KROOMBIT TOURIST PARK - BILOELA

SELF-GUIDED GEOLOGICAL WALK

By Mark Hayward

Rocks in the Kroombit Dam to Marble Waterhole area south of Biloela were re-mapped in 1995-97 by the Geological Survey of Queensland (of the Department of Mines and Energy) as part of a regional interpretation of rock sequences in the Monto - Rockhampton region.

A 600m-thick sequence of rocks mapped in detail 0.5km south of the Kroombit Tourist Park provides a good illustration to visitors of some of the ancient geological events of the region.

A 10-stop, self-guided geological walk has been set up to allow interested people to learn about some of the geological features within walking distance of the Park (Figure 1). This guide describes the rocks found at each of the stops.

At most stops you will find prepared samples of the described rock for your closer examination. Please place these back in the pile for the next group to look at.

Geological history

The rock sequence forms part of a 2000m-thick unit known as the Lochenbar Formation, which were named after the nearby homestead.

These are rocks which were originally deposited in the ocean in the Late Devonian period, approximately 360 to 375 million years ago -off the edge of the coastline which at that time was further west than at present.

The presence of abundant volcanic rocks of this age indicates that there would have been numerous active volcanoes in a belt to the west of the Kroombit-Biloela area.

These volcanoes added large volumes of rock to the continent directly as lava and ash deposits, and as sediments derived from the weathering and erosion of these rocks. The presence of primary andesitic lava in the sequence of rocks that you will be looking at indicates that this area was very close to an active volcano in the Devonian period.

These volcanoes would have been strato-volcanoes similar to modern day ones in the Andes of South America. These are distinct peak- shaped mountains, whereas the other main type of volcano - shield volcanoes, such as those found in Hawaii, form gently sloping, broad lava fields.

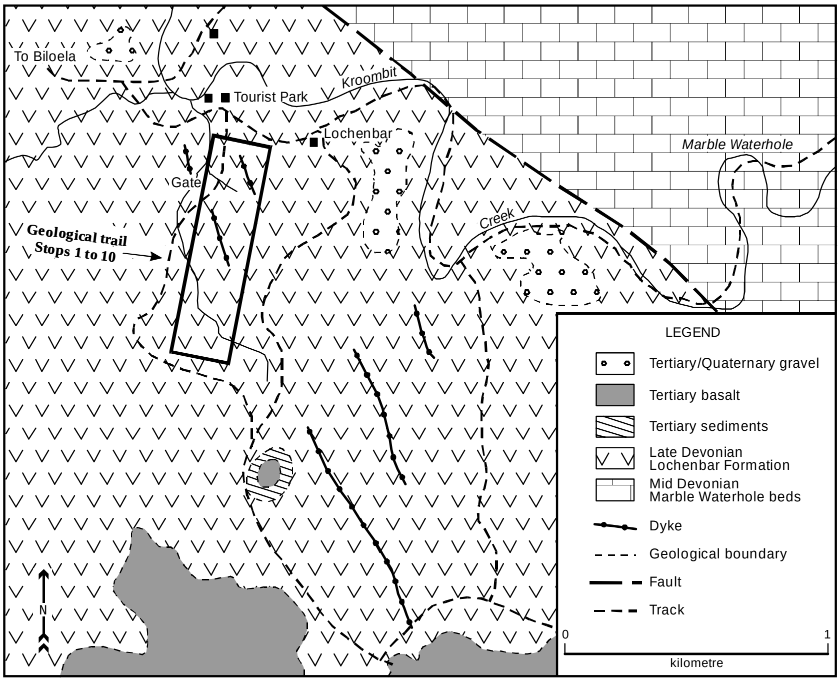

Figure 1 - Location and geology of the Kroombit Tourist Park area.

During the time that these rocks were laid down, animal life was abundant in the seas. Many types of shellfish were well established; primitive sharks had evolved and there were primitive armour-plated and bony fish. Coral reefs were growing in the warm waters off the coast. Air-breathing fish were evolving into the first primitive amphibians. Plant life spread from the sea onto swampy fringe areas of land, forming the first thick vegetation.

