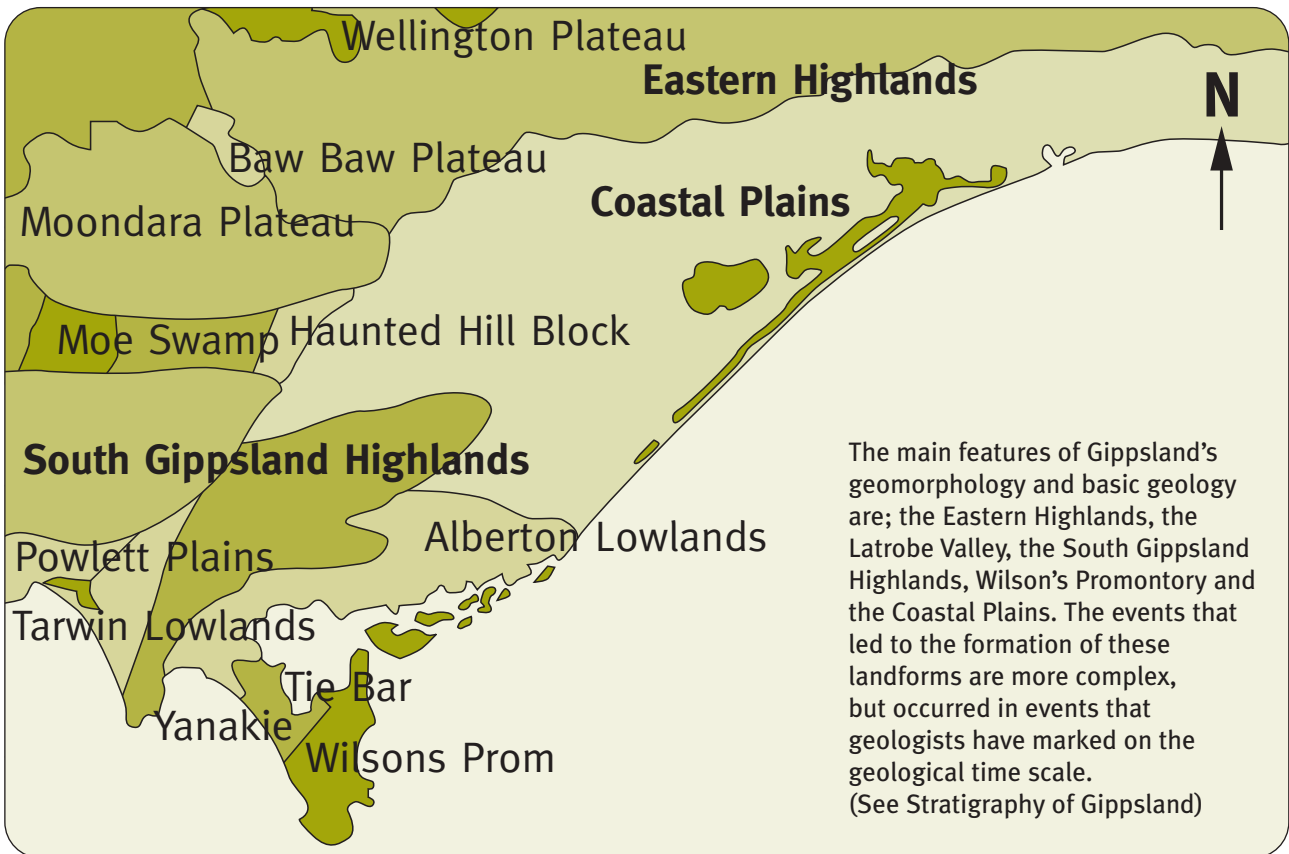




# Geological History

## OUR LANDSCAPES

Gippsland has a fascinating geological history. The lithosphere includes all the rocks and minerals on our earth. It is dynamic and changes through natural geological processes. These can be slow, like water eroding mountains to plains over millions of years, or quick, such as the explosive power of a volcano. The products of geological processes can be highly valuable resources, such as Gippsland's coal, oil and gas, or simply the features of our landscapes such as hill or plains. This is known as Geomorphology.



