COBBOLD CREEK GORGE

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The geological history of the rocks around Cobbold Creek Gorge, and the Forsayth area of which it is part, spans almost 1700 million years.

Proterozoic era

The oldest rocks in the area are the schists that lie to the east of the Robertson River. They are part of a sequence of rocks called the Etheridge Group, and were deposited in a shallow sea as fine sand and mud. As the sediment was deposited, the Earth's crust beneath the sea-floor subsided, and eventually, a pile of sediment more than 10km thick accumulated. In places, flows of basalt lava were erupted onto the sea-floor, or were intruded into the sediments. Dating of radioactive minerals in the rocks indicate that they are about 1650 to 1700 million years old. They formed during the Precambrian era, when the only life forms in the sea were simple single-celled algae and bacteria. Evidence of these life forms is preserved in the rocks as carbon or graphite. Dark grey, carbonaceous rocks are common in the area, and can be seen at several places along the road from Forsayth.

Between about 1550 and 1570 million years ago, tectonic forces in the Earth's crust caused the sediments to be compressed and folded, probably forming a large mountain belt. At the base of the folded pile of sediments, at a depth of 15km or more, great pressure and heat caused the minerals in the rocks to change, by processes referred to as metamorphism. The quartz and clays reacted with each other to form new, coarser minerals such as mica, which, because of the pressure, aligned themselves to produce a foliation or 'grain'. These foliated rocks are referred to as schist, if the minerals are coarse enough to be seen with the naked eye, or slate if they are finer.

Still deeper in the crust, the temperature was high enough to cause some of the rocks to partially melt. This molten rock rose through the crust, where it crystallised as the granites that are now exposed around Forsayth and Georgetown.

Palaeozoic era

Nothing much is known about the next 1000 million years, but erosion would have worn down the mountains and washed the material away to the sea. About 400 million years ago, a further period of mountain building and granite intrusion occurred. These granites heated water in the pore spaces in the surrounding rocks and also gave off hot fluids themselves as they cooled. These fluids mixed and circulated through fractures in the rocks and deposited the gold-bearing quartz veins of the Etheridge goldfield.

During the next 50 million years, more erosion took place, exposing many of the metamorphic rocks and granites that we now see. In the Carboniferous and Permian periods, from about 330 million years ago, and continuing until about 280 million years ago, intermittent extremely violent volcanism took place. During single events, tens of cubic kilometres of molten rock was erupted as incandescent ash clouds that settled as sheets of volcanic rock, like that forming the Newcastle Range east of Georgetown and Forsayth. Some of the molten rock did not reach the surface, and instead cooled at shallow depth to form granite. Some of the tin and topaz deposits in the Mount Surprise area, and the giant Kidston gold deposit formed during this period of granite intrusion and volcanism. In the Permian, less violent eruptions in the Agate Creek area resulted in basalt and rhyolite lava flows that contain the famous agate and thunder egg deposits.

Mesozoic era

During the next 100 million years, erosion reduced the area to a featureless plain. Only parts of the hard volcanic rocks such as the Newcastle Range may have formed hills. About 180 million years ago in the Jurassic period, large river systems, probably similar to the Gulf rivers of today, flowed across the region. They carried coarse sand and sometimes gravel, derived from highlands of granite and metamorphic rocks to the southeast and east. Dinosaurs probably roamed the landscape, but none of their remains have been found. As the rivers meandered back and forth across the flood plains, the sand was deposited as a sheet that eventually covered the entire area. With time the sand hardened into sandstone. Geologists refer to this sandstone sheet as the Hampstead Sandstone.

Such Jurassic sandstones are widespread from Cape York Peninsular to northern New South Wales, and form some of the important aquifers in the Great Artesian Basin.

Subsequently, in the Cretaceous period, about 120 million years ago, the sea flooded much of western and northern Queensland. Marine sands and muds were deposited on top of the Jurassic rocks, and even on top of the Newcastle Range.

Cainozoic era

After the sea withdrew, the region underwent a long period of weathering. About 20 million years ago, in the Tertiary period, gentle uplift took place, and probably continued episodically until about 4 million years ago. As a result, the rate of erosion increased, and the sandstone sheet that covered the region, began to be stripped away, exposing the rocks underneath. This process is continuing today, and in most of the Forsayth area, only remnants of the sandstone sheet are preserved as flat-topped hills or mesas.

However, around Cobbold Creek a large area of sandstone is preserved. Unlike most areas, the sandstone does not cap the highest hills. The hills of schist to the east of the Robertson River are higher than the sandstone at Cobbold Gorge. This is because of downward movement of about 200m on the southwestern side of a large fault. Because the sandstone that originally capped the rocks to the northeast of the fault was at a higher level, it has been completely eroded away. The relatively straight northeastern margin of the sandstone marks the line of the fault, which is followed by this part of the Robertson River. Most of this movement probably happened when the area was being uplifted in the Tertiary, but the fault has had a long history of movement dating back well before the sandstone was deposited. The Agate Creek area lies along its southeastern end, and the fault probably provided a conduit for the volcanic rocks there to reach the surface. There is evidence of even earlier lateral (sideways) movement of up to 5km on the fault.

