



# THE GEOLOGICAL HISTORY OF ROB BEN ISLAND

*560 Million Years in the Making*

## A GEOLOGICAL OVERVIEW

### 560 MILLION YEARS AGO

The oldest rocks on Robben Island, the Malmesbury Group, formed in the ancient Adamaster Ocean. Quartz silt eroded from mountains to the south-east was transported to this ocean by fast-flowing turbidity currents, forming well-bedded siltstones. These siltstones contain two types of ripples: (1) symmetrical ripples (3) formed by rapidly deposited silt; and (2) asymmetrical ripples (2) indicating the direction of flow towards the north-west. As the Adamaster Ocean started closing, the originally horizontal siltstone beds developed gentle folds (7) along a north-west axis

### 130 MILLION YEARS AGO

The supercontinent Gondwana began breaking up giving birth to the South Atlantic Ocean. During this early rifting, a crack was formed, oriented from west-south-west to east-north-east into which molten dolerite magma was intruded from below. The magma solidified at a temperature of about 1200 °C to form a dolerite dyke, deep within the crust and has now been exposed through uplift and erosion in Langbaai (6). The rock is dark in colour, because of the presence of dark minerals like magnetite and augite.

### THE LAST ONE MILLION YEARS

One million year old cemented shelly beach gravels (5) are found 8 to 10 m above present sea level, between Langbaai and the lighthouse. Younger cemented dunes are exposed in the walls of the Lime Quarry (8), overlain by a lime-rich soil crust (calcrete) several metres thick. Still younger (125,000 year old) uncemented gravels, 4 to 6 m above present sea level are found near Langbaai (4). Modern shingle (gravel) beaches (1) are found on the west and south coast, exposed to south-west swells from the Southern Ocean. The only sandy beach occurs on the sheltered east coast, immediately south of the harbour wall and proves that the longshore drift of sand is from south to north.

### CREDITS

Original document compilation by John Rogers (University of Cape Town), Jodie Miller (Stellenbosch University) and Coenie De Beer (Council for Geoscience). Series Editorial Responsibility The Geoheritage Sub-committee Western Cape Branch, Geological Society of South Africa. Photo credits: John Compton (8), John Rogers (1, 2, 3, 4, 5, 6), Christie Rowe (7). Geological map and offshore bathymetry provided by the Council for Geoscience with the offshore data after MacHutchon, M.R. & Van Den Bossche, P. 2018. The marine geology of the one-nautical-mile, exclusive zone around Robben Island, South Africa. South African Journal of Geology, 121, 139-154, <https://doi.org/10.25131/sajg.121.0005>.

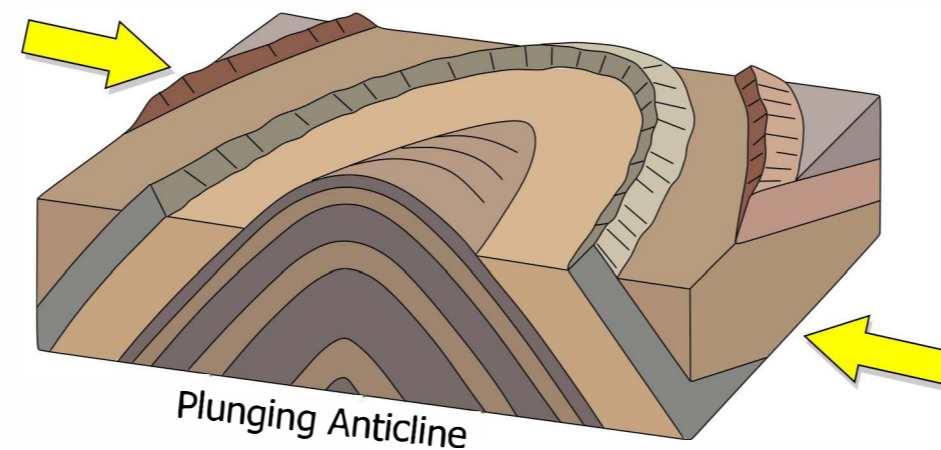


Council for Geoscience

### ANTICLINE (7)



Just after deposition in a deep sea the plate on which the sediments were deposited slid over another subducting plate. In the process the sedimentary layers were first metamorphosed into rock and then folded by massive compressional forces to form NW plunging folds. An arch type fold (anticline) can be seen at Rangatira Bay.



