CAPE GEOSITES

CHAPMAN'S PEAK

Scenic drive

Chapman's Peak, showing sedimentary strata (beige coloured) of the Table Mountain Group (490 to 455 million years old) resting nonconformably on older (540 million years old) granite (light grey) of the Cape Granite Suite. The roadway of Chapman's Peak Drive mostly follows the sub-horizontal nonconformity, which is gently inclined to the south. Chapman's Peak is the highest point in the central-right of the picture at 593 metres above sea level.

Council for Geoscience

THE CAPE GEOSITES SERIES

Chapman's Peak is just one of the many geologically interesting sites in the Cape. This brochure forms part of an educational series that was compiled by the Geoheritage Subcommittee of the Western Cape Branch of the Geological Society of South Africa and is downloadable free of charge from the Branch website (https://www.gssawc.org.za). Bilingual descriptive plaques were placed at the sites during a programme sponsored by SANLAM in the 1990s.

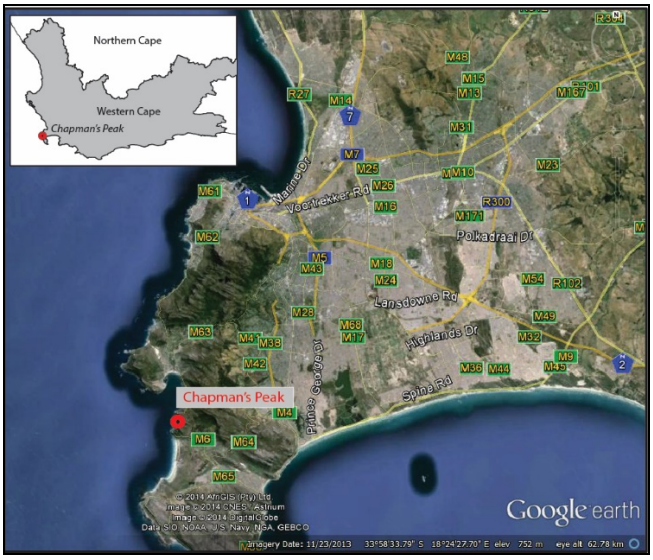

Figure 1: Location map for Chapman's Peak. See geological map below for more detail and GPS co-ordinates.

INTRODUCTION

Construction of Chapman's Peak Drive, between 1915 and 1922, made accessible features which have attracted the attention of geologists for many years. The extensive road cuts revealed details previously hidden and their study has led to considerable refinement in the interpretation of palaeoenvironments, although these are still to some extent controversial. Some of these features, including those shown in the original printed brochure, were masked by shotcrete during refurbishment of the road in 2005 and it therefore became necessary to revise the brochure with updated photographs, as given in the present digital version.