The rocks over which you are about to walk were deposited as sediments and volcanic lavas. At some stops you will see fossilised corals which lived in an environment similar to the Great Barrier Reef of today. Since they were laid down, the rocks have been consolidated and tilted about 40°

towards the south by tectonic processes. Therefore as you walk south, you are moving upwards through the sequence, and the rocks are getting progressively slightly younger (see Figure 2).

There are about 40 recognisable beds of rock in this sequence, and some rock types appear more than once. You will only stop at a representative selection of these units, but see if you can recognise repetitions of the units as you walk through the section.

The sequence has in places been penetrated by granitic rocks of probable Triassic age (250 million years ago).These igneous rocks were formed when molten magma ascended from deep below the Earth's surface along cracks or fissures in the overlying solid rocks. We will look at an example of this rock type at Stop 1.

STOP 1 - DIORITE (also known as "black granite")

This is an outcrop of the Triassic granitic rock that has been intruded into the sequence, in this case in a long linear body called a dyke (Figure 2). It is a hard mottled grey igneous rock, which is resistant to weathering and therefore results in a raised, linear outcrop. This linear feature is clearly visible on aerial photographs and satellite images. The other, older rocks described in the remaining stops are more easily weathered and therefore have been eroded down to a lower level.

The diorite is comprised mainly of white feldspar (plagioclase), dark green to black minerals (hornblende and pyroxene), and minor colourless quartz. At most sites in the Tourist Park this rock is of medium grainsize, but finer grained examples may also be seen. The grainsize is influenced by the rate at which the original magma cooled -slow cooling giving rise to larger crystals, rapid cooling giving rise to finer crystals.

STOP 2 - FINE-GRAINED SANDSTONE

Here we are looking at the rocks in the Lochenbar Formation sequence. This brown-grey sedimentary rock exhibits alternating, very thin beds (or *laminae*) containing eroded rock fragments and feldspar. The grainsize is consistently fine and the sandstone is said to be **well sorted**. Under a microscope it is revealed that most of the grains are either volcanic rock fragments or

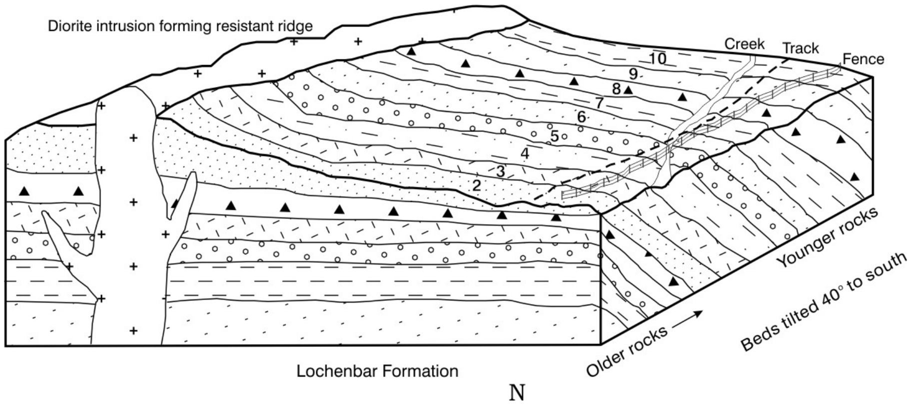

Figure 2 - Simplified 3D geology of the Lochenbar Formation and dyke.

plagioclase feldspar, with rare marine shells and other small organic fragments.

STOP 3 - ANDESITIC BRECCIA.

Two slightly different rocks with a similar composition occur at this locality. One is a grey-brown breccia (a rock made up of angular rock fragments) with white calcite cement. The fragments are almost exclusively fine-grained volcanic rock called andesite, and are all about the same size.