An interesting possibility is that there may have been minor movement in very recent times, and this could have contributed to the formation of the Cobbold Creek Gorge.

Formation of Cobbold Creek Gorge

Until very recently (in geological time), water from Cobbold Creek flowed into the Robertson River at Stone Yard about 1.5km upstream of where it does now. Upstream of what is now Cobbold Gorge, and where it joins another creek that flows from the west, it previously turned and flowed east to southeast through a relatively wide gorge. This gorge is now abandoned, and is a dry valley without any major stream along it. Instead, all the water from Cobbold Creek and its tributaries is funnelled through the very narrow slit in the sandstone that we know as Cobbold Creek Gorge. The exact reason is uncertain.

One possible cause is the process known as stream capture. On the aerial photograph of the sandstone, there are numerous dark lines. These are fractures that have been etched out by weathering. The larger ones form deep gullies. The gorge may have been one such gully that flowed northeast into the river. With time, erosion caused the head of the gully to retreat until it met Cobbold Creek. Because its mouth was at a lower point than the old mouth of Cobbold Creek, the gully captured all the water flowing down Cobbold Creek and its tributaries. Because this happened only recently (perhaps even in the last 10 000 years or so), erosion has not yet had time to widen the gorge.

However, the proximity to a large fault (which is known to have been active spasmodically over a long time), introduces the possibility that minor fault movement in very recent times could have contributed to the change of course of Cobbold Creek. Slight movement on the fault near Cobbold Creek (a few metres would be sufficient) could have tilted the area upwards very slightly to the south so that the old course was now uphill. This would have forced the creek to find an alternative course through the sandstone. It may have done this by following open fractures or an existing gully in the sandstone, possibly favoured by downwards tilting to the north.

The narrow nature of the gorge indicates that it is a very young feature. Because the diversion of Cobbold Creek happened only very recently (perhaps even in the last 10 000 years or so), erosion has not yet had time to widen the gorge. Below water level, the walls are undercut and extend back many metres in places. This is caused by abrasion by boulders and pebbles move along the bed during floods. Eventually the walls will collapse and the gorge will progressively widen.

Features of the Hampstead Sandstone

The Hampstead Sandstone at Cobbold Creek shows a variety of structures. The most conspicuous is the layering, or bedding, which is a feature of most sedimentary rocks. Each layer represents slight differences in the grain size of the sediment, the types of grains or the conditions under which they were deposited. Because the layers have different resistances to weathering, they become etched out.

Two types of bedding are present in the Hampstead Sandstone. Large, generally horizontal beds can be seen, but within these beds, a second type known as cross-bedding can often be seen as sets of inclined layers between the larger bedding planes.

The styles of cross beds seen in the Hampstead Sandstone are typical of those formed in sandy rivers and streams like the Robertson River itself. Cross bedding generally forms when large ripples and sand bars migrate along the sandy bed of the stream during high flow. Sand carried forward by the current cascades down the steeper front of the ripple or sand bar forming an inclined layer. It can also form in sand bars on the inside of bends in a meandering stream or as small channels in the stream bed are filled by migrating sand. The sets of sand bars with their cross beds may be buried by a fresh set of migrating bars and ripples during a subsequent flood, thereby building up another set of cross-bedded layers.

