Geology of the Batemans Bay region

Geological evolution

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The word "orogen" is derived from the ancient Greek language word for "mountain building".

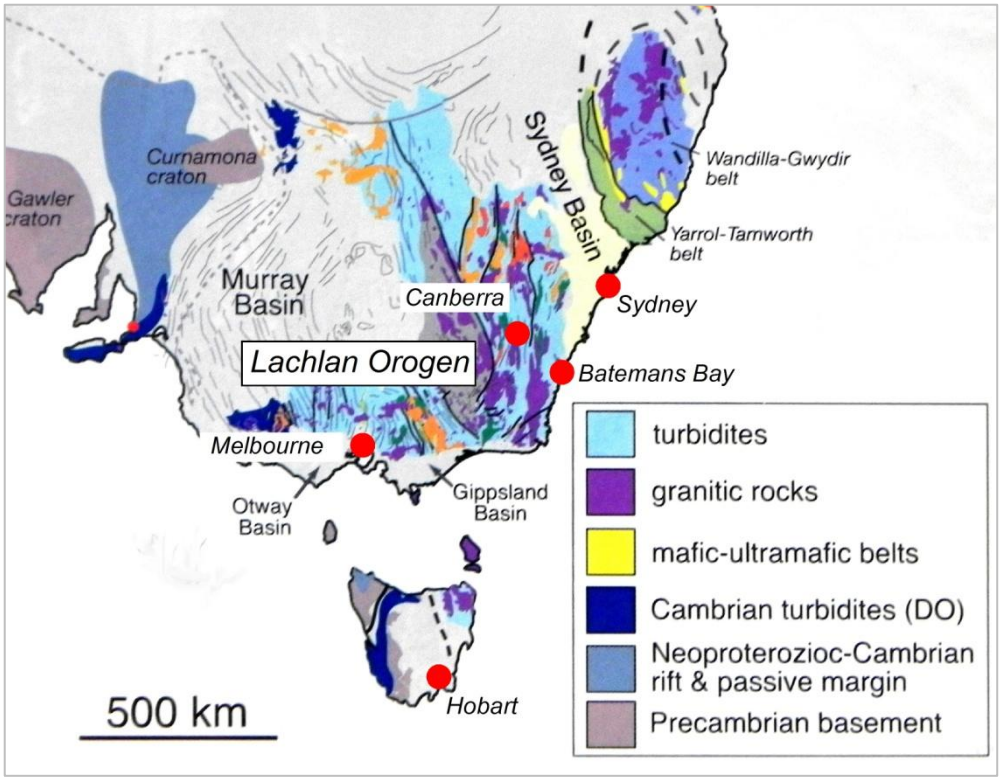
The Lachlan Orogen

The rocks exposed in the Batemans Bay region are part of the geological province called the Lachlan Orogen, sometimes referred to as the Lachlan Fold Belt.

This orogen extends from near the South Australia-Victoria border to the southeastern Australian coast.

The story of the Batemans Bay region's geology and its evolution can be described in terms of the evolution of the Eastern Lachlan Orogen.

Australian Journal of Earth Sciences



Widespread deep-water sedimentary rocks called turbidites are among the oldest rocks across the Eastern Lachlan Orogen.

The extensive granites are igneous rocks originating deep in the Earth's crust.

Cambrian-Ordovician Narooma-Batemans Bay mélange rocks at Melville Point near Tomakin.

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Geology of the Batemans Bay region

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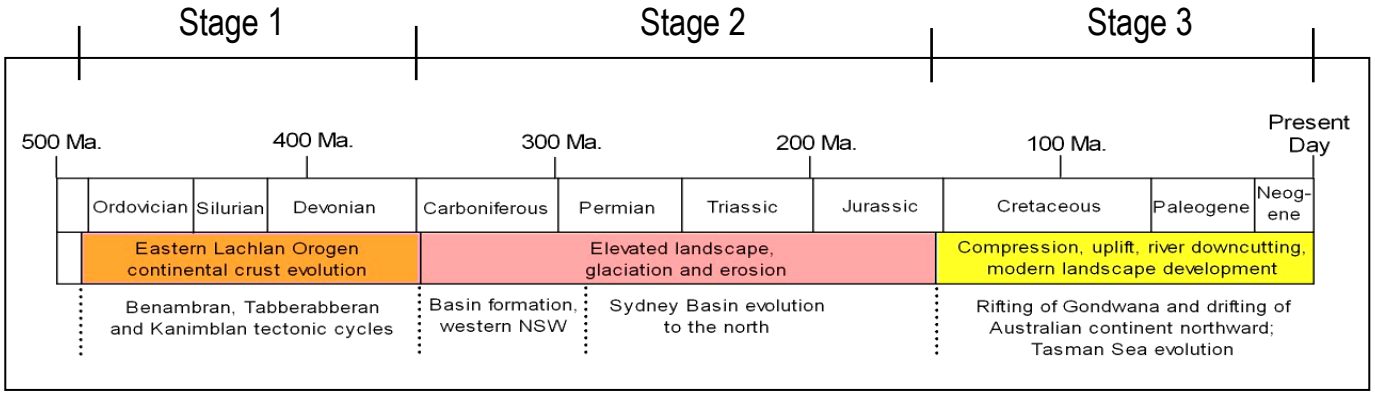
The development of the geology and landscapes in the Eastern Lachlan Orogen and the Batemans Bay region can be described in three stages.