The other is similar, but the fragments vary in size and include some fossilised corals (light blue-grey in colour). If you search around you will find a ring of rocks painted pink. Inside this ring is a colony of fossil **rugose corals** (Figure 3). These corals attached themselves to the sea floor and progressively grew upwards. Please do not remove or destroy this occurrence. Leave it as you found it so others can see it too.

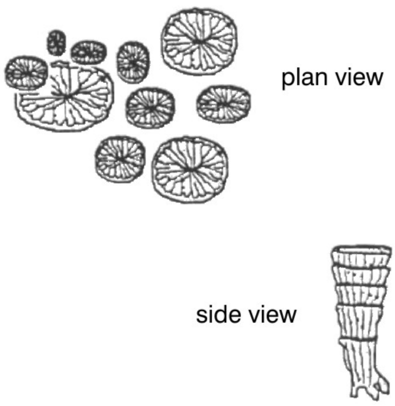

Figure 3 - Colonial rugose coral.

STOP 4 - ANDESITIC LAVA

This rock, which is similar to basalt, was erupted from a volcano. Its relative position overlying the fossiliferous andesitic breccia at Stop 3 indicates that the lava was either (a) erupted into the ocean or (b) the sea level dropped (or the sea floor was pushed upwards) allowing the andesite to be erupted onto dry land.

If you look closely at this rock you will notice that it has a very fine-grained groundmass which makes up most of the rock. Under a microscope the groundmass is seen to be made mostly of fine, elongate feldspar crystals, all aligned in one direction. This texture is formed when the crystals align in the direction of flow of the lava. Scattered throughout this rock are green (hornblende) and cream (feldspar) crystals 2mm to l0mm long (Figure 4).

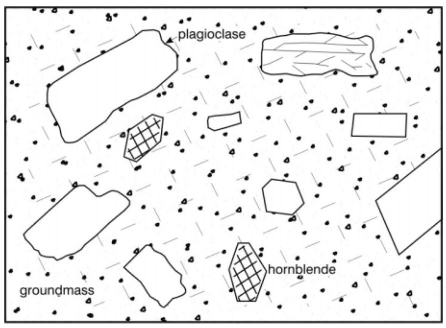

Figure 4 - View of a porphyritic Andesite under a microscope.

These crystals are called **phenocrysts** and form due to solidification of certain mineral phases in the magma chamber below the Earth's surface before the hot lava is erupted. Once the lava reaches the surface it rapidly loses heat to the environment by being in contact with cooler rocks; letting off steam and other gases; or being erupted into water. Most of the lava therefore forms small crystals, but the phenocrysts formed in the magma chamber generally retain their original size. A rock with larger phenocrysts in a finer groundmass is called **porphyritic**.

STOP 5 - ANDESITIC BRECCIA

The rocks at this stop are similar to those at Stop 3 but are better exposed. In fact if you look uphill from this point you can see the flat **bedding surface** (which was horizontal when the sediment was laid down) **dipping** (sloping) about 40° to the south (see Figure 2). In addition to the rugose corals seen at Stop 3, you may also notice flat, platy tabulate corals.

STOP 6 - ANDESITIC BRECCIA

This stop is located in the middle of a 30m thick breccia/conglomerate unit made up of granule to cobble (2mm - 250mm) size clasts (rock fragments) in a sandy matrix. The matrix can be likened to the cement between bricks.

Note the differences between the white calcite cement at Stop 3 and 5, and the sandy matrix at this locality

Most of the rock fragments are andesite and come from a volcanic source. The matrix is made up of sand-size particles of weathered rock and crystals. Where the matrix is weathered away. the andesite clasts are exposed giving the rock a very knobbly, rough surface.

Consider the difference between the energy of the water required to move these large rock fragments (high energy compared to that needed to move the fine sand particles that make up the rock at Stop 2 (low energy).

STOP 7 - AMYGDALOIDAL ANDESITE

This andesite is fine-grained like the one at Stop 4, but whereas the previous andesite had phenocrysts set in the fine groundmass, this rock contains **amygdales**. These are cavities in the rock formed by gases escaping from the cooling lava, which have later been filled up with secondary minerals such as quartz, epidote, calcite or zeolite. These form rounded mineral "beads" highlighted on the surface of the rock after the groundmass has weathered away. (Figure 5).

