HALLETT COVE

Geological trail

A walking trail through a geological site

Government of South Australia
Primary Industries and Resources SA

2010

203822

Introduction

Hallett Cove is one of the best known geological sites in Australia, because of the evidence of an ancient glaciation discovered in 1875 by Professor Ralph Tate from the University of Adelaide. The polished and striated glacial pavements, and sediments associated with the glaciation, are now known throughout the world.

The area has been declared a Geological Monument by the Geological Society of Australia and placed on both the South Australian Heritage Register and the former Register of the National Estate because of its significance for educational and scientific purposes.

Conservation of the site to protect the glacial pavements commenced in 1960 with acquisition of a strip of coastline, named the Sandison Reserve, by the National Trust. When subdivision for housing threatened the site, the State and Federal Governments acquired and purchased adjoining land which was dedicated as the Hallett Cove Conservation Park in 1976.

Geology

Many of the significant events in the geological history of South Australia over the past 600 million years can be observed at Hallett Cove.

The oldest rocks here were deposited about 600 million years ago in the sea within a large elongated north–south depression known as the Adelaide Geosyncline. These sandstones and siltstones were buried, cemented then folded and uplifted during a period of mountain building about 500 million years ago. For the next 200 million years this ancient mountain range was eroded down to form low hills.

About 280 million years ago Australia formed part of a huge single continent called Gondwana, which also included Antarctica, Africa, India and South America. This land mass was centred over the South Pole and was covered by an ice sheet similar to present day Antarctica.

This ice sheet moved over southern Australia in a northwesterly direction and polished the underlying bedrock surface. At the same time, rock fragments embedded in the ice left distinctive scratches on the polished surface (pavement). Glacial pavements showing these scratches (striations) can be clearly seen along the cliff tops north from Black Cliff. As the ice sheet began to melt, sand and clay carried by the icesheet were deposited in a lake dammed against the ice margin, and larger boulders (dropstones) were dropped from melting icebergs floating in the water.

The ice age lasted several million years and was followed by another long period of erosion which removed most of the glacial sediments. About 170 million years ago, Australia and New Zealand began to separate from Antarctica and, by about 100 million years ago, a narrow depression had formed between the two continents. Eventually the sea flooded into this depression.

About 43 million years ago, when Australia had completely separated from Antarctica, ancient fault lines in the Adelaide area became active. The Mount Lofty Ranges remained above sea level but areas to their west and east subsided and were inundated by shallow seas.

Hallett Cove remained near sea level until about three million years ago when downfaulting submerged the area. A thin layer of white fossiliferous sandstone was deposited in the warm shallow sea, covering the ancient glacial sediments. Soon after this the uplift of the Mount Lofty Ranges increased, and the Hallett Cove region was uplifted above sea level to be exposed as land.

Rivers which flowed west from the uplifting Mount Lofty Ranges deposited a thick layer of alluvial clay over the Hallett Cove area. This sequence is best exposed in the Amphitheatre. It is now covered by calcrete and recent soil.

Continuing uplift of the Hallett Cove area caused erosion and the badlands landscape of the Amphitheatre.

Hallett Cove contains rocks and sediments ranging in age from about 600 million years to the present day, that were formed within four major time periods (see cross-section). These rocks are piled on top of each other like a gigantic layer cake.

Interpretive signs are displayed at most of the sites described below and will help you unravel the clues to past landscapes and climates.

Geological trail

1 From sea bed to mountain range

The chocolate-coloured rocks of Black Cliff were deposited as sand and silt in the sea about 600 million years ago. About 500 million years ago, they were uplifted and folded during a period of mountain building which formed what has been called the Delamerian Highlands. The folds are best seen from the top of Black Cliff at low tide.