### BEACHES & SEA-LEVEL FLUCTUATIONS

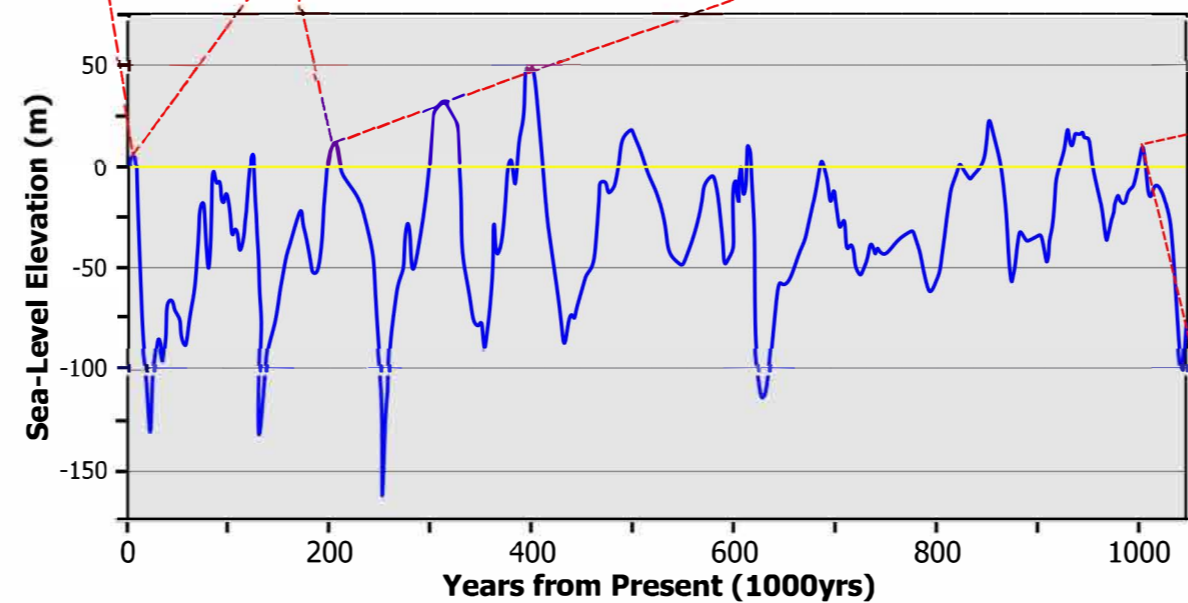
(1) (4) (5)



