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REGOLITH-LANDFORMS OF THE EBAGOOLA 1:250 000 SHEET AREA (SD54-12), NORTH QUEENSLAND

by
C F Pain, J R Wilford and J C Dohrenwend

RECORD 1994/7

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Regolith-Landforms of the Ebagoola 1:250 000 Sheet Area(SD54-12) North Queensland

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C F Pain and J R Wilford (AGSO), and J C Dohrenwend (USGS)

Mineral and Land Use Program

A Product of the National Geoscience Mapping Accord

NORTH QUEENSLAND PROJECT

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

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PREFACE

The 1:250 000 Regolith-Landform map series follows from the 1:5m Regolith Map of Australia (BMR Record 1986/27) and the Regolith-Terrain maps of the Hamilton (Victoria) and Kalgoorlie (Western Australia) 1:1m sheet areas (BMR Records 1986/33 and 1992/8). The regolith mapping program aims to provide regional data about the nature and distribution of regolith in Australia. These data are made available as maps and accompanying map commentaries. In line with this aim, the AGSO Minerals and Land Use Program has also developed a database of information about the Australian regolith. The database (RTMAP) contains information about specific field sites and general mapping units.

Each regolith-landform map together with its accompanying map commentary and data records consists of a set of vectorised map polygons that are digitally linked to a data base of regolith and landform attributes for each polygon. These data are usually available in hard copy as well as digital formats. They will be of value for minerals exploration, land-use planning, and regional environmental analysis. Attributes relevant for particular uses can be selected and then digitally related to the map polygons to produce special purpose maps for a broad range of planning and assessment activities.

EBAGOOLA is part of the National Geoscience Mapping Accord North Queensland Project area. The EBAGOOLA Regolith-Landform Map is the first 1:250 000-scale map of its kind to be produced in Australia. Moreover, as far as we are aware, it is the first such map to be produced world wide. Site data on which the map is based are also available.

For more information concerning the EBAGOOLA Regolith-Landform Map and data presented in this report, or if you are interested in receiving information about any of AGSO's regolith maps and data sets, please contact:

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SUMMARY

Regolith in the EBAGOOLA (SD54-12) 1:250 000 sheet area in North Queensland consists of both *in situ* weathered bedrock and transported materials. *In situ* weathered bedrock includes:

Deep weathering profiles with bauxite, mottled and pallid zones, found on remnant land surfaces

Residual sand over moderately weathered saprolite in areas of relatively low geomorphic activity

Thin soils lying directly on slightly weathered or unweathered bedrock on steeper slopes and unstable areas

Transported regolith includes:

Large areas of alluvium in fans in the east, and a small area of slightly dissected fan alluvium in the south west

Narrow strips of alluvium, with occasional terraces, along the major rivers

Coastal sediments (beach ridges and estuarine sediments)

Small areas of colluvium in footslopes below steeper hill slopes

Iron cementing forms immature ferricrete in a few locations. Siliceous cementing is more widespread, both in present valley floors, and as silcrete in alluvium that now caps small remnant land surfaces.

EBAGOOLA is divided into four regolith-landform provinces. The Carpentaria Plains Regolith-Landform Province consists of alluvium in the south west corner. The Merluna Province is on Cretaceous rocks of the Rolling Downs Group, and is largely *in situ* weathered bedrock. The Peninsula Uplands consist of shallow soils on the metamorphic rocks that dominate the hillier landforms, and residual sand on moderately weathered saprolite on the more gently sloping granites. The Laura Province in the east consists of areas of residual sand on bedrock emerging from a cover of alluvium inland and coastal deposits near the coast.

INTRODUCTION

This research forms part of the National Geoscience Mapping Accord (NGMA) North Queensland Project undertaken jointly by the Australian Geological Survey Organisation and the Queensland Department of Resource Industries. The National Geoscience Mapping Accord, endorsed by the Australian (now Australian and New Zealand) Minerals and Energy Council in August 1990, is a joint Commonwealth/State/Territory initiative to produce, using modern technology, a new generation of geoscientific maps, data sets, and other information of strategically important regions of Australia over the next 20 years.

This Record provides commentary for the Ebagoola 1:250 000 Sheet area (EBAGOOLA) Regolith-Landform map. The regolith-landform units of EBAGOOLA were mapped using a combination of 1:80 000 panchromatic aerial photography (1970), 1:50 000 colour aerial photography (1990), Landsat TM image data, airborne magnetic and gamma-ray spectrometric image data, and field work carried out during July to September 1991 by the Australian Geological Survey Organisation (AGSO). The map was digitised by the Cartographic Services Unit at AGSO.

Some general information about the EBAGOOLA sheet area is provided in the first sections of the record. The philosophy behind the map and descriptions is then presented, and some views on its potential use are noted. The main part of the Record discusses the regolith, first in relation to regolith characteristics and landscape position (Map Units), and then as the regolith materials occur in the landscape (Regolith-Landform Provinces and Associations). There is then a brief discussion on the evolution of regolith-landforms in EBAGOOLA. A brief glossary can be found at the end of the record.

GENERAL

Location, Access, and Land Use

EBAGOOLA lies between latitudes 14° 00' and 15° 00'S and longitudes 142°30' and 144°00'E on the east side of the Cape York Peninsula, west of Princess Charlotte Bay (Figure 1).

Access by road throughout EBAGOOLA is generally poor. During the dry season many roads are suitable for only four-wheel drive and heavy vehicles. During the wet season most roads become impassable. The Peninsula Developmental Road, which connects the tip of Cape York Peninsula and Weipa to the north with Laura, Mareeba and Cairns to the south, is the principal access route to the sheet area. Formed public roads diverge from the Peninsula Developmental Road to the Parmpurraw (Edward River) Community and to Aurukun in the west and to the mouth of the North Kennedy River and Port Stewart on Princess Charlotte Bay to the east. A network of private tracks links homesteads throughout the area. A regular airline service operates to the township of Coen immediately north of EBAGOOLA, and light aircraft also service some station homesteads.

Pastoral holdings used for cattle grazing are the dominant form of land tenure within the Sheet area. The south eastern corner is covered by the Lakefield National Park.

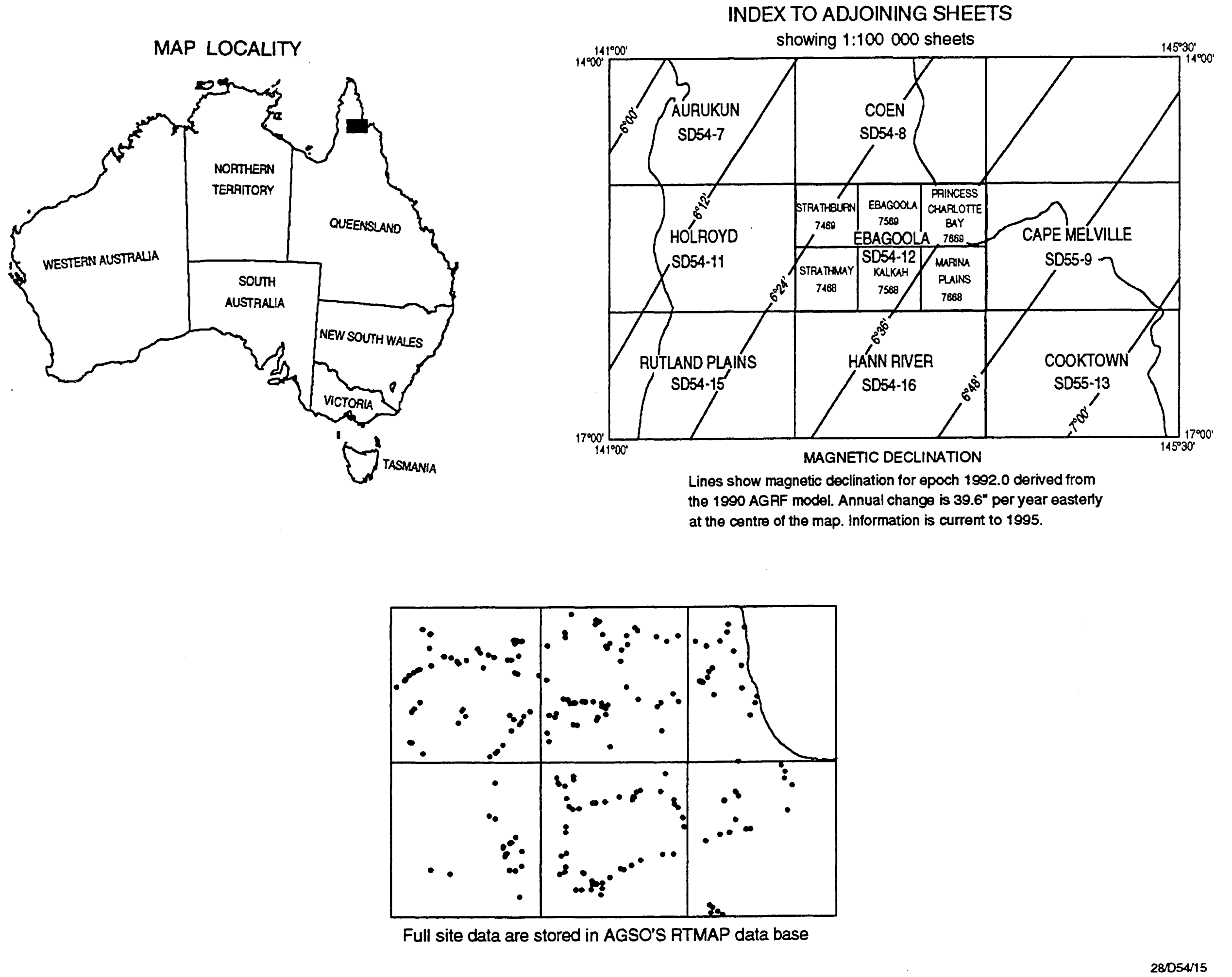

Figure 1. Location of the EBAGOOLA map sheet area.

Climate and Vegetation

The climate of Cape York Peninsula is monsoonal. Most of the region's annual rainfall (generally 1000-1800 mm per year) occurs during the summer months (November to April). Temperatures in the summer months range from minimums in the low to mid 20's to maximums in the low to mid 30's (degrees Celsius); corresponding winter temperatures are usually 5 ° C cooler (Connell Wagner 1989).

Vegetation over most of the sheet area consists of an open forest and woodland of eucalypts with an understorey of shrubs and grasses (Connell Wagner, 1989).

Previous Investigations

The most comprehensive geological investigations in EBAGOOLA resulted from joint AGSO/GSQ field mapping from 1962 to 1974. These include surveys of the Laura Basin (de Keyser & Lucas 1968), the Coen Inlier (Trail & others 1968; Whitaker & Willmott 1968; Willmott & others 1973) and the Carpentaria and Karumba Basins (Doutch & others 1973; Powell & others 1976; Smart & others 1980). Ewers & Bain (1992) present a preliminary compilation of the most recent geological mapping in the area.

Regolith-related information is sparse. Isbell & others (1968) compiled a 1:2m-scale map and explanatory data of soils of Cape York Peninsula as part of the Atlas of Australian Soils. EBAGOOLA is also part of the area surveyed by the CSIRO Division of Land Research (Galloway & others 1970). Their report includes a 11m scale map of land systems, and a brief discussion of the area's landforms and soils.

A preliminary commentary on the regolith of EBAGOOLA is presented by Pain & Wilford (1992b).

Bedrock Geology

The geology of EBAGOOLA (Ewers & Bain 1992) consists of the pre-Mesozoic basement rocks of the Coen Inlier flanked by the Mesozoic Carpentaria Basin and Cainozoic Karumba Basin to the west and the Mesozoic Laura Basin to the east (Figure 2).

In EBAGOOLA the north-trending Coen Inlier is the exposed part of an extensive province of Proterozoic metasedimentary rocks pervasively intruded by Siluro-Devonian granites. The Proterozoic rocks are greenschist grade pelitic sediments and sandstones grading to upper amphibolite facies schist, gneiss, and quartzite. The dominant igneous rocks are the granitoids (both S- and I-type) of the Siluro-Devonian Cape York Peninsula Batholith (CYPB), which constitutes more than half of the exposed pre-Mesozoic basement in EBAGOOLA. Dykes of rhyolitic to andesitic or basaltic composition, rhyolite plugs, and one small stock of microgranite, all of probable Late Carboniferous-Early Permian age intrude the CYPB and its metasedimentary host rocks. An isolated exposure of Tertiary basalt crops out in the north eastern part of the Sheet area.

Mesozoic sedimentary rocks of the Carpentaria and Laura Basins overlap the Coen Inlier on its west and east flanks respectively. Rocks in these basins consist of a conformable Jurassic to Lower Cretaceous sequence of continental sandstone and conglomerate overlain by marine sandstone and mudstone (Smart & others, 1980; Hawkins & Williams, 1990).

The Cainozoic Karumba Basin (Smart & others, 1980) unconformably overlies the Carpentaria Basin and is characterised by fluvial sediments. Probable correlatives of units within the Karumba Basin overlie the Laura Basin along the eastern margin of the sheet area.