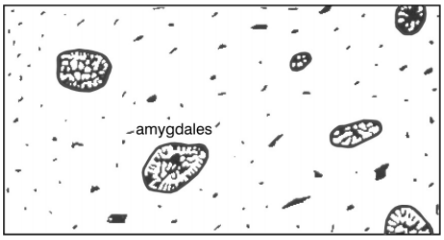

Figure 5 - Amygdaloidal andesite.

STOP 8 -CALICHE

The white limy material covering and lying around the outcrop of andesitic breccia is called caliche (pronounced *kal-eesh*). It is made of 'limestone' (calcium carbonate) which forms in the soil above or near rocks containing lots of calcium carbonate. At this location, it is forming on top of a calcite-cemented andesitic breccia as we saw at Stops 3 and 5. The calcium carbonate from the calcite cement has been removed in solution into water contained in the soil. As this solution, which is rich in calcium carbonate, rises up through the soil, water is evaporated at the surface causing the calcium carbonate to be re-precipitated near the surface. This is a very recent deposit formed in the Quaternary period (0-2 million years ago).

STOP 9 - CALCAREOUS SANDSTONE AND CONGLOMERATE

A good exposure of well-bedded limy rocks occurs in the small gully near the marker sign. The sandstone and conglomerate beds have platy tabulate corals within them, again indicating deposition in a marine environment. The tilting or dip of the beds is clearly visible at this site.

STOP 10 - ANDESITIC BRECCIA AND VEINING

This site is located at a flat outcrop in the creek bed.

You will see an andesitic breccia similar to that at Stop 6, but here the rock has been worn smooth by water. If you inspect closely you will notice that most of the rock clasts are porphyritic andesite like that seen at Stop 4. However, the size, composition and relative abundance of the phenocrysts varies, reflecting a variety of sources for the different andesites.

There are also rare clasts of reworked breccia formed by the erosion of a previously consolidated breccia (Figure 6). These clasts of breccia rock were then transported by water and incorporated in the sedimentary pile that formed this outcrop. See if you can recognise any of these clasts.

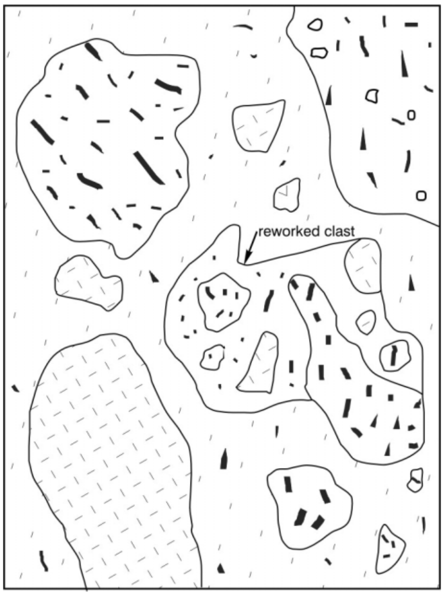

Figure 6 - Andesitic breccia with reworked andesitic breccia clasts

The other feature of this outcrop is the presence of a variety of veins and dykes(in filled cracks) which cut through the rock (Figure 7). Most of the veins are in filled with quartz or calcite. Both are white minerals but quartz is the harder of the two. In some of the white veins you will see dark, angular fragments of the rock into which the vein intruded. You may also see a narrow andesite dyke cutting through the pavement outcrop.

This is the last stop of this walk. You can return to the Tourist Park by retracing your steps or alternatively head a few hundred metres to the west via the marked " adventure trail" until you intersect the vehicle track. Head north on this track, back to the Park.