Stage 1 - The evolution of a continental crust during the middle Paleozoic era on the eastern margins of the Gondwana supercontinent about 490 to 359 million years ago (Ma). During Stage-1 there were three major tectonic cycles – the Benambran, Tabberabberan and Kanimblan tectonic cycles.

Stage 2 - Changes to the continental crust during the Late Paleozoic and early Mesozoic eras about 359 to 145 million years ago (Ma) while Australia was still part of the Gondwana supercontinent. These changes included uplift, large-scale erosion of surface and near-surface rock and the exposure of deeper crustal rocks.

Stage 3 - The evolution of the modern landscape, drainage systems, soils and topography from the late Mesozoic era (about 145 Ma million years ago, Ma) up to the present day after the breakup of the Gondwana supercontinent. During this time the Australian lithospheric plate separated from Antarctica and drifted northward to its present location where it now collides with the SE Asian plate, the western margin of the Pacific plate and a number of small intervening plates.



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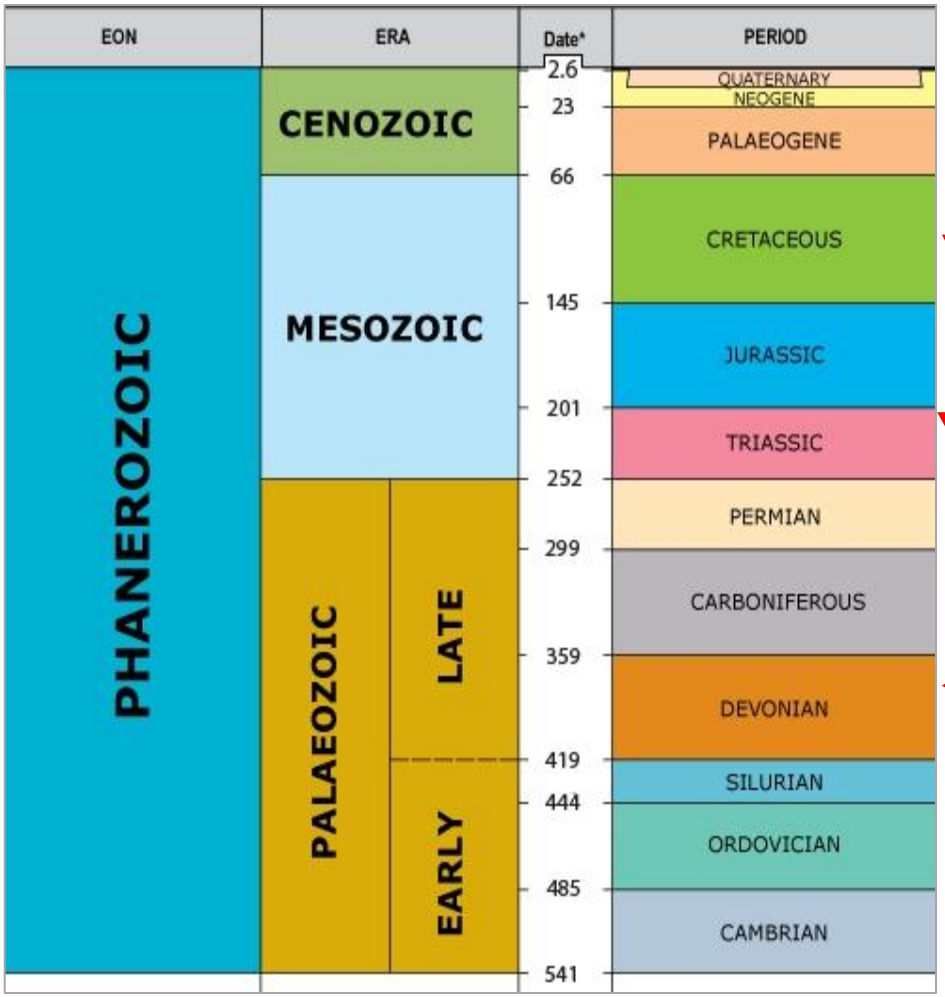
Geological Timescale

Geological time is usually measured in millions of years (Ma).