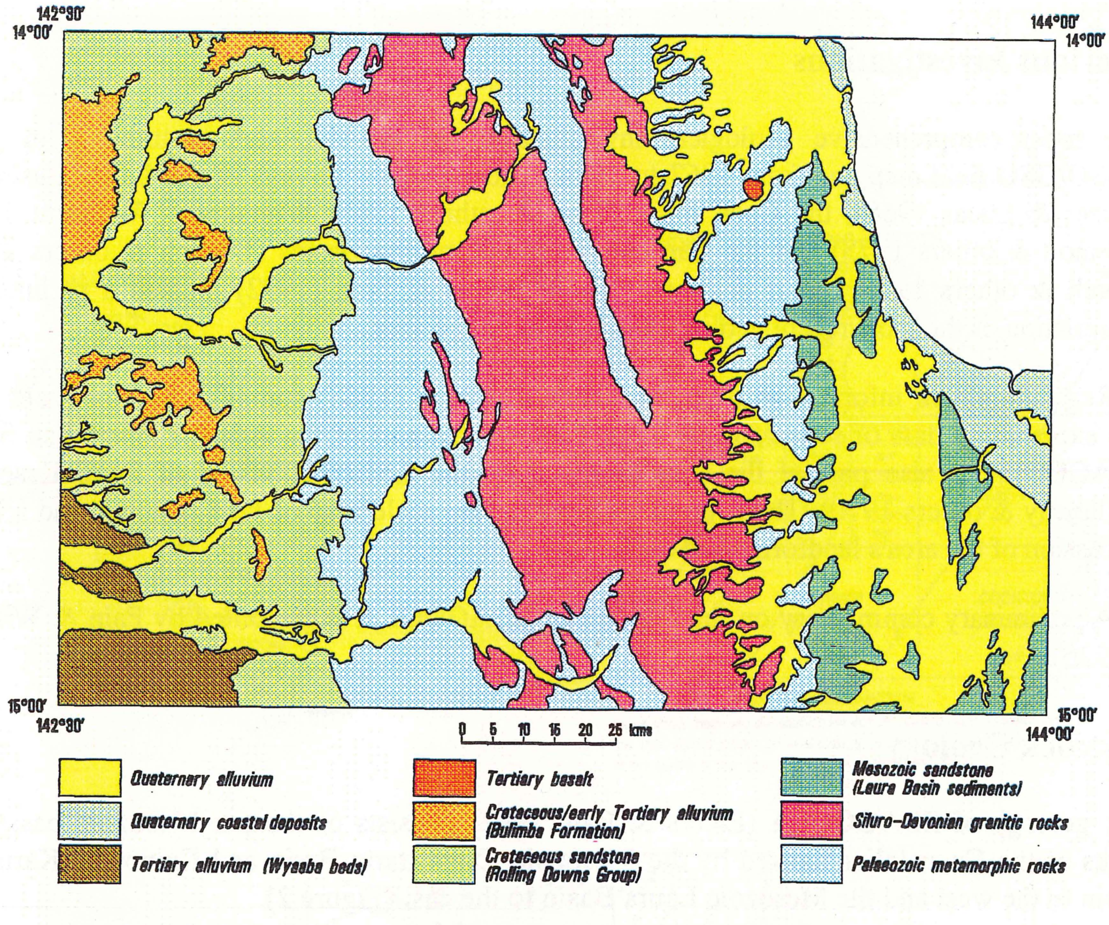

Figure 2. Simplified bedrock geology of EBAGOOLA (after Trail & others).

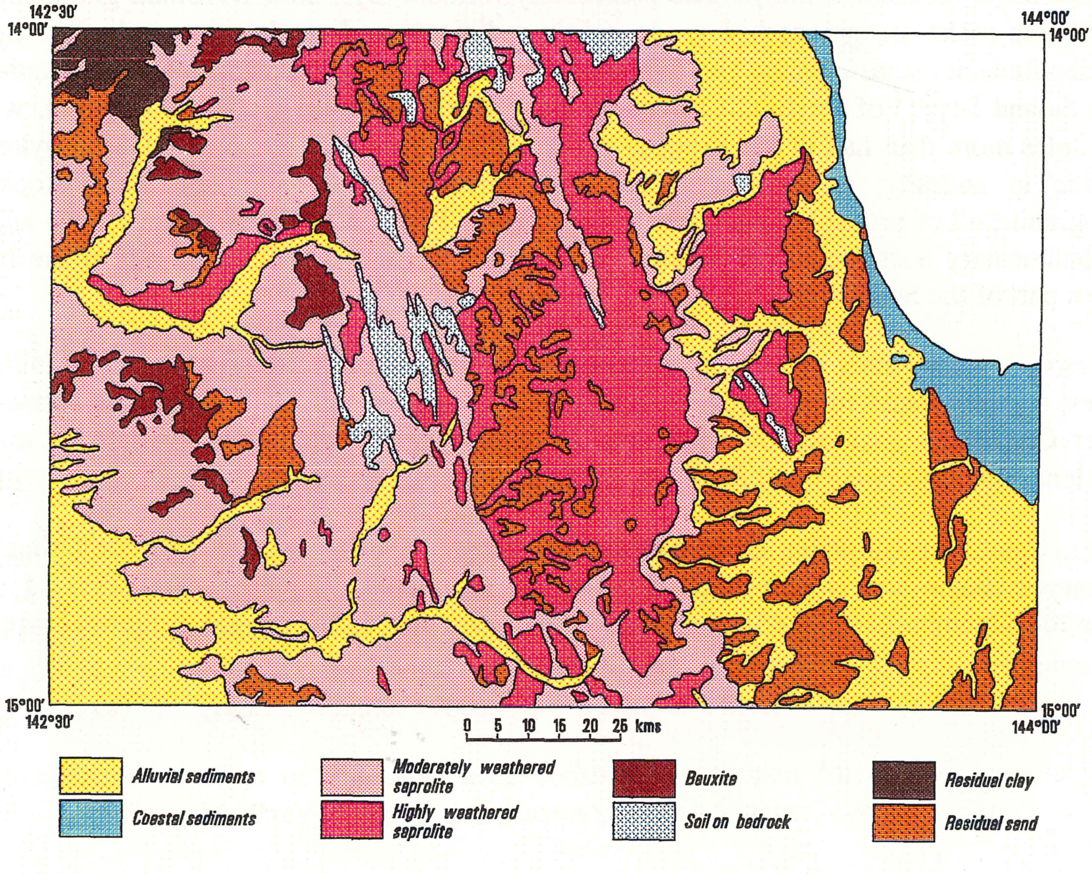

Figure 3. Simplified regolith map of EBAGOOLA.

Three general bedrock types, granite, metamorphic rocks, and siliceous sandstone, all exert a significant influence on landforms and regolith types in EBAGOOLA. Granitic rocks, because they weather readily, tend to develop lower relief landforms and deeper regolith (>3m). Metamorphic rocks, especially quartzite, stand higher in the landscape and have shallow regolith (<1m). Landforms and regolith developed on the siliceous sandstone of the Carpentaria and Laura Basins tend to lie between these extremes. The regolith is relatively thin and is dominated by quartz-rich soils and residual sand. It is important to remember, however, that land surface age, geomorphic processes and ongoing landscape evolution also work to modify the landscape and its associated regolith.

REGOLITH-LANDFORM MAPPING

some points as a background to descriptions of the regolith and landforms of EBAGOOLA.

The regolith-landform unit is the basic mapping unit, and is defined by Pain and others (1991) as an area of land possessing similar landform and regolith attributes. A regolith-landform unit refers to an area of land of any size that can be isolated at the scale of mapping. Units are mapped primarily on the basis of landforms and then described in terms of the relationships between landforms and regolith. Often the landforms and regolith will be related both spatially and genetically. These relationships can be expressed as regolith toposequences, which, like soil catenas, show the location of regolith materials associated with particular parts of the landscape. The difference between a regolith toposequence and a soil catena is that the former is likely to be deeper and more complex.

It is important to note that regolith-landform maps show mapping units that are a composite of various regolith types and landforms. This follows from the fundamental difference between regolith and landform classification units and regolith-landform mapping units. The arrangement of regolith materials in a classification is based on logical and hierarchical relationships between the different kinds of regolith. The same is true of landforms, which are classified separately from regolith. However, such arrangement in a classification has little in common with the spatial arrangement of these materials or landforms in a landscape. The arrangement of regolith-landform units in a landscape depends on the geomorphic character and development of an area. The difference between classification and mapping units is contained in the following definitions:

> *Classification units* consist of regolith units which are defined in terms of various regolith characteristics. They are ideal or conceptual units which can be precisely defined.
>
> Mapping units are real regolith-landform units that can be conveniently mapped, and their delimitation will therefore depend to some extent on the scale of the map. The more detailed the scale, the more pure the regolith-landform units will be. A mapping unit will almost always include regolith units that do not belong to the appropriate classification unit. These different units occur in areas that are too small to appear on the map. An example of this is narrow sedimentary areas in floodplains in dominantly highly weathered saprolite.

Regolith-landform units, therefore, do not define areas of uniform regolith materials, and regolith-landform maps cannot be interpreted in the same way as geology maps. The regolith at a particular point in the field will not necessarily be that which is shown on the map for the surrounding area within that regolith-landform unit. The regolith at a particular point may only be a minor regolith type, perhaps mentioned in the database but not highlighted as part of the unit description on the map. The same applies to landforms. The regolith toposequence concept, embodied in the descriptions contained in this record, allows the map to be used as a guide to the dominant regolith types that occur in particular landscape positions in each mapping unit. The map should not be used to identify a particular regolith type at any given point.

MAP UNITS

Regolith information was derived largely from reconnaissance field work. Site descriptions are contained in Pain & Wilford (1994).

Landsat Thematic Mapper image data were used in combination with airborne gamma-ray spectrometric image data to assist in defining some regolith-landform units and in locating unit boundaries that are not obvious either from interpretation of aerial photographs or from field observation (particularly in the eastern and western parts of the map sheet area). The integration of Landsat TM imagery with airborne gamma-ray spectrometric imagery, and the in terpretation of airborne gamma-ray spectrometrics for regolith, are presented in Wilford (1992).

Each polygon on the map is labelled with a combination of symbols arranged as:

Regolith Type + Induration
Landform Type

This coding system facilitates the grouping of map units according to any combination of these codes. The regolith-landform map of EBAGOOLA and the map legend are grouped according to regolith type. A simplified regolith map is shown in Figure 3 (p. 4), and a simplified landform map in Figure 4 (p. 7).

Residual Material

Residual material is derived from the weathering of bedrock, and remains in place after more mobile weathering products have been removed. There is loss of volume from the weathered mass, and there may have been local disturbance, particularly by bioturbation.

Soil on Bedrock (Z)

Soil on bedrock is mapped in areas where fresh or weakly weathered bedrock lies within 2 m of the surface. In EBAGOOLA, such areas are confined mainly to metamorphic bedrock, although small areas also occur on granite, and one small area is underlain by basalt.

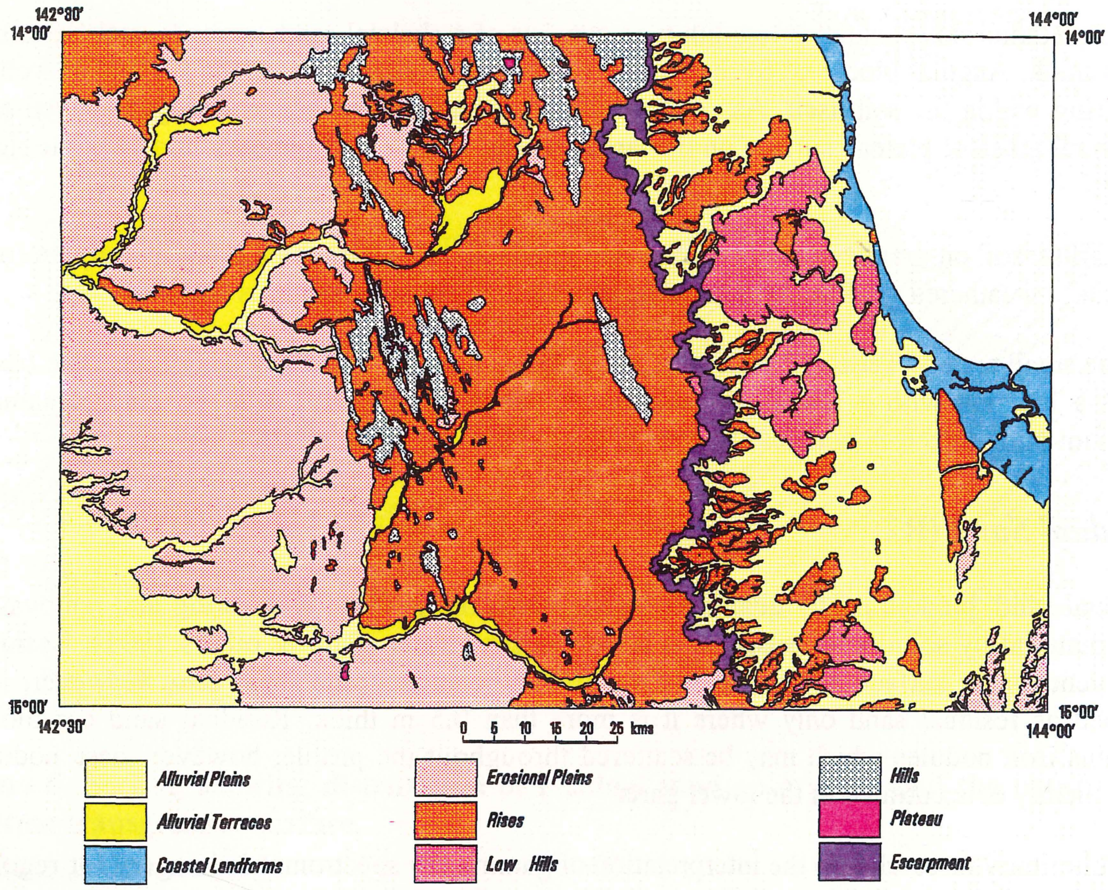

Figure 4. Simplified landform map of EBAGOOLA.

