

A journey through the earth history of
Australia's Coastal Wilderness

Part 6 The region's geological floor – the Ordovician



Ordovician turbidite. Narooma

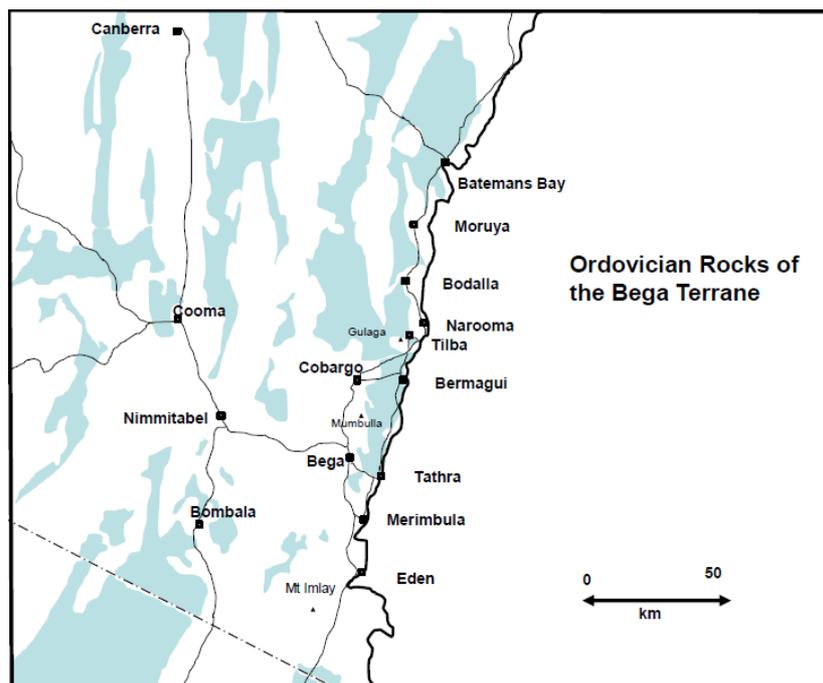


6. The region's geological floor– the Ordovician sedimentary rock

The region's geological floor comprises the background rocks that everything else intruded into, melted, cooked or layered upon – the Ordovician rocks of the Bega Terrane.

The 450-500 million year old (Mya) Ordovician rocks in the region are made up of layers of mudstone and sandstone. These sediments were shed down the continental slope in watery avalanches called turbidity currents. Over time the flat layers on the seabed built up a thick mass in what is now the Ross area of Antarctica. The sequence includes some chert beds – chert is a chemical sediment composed of fine grained silica. As well as accumulating a great thickness, the sediments were laid down over a huge area of this ancient ocean. The base of the sediment pile was under great pressure from the overlying mass and began to heat up, which baked the wet sediment into rock, and formed some new minerals in the process, and squashed the soft mudstone into layered shale.

Turbidites have their origins in off shore mud laden (turbid) currents generated by undersea avalanches of thick piles of unstable sediments deposited on the continental slope. The mud settles and duly forms turbidite rock.



A **terrane** is a fragment of crustal material broken off from one tectonic plate, rafted away (often a considerable distance) and accreted onto the crust on another plate. India is a classic example, rifted off Gondwana and now plastered onto the Eurasian plate. Another example is the Malay Peninsula, which was split off from The Kimberley in northwest Australia

Carried along on a tectonic plate for over 1000 km from its origin off Antarctica, the mass of sediment eventually met the ancient eastern continental margin of Australia. Around 440 million years ago, this margin lay where western NSW and Victoria are

now. The sediment accreted to the continental edge, undergoing further hardening and consolidation to become part of the continent and extending it several hundred kilometres eastwards.

The region's Ordovician rocks form the geological 'basement' into which the Bega Granite and Dromedary Igneous Province were intruded and upon which sandstones were deposited. Other younger deposits, including the Late Devonian sediments and volcanics and the Tertiary-age sandstones, also covered up this basement. The Ordovician rocks have been variously baked, squeezed, buried, exhumed and eroded to form the landscapes we see today. The chert beds form V-shaped folds, but each bed is so brittle that it finally breaks up into tiny blocks.



Layered turbidite, Aragannu



V folds, Cobargo-Bermagui Road

These rocks are often highly deformed, often partially melted, reflecting their history of deep burial and deformation. The practiced eye can often detect a number of different deformation events.



Deformed turbidite, Camel Rock

The Ordovician rocks are relatively easily eroded, forming steep slopes which retain only thin, infertile soils compared with granite-based soils. Thin soils and steep slopes are not suited to agriculture and so you will find them comprising a large part of the bedrock in the region's national parks and state forests. The hard sandstones of the Ordovician rocks are relatively erosion-resistant and buttress coastal headlands around Twofold Bay. Softer mudstone beds between the sandstones allow rain penetration into the bedrock, causing erosional collapses around the bay. This kind of erosion of alternating soft and harder layered rocks also accounts for the gullied landscapes in the mountainous areas formed on Ordovician rocks,

A good indicator of the presence of Ordovician bedrock is a cover of Spotted Gum forest. (*Corymbia maculata* (syn. *Eucalyptus maculata*)).