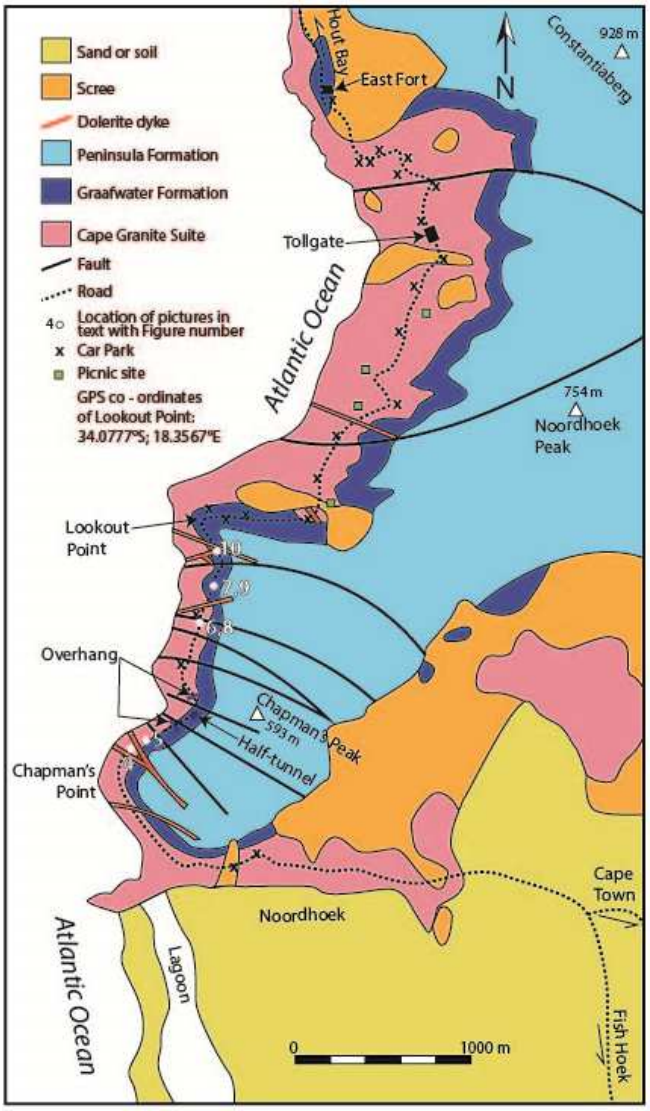

Figure 2: Geological Map of Chapman's Peak and adjacent areas showing infrastructure and location of pictures as given in the geosite description. Chapman's Peak Drive extends from Hout Bay, where the road meets the coast, 1 km north of East Fort, to Noordhoek, 1 km east-southeast of Chapman's Point.

GEOLOGY AND GEOLOGICAL HISTORY

The exposures along Chapman's Peak Drive consist of a gently undulating platform of 540 million year old granite, non-conformably overlain by a 550 m thick sequence of flat-lying sedimentary rocks made up of sandstone, siltstone and mudstone. A nonconformity is defined as the plane of juncture between sedimentary rocks and metamorphic or igneous rocks when the sedimentary rocks lie above and were deposited on the pre-existing and eroded metamorphic or igneous rock (Wikipedia, 2014, within UNCONFORMITY). The sedimentary rocks, which belong to the Graafwater and Peninsula Formations of the Table Mountain Group, were deposited between

about 490 and 455 million years ago. An occasional feature of these rocks is the presence of steep normal faults that displace the beds. The contact between the granite and the overlying beds is irregular, with the sediments occasionally occupying depressions (as much as 3 m deep) on the granite surface. Good examples of this feature can be seen along the road towards the southern end of Chapman's Peak Drive just beyond Chapman's Point. A weathered zone ranging from a few millimetres to several metres in thickness is present in the granite below the contact.