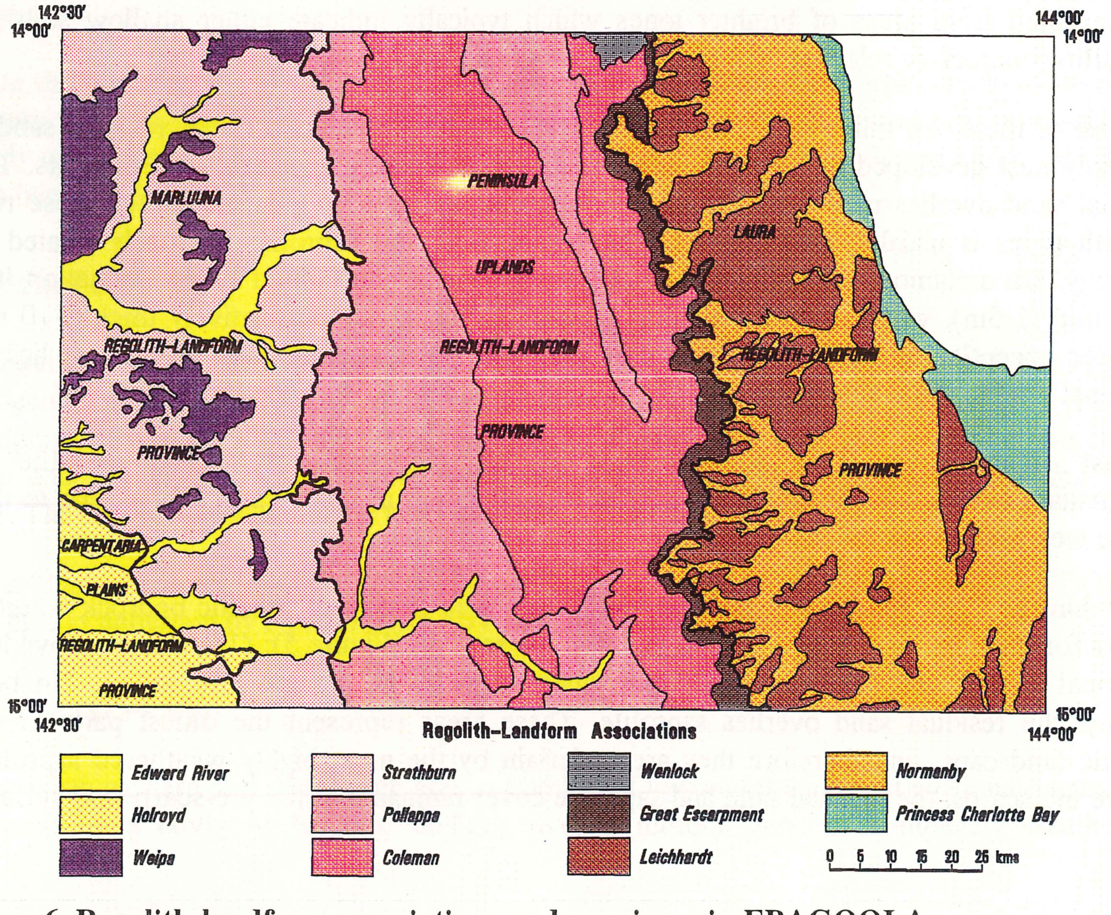

Figure 6. Regolith-landform associations and provinces in EBAGOOLA.

On metamorphic rocks this regolith type consists of a skeletal sandy soil generally less than 0.5 m thick. Angular blocks of fresh or weakly weathered bedrock lie on the surface as well as occurring within the soil itself. Associated landforms include low hills and ridges as well as a few small areas of plateau surface on the larger ridges. Quartzite commonly underlies the ridge crests.

Shallow soil on granite consists of sand and gravel up to a metre thick lying directly on fresh or weakly weathered granite. Associated landforms are primarily low hills and tors.

One small area of Tertiary basalt near Silver Plains also has a shallow soil cover. The basalt forms a low hill with a few small benches on the sides. The soil is a red clay containing abundant numerous iron nodules and cobble to boulder-size basalt clasts.

Residual Sand (R2)

Residual sand, predominantly quartz, is derived from the in place weathering and removal of finer material by solution or suspension in sub surface water (Pain & others 1991). Residual sand veneers the surface of much of the weathered bedrock in the sheet area. However, it is mapped as residual sand only where it is more than 0.5 m thick. Residual sand commonly contains iron nodules which may be scattered throughout the profile; however these nodules are typically concentrated in the lower parts.

Preliminary research into the interpretation of gamma-ray spectrometric imagery for regolith mapping (Wilford 1992) facilitated the mapping of quartz-rich residual sand in many places. Quartz-rich residual sand more than 0.5 m thick appears as very dark tones (low in potassium, thorium and uranium) on RGB-composite gamma-ray spectrometric images and is easily distinguished from areas of brighter tones which typically indicate either shallow soils on crystalline bedrock or relatively young alluvium derived from these rocks.

West of the Coen Inlier on sedimentary bedrock of the Carpentaria Basin, residual sand is generally best developed on sandy intervals within these shallow marine/fluvial deposits. The residual sand overlies moderately weathered saprolite, and the boundary between these two regolith types is usually quite distinct. The thickness of the saprolite is closely related to lithology. On metamorphics rocks and on the sandstones of the Gilbert River Formation it is quite thin (1-5m), whereas on the Rolling Downs Group it may be relatively thick (>10 m). With the exception of a few small areas near the Coen Inlier, residual sand in this area lies on erosional plains.

East of the Coen Inlier, residual sand overlies moderately weathered saprolite on sedimentary bedrock of the Laura Basin. The regolith cover in this area is very similar to that on the west side of the Inlier.

Within the Coen Inlier itself, residual sand is confined largely to granitic bedrock where it occurs for the most part in two general geomorphic settings (Figure 5): (1) on rises above low erosional scarps; and (2) below and some distance from these same low scarps. In both settings the residual sand overlies saprolite. These areas represent the oldest parts of the granitic landscape, and therefore they are underlain by the most highly weathered saprolite. Above the scarps, the residual sand and saprolite cover remnants of the pre-scarp land surface,

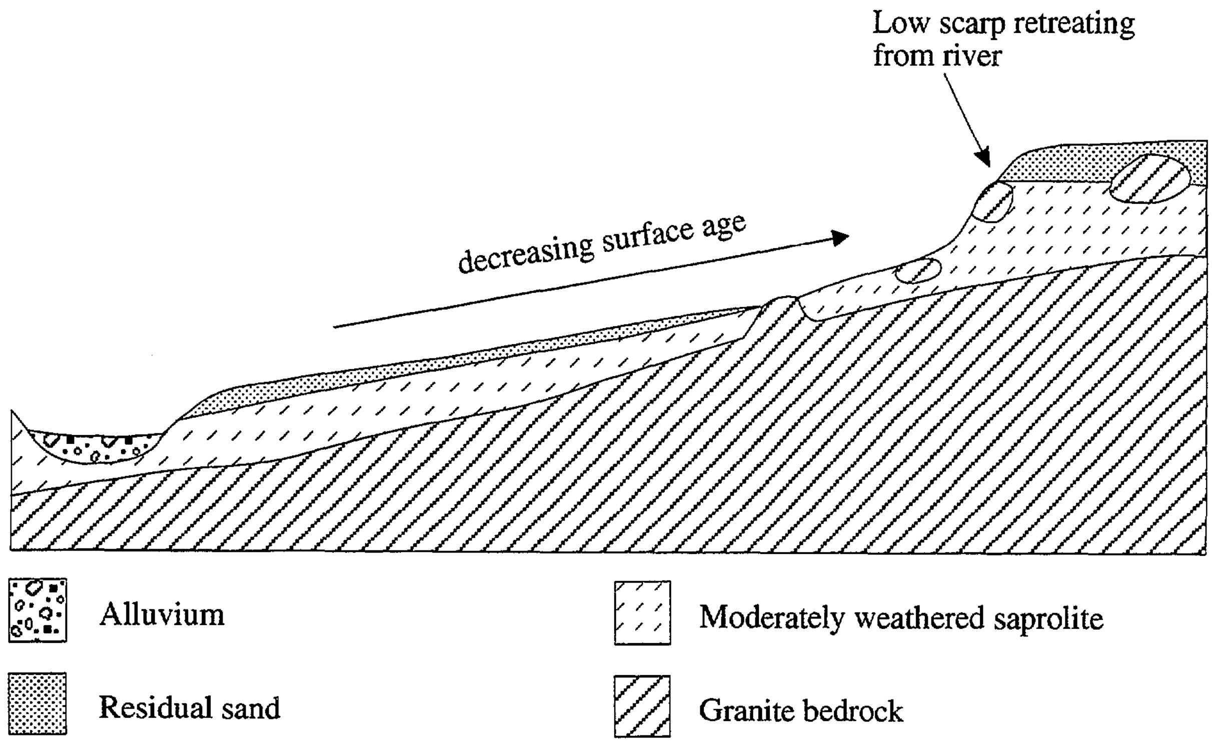

Figure 5. Section showing distribution of residual sand on granite, and the nature of the time-transgressive surface.

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whereas below the scarps they have developed on a time-transgressive surface formed as a result of scarp retreat, and thus they occur on that part of the surface furthermost from the scarp.

On the western side of the Inlier, residual sand also overlies metamorphic rocks. However, because metamorphic rocks rarely weather to sand sized material, this sand may represent the deeply weathered remnants of a former cover of Mesozoic sedimentary deposits most of which have been eroded away.

Residual clay (R3)

Residual clay is bedrock weathered in place, with losses of material mainly by solution. There has been some local rearrangement of materials in this regolith type. The clay minerals present (predominantly montmorillonite) have expanding clay lattices, and lead to the formation of gilgai micro relief, deep cracking of the upper part of the regolith profile, and a self mulching layer. The highly seasonal climate emphasises these features.

Residual clay is confined to a relatively small area in the north west corner of EBAGOOLA. This area is underlain by a particularly clay-rich unit in the Rolling Downs Group.

Bauxite (D5+N1)

In the north western part of the map area, a number of low mesas and relict erosional plains are veneered by a cover of bauxitic nodules over a mottled zone of completely weathered saprolite. The regolith consists of a few centimetres of residual sand and silt over a layer of well developed bauxitic nodules up to 1 m thick. This in turn overlies a mottled zone on saprolite developed on sedimentary bedrock. The mapped areas are locally bounded by low erosion scarps. Some of these relict surfaces include small unmapped areas of moderately weathered saprolite, some of which are strongly silicified.

Saprolite

Saprolite is defined as moderately to completely weathered bedrock which has been weathered in place without volume alteration. Primary rock fabric is usually apparent. In EBAGOOLA saprolite is divided into completely weathered, highly weathered, and moderately weathered saprolite on the basis of the degree of preservation of rock fabric and the abundance of earth material. Detailed definitions are given in Pain & others (1991).

Moderately Weathered Saprolite (D2)

Moderately weathered saprolite occurs in three principal areas in EBAGOOLA:

1. In the western part of the sheet area, erosional plains developed on gently dipping to flat lying strata of the Rolling Downs Group are covered by moderately weathered saprolite. This regolith consists of a thin layer of residual sand, sometimes with iron pisoliths, developed on moderately to highly weathered light grey fine sandstone and siltstone. Total depth of weathering is not known, but moderately weathered regolith is generally less than 5 m thick before it grades into slightly weathered saprolite which may be as much as several tens of metres thick. This slightly weathered saprolite is not mapped because it is always covered with other regolith materials. Locally, this map unit contains included areas of deeper residual sand and small areas of deep weathering on low hills where silicified mottled zones overlie the saprolite. Rounded quartz gravels and cobbles veneer the crests of some of these hills. These latter occurrences probably represent the degraded remnants of an older higher landscape. Valley floors contain thin alluvial sequences, and siliceous hardpans commonly cement both the alluvium and the adjacent weathered bedrock.

2. On metamorphic rocks, this regolith type consists of a thin soil formed on moderately to highly weathered saprolite developed on rises and low hills. Total regolith cover is generally thin, ranging from 1 to 5 m.

