

3. MOUNTAINS, COAST AND SHELF

HISTORY OF EROSION

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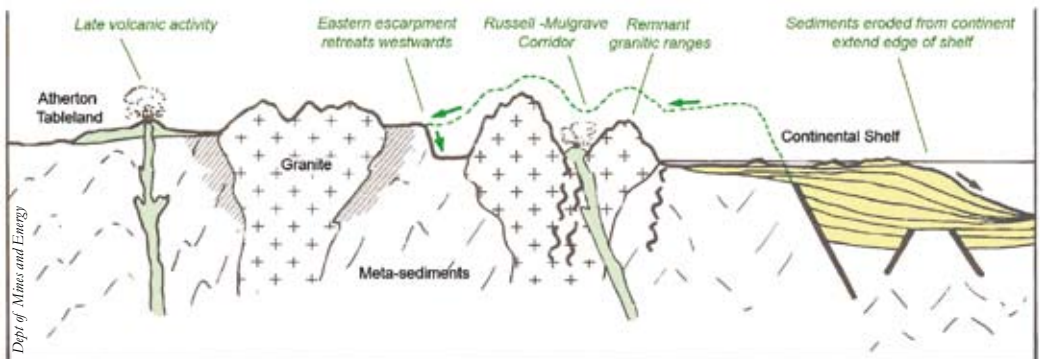
All mountains and hills are gradually worn down by the agents of erosion. Erosion starts with the gradual softening and decomposition of the rocks (weathering) near the surface by penetrating water, air, roots and biological activity. As the rocks are gradually exhumed, they also crack from the release of pressure from the removal of the material above. Water becomes channelled along these fractures, and removes the softened rock on the sides of the joints, grain by grain, over millions of years. Such erosion can allow flowing water to cut deeply into the rocks, producing long narrow gorges such as those we see today in the Wet Tropics (for example, those of the Barron, Mossman, Tully and Herbert Rivers).

Forming the present landscape

The landscapes that result from erosion are not uniform. They are very much dependent on the types of rocks present and the geological history of the district.

The landscapes today consist of the high tableland in the west, formed mainly on the meta-sediments of the Hodgkinson Province, with even higher mountains, mainly of granite, protruding in places; a steep eastern escarpment forming the edge of this tableland; a narrow coastal plain and associated alluvial river valleys; remnant coastal ranges; and, offshore, a flat continental shelf.

The tableland is believed to have formed from up-doming of a previously relatively flat area which existed before the fracturing of the eastern edge of the Australian continent (see Episode 6 in Chapter 1). After this uplift a relatively steep eastern face was left on the remaining continent. Streams with steep gradients rapidly eroded this, and their headwaters co-operated to form a steep escarpment (part of the Great Escarpment of eastern Australia). This gradually retreated westwards to its present position, leaving behind a continental shelf, the coastal plain and the alluvial corridors separating remnant ranges. The major streams retreated more quickly to form narrow gorges extending further inland.



Erosion and retreat of the 'Great Escarpment' at the edge of the Atherton Tableland.



The Herbert River has eroded a major gorge into the coastal escarpment.

Different landscapes

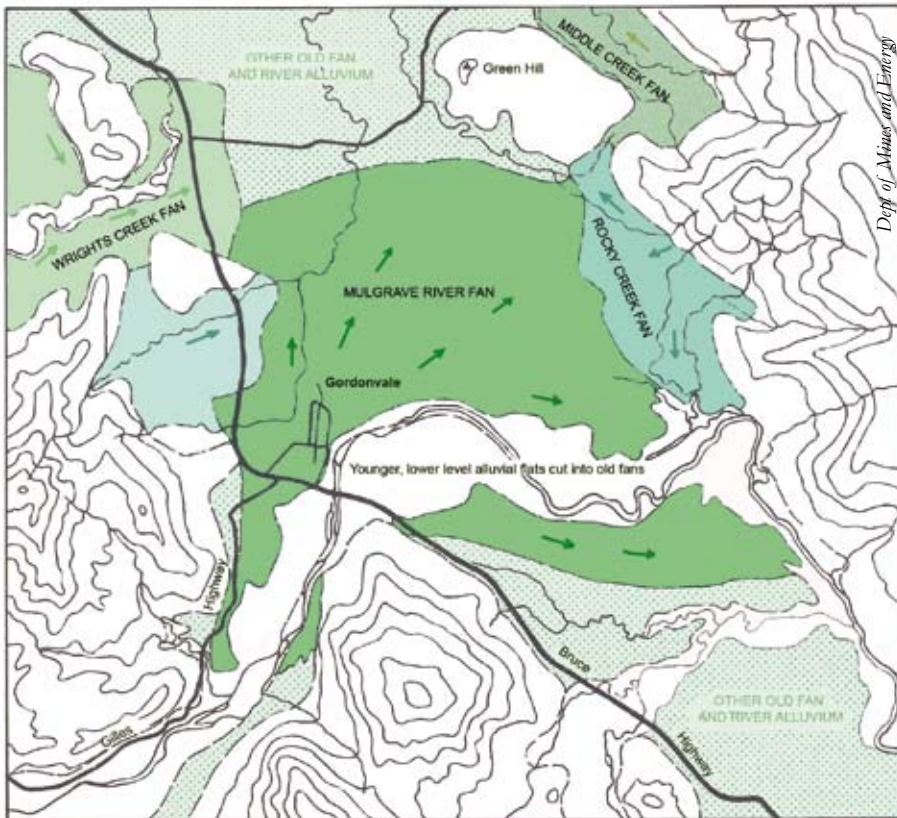
In the *Hodgkinson Province* the layering and close fracturing in the rocks assists entry of percolating water, and in the wet tropical climate near the coast, this has led to considerable depths of softened rock material. On steep ground, bouldery soil and clay has moved downhill by processes such as boulder rolling, soil creep, and small slumps and landslides. Some landslides also have occurred in the softened rocks themselves. Further to the west, such as north of Mareeba, the rocks are less softened, and form ridgy country from the inclined strata trending north-north west.

