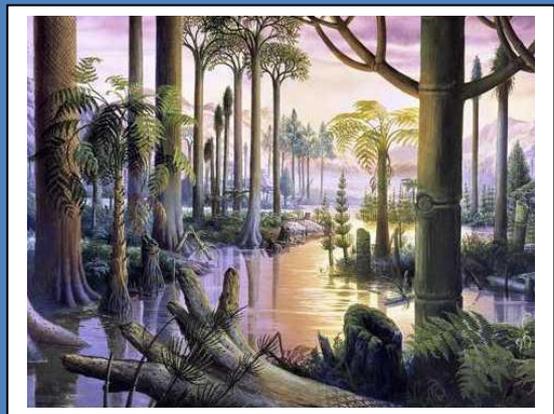
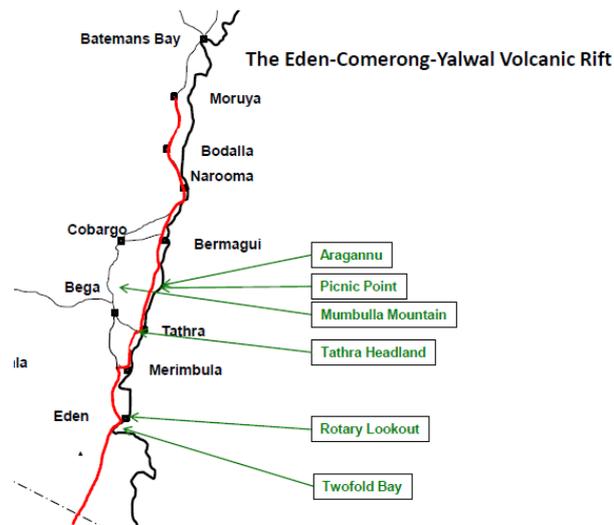


A journey through the earth history of
Australia's Coastal Wilderness

Part 8 **Ancient volcanoes and armoured fish**



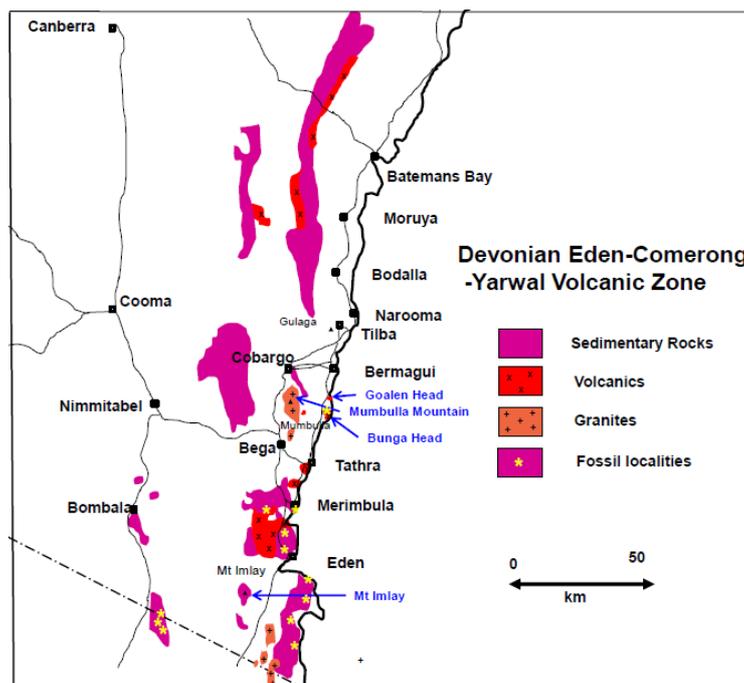
8. The Eden-Comerong-Yalwal Volcanic Rift



The Devonian – Australia’s Yellowstone 380 to 360 million years ago

By Middle and Late Devonian time, south eastern Australia was a land mass with a moderate relief and possible shallow seas or large lake systems to the east. The land mass formed part of the pre-Gondwanan supercontinent Pangea. The continental crust of Pangea began to stretch and thin to form a narrow rift in response to changes in the motions of the tectonic plate margin to the east.

The Eden-Comerong-Yalwal rift zone is the name given to the long narrow zone that preserves the deposits accompanying this event. This name describes the known extent of the rocks in the rift from Eden in the south to Yalwal, west of Nowra, in the north. The northernmost extent of the zone is unknown as it is covered by younger rocks of the Sydney Basin.