3. Along the Great Escarpment, a thin soil on moderately weathered saprolite covers slopes up to 25°. Corestones and tors are common. This regolith type also occurs along most of the smaller erosional scarps developed on granite in the sheet area, but these occurrences are generally too small to show at a scale of 1:250 000.

Highly Weathered Saprolite (D4)

Highly weathered saprolite is mapped mainly on granite and metamorphic rocks, although some small areas also occur on sandstones of the Rolling Downs Group. On granite, this regolith type consists of a thin sandy soil over weathered granite with many unweathered mineral grains. Corestones and tors are common, especially on lower valley slopes. Other regolith types occur locally within this map unit. For example, almost all valley floors have a narrow belt of shallow alluvium, usually less than 10 m wide and 2 m thick. Valley floor regolith, both alluvium and saprolite, is sometimes silicified to form a siliceous hardpan. The predominant landforms are rises. Regolith derived from metamorphic rocks consists of a shallow soil over moderately to highly weathered saprolite. The saprolite normally shows original metamorphic structures quite clearly, although the material is soft and primary minerals are typically altered to clay. The principal landform types are rises and low hills with steep slopes developed on the more resistant quartzites and gentle slopes developed on the less resistant saprolite. Also included within this map unit are areas of shallow coarse angular to subangular alluvium along valley floors and thin colluvial mantles on some lower valley slopes. Ferruginous induration of the valley floor regolith is common. Regolith thicknesses in all areas are generally less than 10 m.

Completely Weathered Saprolite (D5)

In EBAGOOLA completely weathered saprolite consists of mottled zone material, which contains abundant reddish, usually ferruginous mottles. The mottled zone is considered by many workers to be part of the typical lateritic deep weathering profile, and its occurrence at the surface may imply some removal of surface material. In EBAGOOLA, a thin layer of residual sand with scattered pisoliths locally overlies the mottled zone. Commonly the upper part of the mottled zone consists of nodules and pisoliths, whereas the mottles are more tubular or reticulate further down the profile. In places the mottled zone grades into a pallid zone with depth.

Two types of completely weathered saprolite occur in EBAGOOLA, although none lies at the surface:

1. A number of small areas underlain by metamorphic rocks in the southern part of the map sheet area have a ferruginous mottled layer on the surface. Locally, this layer is strongly indurated and contains some iron nodules and pisoliths. It overlies very highly weathered saprolite, and the total thickness of the regolith ranges from 5 - 15m.

2. Small areas of completely weathered saprolite occur on low narrow hills north of Strathmay in the south western part of the map area. Thick saprolite, silicified to silcrete in the top metre or so, is now confined to the tops of these low hills. Locally, the silcrete contains well rounded quartz pebbles and cobbles which also occur as loose surface clasts on the tops of some of these hills.

3. Completely weathered saprolite underlies bauxite nodules on low plateau surfaces in the west and north west.

Alluvial Sediments

Alluvial sediments occur along most of the streams and rivers in the map area; however, these deposits are extensive enough to be mapped only along the larger channels. Where possible channel deposits, over bank deposits, and fluvial terrace deposits have been differentiated and mapped as separate units.

Undifferentiated Alluvium (A0)

Undifferentiated alluvium is mapped over much of the sheet area. In the west most valleys contain continuous alluvial deposits; however, many of these valleys are too small to allow discrimination between channel and over bank deposits at the scale of mapping. Moreover, in some cases the difference between channel and over bank deposits is not obvious because of a lack of distinct channels. In general the regolith consists of channel deposits either at the surface or overlain by finer over bank deposits. This fining upwards sequence is typical of alluvial deposits in a large number of areas. The alluvium is rarely more than a few metres thick. In the eastern part of the map area, undifferentiated alluvium forms large low angle fans and broad flood plains. These areas consist of numerous anastomosing channels and intervening flood plains. Typical regolith is a coarse channel deposit, mainly sand, which is overlain in the flood plain areas by finer sediments.

In the east, alluvial deposits have been subdivided into sediments derived mainly from granites, from metamorphics, and from a mixture of these two general rock types. This subdivision is based on an interpretation the gamma-ray spectrometric image data.

Channel Deposits (A1)

Channel deposits occur in both active and abandoned stream channels. Channel alluvium is mapped along all major west-flowing streams and along the larger streams of the south eastern corner of the map area. These deposits are particularly extensive in the broad channels of the Holroyd and Coleman Rivers near the western edge of the map area. They are predominantly sandy, and gamma-ray spectrometric image data indicates that the sand is derived mainly from the granitic bedrock of the Coen Inlier (Wilford 1992). Within the Inlier, deposits within smaller channels are generally less than 1 m thick and bedrock is exposed in most channel floors. West of the Inlier, channel alluvium in the main rivers is also relatively thin, although thicknesses are not so readily documented. In many places, channel deposits are cemented by silica to form a siliceous hardpan. This hardpan commonly extends into the weathered bedrock adjacent to the channels.

Over Bank Deposits (A2)

Over bank deposits are deposited outside the perimeter of the active channel during flooding. These deposits tend to be finer than adjacent channel deposits.

Over bank deposits are mapped only within a few active flood plain areas along the Holroyd and Coleman Rivers on the western side and along the Moorehead River in the south eastern corner of the map area. These deposits consist of fine sandy alluvium a few metres deep, which locally overlies coarser channel deposits.

Fluvial Terrace Deposits (A3)

Areas of older fluvial deposits occur in the headwaters of the Holroyd River. One such terrace, located between the Holroyd River and Station Creek, lies approximately 15m above the modern flood plain of the Holroyd River . Another occurs further to the north in the headwaters of Station Creek.

These deposits generally consist of about 1 m of alluvial sand grading down to well rounded quartz gravels and cobbles. The lower contact is sharp, and the alluvium rests on very highly or completely weathered saprolite.

Colluvial Deposits (C0)

Colluvial deposits, generally less than 5 m thick, occur in footslope locations, and consist mainly of sheet flow deposits and fanglomerates overlain by stony soils. Usually they are massive but in places weak bedding suggests sheet wash deposition. Near valley floors, these deposits typically inter finger with alluvium.

Colluvial deposits are only mapped in areas adjacent to metamorphic ridges and hills. These upland areas are generally steeper than hills on other bedrock types, and they are the source of abundant coarse angular material. However, colluvium also occurs in small unmapped areas on granite and sandstone bedrock. In these latter areas, it is not easily recognised because of its grain size similarity to residual sand.

Coastal Deposits

Coastal sediments, including both beach and estuarine deposits, underlie the coastal plain adjacent to Princess Charlotte Bay in the eastern part of the map area.

Undifferentiated Coastal Deposits (S0)

Undifferentiated coastal sediments consisting of sand, silt, clay, and organic mud underlie a broad coastal plain characterised by meandering channels, point-bar deposits, oxbow lagoons, mudflats, saltpans and tidal creeks. Soils are variable, consisting of uniform sands and earths on channel sands, cracking clays and saline alkali soils on flood plains and supra tidal plains, and black organic muds adjacent to tidal creeks.

Beach Sediments (S1)

Beach deposits form beach ridges and chenier plains along Princess Charlotte Bay. These deposits are primarily sand and appear to be derived from the granitic alluvium of rivers which rise in the Coen Inlier. Two ages of beach deposits can be distinguished on the basis of location and composition. Older beach deposits are characterised by strongly leached quartz sands. Soils are deep, sandy, and uniform-textured with a grey-brown organic stained A_1 horizon. These older deposits form a truncated beach strand-line up to 15 km inland from the present coast. This strand-line may be coeval with Pleistocene beach ridges along the west coast of Cape York Peninsula (Smart 1976). Younger (Holocene?) beach ridges lie within 4 km of the shoreline and consist of quartz, mica and shelly material. Soils on these younger deposits have poor horizon differentiation and are characterised by sandy uniform-textured profiles with weak organic stained A horizons.

Gamma-ray spectrometric image data indicates that the younger deposits contain potassium-rich minerals whereas these minerals have been weathered and leached from the older deposits.

Estuarine Deposits (S2)

Estuarine sediments underlie broad flats between the beach ridges and tidal flats along the southern margin of Princess Charlotte Bay. They consist of fine sands, silt, muds and minor evaporitic salts forming clay flats and salt pans. Two types of estuarine deposits have been mapped. One is frequently covered by tides and consists mainly of black organic muds. The other is slightly higher in elevation, less frequently inundated by tides, and consists of dark grey to greyish brown cracking clays, saline alkali soils and black organic muds.

REGOLITH-LANDFORM PROVINCES AND ASSOCIATIONS

Regolith-landform provinces are defined as areas with similar regolith and landform types (Chan & others, 1992). There are four regolith-landform provinces in EBAGOOLA (Figure 6, on p. 7), and these are based largely on bedrock characteristics. Each regolith-landform province is made up of a number of regolith-landform associations. Regolith-landform associations are areas where specific regolith types are associated with specific landform types in a regolith toposequence. These regolith-landform associations are given informal names to facilitate discussion. They are generally similar to the land systems defined by Galloway & others (1970), and, where applicable, the land system/regolith-landform association equivalents are given in Table 1.

Carpentaria Plains Regolith-Landform Province

A small part of the Carpentaria Plains Regolith-Landform Province lies in the south western corner of EBAGOOLA. Most of it lies outside EBAGOOLA, to the south and west. In EBAGOOLA the Province consists of alluvial plains that are slightly dissected by broad very shallow valleys. These plains are part of the eastern-most fan surfaces in this part of the Cape York Peninsula, and are formed mainly on the mid-Tertiary Wyaaba Beds. In EBAGOOLA there are two regolith-landform associations in this Province.

Edward River Regolith-Landform Association

The Edward River Regolith-Landform Association occurs along the major rivers in the western part of the sheet area. Relationships between landforms and regolith type are illustrated in Figure 7. Channel deposits occur along active channels; commonly these sediments are indurated to form a siliceous hardpan. The channels and floodplains appear to be slowly aggrading: there are small valley-dammed lakes and swamps where tributaries join the main channels. Over bank deposits occur outside the main channels. Islands of bedrock or older alluvium within this alluvial plain suggest that the alluvium is thin.

Table 1. Land systems on EBAGOOLA (from Galloway and others 1970), with their equivalent regolith-landform provinces and associations.

Land-system	Bedrock	Landform	Regolith	R-L Province R-L Assoc.
Starcke	Granite, metamorphics	Mountains, hills	Soil on bedrock	Peninsula Uplands Pollappa Wenlock Great Escarpment
Arkara	Granite, metamorphics	Hills, low hills	Soil on bedrock (mets) Residual sand (granite)	Peninsula Uplands Coleman
Koolburra	Tertiary sediments*	Plains/low plateaus	Residual sand	Merluna Weipa
Balurga	Tertiary sediments*	Plains	Red and yellow earths (mod. weath. sap) siliceous hardpan	Merluna Strathburn
Mottle	Tertiary sediments*	Plains	Red and yellow earths (mod. weath. sap) siliceous hardpan	Merluna Strathburn
Ninda		Footslopes/fans	colluvium/alluvium	no equivalent
Radnor		Inactive alluvial plains	Alluvium	Carpentaria Plains Edward River
Cumbulla		Alluvial plains	Alluvial silt and clay	Carpentaria Plains Edward River
Inkerman		Coastal plains Minor beach ridges	Coastal sediments	Laura Princess Charlotte Bay
Battersea		Coastal mudflats	Coastal clay	Laura Princess Charlotte Bay

* In EBAGOOLA some areas previously thought to be Tertiary sediments are for the most part Cretaceous marine sandstone of the Carpentaria and Laura Basins.

Holroyd Regolith-Landform Association

A small area of slightly dissected older fan surface lies in the south west corner of EBAGOOLA. Surface relief is low, often being less than 5m between valley floors and adjacent interfluves. It is underlain by alluvial sediments of the Tertiary Wyaaba Beds, and has some younger fine alluvial sediments in valley floors (Figure 8). Materials in the valley floors tend to be slightly finer that elsewhere in the Association. There are a few shallow depressions, or melon holes, which appear to be a result of sub surface solution.

Merluna Regolith-Landform Province

The Merluna Regolith-Landform Province lies in the western third of the map area. It coincides in part with the Merluna Plain, Holroyd Plain and Weipa Plateau of Whitaker and Gibson (1977) and Smart & others (1980). The Province consists primarily of erosional plains, low mesas and cuestas underlain by *in situ* weathered sedimentary bedrock of the Carpentaria Basin, with limited areas of alluvium within valley floors and flood plains.

Weipa Regolith-Landform Association

In EBAGOOLA, the Weipa Regolith-Landform Association is confined to the western third of the map sheet and consists of small mesas and gently dipping cuestas standing only a few tens of metres above the general level of the erosional plain (Figure 9). Along the western edge of the map sheet, the regolith consists of a thin veneer of nodular bauxite (about 1 m thick) resting on mottled and pallid zones. The bauxite is not present on the lower slopes and bottoms of shallow valleys which dissect the larger upland surfaces. Areas of residual sand also occur on these surfaces and more particularly below the low scarps which commonly surrounds them. The eastern-most occurrences of this association have no bauxitic cover; instead, they are covered with moderately to highly weathered saprolite cemented mainly by silica, but with some iron cementing as well. Many of these areas are formed on deeply weathered fluvial sediments of the Tertiary Bulimba Formation (Doutch & others, 1972; Grimes, 1979). However, some of them may also be developed on highly to completely weathered saprolite and residual materials derived from shallow marine sediments of the Cretaceous Rolling Downs Group.

