VICTOR HARBOR
Geological trail

A self-drive geological trail

Government of South Australia
Department for Manufacturing, Innovation, Trade, Resources and Energy

Introduction

Grey metamorphic rocks are exposed in natural outcrops, road cuttings and along the sea coast over much of southern Fleurieu Peninsula and Kangaroo Island.

They are called the Kanmantoo Group by geologists and were deposited into a rapidly subsiding ocean basin as fine grained sand and silt eroded from large land masses to the west and south in the Cambrian Period about 520 million years ago.

After the basin filled, this sequence of sediments was buried deeply below the earth's surface and altered (metamorphosed) by heat and pressure into their present form. They were also intruded by masses of molten granite (called the Encounter Bay Granite) and were then thrust up into a mountain range in a major earthmoving event called the Delamerian Orogeny which ended about 475 million years ago.

This ancestral Mount Lofty Range, which was then part of the super continent called Gondwana, was eroded down until the Permian Period of the Palaeozoic Era, 270 to 290 million years ago, when Gondwana lay near the South Pole and the highlands were draped with ice caps.

Evidence of this glacial activity is found at many places between Port Elliot and Hallett Cove in the form of bouldery clay (till) deposits and as striations and grooves on bedrock surfaces over which the ice moved. Boulders of Encounter Bay Granite and Kanmantoo Group rocks, plucked off the surface and moved many kilometres by the ice from their original location, are a common feature of this glacial terrain. They are called erratics.

Most of the many striated glacial pavements on Fleurieu Peninsula indicate a westerly movement of the Permian ice sheet.

Little record remains in the Victor Harbor area of the geological events after the Permian ice retreated but there was another long period of erosion and earth movements along major faults flanking and forming the Mt Lofty Range.

During this time the Murray Basin subsided and was filled with sediment and the St Vincent and Spencer Gulfs were formed.

A major event along the coastline about 130 000 years ago in the Pleistocene Period was the building of extensive dunes of windblown calcareous sand derived from shell fragments on the shoreline. These are called the Bridgewater Formation and capped by a thin layer of hard limestone known as calcrete.

Key elements of the geology of the region can be seen at the following localities.

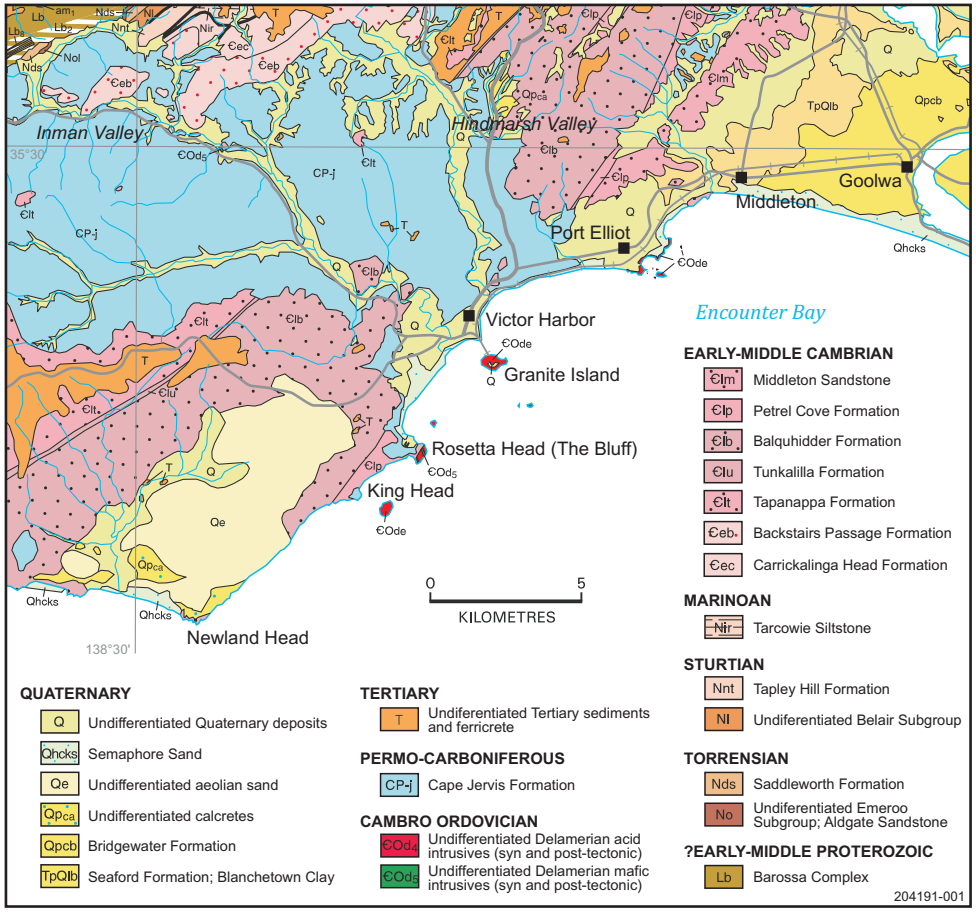


Figure 1. Geological map of Encounter Bay

Detailed descriptions for further study of these sites are listed in the References.