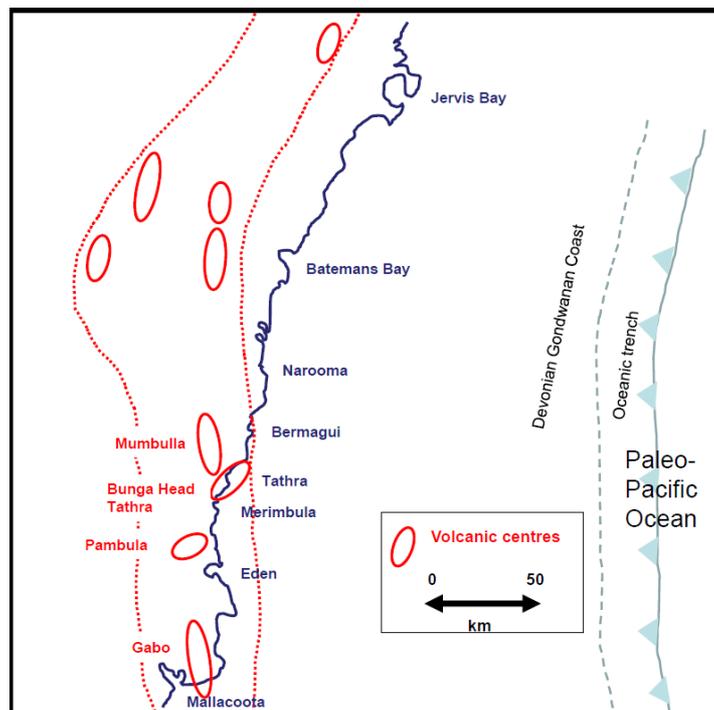
Although narrow, the rift basin was similar to modern rift basins such as those

forming today in the East African Rift. Volcanic activity began, as hot rock exploded through the thinned crust. The main areas of subaerial volcanism were along the eastern part of the Eden region. Thick ignimbrite sheets covered the landscape. Parts of the area were like the active volcanic region of Yellowstone in northwestern United States.

Ignimbrite: An **ignimbrite** is the deposit of a pyroclastic density current, or pyroclastic flow, a hot suspension of particles and gases that flows rapidly from a volcano, driven by a greater density than the surrounding atmosphere.

Ignimbrites are made of a mixture of volcanic ash and pumice fragments. The ash is composed of glass shards and crystal fragments. Ignimbrites may be loose and unconsolidated, or lithified (solidified) rock called lapilli-tuff. The term 'ignimbrite' means 'fiery rock dust cloud', from the Latin *igni-* (fire) and *imbri-* (rain), formed as the result of immense explosions of pyroclastic ash, lapilli and blocks flowing down the sides of volcanoes (modified from *Wikipedia*).

Some ignimbrite sheets contain beds of broken rock and sediment. Two small granite plutons were intruded into shallow crustal levels during the volcanism: red Gabo Island Granite and the Mumbulla Granite, seen today as Mumbulla Mountain just north east of Bega.



The volcanic activity was short lived (5-10 million years). It however produced a suite of rocks and landscape that is a distinctive feature of the region.

Coastal exposures around Eden, Tathra and Mimosa Rocks show what the volcanism was like.

Eden

At Eden, the shoreline around the wharf area at Snug Cove and the lookout on the headland in the heart of Eden are places to see volcanic features. The headland – Middle Head - gives Twofold Bay its name, jutting proudly out into the great bay, separating it into its two 'folds'.



Middle Head at Eden, Balawan (Mt Imlay) in the background



Google Earth

The headland is made of hard, erosion-resistant volcanic rock.

Across from the lookout stands the white pole of the 'lighthouse' leading the way to Snug Cove. Below the lighthouse, the massive cliff is formed from ignimbrite.



As viewed from the lookout the cliff is a cross section through a couple of separate ignimbrite flows. Now tilted towards the open ocean, the flows would have originally been laid down almost flat. The almost vertical structures in the cliff are fractures separating hexagonal columns formed during cooling of flows that poured out over an ancient land surface about 360 Mya. The flows were not liquid lava flows, but clouds of sticky ash particles, so charged with gases that they flowed like water.

These glowing ash clouds flowed over the landscape, gradually losing gas and cooling until they became the consistency of toothpaste. Bubbles of gas became 'frozen' in this sticky rock as it finally set solid. Some fossil bubbles, now filled with soft greenish clay minerals, can be seen embedded in the solid rock at the back of Cobbly Beach, on the western side of Snug Cove, in the Port of Eden.



Pyroclastic flow from Mt Pinatubu, Philippines

Eruption centres were surrounded by fumaroles emitting hot water and steam, similar to today's volcanic fields such as Yellowstone in north western United States, or Rotorua in Aotearoa – New Zealand. This hydrothermal activity altered some parts of the volcanic rock inland from Pambula to a soft, easy to carve clay-like mineral, pyrophyllite.

Mimosa Rocks

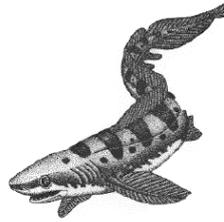
In Mimosa Rocks National Park north of Tathra, volcanic eruptions occurred on the floor of a deep lake. The results can be seen in the cliffs at the northern end of Aragunnu Beach.

