BARKLY TABLELAND REGION, NORTHERN TERRITORY

C.J. Edgoose

Department of Lands, Planning and Environment, PO Box 1512, Alice Springs, NT 0871
Current address: Northern Territory Geological Survey, PO Box 8760, Alice Springs, NT 0870
Christine.Edgoose@nt.gov.au

INTRODUCTION

The Barkly Tableland comprises an area of about 100 000 km^2 situated northeast of Tennant Creek and extending from the Northern Territory into Queensland (Figure 1). Very little regolith-related work has been done in the region, with the only major study of the whole of the area dating back to the late 1940s (Christian *et al.*, 1951). The following summary is based on land resource studies conducted on several pastoral properties in the Barkly Tableland between 1988 and 1995 (Grant, 1989; Edgoose, 1996; Edgoose and Kennedy; 1996a,b; Edgoose and Lehman, 1996).

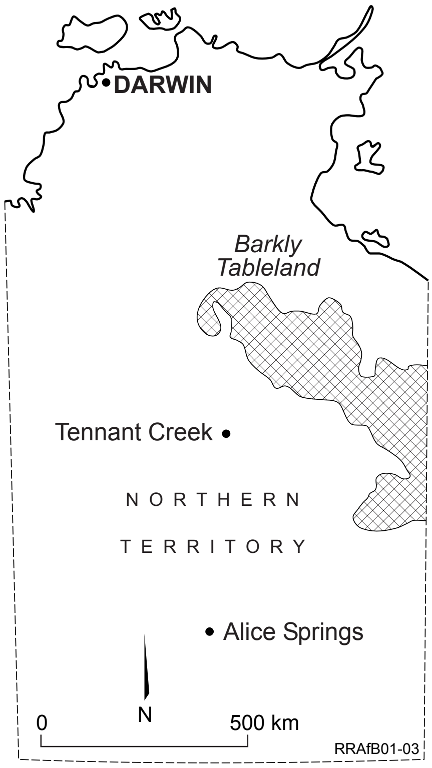

Figure 1. Location of the Barkly Tableland.

PHYSICAL SETTING

Geology

The Barkly Tableland coincides closely with the north–central and northern parts of the Neoproterozoic to Palaeozoic Georgina Basin. Exposures of the basinal sediments in the area are rare, but where present are typically composed of weakly deformed middle Cambrian (c. 520 Ma) carbonate sedimentary rocks (Smith, 1972). Locally overlying the Palaeozoic rocks are thin deposits of flat lying late Palaeogene (c. 25 Ma) limestone. Thin deposits of Cretaceous marine sediments also locally occur in the northern margin of the Barkly Tableland.

Geomorphology

The Barkly Tableland is a vast terrain of flat to very gently undulating plains in which the variation in elevation from the maximum plain level to the drainage minimum is less than 50 m. The drainage is endorheic and flows to several large, shallow lakes in the centre of the region. On the northern margin of the tableland, topographic definition increases northwards toward the drainage divide with the Gulf Fall and its northerly flowing drainage. The tableland's southern margin is encroached upon by extensive aeolian sand plains.

CLIMATE AND VEGETATION

The climate is semi-arid with long hot summers and short cool winters. Rainfall is monsoon-influenced and ranges from 400 to 600 mm per year, increasing northwards across the region. Seasonal rainfall variability is moderate and decreases northwards. The mean daily maximum temperatures in July and January are 24°C and 37°C, respectively.

Mitchell grass and flinders grasses on cracking clay plains characterise the area. Remnant lateritic plains are dominated by turpentine (*Acacia lysophloia*) and spinifex (dominantly *Triodia pungens*), with mallee eucalyptus and soft spinifex sometimes dominating the upper storey where the surface is sandy. Swamps and lakes are dominated by Queensland bluebush (*Chenopodium auricomum*) and coolibah (*Eucalyptus microtheca*).

REGOLITH–LANDFORM RELATIONSHIPS

Several land resource maps of pastoral properties in the region were produced by aerial photograph interpretation supported by field studies. At the broader grouping level the land units produced by these studies correspond closely to regolith–landform units.

Regolith in the region is dominated by *in situ* (eluvial) material and can be subdivided into the following three regolith–landform units.

1. *Ferruginous plains*. This regolith–landform unit (Figure 2) forms the highest part of the landscape and occurs as large continuous areas, and scattered remnants on the cracking clay plains (see below). The margins of ferruginous plains commonly contain gilgai. The ferruginous plains are dominantly underlain by kaolinitic clay profiles with abundant gravel lags of ferruginous nodules and fragments, and chert fragments. Very little duricrust material is present. At shallow depth (~ 2 m), a pallid zone may be present. Drainage is dominantly by sheet flow, with only rare channelised drainage. Slopes are generally 0.5 to 1%, with areas of greatest slope being marginal to the cracking clay plains.

2. *Cracking clay plains.* Cracking clay plains (Figure 3), also known as ‘downs’, are the most widespread and characteristic feature of the region. They form smectite-dominated medium to heavy clay profiles, with common chert and ferruginous fragments and rare tiny lenses of sand. Particularly in marginal areas, the cracking clay plains are gilgaied and contain remnants of the ferruginous plains. The cracking clay plains are traversed by very shallow, open drainages and are commonly mantled by scree of chert and lesser ferruginous fragments.