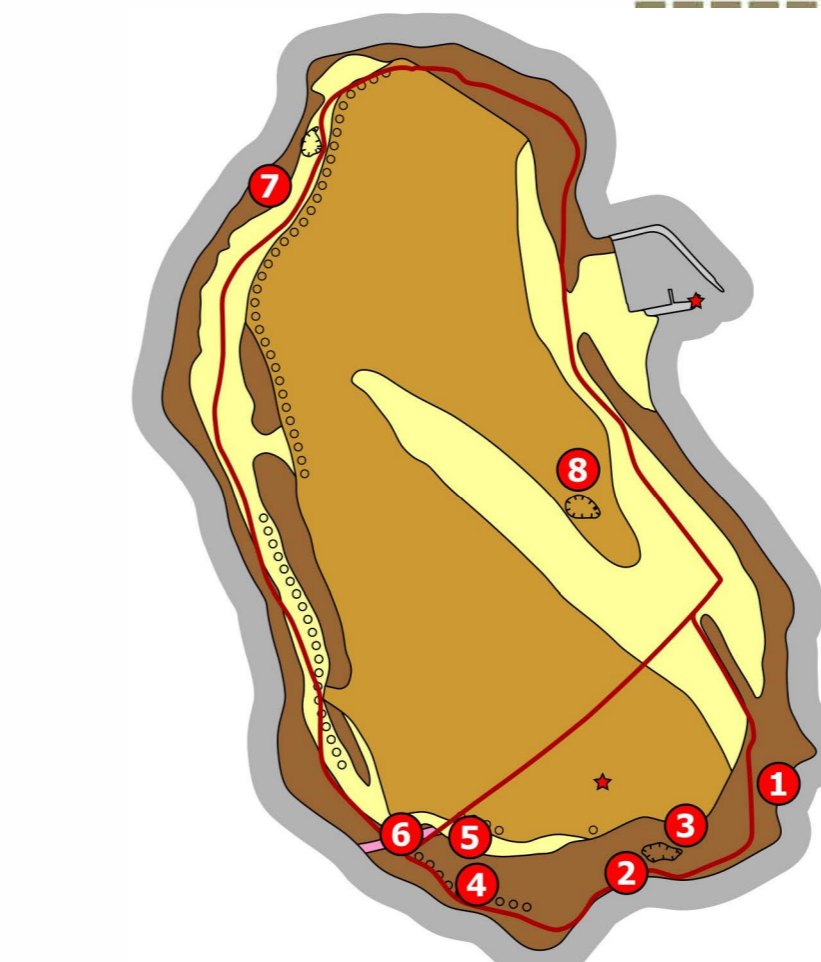
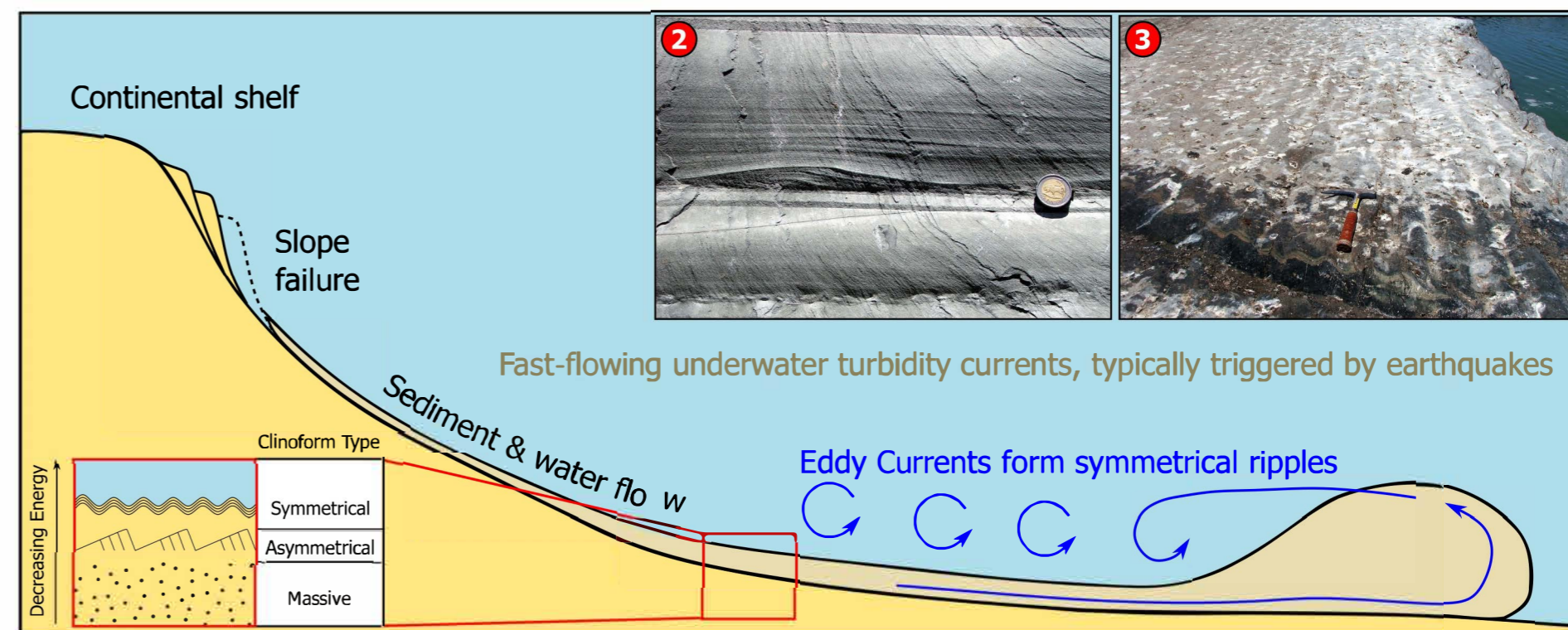
Modern boulder beaches indicate a high-energy surf zone that sorts up to boulder-sized clasts according to size and form as the energy dissipates perpendicular to the beach profile.



An "ancient" boulder beach left stranded above present day sea-level.