### Cambrian

- Gippsland was at the bottom of a deep sea in the Cambrian Period
- Rivers flowing eastwards eroded mountains located in South Australia and deposited sediments in this ancient sea
- There were also submarine volcanoes erupting in this sea

### Ordovician

- The next geological period was the Ordovician. Rocks deposited as sediments during this period make up a lot of the Gippsland region
- During the Late Ordovician, a period of instability called the Benambran Orogeny caused areas of East Gippsland to be uplifted to dry land
- Many granite intrusions occurred in the zone between Bairnsdale and Wodonga
- The deep-sea sediments were also metamorphosed at this time; sandstones became

quartzite and shale became schist's.

The metamorphism occurred due to the great pressure of folding and faulting during the uplift

### Silurian

- There was another uplift in the Silurian called the Browning Orogeny that resulted in more granite intrusions
- The volcanic rocks between the Snowy River and the Tambo River from Nowa Nowa back to the headwaters of the Mitta Mitta River were formed
- The Buchan Basin was formed. As it subsided, it was filled with river gravels and sands and small lava flows
- The basin subsided rapidly. Organisms such as corals, snails and tubeworms lived in its warm waters. After they died the calcium carbonate of their bodies became the limestone deposits of Buchan. Their fossils can be seen in the walls of Buchan caves



## OUR LANDSCAPES

### Devonian

- The Granite intrusions of Wilson's Promontory and the Mallacoota district were formed in the mid Devonian
- During the late Devonian the area between Bairnsdale and Benalla became very unstable and subsidence occurred due to the sudden explosive eruption of lava from a magma chamber close to the Earth's surface. The area subsided and created a large volcanic caldera. This caldera was then filled with sediments from fast flowing rivers until the early carboniferous period

### Mesozoic

- During the Mesozoic era there was not a lot of geological activity due to the dry climate
- Australia is located close to the South Pole.
- The next big geological event was the separation of Australia from Antarctica, which created the Gippsland basin
- The sea flooded part of this basin but much of Gippsland was swamps. The deposits in this basin were uplifted later to form the Strzelecki ranges. The swamps became our deposits of black coal, which can be visited at the State Coal Mine in Wonthaggi

### Tertiary

- The Tertiary saw the deposition of important geological resources such as brown coal, gas and oil. The coal seams of the Latrobe Valley were formed from old forests of trees such as the Queensland kauri pine and our native banksia
- This area was low lying and became a swamp. As trees died and fell to the ground, the fast flowing rivers would flood the swamp, depositing sands and mud over the floor of the swamp. This sealed off the air and prevented the trees from decomposing, forming brown coal
- Groundwater movement through this basin has helped accumulate gases and oils offshore
- Fast flowing rivers supplied gravels such as the Haunted Hills Gravels

### Quaternary

- In the Quaternary, Victoria has again been stable, apart from minor fault movements such as the subsidence of the Moe Swamp
- One large impact upon our landscape has been repeated sea-level rise and falls, due to glaciation in other parts of the world
- In times of high sea levels, sands were pushed inland and river mouths were filled with sediments. The inner barrier of the Gippsland Lakes, which includes Raymond Island, is a

remnant of an old barrier that has been broken through by rivers. The recent barrier extends from Lake Tyers to Corner Inlet

The geological processes, which have built Gippsland, still shape our world today. Recent changes in land use, especially wide scale land clearing, has changed the movement of water across our landscape, and increased both erosion and sedimentation.

## Some common terms are explained

### Geological time scale

The geological time scale is how we determine what geological event occurred first. It is broken up into eras, periods, and epochs. Fossil evidence is utilised to determine the timeframes (see Stratigraphy of Gippsland).

### Igneous rocks

All rocks that are formed from molten material from beneath the Earth's surface are termed igneous rocks. These can be divided into two types; Extrusive rocks that are cooled on the earths surface such as basalt, or Intrusive rocks that cool beneath the surface such as granite.

### Metamorphic rocks

Metamorphic rocks are all those changed by heat or pressure. Heat or pressure causes the parent rock to re-crystallise and form a new type of rock, e.g. when limestone is metamorphosed it becomes marble.

### Sedimentary rocks

Sedimentary rocks are formed when sediments such as sand, mud, or even plant material are compressed and cemented together over time. This process is called lithification.