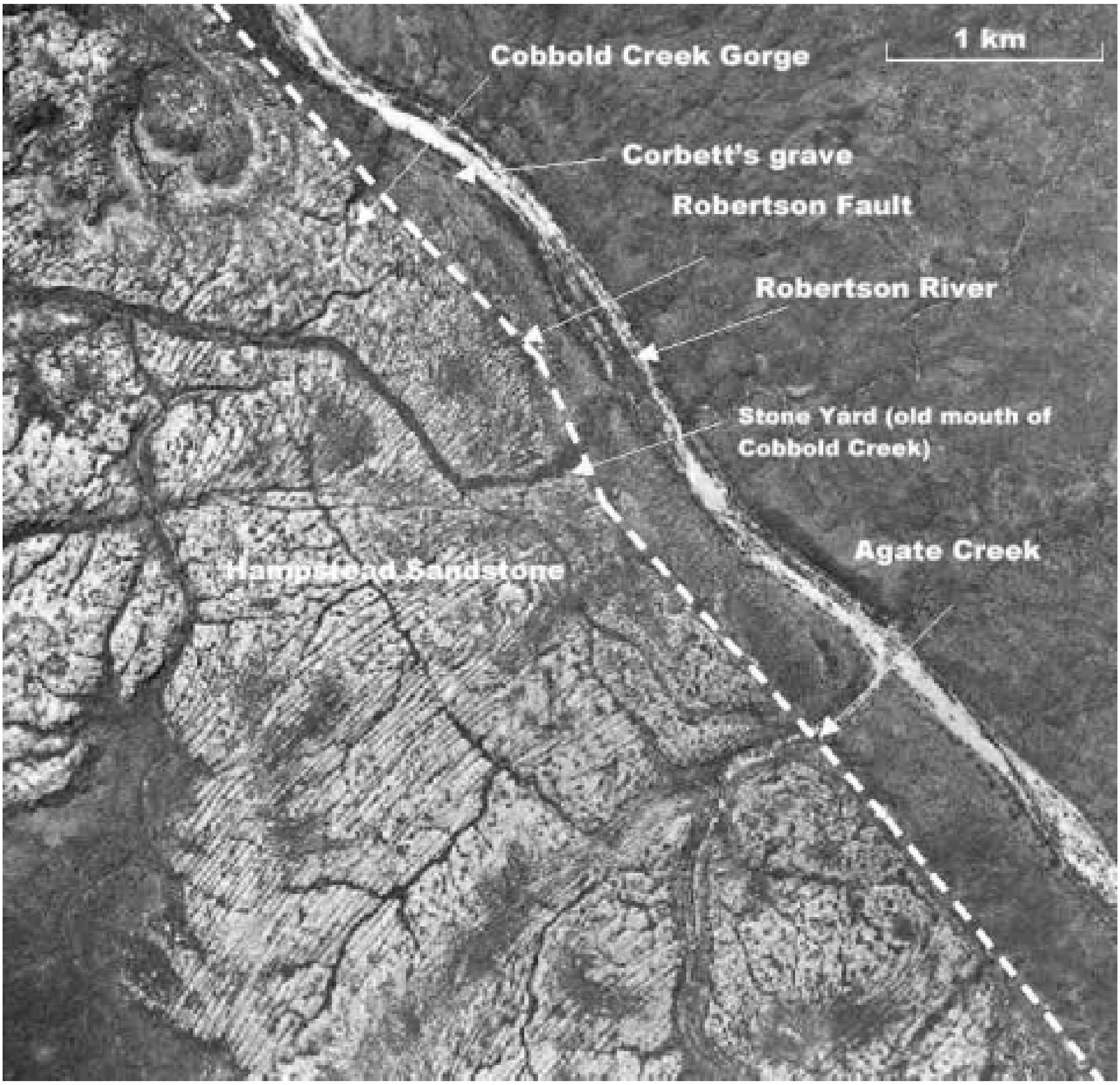
Also present in the sandstone are thin layers of pebbles. These were originally gravel layers in the sand, deposited during times of flood when the stronger current allowed larger material to be transported.

Thin layers of fine-grained shale can also be seen. These formed during the waning stages of floods as the current slowed allowing the suspended silt and mud particles to settle as a thin crust on the coarser sediments. This crust is usually washed away by the next flood, but occasionally it is buried by sand and preserved. Occasional thicker beds of shale may represent deposits on the flood plains. When flood waters break out of their channels and spread over the flood plain, the water becomes slower moving and deposits mud and silt.

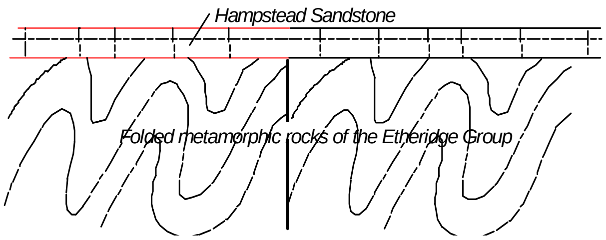
Cutting across the sandstone are numerous fractures (or joints as they are usually known). These joints formed after the sand hardened into rock. The sandstone is about 50m thick but extends over hundreds of kilometres. Therefore it behaved like a brittle sheet and even small flexing of the earth's crust caused it to fracture. These joints are often aligned in particular directions and can be seen from the air as sets of parallel lines, etched out by the weathering (see the airphoto).

Water from rainfall percolates down the joints into the sandstone until it meets an impervious layer like a shale bed. If the impervious layer is exposed in the side of a creek or gully, the water will seep out as a spring. Some springs can be seen along the walls of Cobbold Creek Gorge.