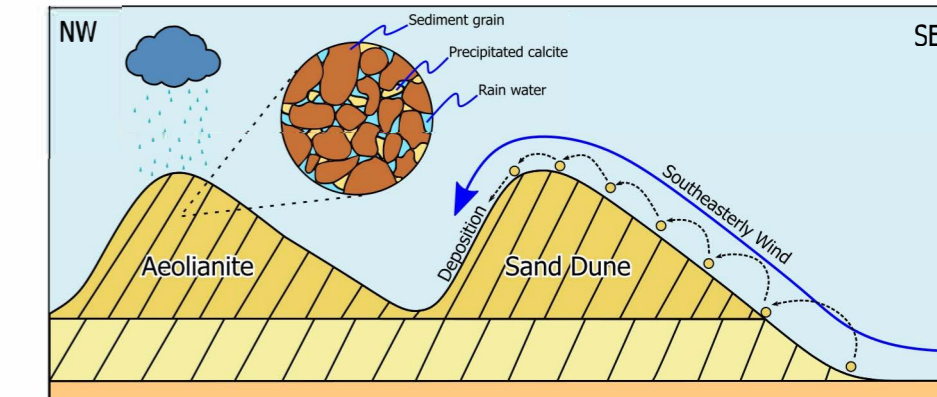
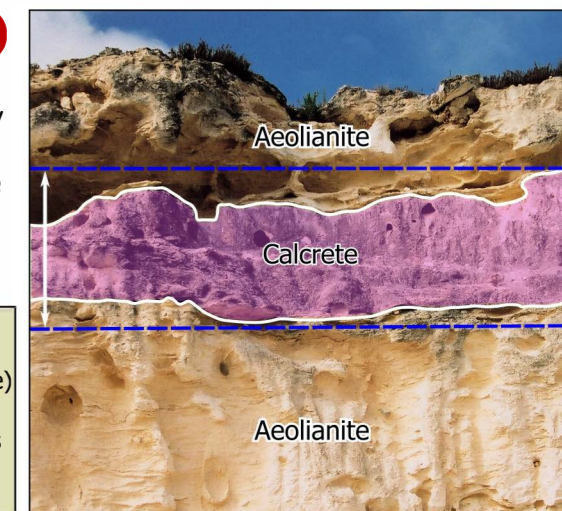
### TURBIDITY CURRENTS (2) (3)



### AEOLIANITES (8)

Aeolianites form when sand dunes become cemented by rainwater dissolved calcium carbonate, derived from the broken shells of the organisms that once lived proximal to the dune.

As water table levels change between wet and dry season (dashed blue line in the picture) calcium carbonate (calcite) is leached out of the aeolianites and precipitates as clay-size calcite to form calcrete.

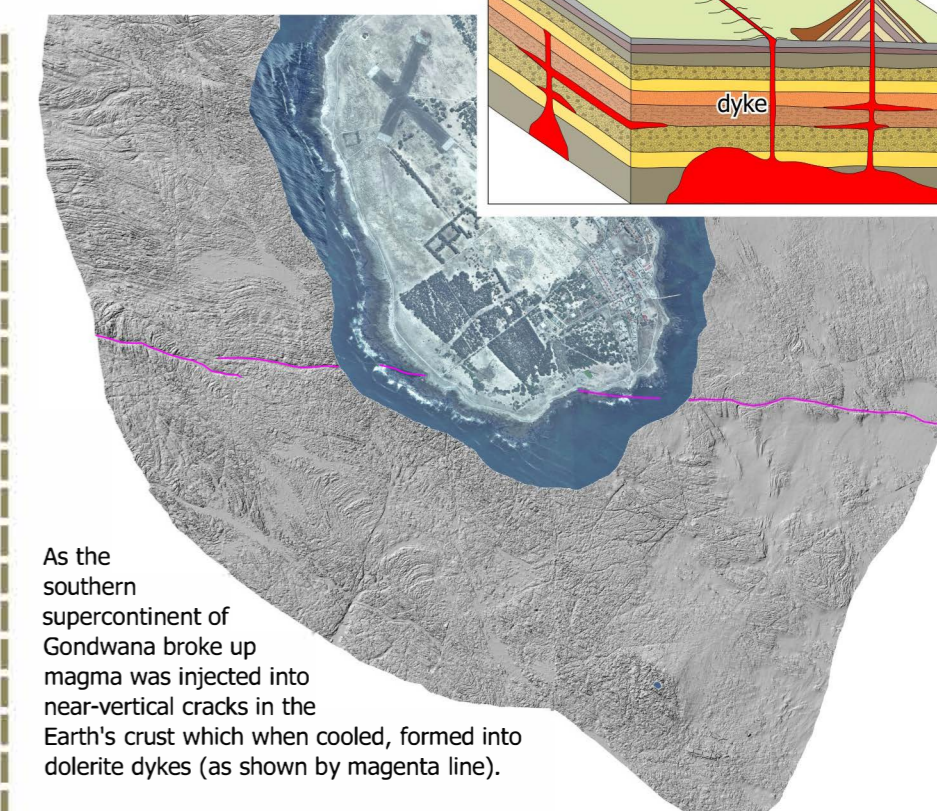
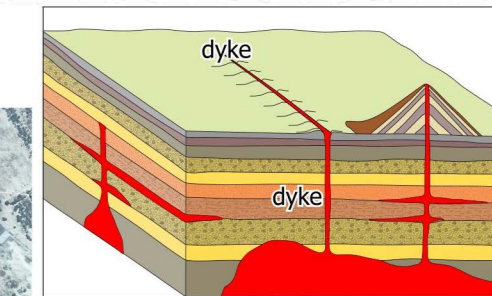


When beaches become cemented they are referred to as beachrocks. The cementation process is a complex interplay between the carbonate concentration in seawater, microbial activity and the degassing of carbon dioxide from seaward-flowing groundwater. Cementation typically occurs within a few decades where suitable coastal morphology provides sufficient accommodation space for soft sediment to settle.