3. *Alluvial plains.* This regolith–landform unit (Figure 4) is confined to drainage and swamp systems. It consists largely of light to medium clay surface material and deeper profiles. These are smectite-dominated and comprise material largely derived from the ‘downs’.

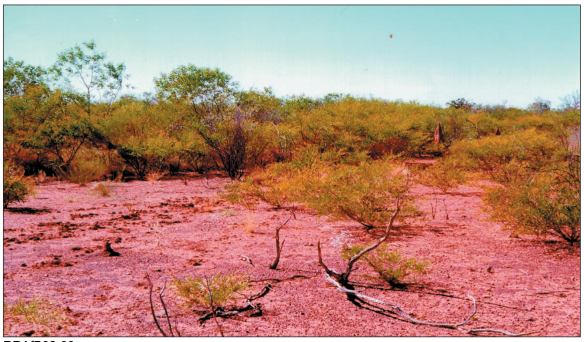

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Figure 2. Ferruginous plain regolith–landform unit.

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Figure 3. Cracking clay pan (’downs’) regolith–landform unit.

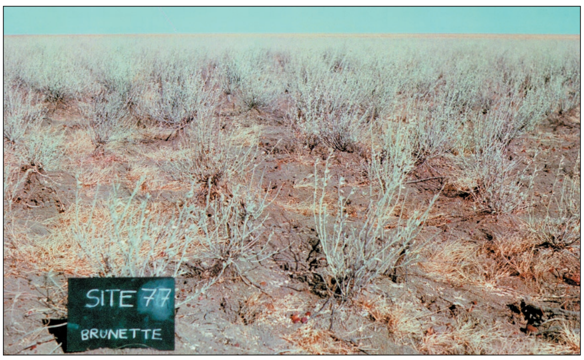

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Figure 4. Alluvial plain (and bluebush swamp) regolith–landform unit.

REGOLITH CHARACTERISATION

Ferruginous kaolinitic regolith typical of the ferruginous plains is pale red in colour and dominated by clay loam to light clay in surface horizons and light to medium clay in lower horizons. Where the lateritic surface persists, a deep profile of pisolitic and nodular gravel is present. The clay is dominantly slightly acidic. Pit excavations reveal a pale saprolitic or pallid zone layer at a depth of approximately 2–2.5 m over middle Cambrian substrate.

The smectite-dominated material (‘downs’ and gilgai) is grey to grey-brown and dominantly medium clay in surface horizons and medium–heavy and sometimes heavy clay in lower horizons. The material is neutral to slightly alkaline, and the soils are dominantly non-calcareous except where the substrate is Tertiary limestone. Pit excavations indicate a pale saprolitic or pallid zone layer at a depth of about 2–2.5 m, developed on the middle Cambrian substrate.

Alluvial material is dominantly brown-grey and varies from light clay to medium and medium–heavy clay. The clay is generally neutral to weakly alkaline in drainage lines, but may become strongly alkaline in swamps and lake floors. Soils may be calcareous where they contain abundant nodules of late Palaeogene limestone.

REGOLITH EVOLUTION

The Palaeogene–Neogene history of the area appears to have had the greatest influence on the development of regolith, although the region has been inherently stable for a very long time. During the Palaeogene–Neogene, widespread peneplanation of an already subdued landscape coincided with ferruginisation and the development of lateritic profiles (including pallid zones at shallow depth) probably within both transported and residual materials. At about 25 Ma broad, very shallow valleys developed brackish to fresh-water lakes, which accumulated thin deposits of limestone. The present day endorhiec drainage largely mimics these deposits, indicating the topographic configuration of this landscape has not greatly changed. The climatic conditions prevailing at this time produced a chemical environment that favoured the development of kaolinitic clays in the regolith.

Minor rejuvenation of the landscape has resulted in very weak incision of drainage allied to stripping of extensive areas of the lateritic plains, and localised exposure of Palaeogene limestone. The cracking clay plains have been described as Palaeogene to Neogene swamp deposits formed concurrently with the lateritic plains (Christian *et al.*, 1951; Randal and Nicholls, 1963), or eluvial material derived directly from the middle Cambrian substrate after stripping of the lateritic surfaces (Randal, 1966; Grant, 1989). However, several factors suggest that the cracking clay plains have evolved through the stripping of the lateritic plains, with the prevailing drier and seasonal climatic conditions favouring the development of smectite through pedogenesis. Conversion of kaolinite-dominated soils to smectite-dominated soils has been described in southeast Queensland by Veen (1972).

The development of gilgai is interpreted to be an integral part of this process, through both the generation of smectite clay profiles, and their strongly landscape controlled distribution i.e. areas of greatest slope in the marginal zones of the lateritic plains and the cracking clay plains. In addition, abundant small remnants of the lateritic surfaces, usually gilgaied, are present across large areas of the cracking clay plains.

More recent alluvial material associated with drainage and low lying areas is largely overprinted by pedogenic processes, a result of the maturity and comparatively low energy of the present day landscape processes.

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