The rocks around Batemans Bay were formed in a geological time called the Phanerozoic eon (541 Ma – present day).



British Geological Survey

Age of some rock units found around the Batemans Bay region.

Coila Basalt 29.1 Ma.

Mount Dromedary (Gulaga) 97.9 Ma.

Sydney Basin sedimentary rocks, 290 - 200 Ma.

Moruya Tonalite, 379 Ma.

Adaminaby Group, about 460-490 Ma.

Narooma – Batemans Bay mélange, about 505 - 445 Ma.

The Phanerozoic is subdivided into geological <u>eras and periods</u>, e.g. Silurian period, Cretaceous period.

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520 Ma trilobite fossil found on Kangaroo Island, SA.

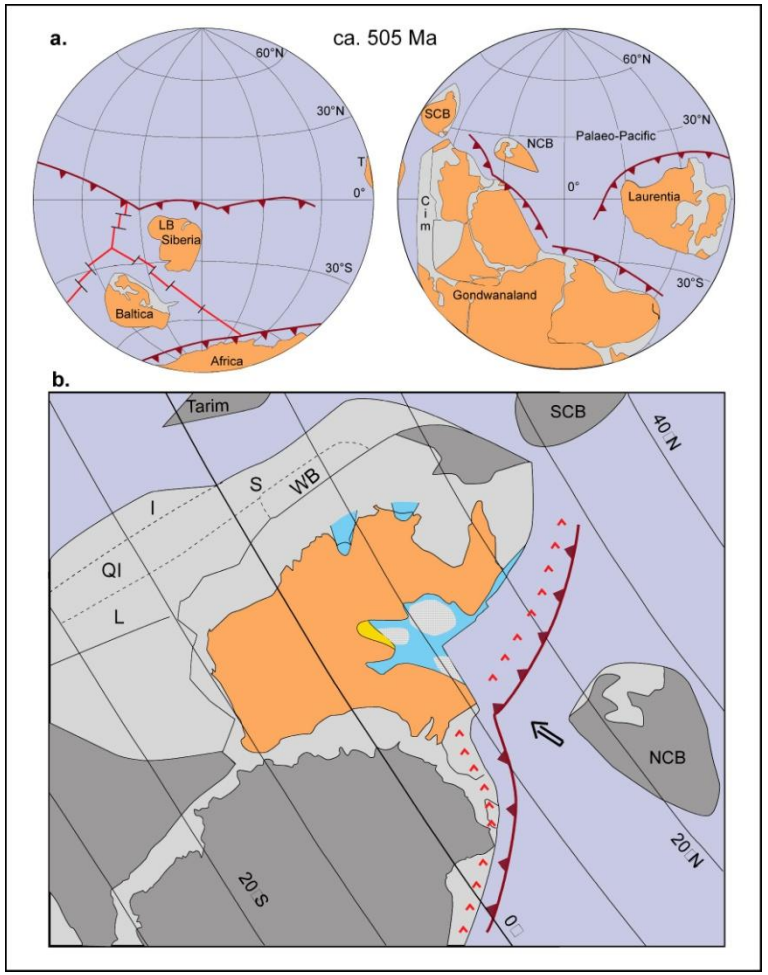
Paleogeographic maps

Geologists can determine the relative locations of continental rocks around the world by studying their magnetic properties "frozen" into rocks of the same age on the various continents.

Thus the science of paleogeographic reconstruction tells us how the various continents and continental fragments have moved across the globe throughout geological history.

Example –
This palaegeographic map shows that there was no eastern Australian continent 505 million years ago, that most of Australia was in the northern hemisphere and attached to Antarctica and India as part of Gondwana.

A continental fragment called the North China Basin (NCB) was pushing against Australia.



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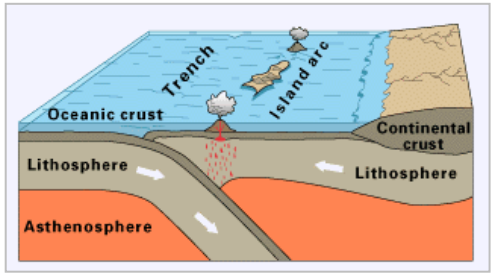
Ordovician graptolite fossils found near Lake George, NSW.