A 1 million year old beach that has been cemented by the calcium carbonate derived from the various mollusc shells that would have lived there at the time.

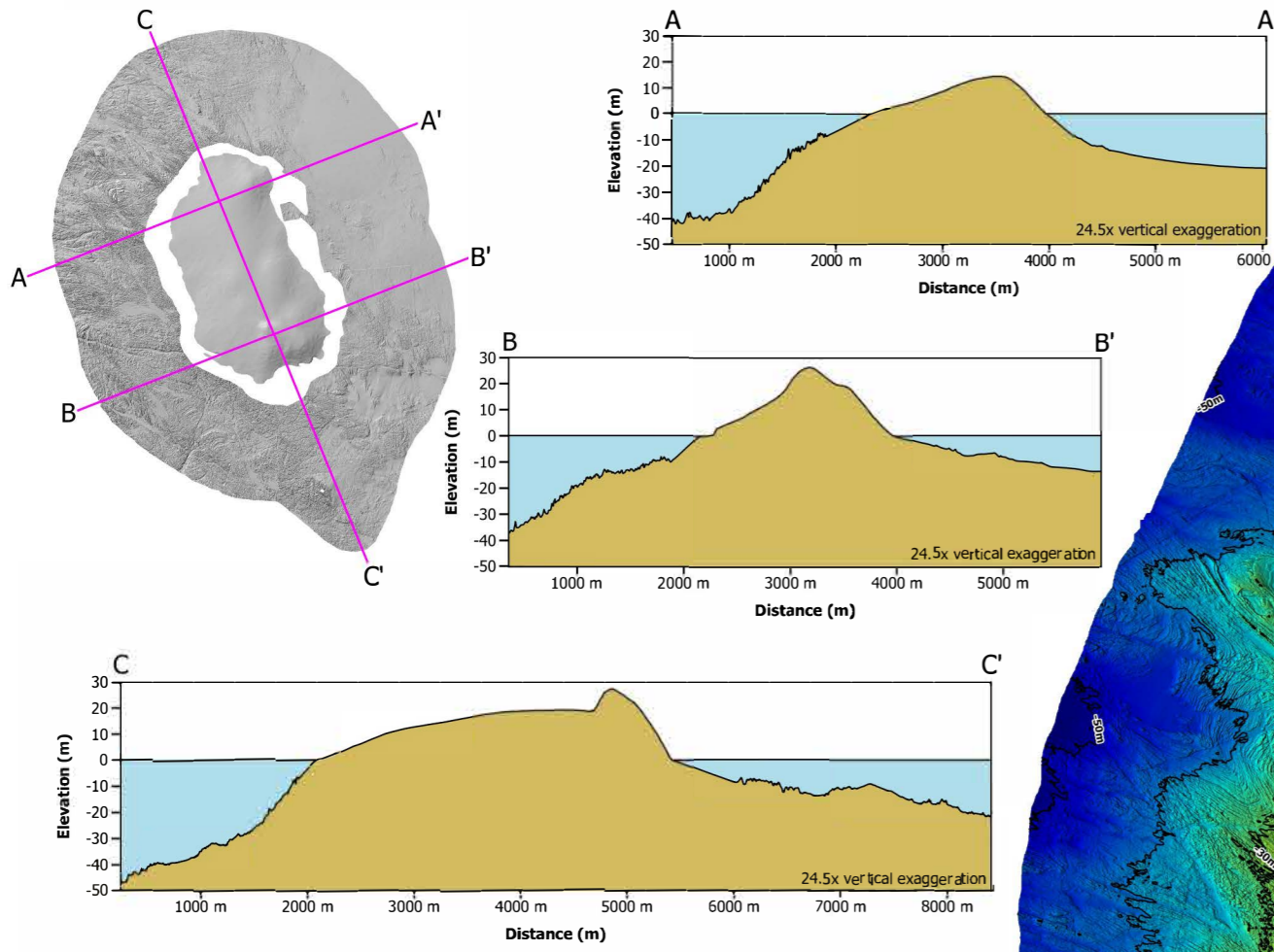


### DOLERITE DYKE (6)



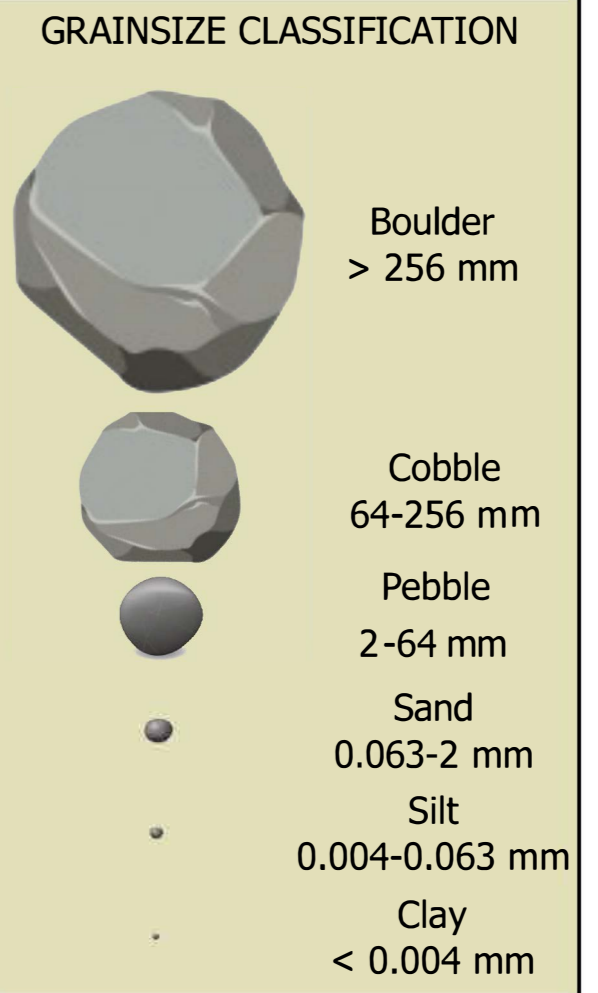
As the southern supercontinent of Gondwana broke up magma was injected into near-vertical cracks in the Earth's crust which when cooled, formed into dolerite dykes (as shown by magenta line).

### CROSS-SECTIONS ACROSS THE ISLAND AND ITS OFFSHORE BOUNDARY



### GEOLOGICAL GLOSSARY

- AEOLIANITE:** Sandstone derived from windblown sand.
- ANTICLINE:** Folded stratigraphy that forms an arch and where the order of stratigraphy is oldest at the bottom and youngest at the top.
- CALCRETE:** Lime-rich soil caused by seasonal fluctuations of groundwater causing sand-size shell fragments to dissolve and calcite to precipitate as clay-size micrite (microcrystalline calcite).
- CONGLOMERATE:** A very coarse-grained rock with mostly rounded clasts between boulder and pebble size, cemented together.
- DOLERITE:** Medium-grained hypabyssal igneous rock with the same chemical composition as basalt (fine-grained) and gabbro (coarse-grained).
- DYKE:** Intrusive igneous rock that forms in tabular seams that are often close to vertical in orientation.
- HYPABYSSAL:** Igneous rock formed beneath the Earth's crust, but not as deep as a plutonic rock such as a granite or gabbro.
- MUDSTONE and SHALE:** Very fine-grained sedimentary rock.
- SANDSTONE:** A medium- to fine-grained rock consisting of sand grains (clasts), normally dominated by quartz grains.
- SILTSTONE:** Similar to sandstone but with smaller grainsize and less dominated by quartz.
- STRATA:** Beds of sedimentary rocks that collectively form stratigraphy.
- SYNCLINE:** Folded stratigraphy that forms a trough and where the order of stratigraphy is oldest at the bottom and youngest at the top.
- TURBIDITY CURRENT:** A deep-sea current of suspended sediment, with seaward-flowing current at speeds of 70 km/hr (like an underwater landslide), usually triggered by earthquakes.
- TURBIDITE:** The deposit of a turbidity current in abyssal depths (greater than 4000 m) fining upward from sand to clay.