### Orogeny

Tectonic processes that lead to the uplift of land and build mountains.

## Resources

### Geoscience

[www.geoscience.gov.au](http://www.geoscience.gov.au)

### Australian Museum Online

[www.amonline.net.au](http://www.amonline.net.au)

### References

Barton, C.M. *The Geology of Gippsland*.  
Gippsland Institute of Advanced Education

Cochrane, G.W. (1991) *Introducing Victorian Geology*.  
Geological Society of Australia



# Stratigraphy of Gippsland

## OUR LANDSCAPES

Eras	Periods	Epochs	Age	Event
Cainozoic	Quaternary	Holocene	10–12,000 y.a.	Building of the outer Barrier of the Gippsland Lakes
		Pleistocene	1.5–2 m.y.a	Alluvium, sand dunes, beach and lake deposits
	Tertiary	Pliocene	5.5–7 m.y.a.	Strzelecki Ranges formed due to tectonic uplift
		Miocene	26 m.y.a	Latrobe coal began forming as forests in an ancient swamp
		Oligocene	37–38 m.y.a	
		Eocene	53–54 m.y.a.	Thorpdale basalts
Paleocene	63–65 m.y.a.			
Mesozoic	Cretaceous		136 m.y.a	Course grained sandstones, mudstones, shales and black coal in Strzelecki Basin and Tyers group formed by deposition in shallow seas that covered most of southern Australia
	Jurassic		190–195 m.y.a	
	Triassic		225 m.y.a.	
Paleozoic	Permian		280 m.y.a.	Glaciers covered most of Victoria
	Carboniferous		345 m.y.a.	
	Devonian		395 m.y.a.	Snowy River Volcanics Buchan Limestones deposited in a shallow marine basin
	Silurian		430–440 m.y.a.	A long period of Granite intrusions across Gippsland is associated with mountain building
	Ordovician		500 m.y.a.	Granite granodiorite intrusion Koscuizsko and highlands. Eastern Highland sediments of sandstone, mudstones and shales were deposited and tightly folded
	Cambrian		570 m.y.a.	Waratah Bay Greenstones
Pre-Cambrian dating from 570 m.y.a. to at least 3300 m.y.a. the date of the oldest rocks				

# Coasts and Shores

## OUR LANDSCAPES

Gippsland has a wide variety of coast to explore from Kilcunda to Cape Howe. There are sandy beaches where the land gently dips to the sea, such as The Ninety-Mile Beach, and cliffed coasts where steep hills appear to dive into the sea. Each is a different environment for plants and animals. To appreciate the variations is a look into Coastal Geomorphology – the study of coastal landforms and how they are evolving over time.

## Interactions on the coast

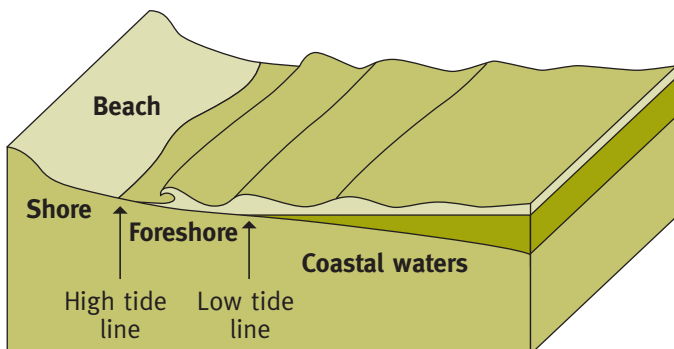
Coastal ecosystems are challenging for plants and animals alike. Like all ecosystems there are interactions between organisms and their physical environments on the coast.

Variations in physical environments include:

- Geological parent material
- Wind exposure
- Tides
- Climate

These interactions form distinct coastal environments such as rock pools, mangrove swamps, sandy beaches, cliff faces and estuaries.

## Features of sandy beaches



In defining the coastline, the basic terms above are used. Beaches are basically loose sediments that can be moved by the waves breaking on the shoreline. The shoreline is constantly changing depending on the tide levels. The zone known as the shore is where wave action occurs. This varies depending upon the weather.

