 2005. Tibooburra, western NSW. In Anand, R.R. & deBroekert, P. (eds), *Landscape Evolution Across Australia,* CRC LEME, Perth.
Hill, S.M., Eggleton, R.A. and Taylor, G., 1997. A regional regolith-landform framework for mineral exploration models in the Broken Hill region. AusIMM Journal Annual Conference Proceedings, 131-138.
Hill,S.M., Eggleton, R.A. and Taylor, G., 2003. Neotectonic disruption of silicified palaeovalley systems in an intraplate, cratonic landscape: regolith and landscape evolution of the Mulculca range-front, Broken Hill Domain, New South Wales. *Australian Journal of Earth Sciences,* 50, 691-707.
Hill, S.M. & Hill, L.J., 2003. Some important plant characteristics and assay overviews for biogeochemical surveys in western NSW. In: Roach, I.C. (ed) *Advances in Regolith,* pp.187-192, CRC LEME.
Hill, S.M. & Roach, I.C., 2003. The regolith-landforms of Sandstone Paddock, Fowlers Gap, western NSW. In: Roach, I.C. (ed) *Advances in Regolith,* pp.193-200, CRC LEME.
Hill, S.M., Taylor, G. and Eggleton, R.A., 1994. Field Guide and notes on the regolith and landscape features of the Broken Hill region, western NSW. *AGSO Record,* 1994/57, 39pp.
Hill, S.M., Taylor, G. and Eggleton, R.A., 1996. Ferricretes of the Broken Hill region, western New South Wales, Australia: chronological and stratigraphic significance. *Geosciencias Rev University of Aveiro,* 10, 15-24.
Hulme, K.A. & Hill, S.M., 2003. River red gums as a biogeochemical sampling medium in mineral exploration and environmental chemistry programs in the Curnamona Craton and adjacent regions of NSW and SA. In: Roach, I.C. (ed) *Advances in Regolith,* pp.205-210, CRC LEME.
Hulme, K.A. & Hill, S.M., 2004. Seasonal element variations of *Eucalyptus camaldulensis* biogeochemistry and implications for mineral exploration: an

example from Teilta, Curnamona Province, western NSW. In: Roach, I.C. (ed.) *Regolith 2004,* CRC LEME, pp. 151-156.

Hulme, K.A. & Hill, S.M., 2005. River red gum biogeochemistry associations with substrate: bedrock penetrators or stream sediment amalgamators? In: Roach, I.C. (ed.) *Regolith 2005 – Ten Years of CRC LEME.* CRC LEME, Perth, pp. 146-151.

Jackaman, B. & Koneck, L., 1974. Assessment of the gold prospects in the Milparinka – Tibooburra district. [GS 1974/027]

Kenny, E.J., 1934a. West Darling District. New South Wales Geological Survey, Mineral Resources, 36. 180 pp.

Kenny, E.J., 1934b.

Kenny, E.J., 1936. Erosion in the west Darling district. Geological Survey of NSW Report, 1936/041.

King, H.F., & Thomson, B.P., 1952. Geological reconnaissance of the Koonenberry and Tibooburra-Milparinka districts. NSW Mines Department unpublished report [GS 1952/08]

Krieg, G.W., Alexander, E.M. and Rogers, P.A., 1995. Eromanga Basin. In: Drexel, J.F. and Priess, W.V. (eds), The geology of South Australia. Vol.2: The Phanerozoic. South Australia Geological Survey Bulletin, 54, 101-127.

Langford-Smith, T. and Watts, S.H., 1978. The significance of co-existing siliceous and ferruginous weathering products at select Australian localities. In: Langford-Smith, T. (ed.), Silcrete in Australia, University of New England, Armidale, 143-165.

Lord, D., 1999. Rabbits and total grazing pressure: a rangeland manager’s perspective. Proceedings VI International Rangelands Congress.