Here there is an extraordinary array of various kinds of volcanic materials mixed with black mudstone. The story revealed in this complexity is that of a deep freshwater lake floored by black muds. Fishes swam in its waters, and an occasional lycopod (a fossil plant like a modern tree fern) floated in and sank to the bottom. Flattened remains of lycopod (club mosses) trunks can be seen in the black mudrocks at Picnic Point, south of Aragunnu. These indicate one of the earliest Gondwanan forest environments, pictured below.

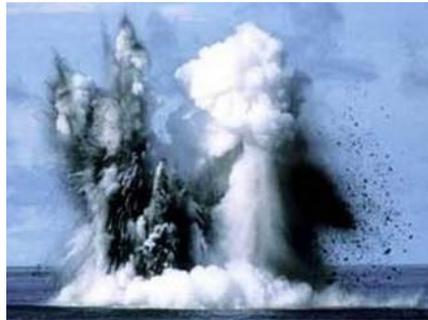


Club mosses are common around the world today but are only present in a ground hugging moss-type form, a far cry from these, the world's first forests.

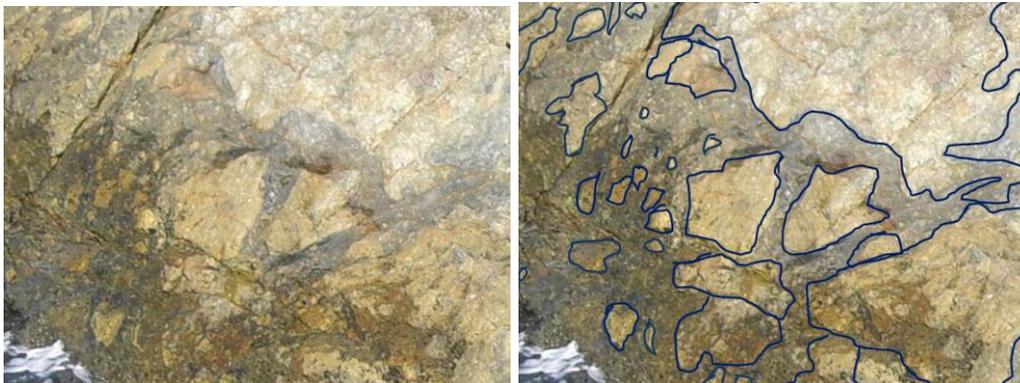
The Bunga beds near Picnic Point also contain some of the earliest known examples of fossilised shark remains.



Into the Aragannu quiet lake environment rose a bulging volcanic dome which eventually burst through the lake floor and began to erupt – underwater. The lake water boiled and fumed, shattering bedrock into a mosaic of interlocking pieces. The erupting lava also broke up, forming a mass of fragments. As the dome grew, large chunks of lava were shed down its sides. The result? Geological chaos.



The mass of fragments is frozen into the rocks next to the Mimosa Rocks.



Ignimbrite similar to that forming Middle Head at Eden is also well-exposed on the coast at Mimosa Rocks. The following overlays the turbidites (now tilted on its side) that formed in the aquatic setting.



Cooling columns of ignimbrite form the next headland north of Aragannu.