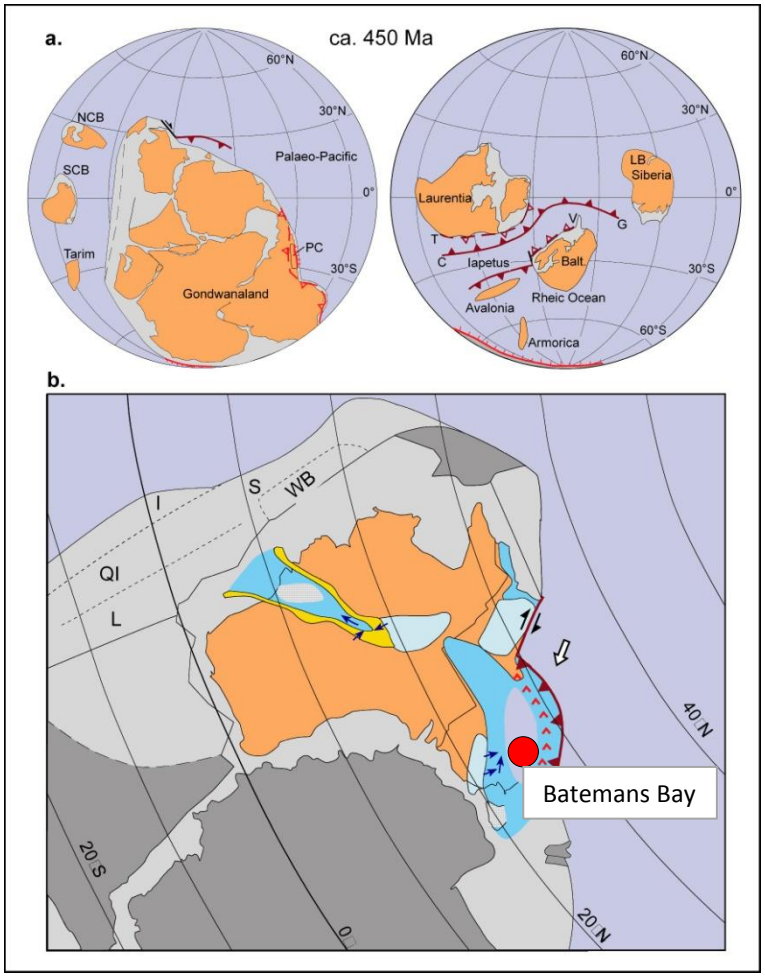
Stage 1 – Benambran Tectonic Cycle

During the Ordovician geological period (485 Ma to 444 Ma) the Australian craton was attached to Antarctica and there was a huge amount of fine sediment being eroded from the continental areas into a deep ocean basin.

During these times an ocean plate was pushing into the Australian craton and volcanic island arcs developed.

About 444-428Ma two uplift episodes resulted in these sediments being squeezed, folded and brought near the surface during the Benambran Orogeny.





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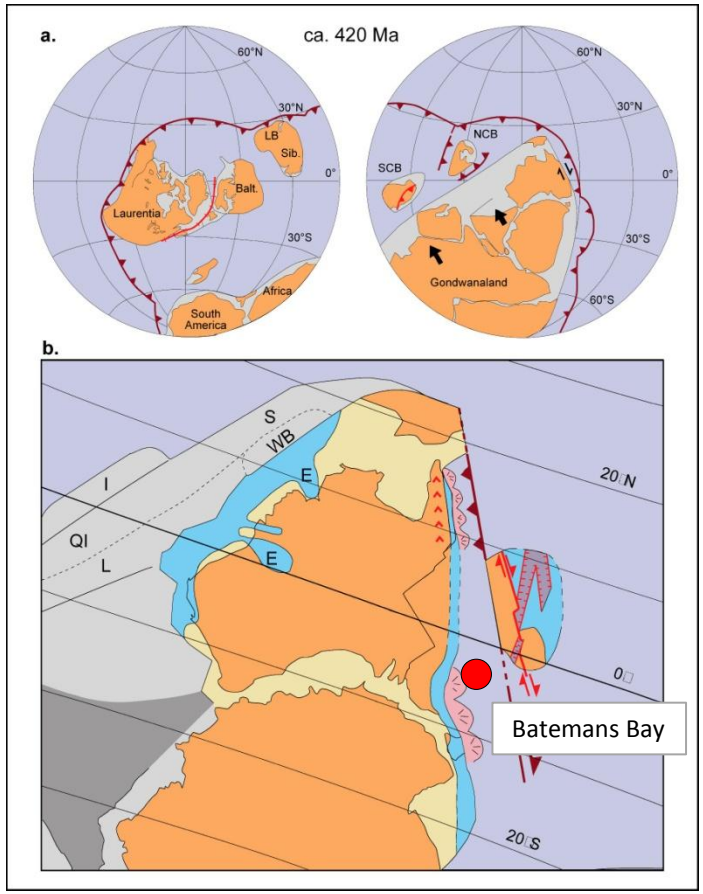
Silurian brachiopods Atrypa duntroonensis (426-423 Ma)