Strathburn Regolith-Landform Association

This regolith-landform association generally coincides with the southern extent of the Merluna Plain of Smart & others (1980). The regolith associated with this erosional plain is moderately weathered saprolite derived from fine sandstone, siltstone and claystone of the Rolling Downs Group (Figure 10A). In most cases bedrock structures are still preserved within one or two m of the surface. The soil is typically a shallow sandy yellow earth. Locally more than 50 cm of residual sand, predominantly quartz, overlies the moderately weathered saprolite. A few residual mesas, hills and narrow sinuous ridges have mottled zone and pallid zone material near their tops. In a few cases these small hills are capped by silcrete developed in quartz gravel-rich alluvium. Where this alluvium is not present, the upper part of the mottled zone is silicified. Alluvium also occurs along valley floors where it is confined either to the channels or to low narrow flood plains. Both the alluvium and underlying saprolite may be cemented by a siliceous hardpan. However, the hardpan is usually confined to areas within or immediately adjacent to the channels (Figure 10B).

Peninsula Uplands Regolith-Landform Province

The Peninsula Uplands Regolith-Landform Province occupies the central part of EBAGOOLA, This province consists of ridges, hills, and rises with intervening valleys and erosional plains developed on metamorphic and granitic rocks of the Coen Inlier. For the most part it coincides with the Coleman Plateau of Whitaker & Gibson (1977) and Smart & others (1980).

Pollappa Regolith-Landform Association

The Pollappa Regolith-Landform Association is found on metamorphic rocks in the Peninsula Uplands. Quartzite ridges underlie the topographic highs of this association whereas weathered gneiss and schist occupy the lower lying areas (Blewett & others 1992a). The general pattern of regolith is thin soils on steep slopes underlain by quartzites, and thin (about 3m thick) colluvium and alluvium overlying moderately weathered saprolite in the lower parts of the landscape (Figure 11A). The thin soils usually consist of as much as 0.5 m of angular gravel and sand with abundant boulders resting directly on fresh to weakly weathered bedrock. In broader valleys colluvial footslopes lead down to narrow valley floors. The colluvium on these footslopes consists of angular gravels and cobbles, locally cemented by iron to form blocky ferricrete up to 8 m thick. Some valley floors are underlain by a mixture of colluvium and alluvium that is locally cemented by ferricrete (Figure 11B).

Coleman Regolith-Landform Association

This regolith-landform association is formed on granite rocks on the Coleman Plateau of Smart & others (1980). Landforms consist of erosional plains and rises, with a small area of hills east of the Holroyd River. It is bounded on its eastern side by the Great Escarpment. Most valleys have narrow floodplains, and the Holroyd River has a low alluvial terrace along part of its right bank. The regolith is mainly moderately and highly weathered saprolite on granite (Figure 12). Large areas of residual sand cover the granite in places, especially in the west and mainly on the Barwon and Burns Granites (Mackenzie & others 1992). Corestones and tors are a common feature.

Narrow floodplains along valley floors have a thin cover of alluvial sand over fresh or slightly weathered granitic saprolite. The low terrace on the right bank of the Holroyd River is capped by approximately 2m of coarse quartz alluvium resting on highly weathered granitic saprolite.

Wenlock Regolith-Landform Association

In EBAGOOLA the Wenlock Regolith-Landform Association is confined to a small area of hills in the northern part of the sheet area. It forms part of the McIlwraith Uplands of Whitaker & Gibson (1977) and Wenlock Uplands of Smart & others (1980). Most of this association occurs north of EBAGOOLA, in the COEN 1:250 000 sheet area.

The association consists of hills with moderately weathered saprolite and thin soils on slopes, and narrow areas of coarse alluvium in valley floors (Figure 13). Total thickness of regolith on hill slopes rarely exceeds 2 m.

Great Escarpment Regolith-Landform Association

The Great Escarpment Regolith-Landform Association is a continuous east-facing escarpment that forms the boundary between the Peninsula Uplands Regolith-Landform Province and the Laura Regolith-Landform Province. Clear evidence of stream captures or reversals in several locations (the Stewart River rapids being the best example) indicates that this escarpment is an actively retreating landform. This association is confined to the Kintore Granite (Mackenzie & others 1992). It transects EBAGOOLA from north to south with steep to locally precipitous slopes and local relief of up to 200 m. Moderately weathered saprolite covers high steep slopes. Tors and corestones are common and small areas of thin soil and bedrock outcrop occur locally (Figure 14). Narrow valley floors have pockets of sandy alluvium.

Laura Regolith-Landform Province

The Laura Regolith-Landform Province occupies the eastern part of the map area, between the base of the Great Escarpment and the Coral Sea. The Province consists largely of transported alluvium derived from weathered granitic and metamorphic rocks of the Peninsula Uplands. Hills and low hills which rise above the alluvial plains are underlain by *in situ* weathered bedrock. Beach ridges and estuarine flats fringe the coast. In the south eastern corner of the map area a large depositional plain has formed from the accumulation of alluvial and estuarine sediments.

Leichhardt Regolith-Landform Association

The Leichhardt Regolith-Landform Association is confined to small hills and rises. On hilltops and steeper slopes, the regolith is characterised by shallow stony and sandy earths over slightly weathered bedrock. Colluvial footslopes and pediment surfaces extend down slope from these hills and rises (Figure 15). The colluvium consists of angular gravels and minor cobbles in a sandy matrix. Pediments are characterised by thin sandy soils over moderately weathered bedrock.

Normanby Regolith-Landform Association

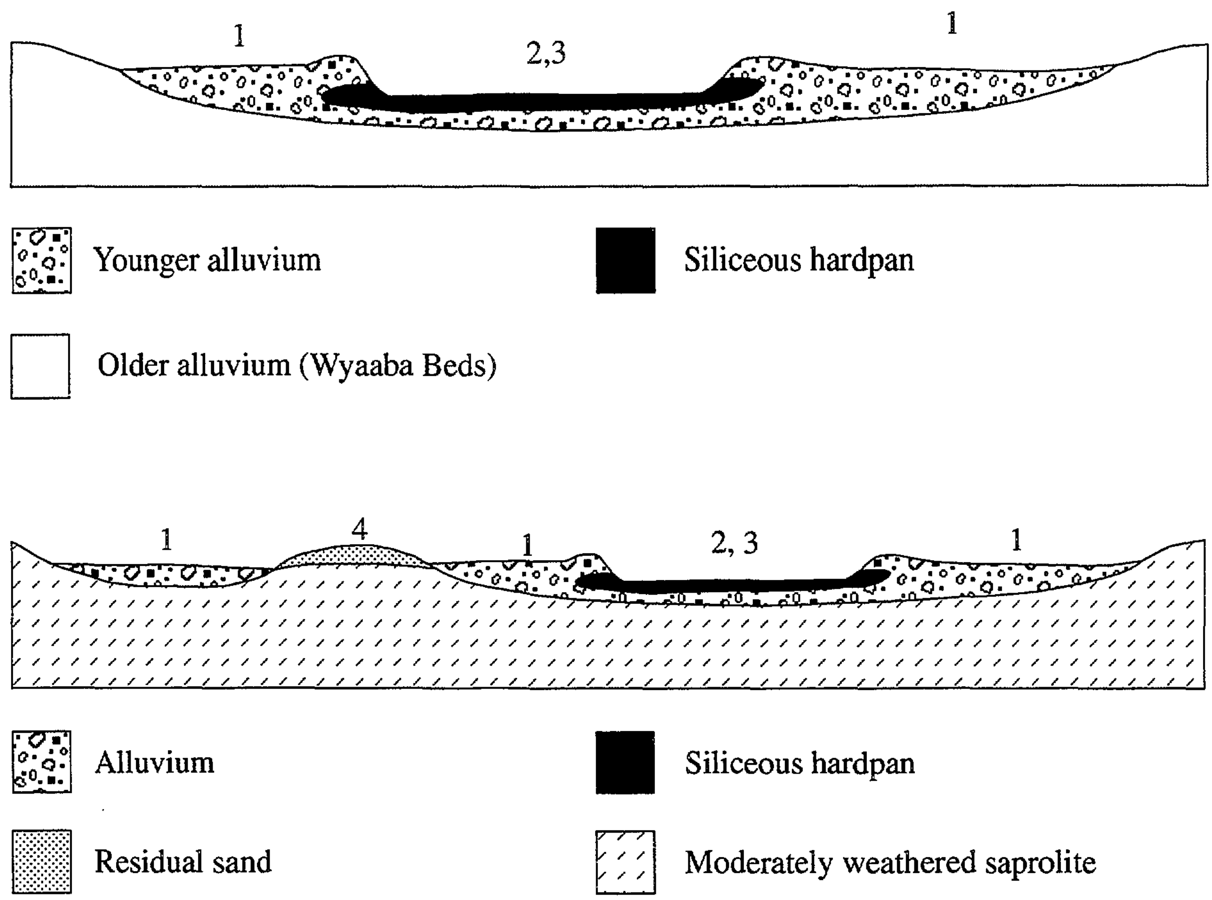
Normanby Regolith-Landform Association, equivalent to the Normanby Plain of Smart and others (1980), covers large areas of the Laura Regolith-Landform Province. The landform consists of extensive low lying active and inactive alluvial plains. The floodplains are covered with water in the wet season, channels are flanked by levees. The regolith consists of channel and over bank alluvium including quartz sand, silt and clay. Siliceous and clay induration of the river channel alluvium (hardpan) is common and locally forms low cliffs and waterfalls. Rises protruding above the alluvial plains are characterised by deep, iron strained residual quartz sands with ferricrete nodules overlying weathered bedrock. Relationships between regolith and landforms are shown in Figure 16.

Princess Charlotte Bay Regolith-Landform Association

The Princess Charlotte Bay Regolith-Landform Association lies along the eastern coast of the peninsula. It extends 4 to 8 km inland from the coast in the north and up to 22 km inland from Princess Charlotte Bay in the south. The regolith consists of sandy beach deposits which form ridges and chenier plains adjacent to the coast; estuarine silts and muds, cracking clay and saline soils associated with tidal lagoons and mudflats, and coastal alluvium including sand, silt and clay over broad coastal plains (Figure 17).

EDWARD REGOLITH-LANDFORM ASSOCIATION

Bedrock: Cretaceous and Cainozoic sandstones (Rolling Downs Group and Wyaaba Beds)

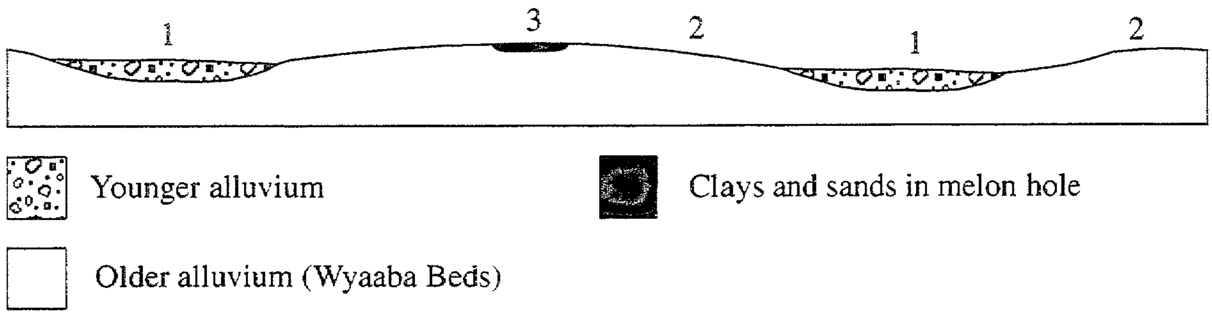


Regolith Type		Landform Type
1	Over bank silts and sands	Floodplain surface, inundated each wet season, with levees near channels
2	Channel sands	Active channel. Flow ceases during dry season.
3	Silicified alluvium (hardpan)	Channel and adjacent floodplain
4	Residual sand over weathered sandstone (Rolling Downs Group)	Very low hills emerging from floodplain

**Figure 7. Cross section of the Edward River Regolith-landform Association.
Top: Downstream. Bottom: Upstream**

HOLROYD REGOLITH-LANDFORM ASSOCIATION

Bedrock: Cainozoic sandstone (Wyaaba Beds)

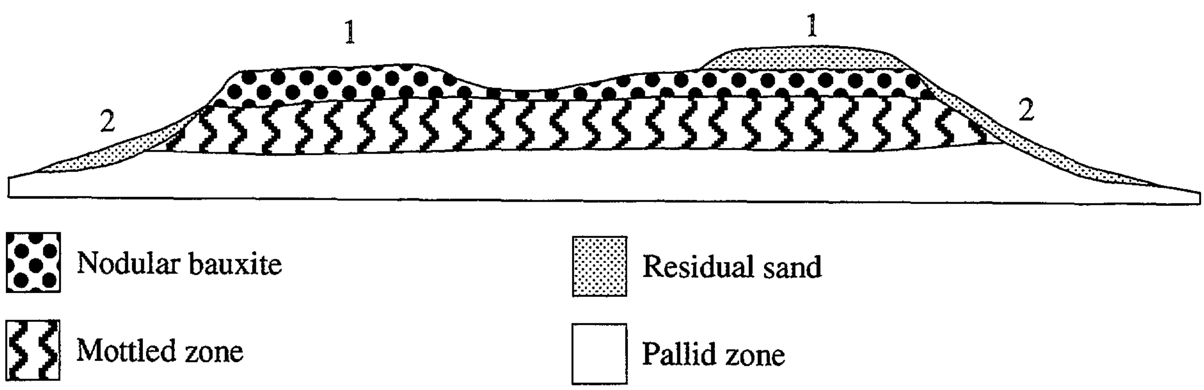


Regolith Type		Landform Type
1	Silts and fine sands, some clay.	Broad valley floors, inundated each wet season. Some minor gullying and fluvial transport.
2	Fine sands	Gently sloping, low interfluve areas, usually only one or two metres above the adjacent valley floors.
3	Fine sands and clays	Melon holes (shallow more-or-less circular depressions up to 1 km wide).