Rosetta Head (The Bluff)

This dominant landform is underlain on the seaward side by a hard coarse grained mass of Encounter Bay Granite which can be seen intruding the Kanmantoo Group at the wharf around from Whalers Inn on the northern side and from the beach along the eastern and south-eastern shore at low water.

The effect of the hot intrusive granite on the Kanmantoo Group rocks (called contact metamorphism) can be seen at the wharf, and also on the south-western tip of Rosetta Head in Petrel Cove, by the presence of thin stringers, veins and irregular masses of coarse grained albite chlorite rock.

The Bluff is considered by many geologists to be a characteristic feature of glacial terrains, called a roche moutonne'e, cut into the Kanmantoo Group bedrock during the passing of a Permian glacier.

In Petrel Cove and to the west beyond Newland Head, bands of dense fine grained grey sandstones with interbedded siltstones and phyllites, dipping at moderate angles seaward, are displayed on the wavecut platform and the low cliffs.

Roche moutonne'e on Rosetta Head where granite has been plucked from upper slopes by northward moving Permian ice. (Photo 409491)

Wharf at the Bluff (Rosetta Head). Contact between Encounter Bay Granite on the left and metamorphosed Kanmantoo Group sediments in the right foreground. Brownish weathered Kanmantoo Group rocks exposed in the road cuttings on the way to the wharf display various depositional and structural features. (Photo 409492)

Kanmantoo Group sediments displaying sedimentary bedding (dipping at a flat angle to the left) and cleavage (dipping at a steep angle to the left) seen from the access road from Whalers Inn to Rosetta Head. (Photo 409493)

Thin steeply dipping yellow-brown quartz vein intruding Kanmantoo Group sediments seen from the access road from Whalers Inn to Rosetta Head. (Photo 409494)

Kanmantoo Group metasediments on the beach in Petrel Cove and Encounter Bay Granite in the face of the Bluff. Granite boulders on the beach are likely to be talus fallen from the cliff rather than glacial erratics. (Photo 409495)

Kanmantoo Group sediments in Petrel Cove and blanketed inland by Permian glacial deposits. Granite boulders on the beach to the west are likely to have been eroded out of the Permian sediments. (Photo 409496)

As noted earlier, these were derived from erosion of older landmasses to the west and south and deposited as fine grained, and occasionally pebbly sands, interspersed with thin beds of silt and clay in a rapidly subsiding basin.

Small scale depositional features such as bedding planes, current bedding, ripple marks and 'flame' structures are common in these rocks.

Unlike the slightly older richly fossiliferous Cambrian limestones between Sellick Hill and Rapid Bay, there is only rare evidence of marine life in the Kanmantoo Group rocks in the deeper water parts of the depositional basin such as the trilobite tracks observed near Truro and traces of fossils at Red Creek and near Parawa.

Granite Island

Like the adjacent but inaccessible Wright and West Islands, this popular tourist locality is composed of medium to coarse grained granite made up of pink and white feldspar, bluish quartz and black biotite mica.

Xenoliths (fragments and lumps) of Kanmantoo Group sediments, detached from the wall rock by the invading molten granite, like the sample displayed near the kiosk on Granite Island, are a common feature of granite intrusions.

A variety of granite weathering features, such as flared slopes and tafoni, are displayed along the walking trails on the island.

Xenoliths of Kanmantoo Group and other wall rocks in massive granite block. (Photo 409497)

Tafoni, a common feature of granitic weathering. (Photo 409498)

Granite blocks were quarried on Granite Island for the breakwater between 1878 and 1882 and in the 1870s from West Island for Parliament House in Adelaide.

Port Elliot

Evidence of several distinctly different geological processes can be viewed from Knights Beach and on the masses of Encounter Bay Granite to the east and west of Green Bay.

Rectangular joint sets and rounded tor-like shapes, typical surface features of granite terrains, are prominently displayed on the headlands adjacent to Green Bay.

Thin steeply dipping aplite dykes which were injected into the granite during the final stages of intrusion and cooling are visible along the western face of Green Bay and higher up on the granite surface to the east.

Google Earth image showing the granite outcrops at Port Elliot.