Stage 1 – Tabberabberan Tectonic Cycle

During the Silurian and Devonian geological periods the Australian craton was still attached to Antarctica and there was still an ocean plate pushing into the Australian craton and volcanic island arcs were still on the eastern Australian margin.

The Tabberabberan Tectonic Cycle (428-385 Ma) resulted in large volcanic igneous rocks suites across the region and the intrusion of plutons that form the Bega Batholith (420-380 Ma) including the Braidwood Granodiorite (410-411 Ma) and Moruya Tonalite (379 Ma).

At about 380-370 Ma there was a huge compression event on eastern Australia (Tabberabberan Orogeny) that resulted in major uplift, faulting and folding across the Lachlan Orogen.



Li and Powell, 2001

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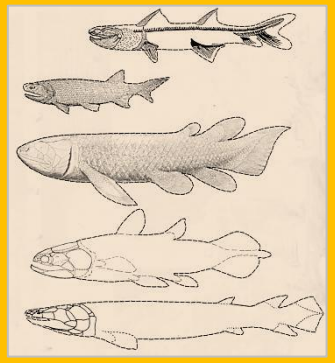


Reconstructions of ancient fish found as fossils in the Devonian rocks (360-390 Ma) on the NSW South Coast.

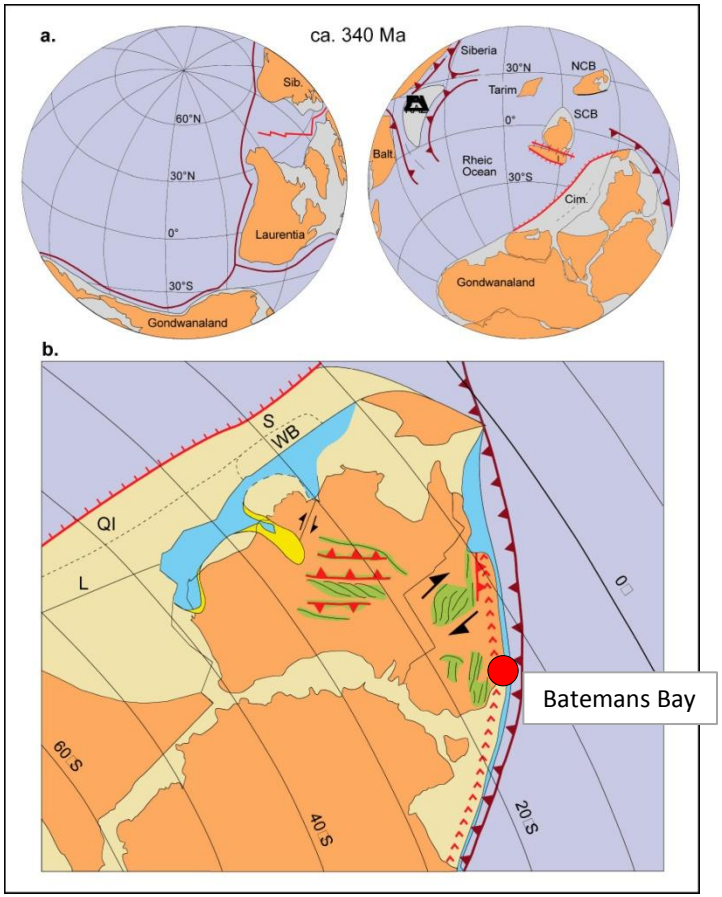
Young, 2007

Stage 1 – *Kanimblan Tectonic Cycle*

During the later Devonian and early Carboniferous geological periods the Australian craton was still attached to Antarctica. The Tabberabberan Orogeny had essentially cemented the eastern part of the Australian continental crust onto the older continental craton.

The Kanimblan Tectonic Cycle (385-318 Ma) affected areas across the whole of eastern Australia. There was a significant folding, faulting and deformation event identified at about 340 Ma (Kanimblan Orogeny).

The end of the Kanimblan Tectonic Cycle is taken to be the end of Stage 1 of the major evolutionary events affecting the Lachlan Orogen.