Figure 8. Cross section of the Holroyd Regolith-Landform Association.

WEIPA REGOLITH-LANDFORM ASSOCIATION

Bedrock: Cretaceous and Tertiary sandstone (Rolling Downs Group, Bulimba Formation).

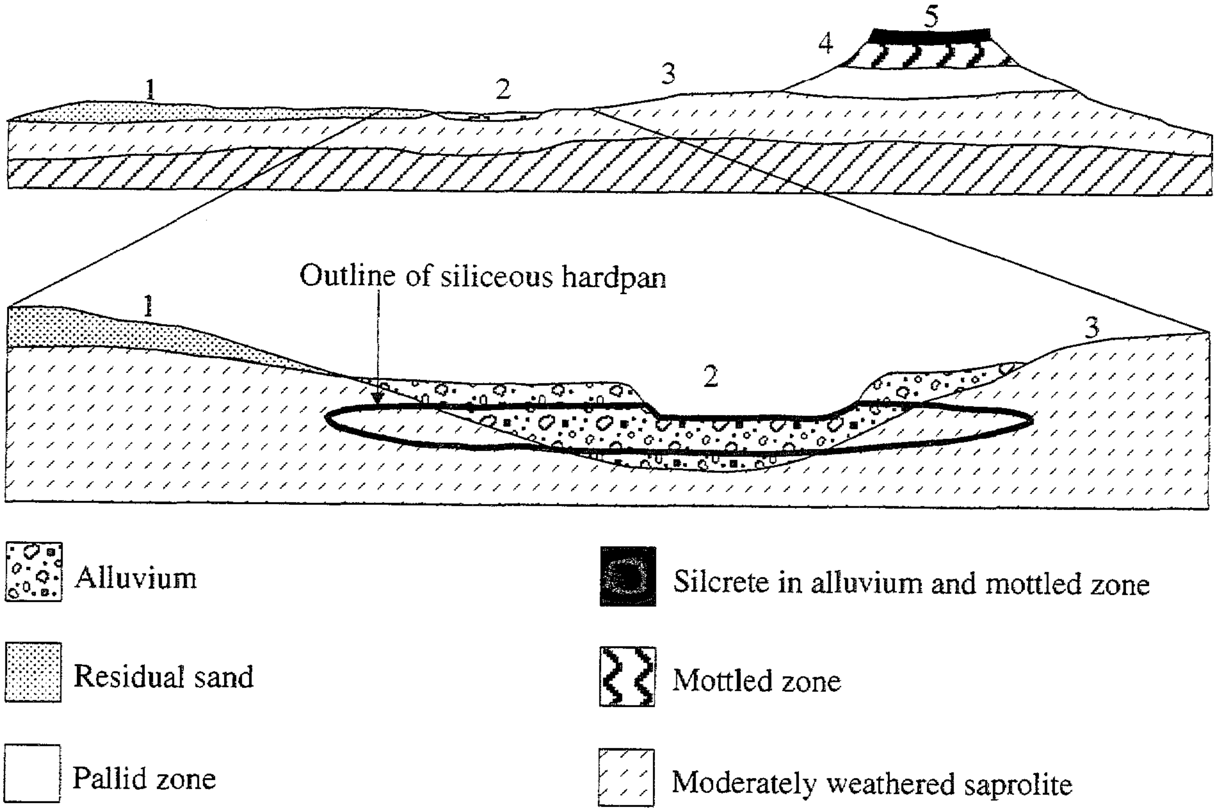


Regolith Type		Landform Type
1	Nodular bauxite up to 1 m thick, with patches of residual sand	Plateau surface, with very low relief and some shallow drainage lines
2	Residual sand over weathered sandstone	Low erosional scarps and low angle footslopes. This unit is not continuous around all plateaus.

Figure 9. Cross section of the Weipa Regolith-Landform Association.

STRATHBURN REGOLITH-LANDFORM ASSOCIATION

Bedrock: Cretaceous sandstone (Rolling Downs Group)

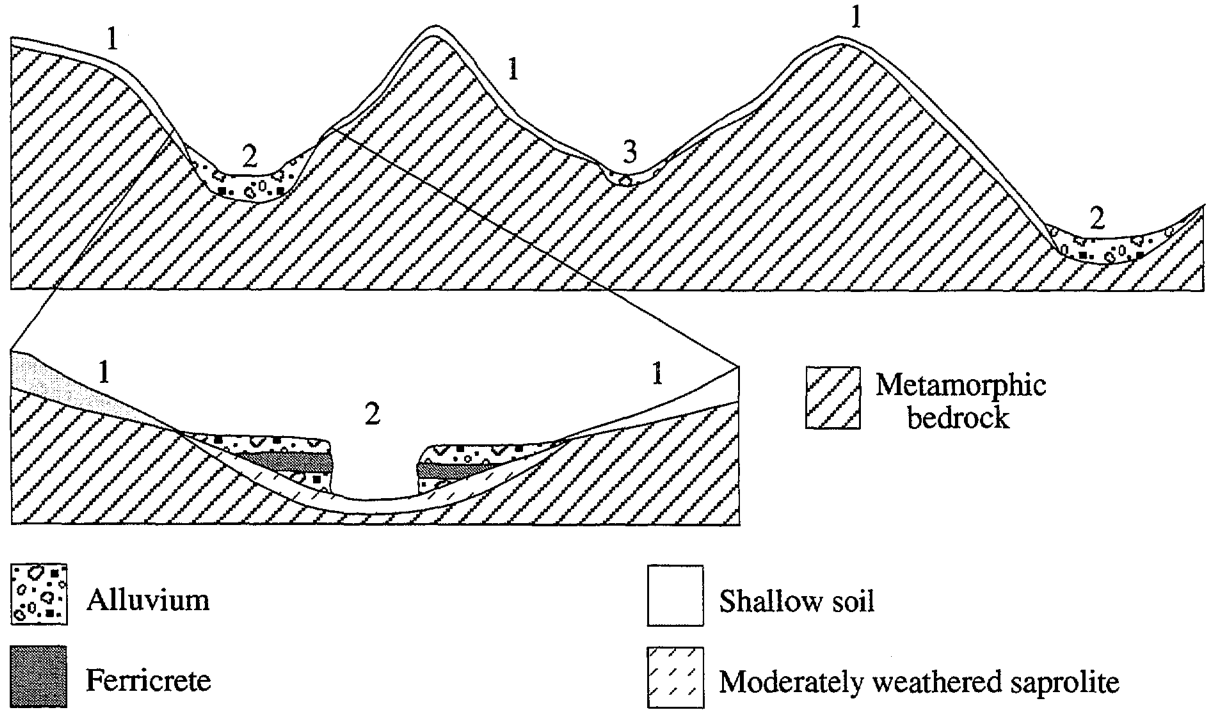


Regolith Type		Landform Type
1	Residual sand over moderately weathered sandstone	Erosional plain
2	Alluvium, with siliceous hardpan	Narrow floodplains, channels
3	Moderately weathered saprolite	Erosional plain
4	Pallid zone and mottled zone	Slopes of mesas, residual hills and narrow sinuous ridges
5	Silcrete (alluvium, mottled zone)	Tops of mesas, residual hills and narrow sinuous ridges

Figure 10. Cross sections of the Strathburn Regolith-Landform Association.
A. General cross section
B. Detail of valley floors showing the siliceous hardpan.

POLLAPPA REGOLITH-LANDFORM ASSOCIATION

Bedrock: Metamorphics

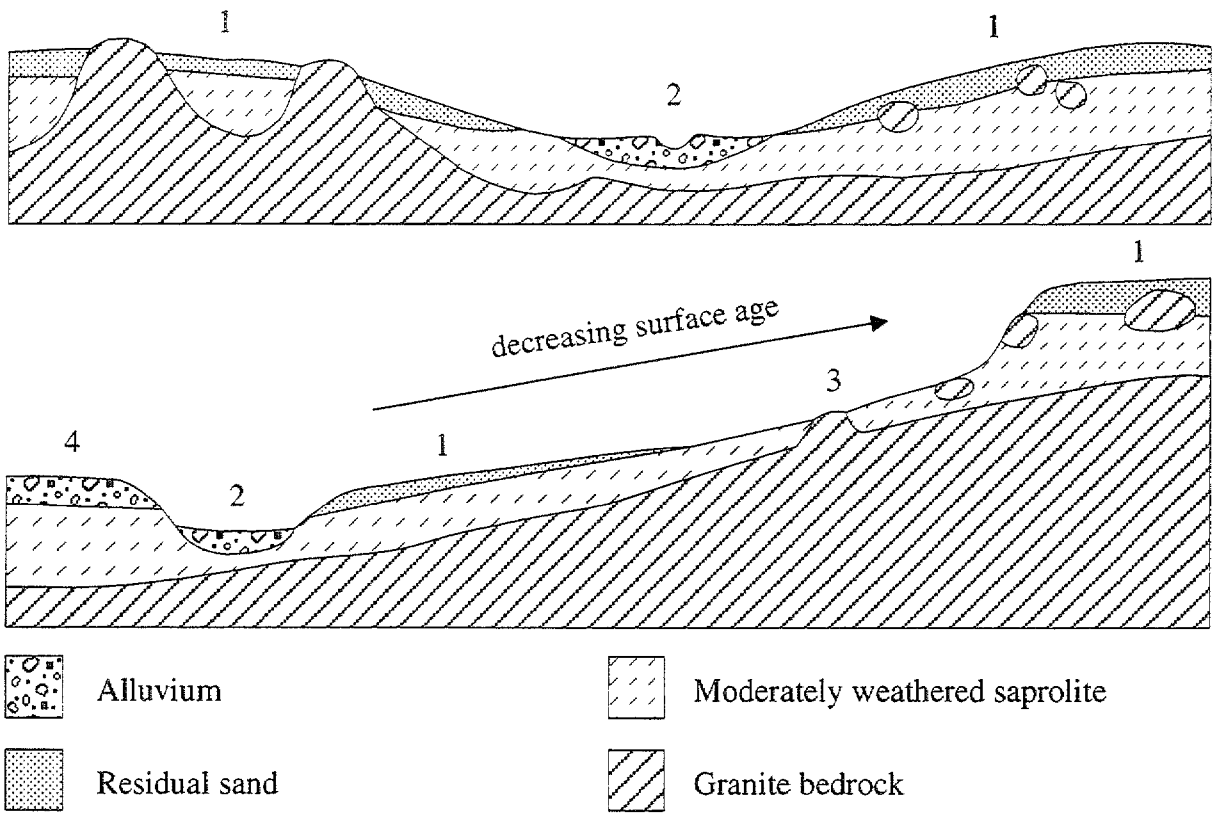


Regolith Type		Landform Type
1	Soil on bedrock	Low hills, hills
2	Alluvium on moderately weathered saprolite, colluvium, some ferricrete	Fans and footslopes, narrow floodplains
3	Alluvium	Narrow floodplains

Figure 11. Cross sections of the Pollappa Regolith-Landform Association.
A. General cross section
B. Detail of valley floors showing the colluvial and alluvial sediments cemented to ferricrete.