Spotted gum, Mimosa Rocks National Park

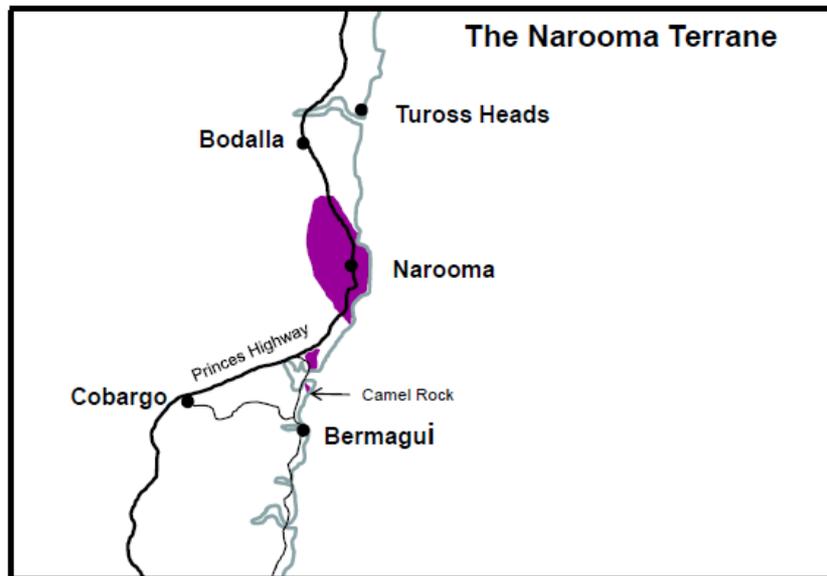
In this photograph another ancient plant is common, the Burrawang, a cycad (*Macrozamia communis*) dating back to the time of the Gondwana supercontinent. It is a cone-bearing plant of the same group as pines and other conifers (gymnosperms).

Although the Ordovician sandstones and mudstones were originally laid down as flat layers on the deep sea floor, the beds forming the headlands around Twofold Bay often stand almost vertically, or have a wavy appearance caused by the squeezing and crunching that they have undergone. A walk around the coastal cliffs near Quarantine Bay, within Twofold Bay west of Eden, reveals these features. Wave attack on the base of the cliffs undermines the rock, causing collapse of large chunks of cliff on to narrow beaches, where wave action gradually wears away the bits of rock. One day the pieces of rock will be sand sized particles and part of a new sandy beach.



The Narooma Terrane

You are now familiar with the way in which the Ordovician Bega Terrane plastered itself against the growing continent. There was another later Ordovician interloper, the Narooma Terrane, which rafted some even older Ordovician and Cambrian rocks some 2500 km across the ocean to pile up against the Bega Terrane.



The Narooma Terrane extends from areas near Batemans Bay and down to around Mallacoota in Victoria. It is likely to occur in bedrock offshore and in the submerged Zealandia (the large chunk of the Gondwanan continent between Australia and New Zealand). The terrane is interpreted as being ocean floor. It includes cherts derived from deep ocean ooze, submarine (oceanic) basalt and a range of younger Ordovician sediments that accumulated as the terrane slowly approached the continent before collision.

A distinctive feature of this terrane is Camel Rock on the northern part of Haywards Beach north of Bermagui.



Camel Rock



Camel Rock from Haywards Beach Bermagui

Camel Rock is made up of turbidite. Adjacent to it is oceanic basalt, possibly of Cambrian age around 500 Mya, making them the oldest rocks in NSW outside of Broken Hill near the South Australian border. Compared with the age of the rocks at Broken Hill (1710-1640 Mya) Camel Rock is a youngster.

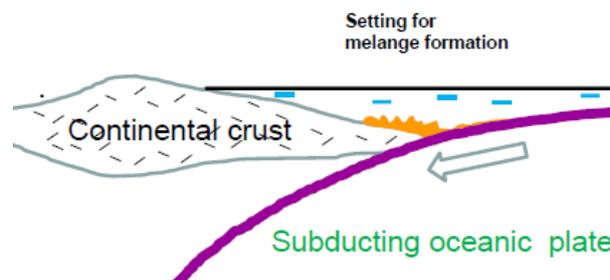


Oceanic Basalt next to Camel Rock, Bermagui

As an aside, Western Australia's venerable Jack Hills rocks in the Pilbara which, at 4,400 million years, include the oldest identified minerals on earth.

Another site well worth the visit is the beach near the golf club in Narooma. The headland rocks at each end of the beach illustrate well the unusual rock formations found in the Narooma Terrane, including mélangé.

Mélangé is a geological mess. It is usually formed in the debris scraped off a descending oceanic plate above a subduction zone.



Mélangé



Deformed turbidites

This site also shows pillow lava. This is lava extruded onto the ocean floor. The cooling action of sea water (often under immense water pressure) result in the lava exuding like tooth paste and cooling into pillow structures. These are seen at Narooma Beach.



Pillow Lava – Narooma Surf Club Beach