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Unconformity

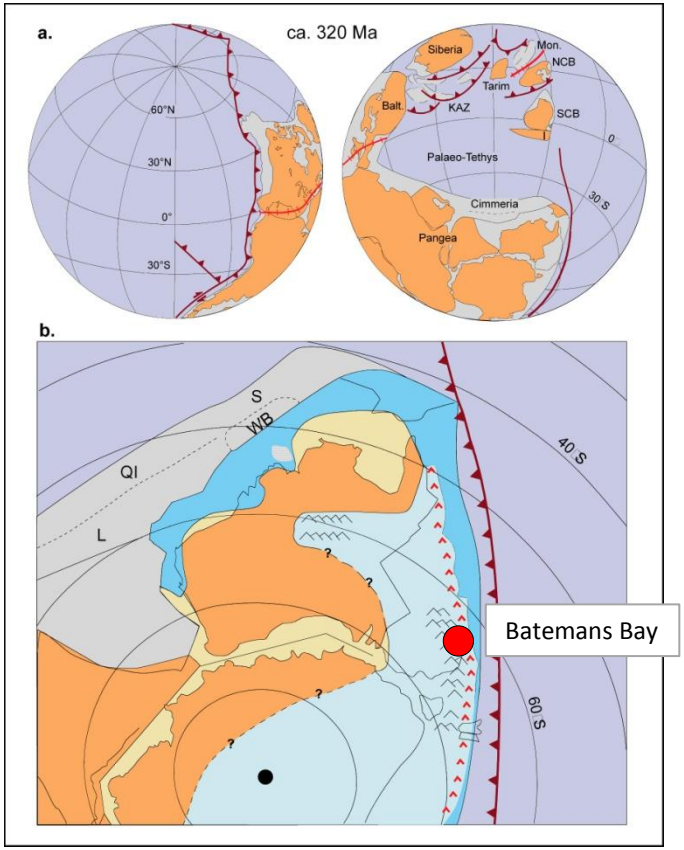
The unconformity between older rocks (Ordovician metasediments) and the Sydney Basin sediments can be seen at Myrtle Beach near South Durras.

Stage 2 – Development of the Sydney Basin

Over a long period during the Permian and Triassic geological periods the Sydney Basin formed (290-200 Ma). At South Durras, just north of Batemans Bay, the oldest basin sequences are exposed in the sea cliffs.

Drop stone

During this period Australia was at high latitudes. Glaciers moved sediments containing "drop stones" that we can see now in the cliffs at South Durras.



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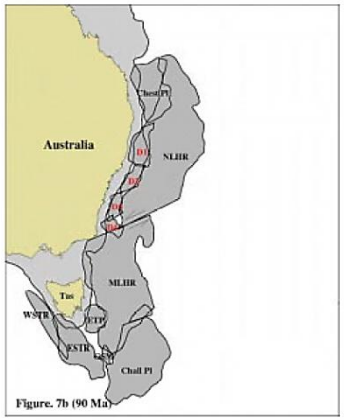
Syenite pillars near the summit of Mount Dromadery (Gulaga)

Stage 3 – Separation of Australia from Antarctica and opening of the Tasman Sea

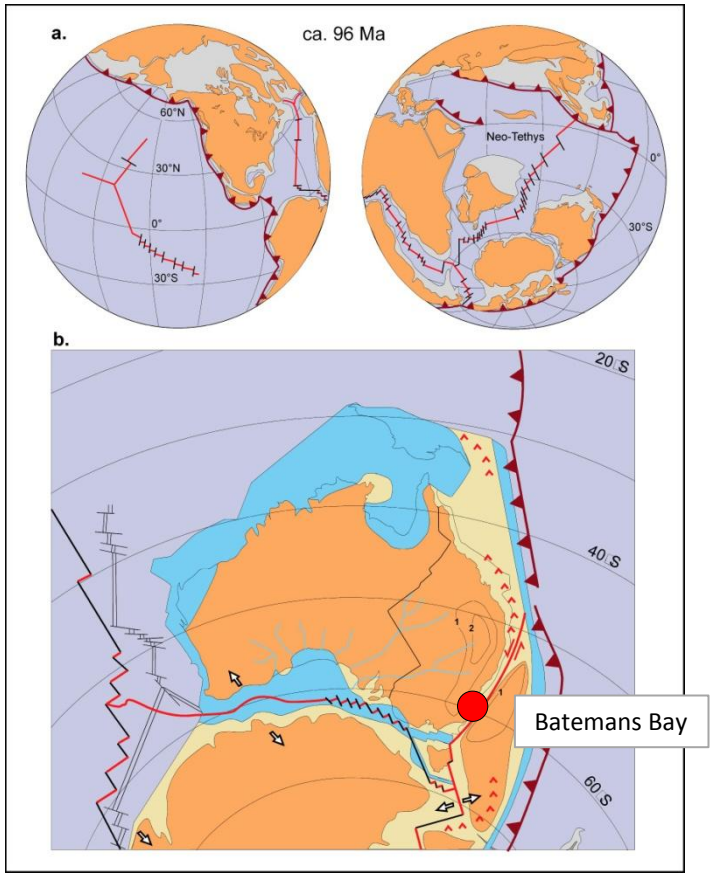
During the Juarassic-Cretaceous geological periods the Australian craton started to rift from Antarctica and drift northwards. By about 95 Ma a number of continental microplates started to rift from eastern Australia. This initiated the opening of the Tasman Sea in the period 90-52 Ma.