COLEMAN REGOLITH-LANDFORM ASSOCIATION

Bedrock: Granite

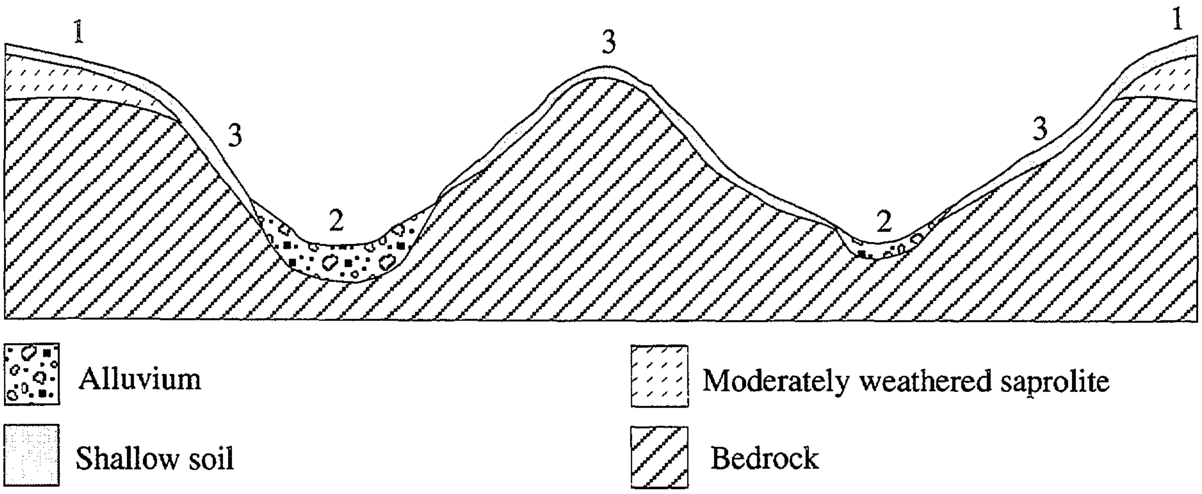


Regolith Type		Landform Type
1	Residual sand over highly weathered saprolite. Occasional corestones and tors.	Erosional plains, rises.
2	Alluvium, some siliceous hardpans.	Floodplains.
3	Highly weathered saprolite.	Rises.
4	Alluvium on highly weathered saprolite.	Terraces.
5	Soil on bedrock.	Small area of hills (not shown).

Figure 12. Cross sections of the Coleman Regolith-Landform Association.

WENLOCK REGOLITH-LANDFORM ASSOCIATION

Bedrock: Granite

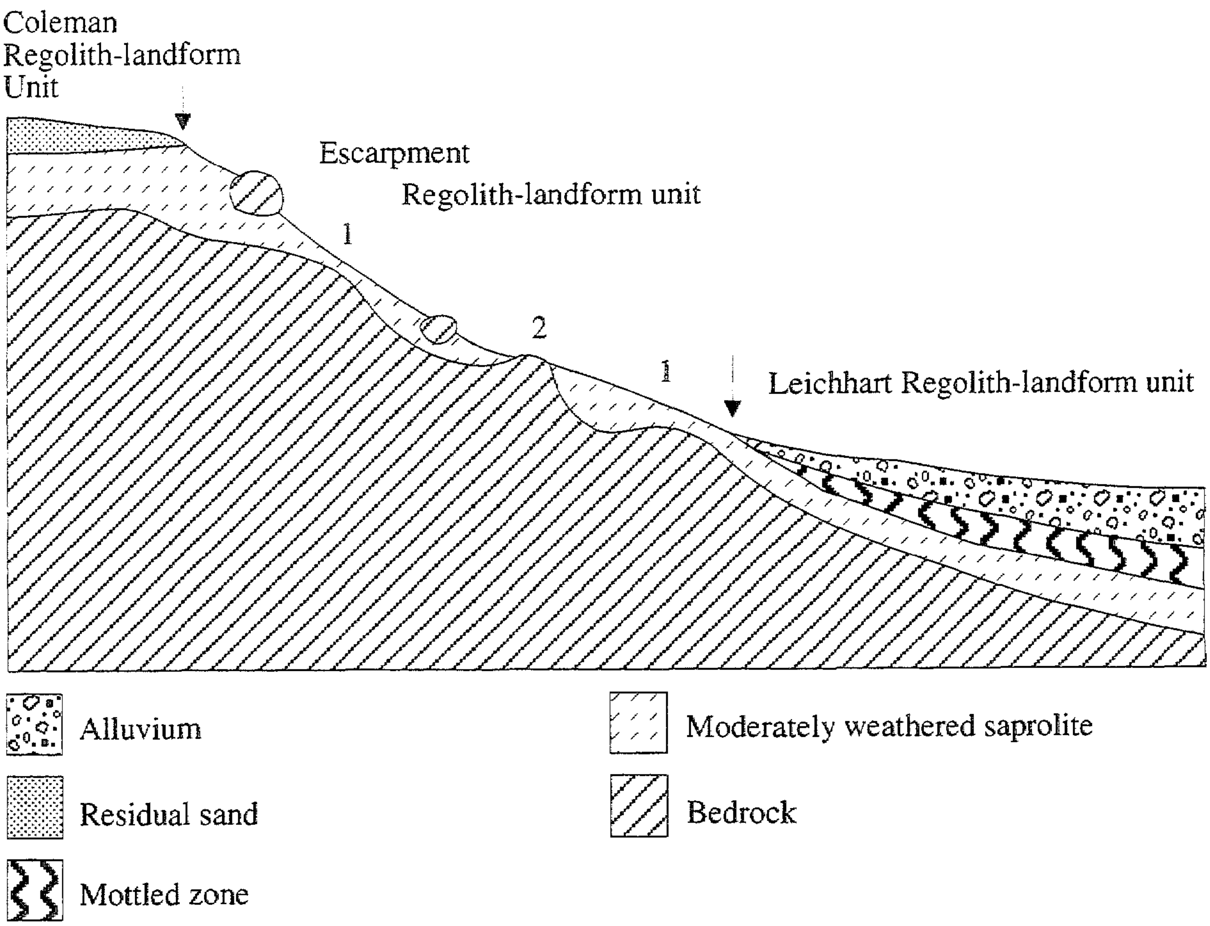


Regolith Type		Landform Type
1	Moderately weathered saprolite, with thin soil cover	Hills
2	Alluvium	Valley floors
3	Soils on bedrock	Steeper hill slopes

Figure 13. Cross sections of the Wenlock Regolith-Landform Association.

GREAT ESCARPMENT REGOLITH-LANDFORM ASSOCIATION

Bedrock: Granite, some areas of metamorphics

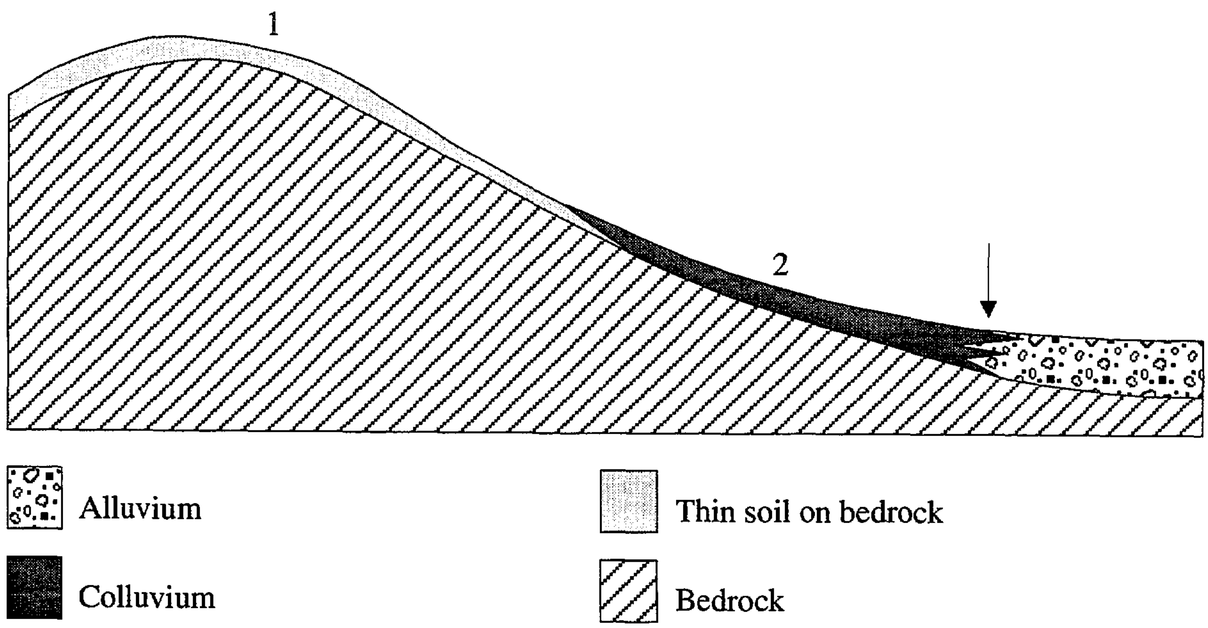


Regolith Type		Landform Type
1	Moderately weathered saprolite, thin sandy soils over weathered bedrock	Escarpment, steep slopes with locally hilly relief. Upper margin marked by cliff or scarp edge.
2	Thin soil and bare rock	Escarpment
3	Sandy alluvium	Channels

Figure 14. Cross section of the Great Escarpment Regolith-Landform Association.

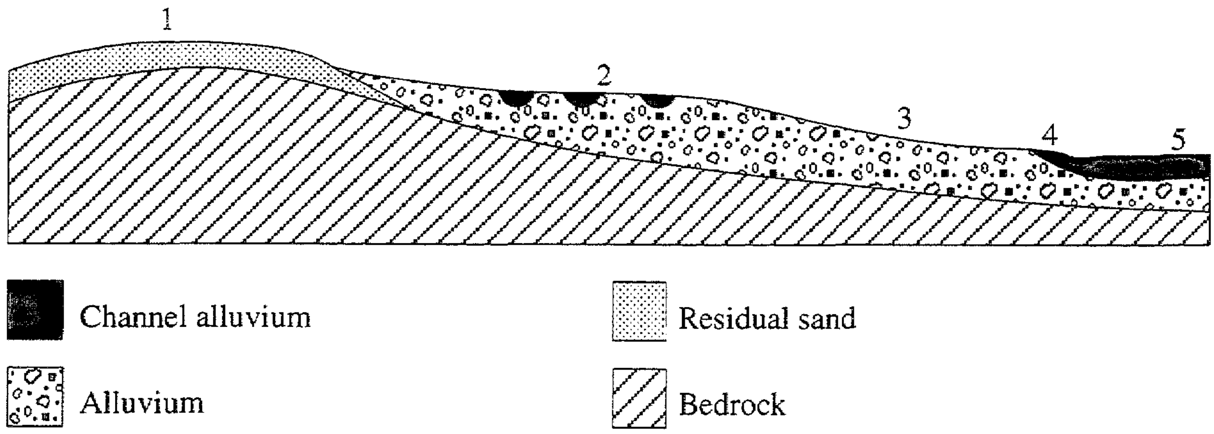
LEICHHARDT REGOLITH-LANDFORM ASSOCIATION

Bedrock: Sandstone, granite, metamorphics



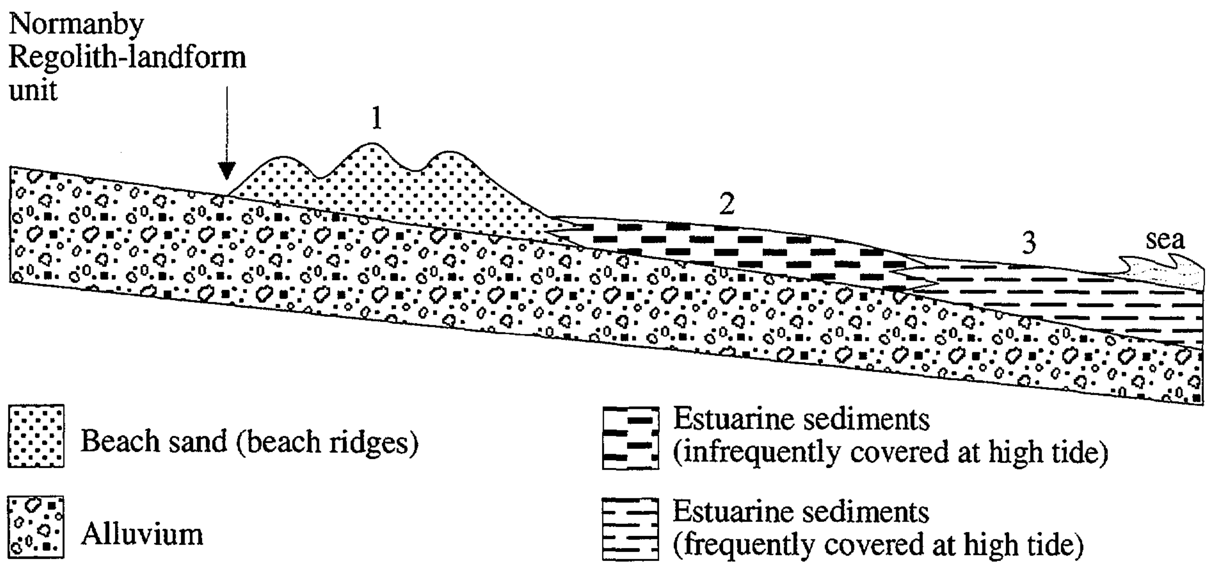
Regolith Type		Landform Type
1	Soils on bedrock	Hills to low hills
2	Sandy soils with angular gravels and cobbles	Colluvial footslopes
3	Alluvium	Alluvial plains in the Normanby Regolith-Landform Association.

Figure 15. Cross section of the Leichhardt Regolith-Landform Association.