In winter, waves are larger and more frequent, eroding sand. In summer, more gentle swells allow the dunes to rebuild. Coastal vegetation traps the sand and prevents it from blowing inland. The foreshore is basically the zone between the high tide mark and the low tide mark.

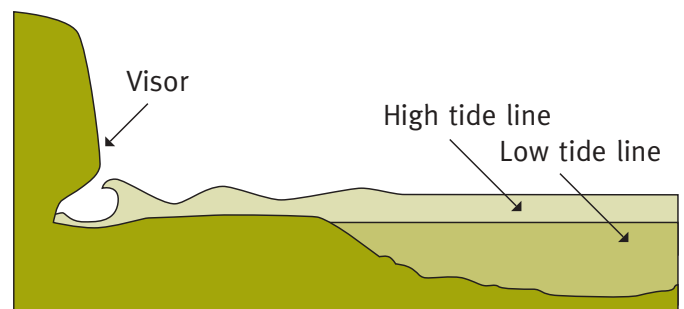
Good sandy landforms to explore in Gippsland include:

- Barriers, such as Ninety-Mile Beach
- Spits, such as Butlers Point and Metung
- Tombolos, such as Cape Woolamai and Wilson's Promontory
- Successional dune systems where vegetation changes as you walk inland

### Visit

- Cape Liptrap
- Shallow Inlet Marine & Coastal Park

## Features of cliffed coasts



Interesting landforms created by natural processes can be found on cliffed coasts such as:

- Potholes formed by rocks swirling in depressions in the wave cut platform
- Blowholes from sea caves when waves compress air causing water to be thrust out from the cave before the tide retreats
- Stacks and arches from continual erosion along rock weaknesses

### Visit

- Bunurong Marine Park
- Cape Conran Coastal Park



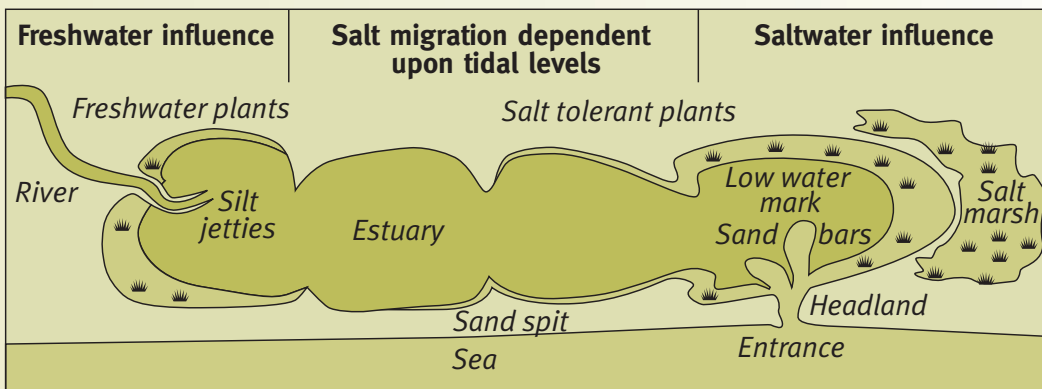
## OUR LANDSCAPES

### Features of estuaries

Estuaries allow you to observe their impact upon the diversity of plants and animals. For instance, as you get closer to the sea, freshwater river plants are replaced with more salt tolerant species.

#### Visit

- Wilson’s Promontory National Park
- Corringale Foreshore Reserve
- Gippsland Lakes Coastal Park



### CASE STUDY Global climate change impacts

Most of our coastline is reserved by legislation as public land and is subject to strict planning laws. Many of the coastal formations around Gippsland have their history in global sea level changes that occurred in the last 2 million years. The potential for sea-level rise associated with global warming is a threat to our coastline.

It is thought that sea level was up to 1 m higher about 6000 years ago. The seas retreat allowed for deposited windblown sands to form features such as Ninety-Mile Beach and the islands east of Corner Inlet. Current predictions indicate that by 2100 sea levels could rise to 88 cm higher than today. Higher tides and increased storm frequency and intensity associated with global warming could break through the lakes natural barriers and change the ecosystems forever.

Low lying coastal villages and farming areas could also be under threat from global warming, resulting in potential flooding. Damage to infrastructure such as ports and jetties, drainage and sewage systems will occur with higher sea levels.