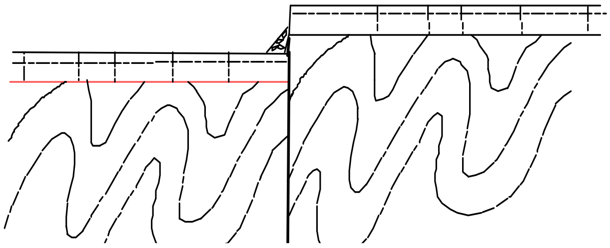
Although the sandstone has these large conspicuous joints, they are often metres apart. The metamorphic rocks, on the other hand, are strongly foliated and are cut by fractures on a centimetre scale. As a result, weathering easily penetrates these rocks and they are covered in soil and are generally well-vegetated with grass and large trees, particularly eucalypts. However, weathering is less able to penetrate the sandstone, and the upper surface is largely bare rock that stands out strikingly from the air. Vegetation therefore is mainly restricted to small patches of soil developed along the joints and consists mainly of hardy species such as spinifex grass and acacias.



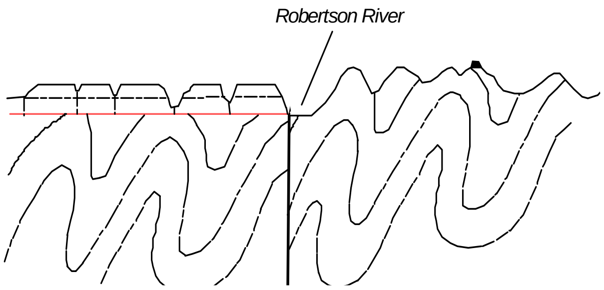
Aerial photograph of the Cobbold Creek area, showing the white Hampstead Sandstone. The arrays of thin dark lines are prominent joints in the sandstone. The former course of Cobbold Creek, prior to the formation of Cobbold Gorge, can be clearly seen joining the Robertson River near Stone Yard. The dotted line outline the trace of the Robertson Fault. Portion of North Head Run 9 photo 4305, flown 14-5-1972 for the Commonwealth of Australia (used with permission)



Before faulting - Hampstead Sandstone covers the whole area



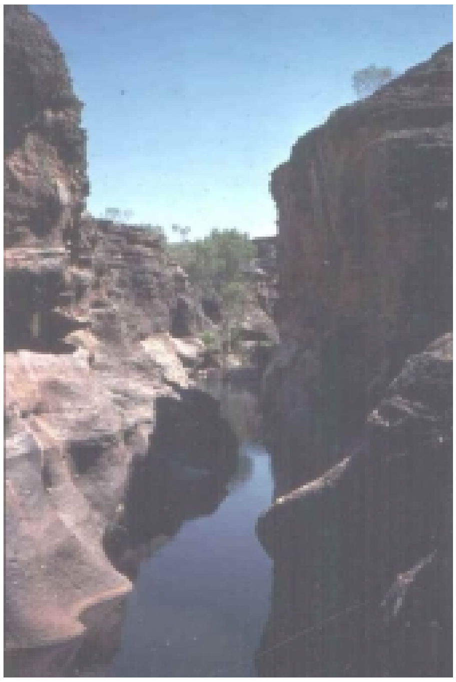
The Hampstead Sandstone has been down-faulted west of the Robertson Fault



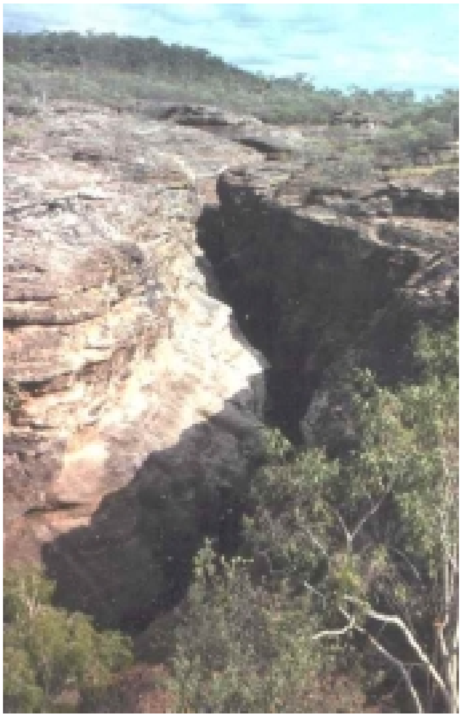
After erosion - the Hampstead Sandstone east of the fault has been completely removed

E-W cross sections across the Cobbold Creek area, showing how down-faulting has preserved the Hampstead Sandstone

Hampstead Sandstone showing typical cross-beds



View of Cobbold Creek Gorge showing the shear walls. Below water level, the walls are undercut and extend back many metres. Eventually the walls will collapse, and the gorge will progressively widen. The narrow nature of the gorge indicates that it is a very young feature.



View of Cobbold Creek Gorge from on top of the sandstone showing the bare landscape and horizontally bedded sands

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