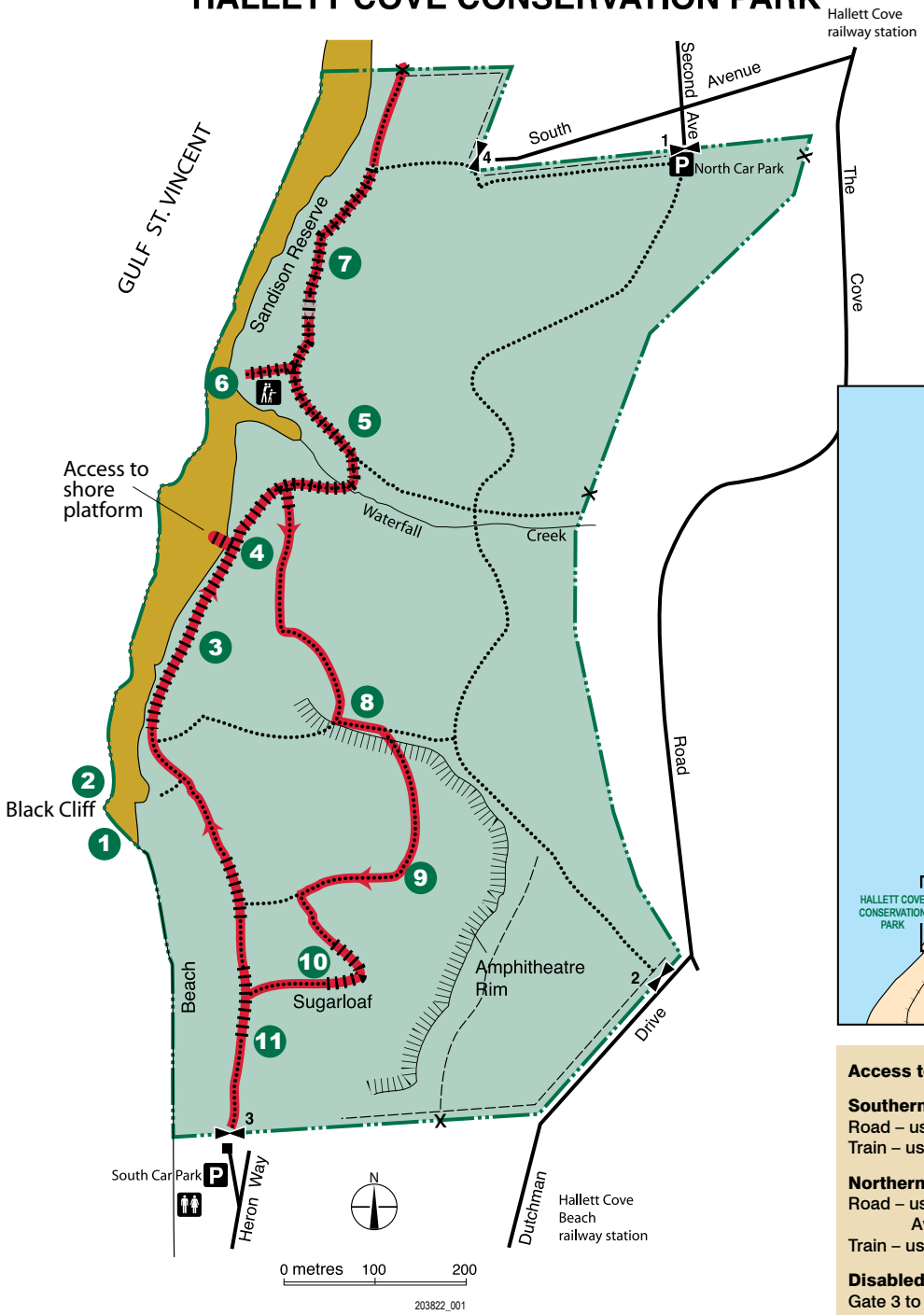
View south from Black Cliff of folded sandstones and siltstones at Hallett Cove beach. (Photo 408666)

2 Evidence of an ancient ice age

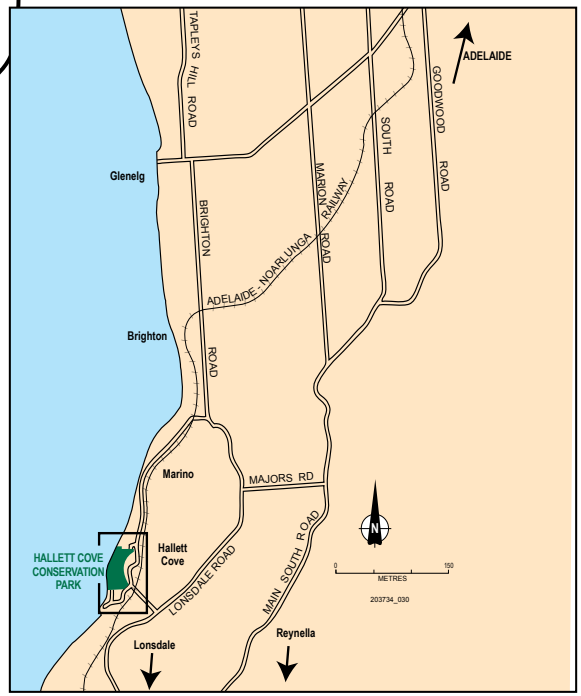
The polished and striated rock surface (glacial pavement) on the top of Black Cliff was caused by a northwesterly moving ice sheet about 280 million years ago. It was discovered in 1875 by Professor Ralph Tate.

Glacial pavement on Black Cliff. (Photo 038744)

HALLETT COVE CONSERVATION PARK



Park boundary
Sealed road
Fire access track
Walking trail
Geological walk
Boardwalk
Watercourse
Pedestrian gate
Gate number
Parking
Lookout
Toilet



Access to Hallett Cove Conservation Park

Southern end
Road – use Heron Way and car park at the cafe and toilets
Train – use the Hallett Cove Beach station.