Marston, R.J., 1984. Zenith Explorations Pty. Ltd., E.L. 1593, Relinquishment and final report. (Report on exploration for surficial gold in E.L. 1593, Tibooburra) [GS 1981/479]

McAvaney, D.J. & Hill, S.M., 2006. Neotectonism along intracratonic basin margins: regolith and landscape evolution of Warratta South – New Bendigo Inliers, northwestern New South Wales. In: R.W. Fitzpatrick & P. Shand eds. *Regolith 2006 – Consolidation and Dispersion of Ideas,* CRC LEME, Perth, pp.223-226

McBarron, E.J., 1977. Medical and vetinary aspects of plant poisons in New South Wales. NSW Department of Agriculture, Sydney.

McGowan, B., 2002. *Australian Ghost Towns.* Lothian Books, Melbourne, 246pp.

McMinn, A., 1981. Palynological evidence for the age of the Gum Vale Beds of the Tibooburra District. *Geological Survey of NSW Palynological Report,* 81/23 [GS 1981/394].

McQueen, K.G., Hill, S.M. and Foster, K.A., 1999. The nature and distribution of regolith carbonate accumulations in southeastern Australia and their potential as a sampling medium in geochemical exploration. Journal of Geochemical Exploration.

Morton, J.G.G., 1982. *The Mesozoic-Cainozoic stratigraphy and faunas of the Tibooburra-Milparinka area.* M.Sc. thesis, New South Wales University. 258 pp. Unpublished.

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

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.

Nelson, R., 1988. Exploration reports E.L.s 2924, 2925, 2927, 2928, Mt Stewart – The Peak – Tibooburra – Mt Poole area. CRA Exploration Pty. Ltd., unpublished. [GS 1988.097]

Ogden, J., 1978. On the dendrochronology potential of Australian trees. *Australian Journal of Ecology*, 3, 339-356.

O'Sullivan, P.B., Kohn, B.P. and Mitchell, M.M., 1998. Phanerozoic reactivation along a fundamental Proterozoic crustal fault, the Darling Lineament Australia: constraint from apatite fission track thermochronology. *Earth and Planetary Science Letters*, 164, 451-465.

Pain, C.F., Chan, R., Craig, M., Gibson, D.L., Ursem, P. & Wilford, J. (in prep.). RTMAP regolith database: field book and users guide (2nd edition). *CRC LEME Report* 138.

Pittman, E.F., 1895a. *The Mineral resources of New South Wales.* Geological Survey of New South Wales.

Pittman, E.F., 1895b. Note on the Cretaceous Rocks in the NW portion of NSW. *Australian Association for the Advancement of Science Report*, 6, 344-348.

Plimer, I.R., 1984. The mineralogical history of the Broken Hill Lode, NSW. *Australian Journal of Earth Sciences*, 31, 379-402.

Rogers, P.A., 1995. Berri Basin. In: Drexel, J.F. and Priess, W.V. (eds), The geology of South Australia. Vol. 2: The Phanerozoic. *South Australia Geological Survey Bulletin*, 54, 127-129.

Rogers P.A., Lindsay, J.M., Alley, N.F., Barnett, S.R., Lablack, K.L. and Kwitko, G., 1995. Murray Basin. In: Drexel, J.F. and Priess, W.V. (eds), The geology of South Australia. Vol.2: The Phanerozoic. *South Australia Geological Survey Bulletin*, 54, 157-163.

Rose, G., O'Connell, P., & Menzies, I.A., 1967. *Milparinka 1:250,000 Geological Survey Sheet.* New South Wales Geological Survey, Sydney.

Scheibner, E. & Basden, H. ed., 1998. *Geology of New South Wales – Synthesis. Volume 2 Geological Evolution*. Geological Survey of New South Wales, Memoir, 13(2), 666pp.

Shirtliff, G., 1998. Massive gypsum, ferricretes and regolith landform mapping of western Balaclava, Broken Hill, NSW. BSc(Hons) thesis, Australian National University, 129pp.

Stephens, C.G., 1971. Laterite and silcrete in Australia: a study of the genetic relationships of laterite and silcrete and their companion materials, and their collective significance in the formation of the weathered mantle, soils, relief and drainage of the Australian continent. *Geoderma*, 5, 5-51.

Stevens, B.P.J., 1986. Post-depositional history of the Willyama Supergroup in the Broken Hill Block, NSW. *Australian Journal of Earth Sciences*, 33, 73-98.