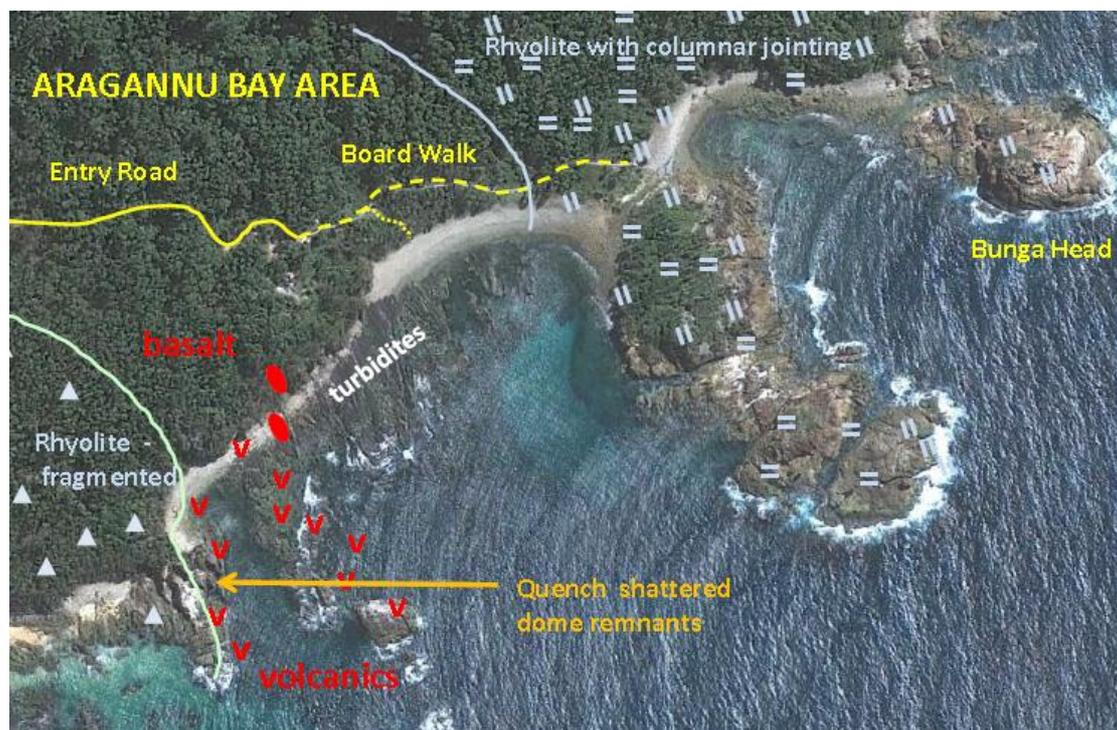


North headland Rocky Beach – Aragannu, Mimosa Rocks National Park

Wave attack has detached many columns, which have broken up into the boulders now forming the beach.



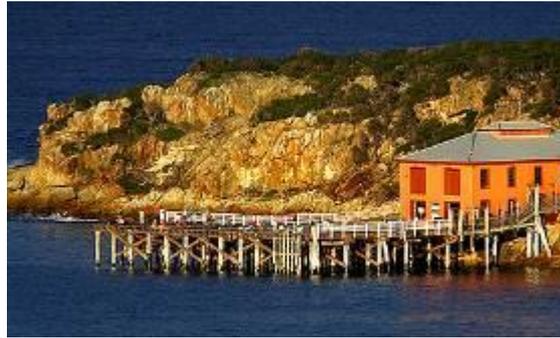
Broken columns, Rocky Beach – Aragannu, Mimosa Rocks National Park



Google Earth

Tathra

Tathra Headland and the rugged rock coast southwards to Bournda Island is composed of Devonian volcanics.



Heritage listed Tathra wharf and headland

The rocks are so shattered by folding and faulting that any original structure is difficult to see. Around the boat ramp area at Kianinny Bay, and near the remains of the old road around Tathra Headland, can be seen fine-scale layering that may be layers of ash. On the northern headland overlooking the boat ramp, it's possible to see a layer of rounded cobbles within the volcanics if you walk towards the open sea.



Kianinny Bay, Tathra

When volcanic activity died away, the Wilderness Coast region returned to a stable landmass with moderate relief inland, with coastal or lake conditions in the east. A change in climate initiated large river systems across the landmass. Following an initial phase of river deposition, typified by conglomerate, pebble sandstone, purple coarse sandstone and red mudstone, there was a rise in sea level. Shallower areas were inundated and fine sediments typical of shallow marine to lagoonal conditions were deposited. A slight sea level fall allowed the rivers to extend across land again, burying the lagoonal muds.

The Devonian – the Age of Fishes (360 million years ago)

Not for nothing is the Devonian known as the Age of Fishes. Dozens of species of enormous armoured fishes evolved to live, breed and die in Devonian rivers and seas.

Land masses around the world were criss-crossed by giant rivers carrying sand and mud left behind extensive deposits of pink sandstone, representing former sandy river channels, and red floodplain mudstone. The rivers were ideal habitats for evolving fishes.

The coastline of the Sapphire Coast between Tura Beach and the Victorian border is composed largely of these red, riverine rocks. Here and there on rock platforms the scattered remains of the platy armour of these fishes can be seen. Rarely, entire corpses of these fishes are preserved where they died, trapped in drying billabongs and rapidly buried by sediment carried by the next flood. Casts of some of these fishes are on display at the Eden Killer Whale Museum.



Wikipedia

ANU

Not only is our coastline a happy hunting ground for fossil fish researchers, but it has yielded species new to science, making it a world-class fossil fish site.

A new species of fossil fish from Eden has been named *Edenopteron*.

The reddened rocks mark a great leap upwards in atmospheric oxygen as land plants began to cover large parts of Earth. Roots of plants that grew on river floodplains can be seen in the red mudstones behind the building at Merimbula Wharf. The oxygen-rich atmosphere encouraged the development of lungs instead of gills, and gave rise to the first amphibians and land-dwelling reptiles. The oldest tetrapod (*four footed animal* -) trackway in the world is found in Devonian rocks just across the NSW-Victoria border.



Museum of Victoria