Northern end
Road – use the car park south of the intersection of South Avenue and Second Street
Train – use the Hallett Cove station.

Disabled
Gate 3 to steps up to Black Cliff.
Gate 2 to locality 8.
Gate 1 west to gate 4
Gate 1 south for about 200 metres.

3 An ancient glacial lake

Multicoloured silt, clay and sand were deposited from the melting ice sheet near the end of the ice age about 280 million years ago, in a lake dammed against the ice margin.

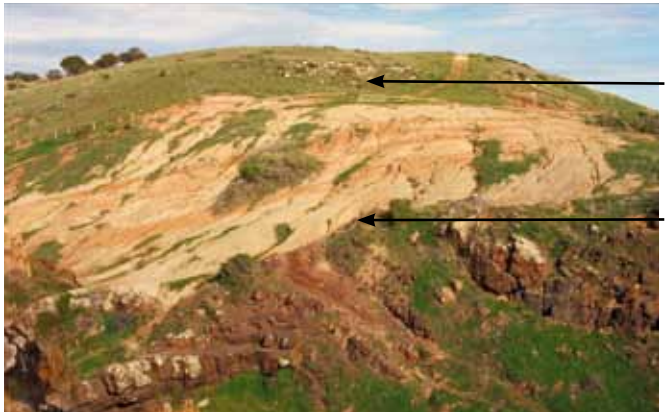
4 Erratic rocks

These two large boulders (called erratics) of quartzite were dumped by the melting ice sheet. Erratics of granite, which can be seen on Hallett Cove beach, were carried from the Victor Harbor area.

Erratics of quartzite. (Photo 408668)

5 Gaps in the geological record

The contact (U1) between the 600 million year dark folded rocks and 280 million year soft, pale glacial sediments is well exposed along Waterfall Creek. The contact between these represents a break in the geological record of about 320 million years and such a break is known as an unconformity.



Unconformities exposed on the south bank of Waterfall Creek. (Photo 042601)

There is another unconformity (U2) of about 277 million years between the glacial sediments and the overlying Hallett Cove sandstone (three million years) which is the light-coloured 'rubbly' layer just below the skyline.

6 Shore platform

The level shore platform has been eroded by wave action across the rocky coastline during the past 7000 years. The big fold was formed during the mountain building about 500 million years ago.

During the Recent ice age about 20 000 years ago, sea level was about 130 metres lower than today and South Australia's coastline was about 150 kilometres south of where Victor Harbor now is. The ice cap started to melt about 15 000 years ago. Sea level began to rise and reached its present level about 6000–7000 years ago.

Views south over the shore platform showing folded red-brown sediments (approx. 600 million years old) unconformably overlain by light-coloured glacial sediments (approx. 280 million years old). (Photo 408669)

7 The last marine deposit

A thin layer of hard white fossiliferous sandstone (Hallett Cove Sandstone) was deposited in a warm, shallow sea which covered the area about three million years ago. The impressions of various shells (fossils) can be seen. The sandstone overlies glacial sediments.

Hallett Cove Sandstone (approx. 3 million years old) unconformably overlying glacial sediments (approx. 280 million years old). (Photo 408670).

8 The Amphitheatre

The upper part of the Amphitheatre has a capping of hard calcrete limestone, overlying purple and mottled alluvial silt and clay deposited on a flood plain one to two million years ago.

Uplift of the area has resulted in erosion which has produced the 'badlands' Amphitheatre landscape.

View south into the Amphitheatre and the Sugarloaf. (Photo 408671)

9 Hands on unconformity

The hard layer of white fossil-bearing Hallett Cove Sandstone (approx. 3 million years old) unconformably overlying light-coloured glacial sediments (approx. 280 million years old).

Put your hand on the base of the Hallett Cove Sandstone. This represents a gap in the geological record (unconformity) of about 277 million years of time. *(Photo 408672)*