### STRATIGRAPHIC LEGEND

AGE	FORMATION	DESCRIPTION
Quaternary	Witzand	Beach and dune sand, crushed shells and gravel
	Springfontein	Boulder beaches
	Langebaan	Aeolianite and calcrete
Cretaceous	False Bay Dolerites	Dolerite dyke
Proterozoic	Tygerberg	Greywacke and phyllite

### STRUCTURAL SYMBOLS

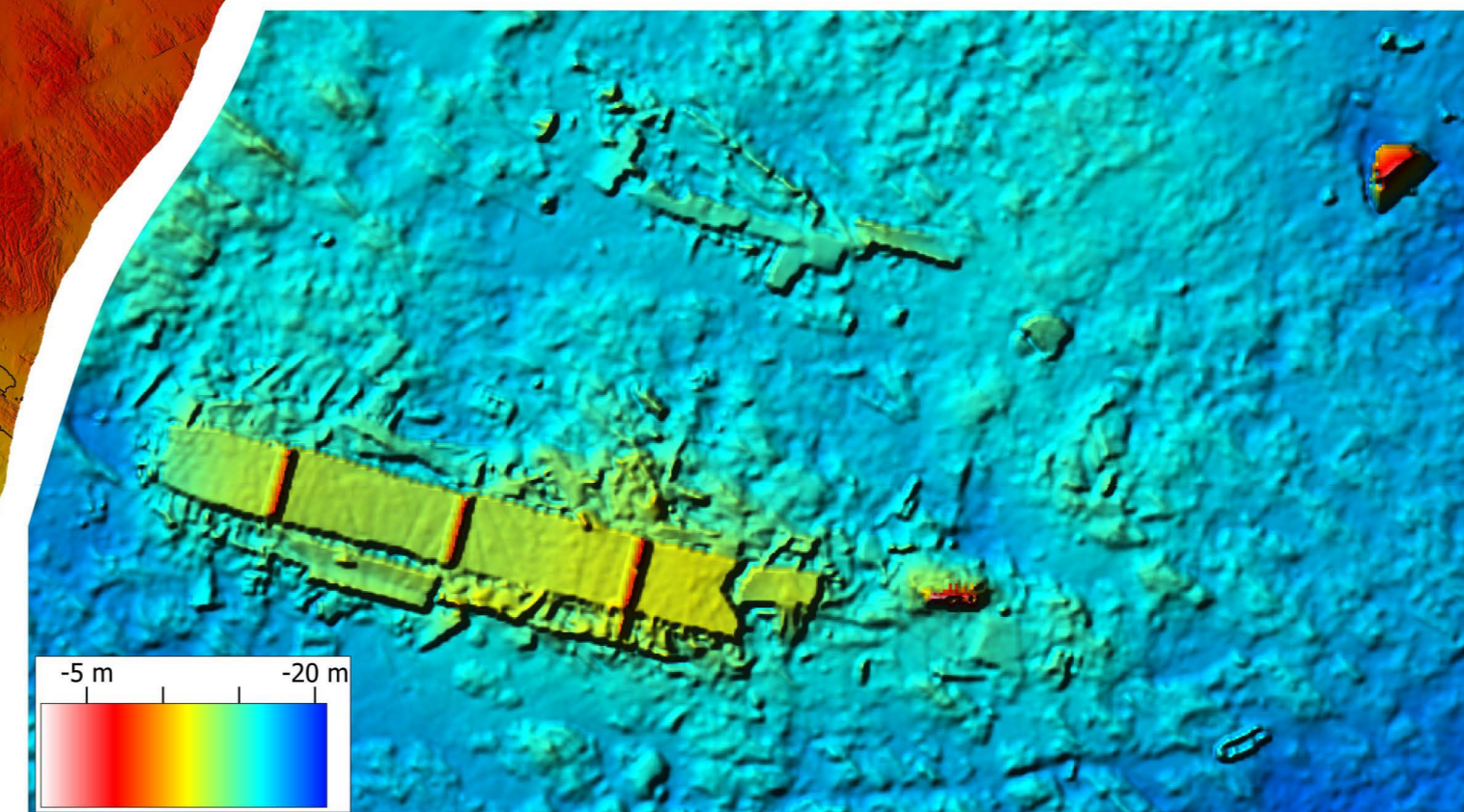
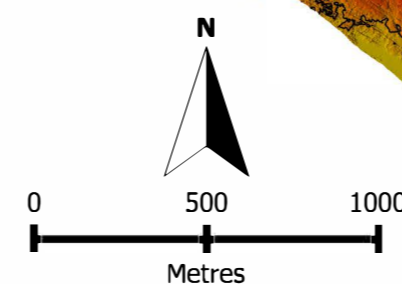
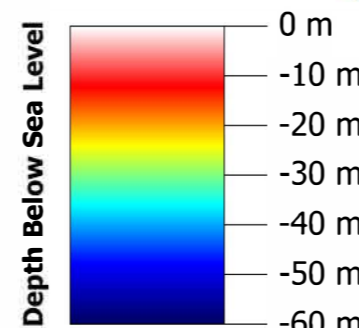
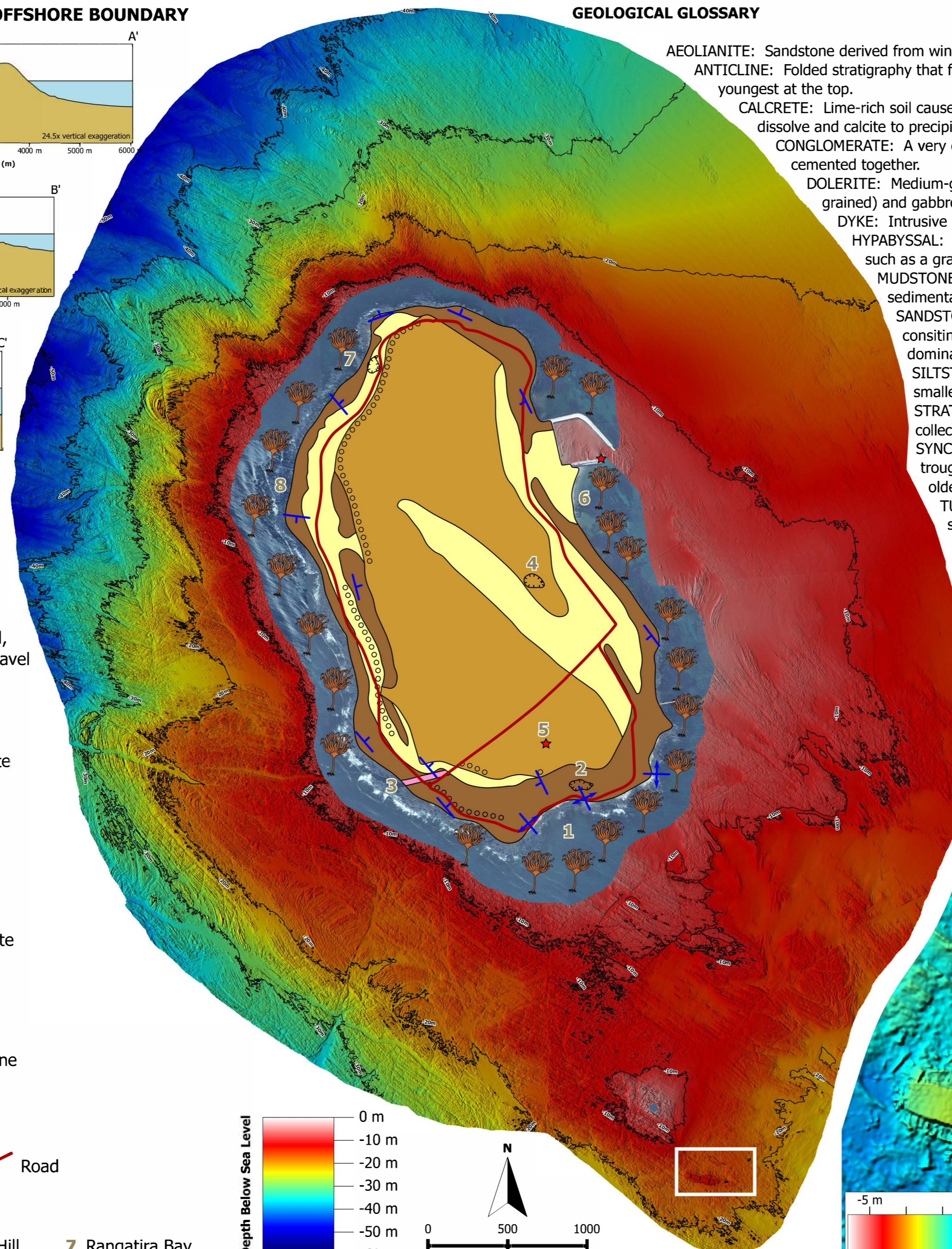
- Strike and dip of bedding
- Anticline
- Syncline

### CARTOGRAPHIC SYMBOLS

- Kelp
- Quarry
- Lighthouse or Harbour light
- Road

### PLACE NAMES

- 1 Edmond's Pool
- 2 Jan Van Riebeeck Quarry
- 3 Langbaai
- 4 Lime Quarry
- 5 Minto Hill
- 6 Murray's Bay
- 7 Rangatira Bay
- 8 Shelly Beach



### SHIPWRECKS

There are over 50 wrecks around Robben Island from as far back as 1611. One of the more recent, is the *Daeyang Family* (shown below and the white rectangle on the main map), a Korean bulk carrier that sank in 1986. While waiting to be repaired by divers, she was dragged onto Whale Rock, where she cracked her hull. She was carrying 162,000 tons of iron ore.