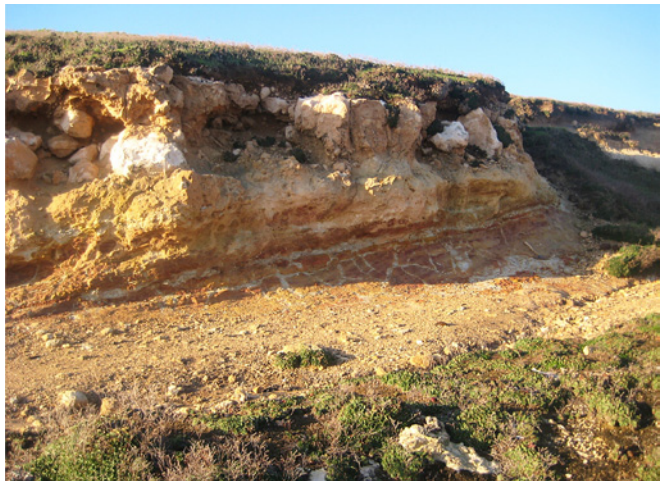
Aplite dyke intruding Encounter Bay Granite. Several others can be seen to seaward (left of this photo). (Photo 409961)

Location of xenolith (X) and aplite (A) in Encounter Bay Granite. (Photo 409963)

Looking easterly from the walking track down to Knights Beach at the smoothed glacial pavement on Encounter Bay Granite to the right (south) and Permian glacial sediments in the shallow cutting to the left (north). (Photo 409754)

Aplite dyke with pods of black tourmaline intruding Encounter Bay Granite east of Green Bay. (Photo 409962)

Xenolith of Kanmantoo Group sediment in Encounter Bay Granite. (Photo 409964)



Permian glacial sediments in the cutting on the northern side of the walking track shown in Photo 409754. (Photo 409500)

An angular shaped xenolith of dark grey sediment from the Kanmantoo Group into which the granite was intruded several kilometres below the surface about 475 million years ago can be seen on the eastern side of Green Bay.

Before the Permian ice sheets were moving across the land 290 million years ago, a long period of erosion had brought the Kanmantoo Group and Encounter Bay Granite basement rocks to the surface.

Striations and grooves cut by the moving ice can be seen in places on smoothed pavements of the present granite surface and large boulders of granite were transported as far away as Port Vincent.

Fine-grained sand and silt deposited by the melt water from the ice sheet can be seen in the shallow cutting in the lower walking path across the granite promontory.

Evidence of Permian glacial and younger events can be seen from the eastern end of Knights Beach.

To the south, or right-hand-side of the photograph, is the Encounter Bay Granite, dated at about 475 million years old, and the smoothed surface left by the Permian icesheet as it passed over about 290 million years ago.

In the cliffs to the north (right-hand-side) are flat lying coffee coloured and cross-bedded calcareous sand of the aeolian (wind blown) Bridgewater Formation which are about 130 000 years old.

The contact between the granite and the Bridgewater Formation slopes down at a moderate angle to the left below the access path to the beach. A matching northerly

Knights Beach and cliff face looking east. (Photo 409501)

sloping granite pavement can also be seen on the other side of the promontory in the western face of Green Bay.

These are interpreted to be the wall of a valley, extending northwards under the town of Port Elliot, cut through the granite and Kanmantoo Group bedrock by the moving Permian ice.

This valley was filled, with glacial till, like that seen in the walking path cutting, from the melting ice cap.

Subsequent erosion, probably in the Neogene period 10 to 15 million years ago, removed most of these deposits, except for the remnant exposed in the wall of the walking track.

This depression was again filled by the windborne sands of the Bridgewater Formation about 130 000 years ago.

Capping the Bridgewater Formation is a hard white calcrete layer which displays a pocked karst surface formed by partial solution of the limestone by weakly acidic rainwater.

Overlying this surface are fine-grained sands and silts of recent age.

Glacier Rock

A grooved, striated and polished pavement observed by a government geologist, ARC Selwyn in 1859 at Inman Valley, was the first recorded occurrence of glacial activity in Australia. It was followed by other discoveries of glacial features in the region, the next most notable being the iconic site at Hallett Cove in 1875 by Professor Ralph Tate and the presence of erratics of Encounter Bay Granite on the beach at Port Vincent on Yorke Peninsula.

References for further reading

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Glacial pavement at the Glacier Rock café at Inman valley. Note the large overhanging granite erratic in the creek bank to the right. (Photo 409502)

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Be prepared when bushwalking

- wear sturdy shoes, hat and sunscreen
- carry sufficient food and drinking water
- keep to the defined walking trail
- weather conditions can change quickly; ensure you have appropriate wet weather clothing.

Acknowledgment

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