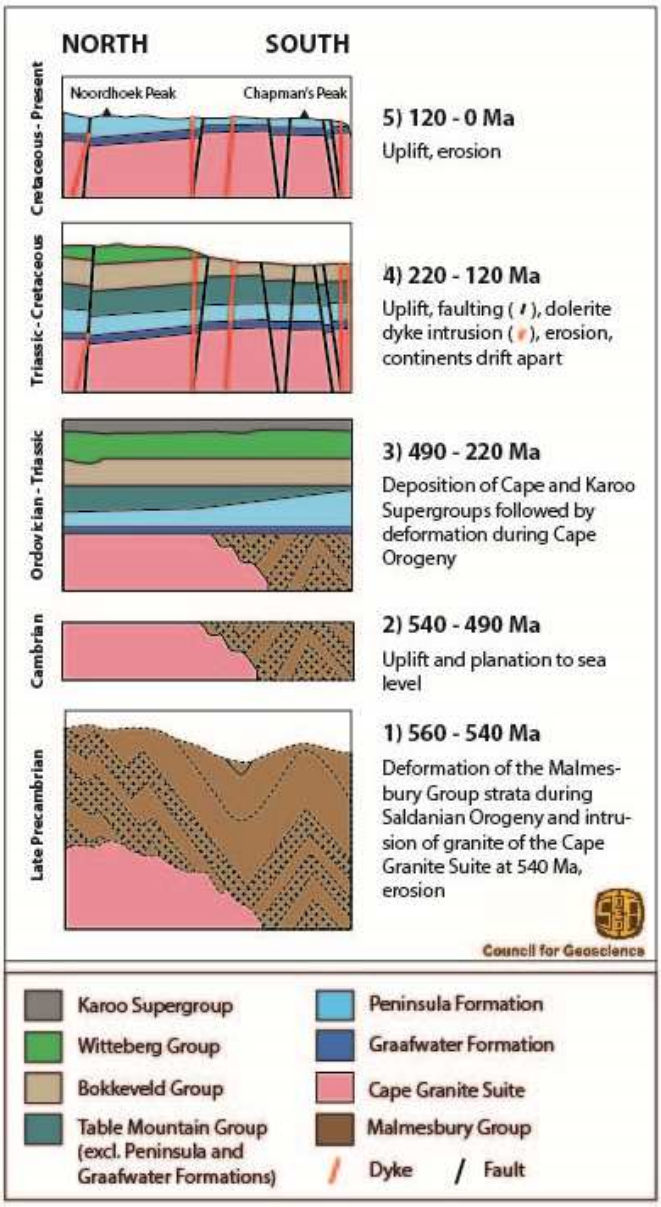

Figure 3: Geological history of Chapman's Peak.

Figure 4: Light grey granite of the Cape Granite Suite overlain non-conformably by interbedded sandstone, siltstone and red-coloured mudstone of the Graafwater Formation, which in turn is overlain by beige-coloured, thick-bedded sandstones of the Peninsula Formation, both of the Table Mountain Group. A dark grey dolerite dyke intrudes both the granite and the Table Mountain Group rocks within the ravine above Chapman's Peak Drive. The photograph was taken between the half-tunnel to the left (N) and Chapman's Point to the right (S). The dolerite crosses the road just south of a 20 km/h sign (co-ordinates 34.09018°S; 18.35188°E).

Figure 5: Lenticular sandstones of the Graafwater Formation resting on a subhorizontal nonconformity above granite of the Cape Granite Suite. A darker-coloured weathered zone, about one metre thick, is present below the nonconformity. Chapman's Peak Drive, 15 metres north of a surveillance camera on a sharp corner south of the half-tunnel (co-ordinates 34.08921°S; 18.35271°E).

The sedimentary rocks above the granite platform were deposited on a vast coastal plain located between a highland area to the north and a sea to the south. The character of the coastal plain changed through geological time as the sediments were deposited. The following sequence of events is envisaged:

Rivers draining the highlands flowed southwards towards a sea in southwest Gondwana. On reaching the coastal plain, where the gradients were low,

current velocity slowed and the main river channels split up into smaller, shallower streams that flowed across a plain to the sea. These streams deposited alternating layers of sand, silt and mud of the Graafwater Formation. Because of the warm, dry climate prevailing at this time, the subaerial surface frequently dried out and mud-cracks developed that later became filled with sand. In time the muds were compacted, gradually dewatered, and the sand filling the mud-cracks was squeezed and contorted. Excellent examples of these sand-filled mud-cracks can be seen in the road cutting about halfway down Chapman's Peak Drive, between the northern Lookout Point and Chapman's Point. The contrast in colour between the sedimentary rocks in the road cutting is due to the formation of fine particles of red iron oxide shortly after deposition. The particles were concentrated in the finer-grained siltstones and mudstones.

Figure 6: Thin- and thick-bedded sandstone interbedded with subordinate red-coloured mudstone of the Graafwater Formation. Chapman's Peak Drive, opposite the second car park uphill and about 650 metres north of the half-tunnel (co-ordinates 34.08344°S; 18.35636°E). Cross-bedded foreset of Figure 8 is located just above the "x" symbol.

The coastal plain was then subjected to periodic flooding by the sea or by large river channels, when large quantities of sand were deposited.