#### What can be done?

Reduction in fossil fuel use, and reliance of energy consumption through changing community perceptions world wide seems like a huge task. Walking instead of driving, car pooling and using public transport are small steps. So is putting on a jumper instead of turning up the heater, recycling and choosing more environmentally friendly products.

[www.gcb.vic.gov.au/documents/c3greenhouse.pdf](http://www.gcb.vic.gov.au/documents/c3greenhouse.pdf)

#### Resources

##### Marine Education Society of Victoria

[www.mesa.edu.au](http://www.mesa.edu.au)

##### Gippsland Coastal Board

[www.gcb.vic.gov.au](http://www.gcb.vic.gov.au)

##### Parks Victoria

[www.parkweb.vic.gov.au](http://www.parkweb.vic.gov.au)

#### References

Bird, E.C.F. (1984) *Coasts: An Introduction to Coastal Geomorphology*, ANU Canberra.



# Erosion

## OUR LANDSCAPES

Soil erosion is a natural catchment process where mountains and hills are worn away by wind and rain, to be transported and deposited elsewhere. The main forms of soil erosion are tunnel erosion, gully erosion, soil creep, streambank and wind erosion. Excess erosion reduces the water quality of our rivers and streams. Our landscapes can be managed in ways that prevent accelerated soil erosion.

### Gully erosion

Gully erosion occurs when water is channelled across unvegetated land and washes away the soil along drainage lines and depressions. Clays scour the landscape as they are transported by water. Gully erosion develops as a result of excessive clearing and soil compaction. Soil left exposed and without vegetation cover is unable to absorb excess water. Gully erosion can occur in the later stages of tunnel erosion when the roof of the tunnel collapses.

Waterways, dams and low lying paddocks are affected by increased sedimentation, resulting in high turbidity of the water bodies.

### Streambank erosion

Erosion of stream and riverbanks through undercutting and collapse is caused by heavy rain in cleared catchments resulting in excess overland flow.

River banks saturated by excess water are undercut and slumping occurs. This increases the sediment load in the water which is transported to low lying areas in our landscape such as dams and reservoirs. Sediments may also be deposited on the stream bed, smothering rock substrate and reducing habitat for aquatic macroinvertebrates.

### Wind erosion

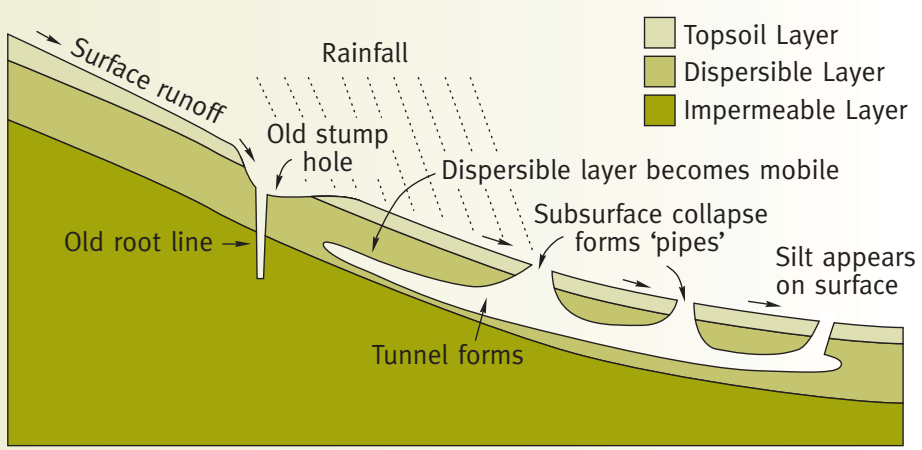
Wind erosion is the removal of exposed topsoil, usually in dry conditions by high winds. It affects land with poor vegetation cover. In Gippsland wind erosion is the major contributor to coastal dune erosion. Dune blowouts occur where vegetation has been removed on dunes. Human activities such as residential development, recreational access, grazing and engineering works, have accelerated the process of erosion in Gippsland.

### Tunnel erosion

Tunnel erosion starts when water moves along channels and cracks in dispersive clay sub soils. The water can readily pick up the clay particles.