Regolith Type		Landform Type
1	Residual sand over moderately weathered saprolite	Low hills
2	Channel sands and over bank silts and fine sand.	Stagnant alluvial plains
3	Over bank silt and sand	Floodplains with levees near channels
4	Silicified alluvium (hardpan)	Channel and adjacent floodplain
5	Channel sands (mainly quartz, minor weathered feldspars and mica)	Active channels

Figure 16. Cross section of the Normanby Regolith-Landform Association.



Regolith Type		Landform Type
1	Channel sands and over bank silts and fine sand with iron mottling at depth. Siliceous hardpan adjacent to channels. Sandy earths and duplex soils	Alluvial plains
2	Beach ridge deposits, uniform sandy soils with organic stained A horizon	Beach ridges and chenier plains
3	Coastal sediments, sandy and silty alluvium, iron mottling at depth. Saline and alkaline cracking clay soils.	Coastal plain
4	Estuarine sediments, silts, clays and organic muds. Grey brown saline and alkaline cracking clay soils.	Tidal flats

Figure 17. Cross section of the Princess Charlotte Bay Regolith-Landform Association.

LANDFORM FEATURES

The major landform types have been described in the sections on mapping units and regolith-landform provinces (see also Figure 4). Here we describe erosional scarps shown in red symbols on the map, and discuss some aspects of drainage patterns.

Scarps

The most important geomorphic boundary in EBAGOOLA is the Great Escarpment, a feature which, with a few gaps, runs from just south of Cape York all the way to Victoria (Ollier 1982; Ollier & Stevens 1989). As elsewhere, it separates old landforms and regolith on the western side from younger landforms and regolith on the eastern side. In EBAGOOLA the Great Escarpment is up to 200 m high. For much of its length it coincides with the Great Divide. Places where the Great Divide is west of the Great Escarpment are often associated with evidence for drainage diversion, the most important being the Stewart River near the northern edge of the map area. Elsewhere small streams have been captured. A particularly good example occurs east of the former mining settlement of Ebagoola, where a stream flows for about 5 km north before abruptly turning and plunging over the scarp. The former course is clearly marked by a dry valley. This particular capture must have occurred fairly recently because the stream has not yet eroded a bedrock channel, flowing instead along joints in the granite.

West of the Great Escarpment, in both the Merluna and Peninsula Uplands Regolith-Landform Provinces, there are smaller less continuous scarps, shown as erosion breaks on the map. These erosion breaks occur around the headwaters of some drainage basins, around low cuestas and mesas, and parallel to some streams. In many cases they form important boundaries between different regolith types, with generally older regolith materials above and younger materials below. In the Merluna Regolith-Landform Province they provide some of the evidence for relief inversion. A well defined fault scarp occurs 7 km west of Strathburn Homestead. It has an east-facing scarp with a relief of about 40 m.

Drainage

In EBAGOOLA a number of west-flowing streams, including the Holroyd and Coleman Rivers, rise within the Peninsula Uplands near the Great Escarpment at elevations of about 200 - 250 m and flow in gorges cut through the higher metamorphic ridges (up to 400 m elevation) on the western side of the uplands. This superimposed drainage indicates inheritance from a higher surface.

The most obvious disruption of drainage is the Stewart River. The headwaters of the Stewart were once part of the westerly flowing Holroyd drainage system. Their diversion into the Stewart is indicated by an abrupt change of channel direction near where the Stewart flows in rapids over the Great Escarpment. This diversion is also indicated by the presence of high level gravels at this bend and by low, poorly drained areas on and west of the Great Divide at the present headwaters of the Holroyd River.

Clear evidence for relief inversion can be found in the Merluna Regolith-Landform Province. At one extreme, this evidence consists of narrow sinuous ridges with a capping of quartz alluvial silcrete. On one of these ridges, between Strathburn and Strathhaven, the central depression of the palaeo-valley floor is still preserved. At the other extreme, active stream channels occupy narrow linear mesas surrounded by erosion breaks. A good example is found west of the Strathburn fault scarp, and north of the Coleman River. Air gaps along the crest of the Strathburn fault scarp may indicate the location of streams that formerly flowed to the west, but were defeated by the fault, leading to accumulation of alluvial sediments on the eastern side of the scarp.

REGOLITH-LANDFORM HISTORY

Mesozoic Sedimentation and Uplift

Formation of the Carpentaria and Laura Basins during Middle to Late Jurassic and Early Cretaceous time (Smart & others, 1980), covered the Palaeozoic and Proterozoic rocks of the Coen Inlier with a veneer of coarse terrestrial to fine marine sediment (Blewett & others 1992b). The emergence of these basin sediments in the Late Cretaceous marks the beginning of landform and regolith evolution in EBAGOOLA. The sediments probably covered most, if not all, of the Coen Inlier (see below), and post-Mesozoic erosion subsequently uncovered the basement to form the Inlier.

Post Mesozoic Regional Tectonics and Erosion

The Mesozoic Carpentaria Basin was subsequently cut by Tertiary or younger N to NNW-trending faults. Regional uplift of the inlier and modest down warping of the Carpentaria Basin would appear to be the primary driving forces behind regional erosion and aggradation.

Substantial erosion and surface lowering in the area following emergence at the end of the Cretaceous is evidenced by the landform features described above. Superimposition of drainage reflects an early drainage pattern inherited from the post-Palaeozoic cover. This inheritance strongly suggests that the Mesozoic cover extended over a large part if not all of the Coen Inlier.

In EBAGOOLA, erosion following emergence left the basement rocks high in the landscape, forming the Peninsula Uplands. Initial drainage directions were to the west and north west from a divide east of the present Great Divide. Indeed, it is likely that rivers at that time, before continental breakup, had their headwaters east of the present coastline, because the continental edge was then much further to the east.

The breakup of the north eastern part of the Australian continent and the opening of the Coral Sea had a profound effect on landforms in EBAGOOLA. Such effects are well known from studies of a number of passive continental margins (eg. Ollier 1985), and most have their origins in pre-separation rifting. In the study area, separation began with tectonism which created rift grabens in the troughs east of the present land area (Mutter & Karner 1980, see also Ollier and Stevens 1989). Major geomorphic affects probably began at this time. Down warping to the east of EBAGOOLA formed the present Great Divide, which runs from north to south along the eastern edge of the Coen Inlier. This down warping had two major results. First, the headwater streams of the formerly west flowing rivers were reversed, to flow towards the newly formed depression and then ocean to the east. In EBAGOOLA, the Stewart River is the best example of this. Some of the sediment supply to the lower reaches of major rivers such as the Holroyd was cut off, and this may have resulted in some down cutting along their valleys. This down cutting appears to have initiated small scarps along some rivers within the Coen Inlier. These scarps have subsequently retreated up to 10 km from their place of initiation. The low scarp between Ebagoola and the Holroyd River is a good example. Second, the new easterly flowing steams were steeper than those flowing to the west, and increased energy and resulting erosion in both the river channels and on adjacent hill slopes led to the formation of the Great Escarpment. Subsequent retreat of the Great Escarpment formed the lowlands to the east, some of which are now covered with a thin (10 m) layer of alluvium. Scarp retreat has also caused river capture in a few places.

West of the Coen Inlier, on erosional plains formed on Mesozoic sediments, there is clear evidence for erosion of several tens of metres of material, and relief inversion. Valley floor materials, both alluvium and adjacent weathered bedrock, were cemented by silica to form silcrete. Subsequent erosion has left this very resistant silcrete as a cap on the higher parts of the landscape. The best examples are between Strathburn and Strathhaven homesteads, where long narrow sinuous ridges with a central depression mark former stream courses. These remnants have resulted from scarp retreat initiated along rivers such as the Coleman and the Holroyd. Further north, both west and east of Pretender Creek, plateaus with a deep bauxitic weathering profile on Rolling Downs Group sediments provide further evidence of the retreat of low scarps across the landscape.

The youngest igneous event recorded in EBAGOOLA was extrusion of the Silver Plains Nephelinite (3.72 ± 0.06 Ma - Sutherland 1991). This small lava mound had very little effect except for local drainage diversion.

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GLOSSARY

This glossary contains definitions of a few of the more important words used in this record to describe regolith materials. It is included because many of the words are used in various ways in different publications. The definitions listed here are taken from Pain and others (1991), and are the standard AGSO definitions.

Bedrock is used to mean the rock from which the regolith is derived. It includes both basement and sedimentary basin rocks. Some confusion may arise in the case of younger sedimentary materials. In general, where sediments, usually terrestrial, are directly related to present-day landforms, they are considered to be regolith rather than bedrock.

Bioturbation refers to disturbance of regolith by the action of plants and animals. In North Queensland the most common kinds of bioturbation are caused by termites and tree fall.

Corestones are fragments, sometimes quite large, of the original bedrock surrounded by weathered material. The frequency, shape and distribution of corestones is important in definitions of degree of weathering (see below). Not all weathered material contains corestones.

Gilgai is surface microrelief associated with soils containing shrink-swell clays. It consists of mounds and depressions showing various degrees of order, sometimes separated by a subplanar or slightly undulating surface (McDonald and others 1990).

Induration refers to cementing of regolith materials by agents that are precipitated from soil or groundwater solutions. Induration processes lead to either absolute or relative accumulation of the cementing agent. There are various degrees of cementing, and a number of common cementing agents (see Pain and others, 1991, for more details).

Silcrete is any type of regolith material completely cemented mainly by silica. It is always very hard.

Siliceous hardpan is any type of indurated regolith less than 70% cemented by silica, often with an open texture. It can be broken easily with either a hammer or with boots.

Ferricrete is any type of regolith material completely cemented mainly by iron. It is very hard. It is not necessarily associated with deep weathering profiles or laterite (see Pain and Ollier, 1992).

Ferruginous hardpan is any type of indurated regolith less than 70% cemented by iron, often with an open texture. It can be broken easily with either a hamer or with a kick (with boots on!).

Nodules are irregular to spherical units of regolith material that occur enclosed within the regolith, as lag, or in duricrusts. They generally have rounded edges. They are distinct because of a greater concentration of some constituent, a difference in internal fabric or a distinct boundary with the surrounding material. In North Queensland the most common nodules are either ferruginous or bauxitic.

Pisoliths are spherical nodules with an internal structure consisting mainly of concentric skins.

Mottled zone refers to material, usually strongly weathered, in which iron segregation results in the development of ferrugenous mottles, commonly reddish in colour. Size of mottles can range from millimetres to tens of centimetres. The latter are sometimes called mega mottles. The mottled zone is frequently near the top of a deeply weathered regolith profile, lying above the pallid zone.

Pallid zone refers to kaolinised zone usually found in the lower part of a weathering profile. This zone is generally light grey to white in colour, and may or may not retain original rock structure.

Regolith toposequences. Often landforms and regolith types will be related both spatially and genetically. These relationships can be expressed as regolith toposequences, which, like soil catenas, show the location of regolith materials associated with particular parts of the landscape.

Residual material is derived from weathering of rock and remains in place after part of the weathered material has been removed. It results from loss of volume from the weathered mass.

Residual clay is clay-sized material that remains behind after weathering has removed part of the original rock. A common example is the clay soil material found on limestone after solution has removed the calcareous part of the rock. In EBAGOOLA residual clay is commonly found associated with a clay-rich bed in the Rolling Downs Group.

Residual sand is a deposit of sand-sized material derived from the underlying bedrock. It is commonly composed largely of quartz, and is formed by the removal of finer material either in solution or suspension in subsurface water. In EBAGOOLA it is particularly common over granite, and some sedimentary bedrock.

Saprolite refers to all those parts of a weathering profile which have been formed strictly *in situ*, with interstitial grain relationships being undisturbed. Saprolite is altered from the original rock by mainly chemical alteration and loss without any change in volume. This is sometimes referred to as constant volume alteration.

Weakly weathered saprolite has traces of alteration, including weak iron staining, and some earth material. Corestones, if present, are interlocked, there is slight decay of feldspars, and a few microfractures. Slightly weathered saprolite is easily broken with a hammer.

Moderately weathered saprolite has strong iron staining, and up to 50 % earth material. Corestones, if present, are rectangular and interlocked. Most feldspars have decayed, and there are microfractures throughout. Moderately weathered saprolite can be broken by a kick (with boots on), but not by hand.

Highly weathered saprolite has strong iron staining, and more than 50% earth material. Core stones, if present, are free and rounded. Nearly all feldspars are decayed, and there are numerous microfractures. The material can be broken apart in the hands with difficulty.

Very highly weathered saprolite is produced by the thorough decomposition of rock masses due to exposure to land surface processes. The material retains structures from the original rock. It may be pallid in colour, and is composed completely of earth material. Corestones, if present, are rare and rounded. All feldspars have decayed. It can easily be broken by hand.

Completely weathered saprolite retains no structures from the original rock. There are no corestones, but there may be mottling. It is composed completely of earth material.

Self mulching layers form at the surface from wetting and drying of clay materials. They are commonly associated with gilgai.

Soil on bedrock: In some areas, particularly on steep slopes, or on young surfaces, the regolith consists of soil material up to 2m thick formed directly on the underlying bedrock. Commonly the soil has a skeletal profile, and is less than 1m thick.