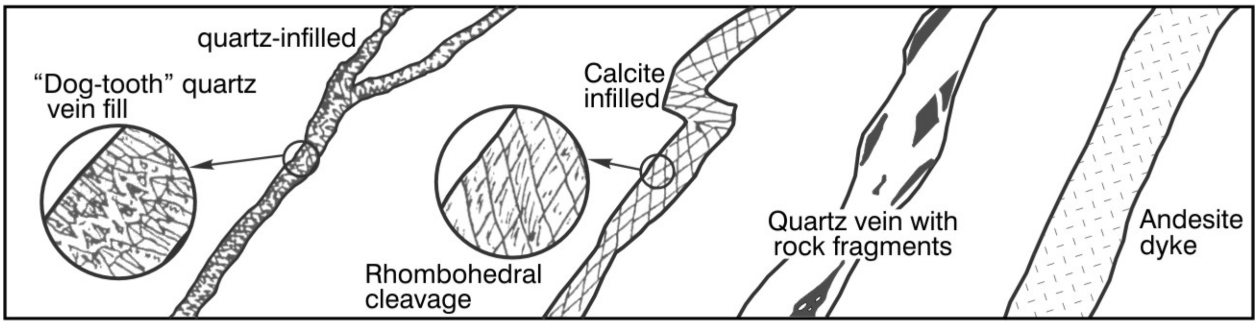

Figure 7 - Vein types and dyke located at Stop 10.

Other geological features of the tourist park.

Four other geological units shown on Figure 1 occur in the vicinity of the Kroombit Tourist Park.

The oldest of these units is the Middle Devonian (approximately 380 million years old) Marble Waterhole beds. The most prominent rock type of this unit is massive blue-grey limestone as seen in the cliff at Marble Waterhole. This limestone contains abundant fossils including many species of coral. An activity sheet is being developed to enable people to locate and identify fossils and other geological features present at Marble Waterhole.

The other three units were all deposited in the Tertiary period, which extended from 65 to 2 million years ago. The oldest of these units is the Tertiary sediments, of which there is a small outcrop 3 km south of the tourist park. These fine-grained sandstones and siltstones were deposited in sedimentary basins and deep valleys. Oil shale deposits of eastern Queensland are located in these Tertiary basins.

Overlying this sedimentary rock is a thin capping of black basalt. Because this is a very hard rock, it protects the underlying sedimentary rocks from being eroded away. These lavas were erupted from Hawaiian-type volcanoes, the vents of which were only a few kilometres away. Where the basalt has been weathered, it forms areas of black soil which can be seen on hills south of the tourist park.

The remaining unit to be discussed is the Tertiary residual gravel which forms low, flat-topped hills flanking Kroombit Creek. This coarse gravel was deposited by water flowing down Kroombit Creek, which was presumably bigger, and certainly at a higher level than where it has eroded down to today. The gravel contains mainly cobbles and boulders of rhyolite and sandstone eroded from these rock types, which occur in the mountains of Kroombit Tops.

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Further reading

BARKER, R.M., and others, 1997: New insights into the geology of the Northern New England Orogen in the Rockhampton-Monto region, central coastal Queensland: progress report on the Yarrol project. *Queensland Government Mining Journal* Volume **98**, pp 11-26.

BLAKE, P.R., and others 1996: Review of mineral exploration within the Biloela (9049), Calliope (9149), Monto (9148) and Scoria (9048) 1:100 000 Sheet areas, central Queensland. *Queensland Geological Record*, **1996/12**.

The re-mapping of the rocks of the Monto to Rockhampton region occurred as part of the Yarrol project, a segment of a major mapping programme (GEOMAP 2005) of the Department of Mines and Energy designed to re-map all of the potentially mineralised areas of Queensland by the year 2005. Mark Hayward publishes with the permission of the Director, Geological Survey Division, Department of Mines and Energy.

This pamphlet and pamphlets covering other parts of Queensland can be found on the website of the Queensland Division of the Geological Society of Australia. Our homepage can be found at
http://qld.gsa.org.au/
and the pamphlets can be found at
http://qld.gsa.org.au/rocks.htm