Mount Dromedary (Gulaga), south of Moruya, is the remains of a volcano that was active at 98 Ma at the start of the Tasman Sea opening.



Eastern Australia microplates, 90 Ma

Gaina et al, 1998



Li and Powell, 2001

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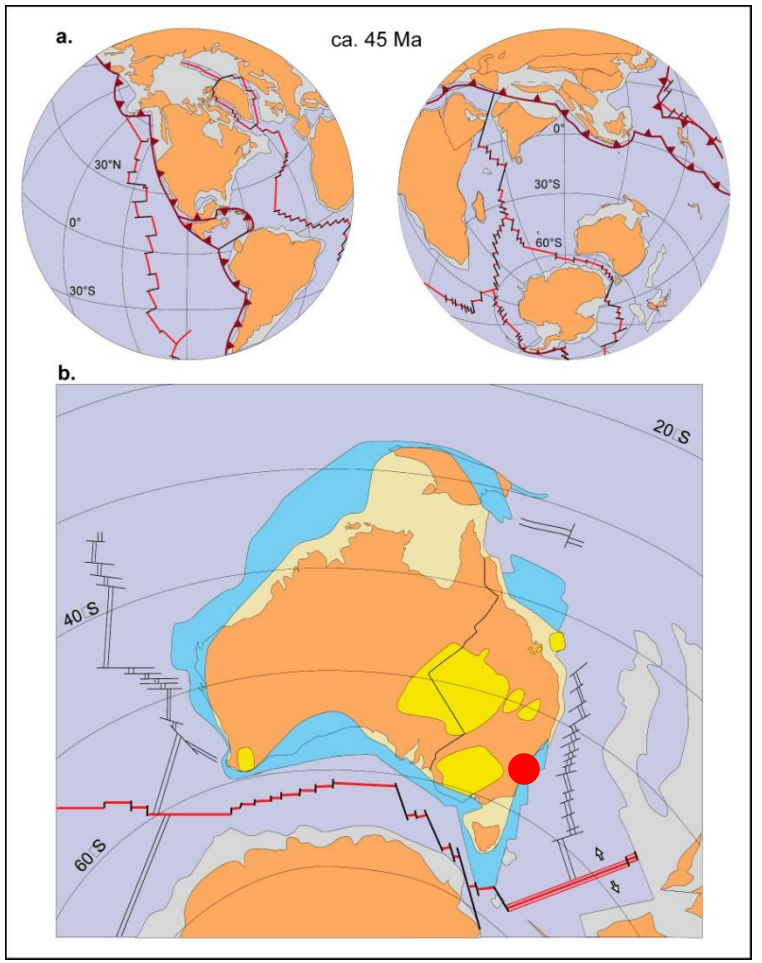
Stage 3 – Opening of the Tasman Sea

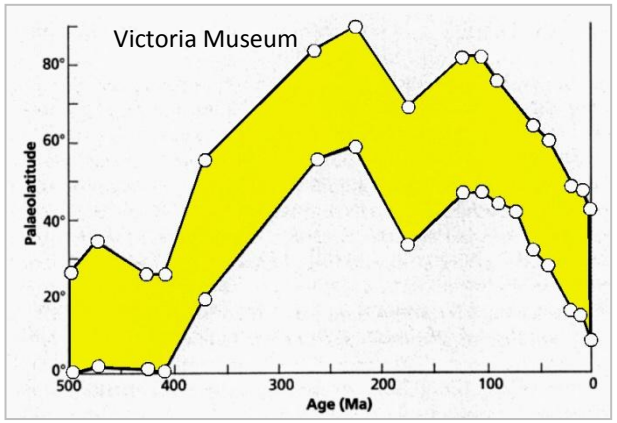
The opening of the Tasman Sea formed many of the coastal geology features that we now see in the Batemans Bay region.