The sandstones display a wide range of sedimentary structures including cross-bedding, scour and fill, flat-bedding with parting lineations, ripples and animal tracks (trace fossils).

Sandstone bedding-surfaces are covered with a variety of ripple marks. These include interference ripples, flat-topped ripples, ladderback ripples and double-crested ripples. The presence of these ripple types, together with marks made by marine organisms, confirms that there was a periodic marine influence on deposition at this time.

Figure 7: Sandstone-filled mudcracks (desiccation cracks) in reddish-brown mudstone overlying ripple formsets in thin bed of beige sandstone, overlain by a thick bed of channel-fill sandstone in the lower part of the Graafwater Formation. Chapman's Peak Drive, 456 metres south of the top Lookout Point (co-ordinates 34.08110°S; 18.35710°E).

Figure 8: Cross-bedded foreset dipping south in sandstone of the Graafwater Formation. Chapman's Peak Drive, opposite the separate southern part of the second car park about 650 metres north and uphill of the half-tunnel (co-ordinates 34.08344°S; 18.35636°E). Position shown in Figure 6.

As each flood waned, mud was deposited on top of the sands in the form of thin layers and lenses. Some of this mud was eroded and reworked by the next flood-event as small mudflakes, which were then incorporated into the sand.

Between flood-events, the exposed mud of the coastal plain dried out in places and cracked. However, the small size of the cracks, compared with those in the lower part of the succession, indicated that the surface was exposed for only a short time prior to the next flood. The sandstones deposited at this time can be traced for some distance from the northern Lookout Point towards Chapman's Point. Close inspection of the bedding surfaces, in the

vicinity of Chapman's Peak Lookout Point, reveals a variety of different sedimentary structures, which testify to the fluctuating conditions of flow responsible for them.

The conditions prevailing at the beginning of coastal-plain development re-established themselves as the coastline began to build seawards towards the southwest. On the landward side, the coastal plain passed into a much more extensive alluvial plain, drained by wide, shallow, river channels, in which were deposited mainly sand and some gravel. These deposits were shaped into migrating subaqueous dunes of various sizes, whose downstream-pointing avalanche surfaces, on burial and preservation, produced sedimentary structures called cross-bedding in the resulting sandstone.

These conditions were influenced by uplift in the source areas (and subsidence of the basin), which caused the alluvial plain to extend seawards and to bury the coastal plain beneath sand and gravel. This seaward extension of the alluvial plain is seen in the abrupt change from thin-bedded coastal plain sandstones, siltstones and mudstones below, to the more thickly bedded, alluvial-plain sandstones of the Peninsula Formation in the cliffs above.

Between some of the major cliff-forming sandstone beds of the Peninsula Formation well above the road, are very thin, less resistant beds of sandstone and siltstone. These occasionally contain burrows and traces made by marine organisms, as well as mud-cracks, which formed when the upper parts of the deposits dried out on exposure to the atmosphere. Some of the traces are thought to have been made by primitive, extinct marine crustaceans called trilobites, as they crawled across the soft, wet bottom in search of food. The finer-grained, softer beds of sandstone and siltstone were laid down under very shallow-marine conditions, when the sea periodically flooded the alluvial plain. Up to eight thin marine intervals can be recognised in the alluvial-plain sediments above Chapman's Peak Drive.