Stevens, B.P.J., 1988. Observations on Mesozoic and Cainozoic sediments in the Tibooburra – Milparinka area. *NSW Geological Survey Report* 1988/124, 16 pp.

Stevens, B.P.J., 1991a. Some aligned claypans in the Strzelecki dunefield, central Australia. *Australian Journal of Earth Sciences*, 38, 485-495.

Stevens, B.P.J., 1991b. Northwestern NSW and its relationship to the Lachlan Fold Belt. *Geological Society of Australia Abstracts*, 29, 50.

Stevens, B.P.J. & Etheridge, L.T., 1989. Traverse geology of the Tibooburra Inliers. *Geological Survey of NSW Report*, 1989/390. 107 pp.

Sturt, C., 1849.

Thalhammer, O.A.R., 1991. Indications for the source of gold in the ilparinka-Tibooburra vein-type gold deposits, NSW Australia: geochemical and isotopic evidences. In: Pagel & Leroy (eds), *Source, Transport and Deposition of Metals.* pp.363-366, Balerna, Rotterdam.

Thalhammer, O.A.R., Stevens, B.P.J., Gibson, J.H., & Grum, W., 1998. Tibooburra Granodiorite, western New South Wales: emplacement history and geochemistry. *Australian Journal of Earth Sciences,*45, 775-787.

Thoms, M., Hill, S.M., Spry, M.J., Chen, X.Y., Mount, T.J., & Sheldon, F., (2004). The geomorphology of the Barwon-Darling Basin. In: Breckwoldt, R., Boden, R. & Andrew, J., *The Darling.* pp.68-103. Murray-Darling Basin Commission, pp.68-103.

Thomas, M., Earl, K.L., Hill, S.M. & Foster, K.A., 2002. A framework for regolith-landform mapping in the Flying Doctor Prospect, Broken Hill, NSW. In: Roach I.C (ed) *Regolith and Landscapes of Eastern Australia*. CRC LEME. pp.127-132.

Tucker, L. & Hill, S.M., 2006. Biogeochemical residence and dispersion of trace metals in the New Bendigo Inlier and margins, northwest NSW, In: R.W. Fitzpatrick & P. Shand eds. *Regolith 2006 – Consolidation and Dispersion of Ideas*, CRC LEME, Perth, pp.346-349.

Wakelin-King, G.A., 1999. Banded mosaic (‘tiger bush’) and sheetflow plains: a regional mapping approach. Australian Journal of Earth Sciences, 46, 53-60.

Wasson, R.J., 1979. Sedimentation history of the Mundi Mundi alluvial fans, western New South Wales. *Sedimentary Geology,* 22, 21-51.

Wasson, R.J., 1983a. Dune sediment types, sand colour, sediment provenance and hydrology in the Strzelecki-Simpson dunefield, Australia. In. Brookfield, M.E. and Ahlbrandt, T.S. (eds), *Eolian Sediments and Processes.* Elsevier, Amsterdam, 165-195.

Wasson, R.J., 1983b. The Cainozoic history of the Strzelecki and Simpson dunefields (Australia), and the origin of the desert dunes. *Zeitschrift fur Geomorphologie N.F.,* 45, 85-115.

Wasson, R.J. and Galloway, R.W., 1986. Sediment yield in the Barrier Range before and after European settlement. *Australian Rangeland Journal,* 8, 79-90.

Watts, S.H., 1978. The nature and occurrence of silcrete in the Tibooburra area of northwestern NSW. In: Langford-Smith, T. (ed.), *Silcrete in Australia,* University of New England, Armidale, 167-186.

Webby, 1984.

Whitehouse, F.W.,1955. The geology of the Queensland portion of the Great Artesian Basin, Appendix G. In: *Artesian Water Supplies in Queensland*, Dept. Coord. Gen. Public Works, Queensland.

Wilkinson, C.S., 1889. Notes on the geology of the Barrier Ranges district and the Mount Browne and Mount Poole Gold-fields. *Records of the Geological Survey of New South Wales,* volume 1, part 1, pp. 1-9.

Wopfner, H., 1978. Silcretes of northern South Australia and adjacent regions. In: Langford-Smith, T. (ed.), *Silcrete in Australia,* University of New England, Armidale, 93-142.

Wopfner, H., Callen, R. 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.