This tectonic event moved New Zealand and the Norfolk Rise to their present locations 90-52 million years ago (Ma).

Deformed Ordovician slates and cherts (505-445 million years old) at Surf Beach near Batehaven.

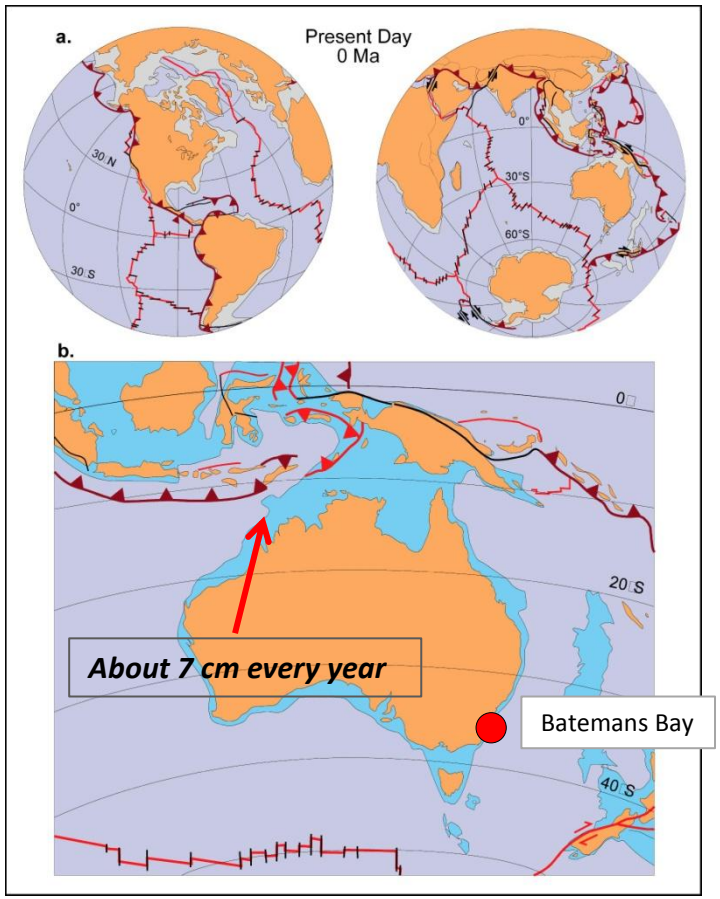


Li and Powell, 2001



Australia continental drift

During the development of the Lachlan Orogen, Australia has drifted from tropical latitudes to polar latitudes and is now drifting northwards again at about 7 cm per year towards Indonesia and Papua New Guinea.



Li and Powell, 2001

- *We live on a dynamic planet.*
- *Landscapes are changing all the time.*
- *Many of the changes can be seen in the rocks around Batemans Bay.*

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Canberra, 2016

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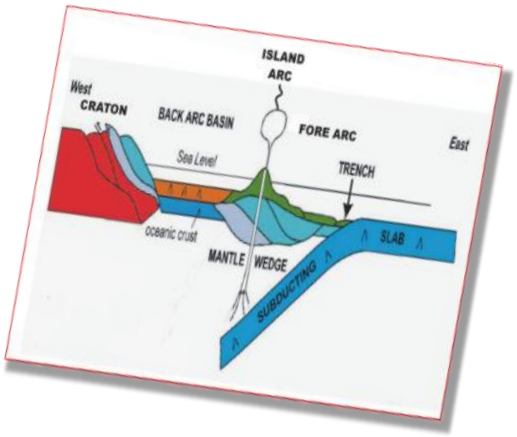
There's much more information on web sites and in books and journals. Some of these are listed below.

- ***The Geology of Australia*** *– D. Johnson, Cambridge University Press, 2004*
- ***Geodynamic synthesis of Phanerozoic eastern Australia and implications for metallogeny*** *– Geoscience Australia Record 2009/18.*
- ***A Geological Guide to Canberra Region and Namadgi National Park*** *– D. Finlayson, Geological Society of Australia, 2008.*
- ***An outline of the palaeogeographic evolution of the Australian region since the beginning of the Neoproterozoic*** *– Li, Z.X. and Powell, C.McA, Earth Science Reviews, 2001.*
- ***The Tasmanides of eastern Australia*** *– Glenn, R.A., Geological Society of London Special Publication 246, 2005.*

Deformed Ordovician mudstones and siltstones (505-445 million years old) at Barlings Beach near Tomakin.



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