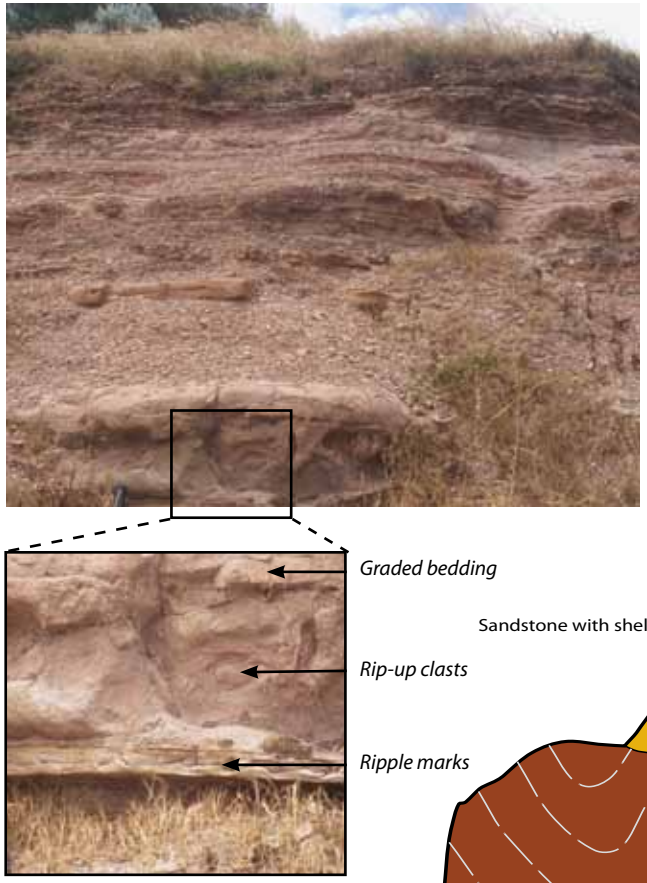
The Sugarloaf – the conical shape is a result of erosion from wind and rain acting on uniform, soft glacial sediments. *(Photo 408673).*

10 The Sugarloaf

This cone-shaped structure is composed of sediments deposited in a lake formed as the ice sheet melted about 280 million years ago. The base of the Sugarloaf is composed of reddish sand (with dropstones from melting icebergs) which is overlain by white sand. It is capped by a thin layer of brown alluvial clay deposited a few million years ago.

11 Glacial sediments

Similar glacial sediments to locality (3) but with ripple marks, graded bedding and rip-up clasts.



The ripple marks are shallow on the north side and steeper on the south side – indicating that about 280 million years ago the water current came from the north side (left to right). *(Photos 408674, 408675)*

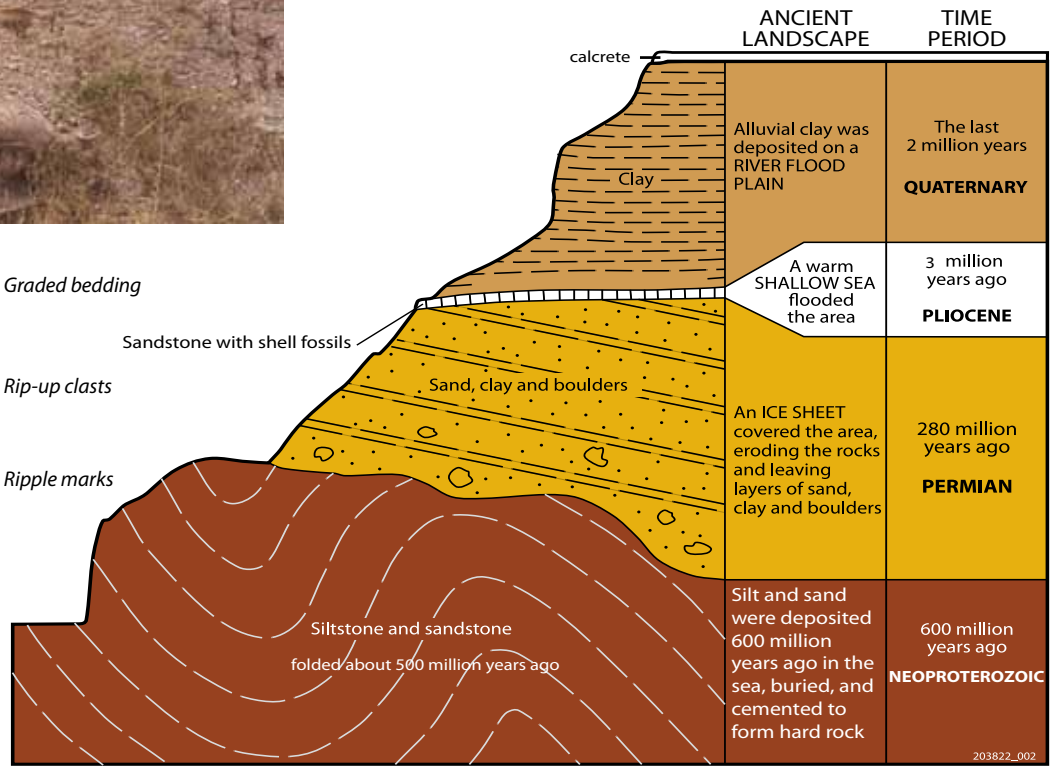
Be prepared when bushwalking

- allow up to two hours to walk the trail
- 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.

Acknowledgement

Original text prepared by R. B. Major, of the Geological Society of Australia (South Australian Division) and the Field Guide Subcommittee.

South Australian Division www.sa.gsa.org.au



Hallett Cove – geological cross-section