In the Late Ordovician Period, about 450 million years ago, glaciers advanced over the alluvial plain sediments of the Peninsula Formation and deposited sand and gravel assigned to the Pakhuis Formation. However, as a result of subsequent erosion over hundreds of million years (Figure 3), these sediments, which became lithified to pebbly sandstone due to burial, are no longer present on Chapman's Peak, but are limited to small exposures on Table Mountain between Maclear's Beacon and Platteklip Gorge. Sedimentation, beginning with clay and silt in a marine environment, following melting of the continental ice-sheets, probably continued at least until 280 million years ago, but these younger formations have been removed by subsequent erosion, following uplift associated with the Cape Orogeny (Mountain-Building Episode) between 280 and 220 million years ago (Figure 3). The opening of the South Atlantic, associated with fragmentation of the supercontinent Gondwana, which began about 150 million years ago, resulted in the formation of steep normal faults at Chapman's Peak. These show varying levels of rock displacement and intersect granite of the Cape Granite Suite and sedimentary rocks of the Graafwater and Peninsula Formations. Fragmentation of Gondwana also led to the intrusion of dolerite dykes, which were directly related to major strike-slip movement along the Agulhas–Falkland Fracture Zone, in the South Atlantic Ocean, southwest of Chapman's Peak. Several dolerite dykes are present at Chapman's Peak, all intruding the basement granite. They are limited in their ascent into the sedimentary rocks of the Graafwater and Peninsula Formations (Figure 2). One dolerite dyke, immediately south of Chapman's Peak Lookout Point, yielded a radiometric potassium-argon (K-Ar) date of 131 ± 5 million years.

Figure 9: Normal fault (indicated by black line) within the Graafwater Formation with downthrow to the north (left) as indicated by black arrow. The horizon of sandstone-filled mudcracks, just below the thick sandstone bed above the geological hammer, have been displaced by about one metre. Chapman's Peak Drive, 424 metres south of the top Lookout Point (co-ordinates 34.08093°S; 18.35730°E).

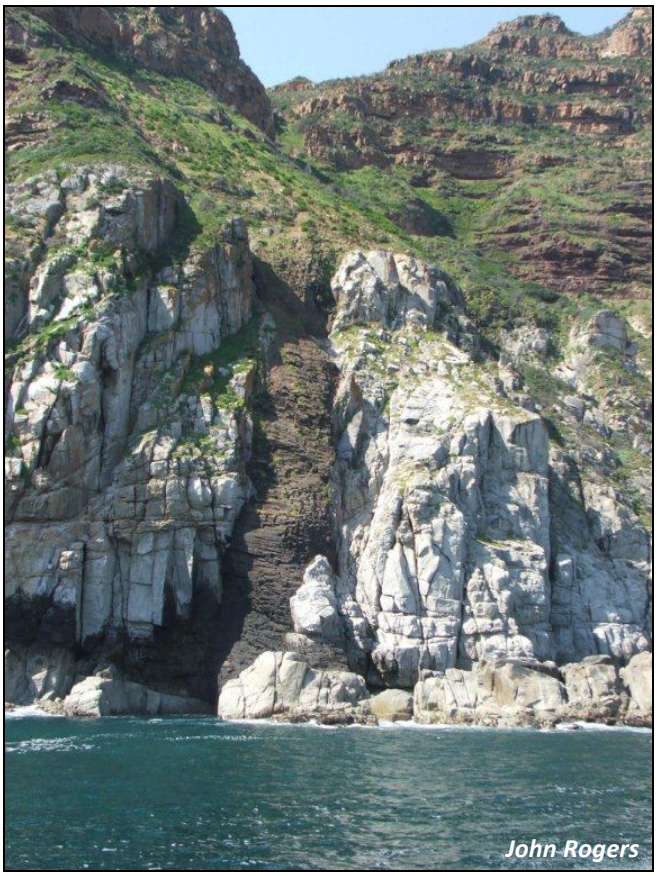

Figure 10: Greyish-black dolerite dyke intruding light grey granite of the Cape Granite Suite about 200 metres south of the top Lookout Point (co-ordinates 34.07955°S; 18.35766°E). It is best seen from offshore rather than from the road. The dolerite also intrudes the sedimentary rocks.

Prolonged erosion continued and the mountainous upland of Constantiaberg, Noordhoek Peak and Chapman's Peak, east of Chapman's Peak Drive, most likely displayed its present shape by the mid-Tertiary Period, some 25 million years ago.

CONTACT

Western Cape Branch of the Geological Society of SA:
https://www.gssawc.org.za

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