On the *granite bodies* the coarse mineral crystals of the rock allow water penetration along the crystal boundaries, and almost complete decomposition of the rock mass to coarse clayey sand. However, the broad fracture spacings in the solid granite bodies means there are limited sites where this decomposition can start. As a result the weathering process results in isolated rounded boulders, which are the remnant kernels of fracture-bounded blocks, set in a decomposed clayey sand. In general the granites tend to be more resistant to erosion than the meta-sediments, and remain as higher mountains. Huge boulders and bare rock slabs can be seen in gorges of streams that are eroding these mountains, such as at the Babinda Boulders west of Babinda and Davies Creek west of Cairns.

The *ryholite volcanic rocks* on the west of the tableland are composed of relatively stable minerals, and also resist erosion. The Featherbed Range between Mareeba and Chillagoe is formed by such rocks which weather to very shallow, stony soils. Similar rocks in the wetter zone between Ravenshoe and Ingham area are more deeply weathered.

The *volcanic landscapes of the Atherton Tableland* have resulted from the eruption of basalt lavas from numerous volcanoes over the last four million years. These shield volcanoes, lava flows, scoria cones and crater lakes have been described in Chapter 2.

The *coastal corridors*, such as the valley of the Mulgrave River, and their adjacent remnant ranges, can be explained by the process of differential erosion - erosion advanced more rapidly in the meta-sedimentary rocks of the Hodgkinson Province than in the more



Alluvial fans in old high-level alluvium in the Mulgrave Valley near Gordonvale.

resistant rocks of the granite bodies. These granites now form the remnant mountains of the Bellenden Ker and Murray Prior Ranges, as well as most of the Lamb Range rising above the northeastern edge of the Tableland. The southern part of the Mulgrave River corridor probably formed along a major belt of easily eroded, sheared and fractured rocks within the Bellenden Ker Granite (The Russell – Mulgrave Shear Zone).

Broad *alluvial fans* have built up at the base of slopes backing the coastal plain. Gravelly material has accumulated on subtle fans or aprons where streams exit from the hills; the sediments gradually become finer down slope (see sketch). It is believed that the main valleys and the coastal plains became choked with sediments from these fans during high sea levels in the Pleistocene epoch. However, when sea level was considerably lower at about 20 000 years ago, the streams eroded down into the fans and plains. With a return to high sea levels, alluvium was again deposited but in lower terraces close to the stream channels. The fans and high level plains are no longer receiving sediments. The younger sediments can be seen along the Mulgrave River, and in the Barron River flood plain.

The coast and continental shelf

The coastal plain where most of the population of north Queensland resides is the result of millions of years of erosion and change. It has had about 50 million years to form as the mountains gradually eroded and retreated under the relentless forces of nature.

Besides eroding their narrow ravines in the coastal escarpment, the major streams have transported gravel, sand, silt and mud towards the coast through river flats and flood deltas. These were finally deposited as successive layers within shallow seas near the coast where the transporting energy was reduced. With each successive layer of sediment, the platform that would eventually become Australia's continental shelf was constructed. The slow subsidence of the platform meant that many layers of sediment could be added, and resulted in a shelf that is over 100 km wide in places, such as off Townsville.

Throughout this long period of erosion and sediment transport, both climate and sea-levels fluctuated dramatically. For example in the last 500 000 years, sea-level has risen and fallen up to 120 m world-wide about four to five times. As sea-levels fell in response to cooler, glacial periods the coastline migrated across the shelf platform, and therefore the rivers which fed sediments to the coastline deposited their gravel, sand and mud further offshore. During the warmer conditions of interglacial periods, such as the one we are now in, sea-levels rose and the coastlines retreated. Any sediments eroded off the land were then deposited closer to the present coastline.

Coral reefs

The first coral reefs on the continental shelf were formed in Torres Strait about 15 million years ago, as Australia drifted into tropical waters towards New Guinea, but they were subsequently buried by sediments draining from the Papua New Guinea highlands. The Great Barrier Reef as we know it today is thought to have begun as series of low-relief coral reefs on the edge of the continental shelf 452 000 to 365 000 years ago. It has since re-grown four to five times with each rise in sea-level. During each period of lower sea-level, the continental shelf became a coastal plain with the exposed coral reefs protruding as limestone hills scattered across a dry landscape, interrupted by streams meandering between them. This exposed landscape would certainly have been used by Aboriginal people, and pollen recovered from sediment cores obtained from the continental shelf record mangroves and eucalypts living here.

The most recent acts of coastal plain development occurred in the interglacial period we now live in. Since the last ice age about 20 000 years ago, the seas have risen about 120 m and the coastline retreated to its present position. The rivers and creeks continue to deposit their sediments at the coast and we see these as the sand bars at the entrance to estuaries, or as flood plumes that are mobilised by the winds, waves and tides along the coast. As the sea-level has been largely stable for the past four thousand years, the coastline in places has actually advanced slowly offshore as mangroves stabilise the soft coastal sediments, then are colonised by land plants to become a new land. In fact, most of the city of Cairns is built upon these ridges of stabilised sediment that have built out seawards over the past several thousand years.

Even in our lifetimes, the coastal plain of north Queensland has continued to change, and the continental shelf continues to evolve. As recently as 1939, the Barron River switched course dramatically to create a new river mouth just to the south of Machans Beach. Today, with building development taking place in increasing density along the coastal fringes, it is prudent to remember that the coastline is actually a thin strip of land in a constant state of flux.