Hilly, cleared land, with an average rainfall of 300–650 mm is highly susceptible to tunnel erosion. Tunnels will develop soils when the land slope is sufficiently steep, driving free water through the soil.

Factors contributing to tunnel erosion include; tree removal, exposure of root channels following the death of trees and other deep rooted vegetation,



a decrease in rate of water usage from the soil profile change of vegetation, rabbit burrowing and poor ripping or trenching practices.

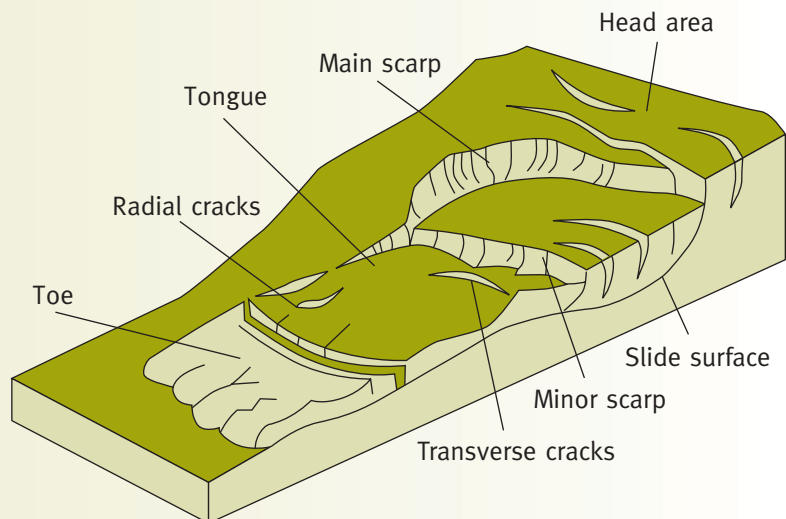


## OUR LANDSCAPES

### Soil creep

Soil creep is the slow movement of soil downhill leaving terraces on the hill slopes. It is the result of a series of processes involving slope, geology, soil type, vegetation type, water, and excess soil water pressure.

Conditions that contribute to soil water pressure include poor drainage, badly situated dams, and the removal of deep-rooted perennial vegetation. Landslips can occur on a wide range of soil types but typically occur on slopes 25° or greater.



### CASE STUDY The Powlett Project

The Powlett River Catchment supplies towns such as Inverloch and Wonthaggi with their drinking water supplies. Over-clearing and poor land management practices have resulted in soil loss from tunnel, gully and stream bank erosion. High rainfall on steep cleared hills also resulted in landslips and soil creep. Excess soil in the waterways resulted in poor water quality.

To address these problems, the construction of a water treatment plant at Lance Creek reservoir has improved drinking water quality. However, landholders and resource managers have developed other strategies such as revegetating the catchment.

The Powlett Project has brought together land and natural resource managers to address these land and water problems. The project has grown from planting trees to supporting land managers in developing whole farm plans. Through workshops and demonstrations, it encouraged effective pasture usage and nutrient management to improve water quality, stabilise soils and facilitate sustainable land use.

On-ground projects throughout the catchment include; streambank planting, wetland protection and re-establishment, sand dune stabilisation, tunnel erosion and landslip control, protection of existing stands of remnant vegetation, establishment of nutrient

management strategies on farms, weed eradication, and the establishment of more Landcare groups.

Since its inception, the Powlett Project has worked on a total of 311 sites retiring 26,000 ha of land from production. 490,000 trees and understory plants have been planted using indigenous species, and 156,000 m of fences have been built. Five Landcare groups, representing over 250 land managers, numerous natural resource management agencies, Greencorp volunteers, schools and even volunteers from Melbourne, have given their support.

The involvement of the West Gippsland Catchment Management Authority ensures that activities target priorities outlined in the Regional Catchment Strategy. The project is sponsored by Edison Mission Energy.

#### Reference

[www.landcareaustralia.com.au](http://www.landcareaustralia.com.au)

### Resources

#### Department of Primary Industries

[www.dpi.vic.gov.au](http://www.dpi.vic.gov.au)

#### Soil erosion information

[www.netc.net.au/enviro/fguide/soil1.html](http://www.netc.net.au/enviro/fguide/soil1.html)