

CONFIDENTIALCONTINUOUS NATIONAL EXAMINATION OF POTENTIAL REGIONS
FOR THE ESTABLISHMENT OF NUCLEAR POWER STATIONS IN S.A.

REGIONAL COASTAL GEOLOGY

1. GENERAL

During the periods 30 January 1983 to 3 February 1983 and 14 February 1983 to 23 February 1983 the coastline geology was examined from Alexander Bay to St. Helena Bay along the West coast and from Cape Agulhas to the Ciskei Border along the South coast (Great Fish River mouth). The purpose of the examination is the phase 1 ranking of regions for the establishment of Nuclear Power Stations.

The daily work programme consisted of a helicopter trip along the water edge in one direction and a trip approximately 3 kilometres inland in the opposite direction.

Ground inspections were very limited in the short time available and also hampered by poor access roads in parts along the South coast and by the sensitivity of diamond concession holders (notably De Beers) along the West coast.

Rock identification, rock classification and recording of strata inclinations were thus done mainly from the helicopter. Published detailed geological maps which cover 40% of the area assisted in interpreting the geology of the remaining unmapped portions.

Although attention was mainly focussed on the geology of the water line and the first dune area geological interpretation was nevertheless done for approximately 5 to 10 kilometres inland as shown on the accompanying 1:500 000 sheets:-

West Coast	Alexander Bay	Sheet No. 1 (Administration Series)
	Springbok	" " 2 " "
	Calvinia	" " 3 " "
South Coast	Oudtshoorn	" " 4 (Topographical Series)
	Port Elizabeth	" " 5 (Administration Series)

The water edge rock exposures are usually very narrow but for illustration purposes it was indicated wider on the abovementioned maps.

The regional geology as indicated on these sheets is estimated to be:-

- 80 - 90% accurate along the water line
- 60 - 70% accurate inland.

2. WEST COAST

2.1 SHEET 1 - ALEXANDER BAY

2.1.1 Rock Exposures

Rock exposures mainly along the coastline consists of:-

Sheared lava (NL), white quartzite (NQ), schist (NSc) (probably sheared greywache and arkose) of the Nosib Group (previously called Cariep), Damara Super Group. The inclinations of this strata vary between 25° and 30° northwards to westwards.

Faults and folds could not be detected but are probably present due to the prolonged periods of deformation of these rocks.

2.1.2 Overburden

Low profile sand dunes and sandy soil cover varying in thickness from approximately 1 to 20m are generally present inland.

2.1.3 Geomorphology

Slightly undulating coastal flats predominate.

2.1.4 Geohydrology

The Orange River is the main surface water feature. Underground water is generally absent.

2.1.5 Mining

Active alluvial diamond mining is the main mining activity close to the coastline. Gypsum is mined locally.

2.1.6 Seismology

Seismic activity of the area is generally low and acceleration times are estimated at 0,10 - 0,12g (refer to "Aardbewinggevaar in Suidelike Afrika"). An earthquake registering 5,8 on the Richter Magnitude scale and VII on the Modified Mercalli Intensity scale occurred on 1 May 1953 at 29,0°S and 17,0°E.

2.1.7 Geological Suitability for Power Station Erection

Favourable geological factors are:-

- (a) Reasonable bed rock strengths;
- (b) Relatively flat terrain;
- (c) Relatively shallow overburden;
- (e) Quartzite can be tested for concrete aggregate.

Unfavourable factors are:-

- (a) Close proximity of single earthquake centre mentioned above;
- (b) Unknown fault pattern;
- (c) Intensive active diamond mining.

2.2 SHEET 2 - SPRINGBOK

2.2.1 Rock Exposures

Rock exposures are mainly confined to the coastline and includes:-

- (a) Granite gneiss, biotite gneiss, migmatite and other metamorphic rocks (Gr) of the Namaqualand metamorphism and granitization (Late Precambrian orogeny).
- (b) Quartzite/meta-quartzite/arkose (NQ), greywache/fillite (NS), limestone and marble (Nc) as well as schists (probably altered sediments) of the Nama, Malmesbury, Gariep and Nosib Groups, Super Group Damara.

The sedimentary beds usually dip seawards at inclinations varying between 5° and 50°. Local folding was observed. Major faults were not detected but should be present due to the deformed state and schistosity of the rocks.

2.2.2 Overburden

The overburden varies from wind blown sand dunes (Port Nolloth, Koingaas and Bitterrivier mouth) to sandy soil and soil cover ranging in thickness from approximately 1 metre to 30 metres.

2.2.3 Geomorphology

Coastal flats generally predominate except for undulations caused by north-south orientated dunes.

2.2.4 Geohydrology

The Buffels, Swartlintjies, Spoeg, Bitter and Groenriviere occur within this region but are not great surface water sources. Underground water is in short supply and absent over long distances.

2.2.5 Mining

Alluvial diamonds are found along the coastline of the entire region and prospecting trenches and pits are abundant. Active mining takes place at Port Nolloth, Kleinsee and Koingaas. Further inland a variety of minerals are present and it is common knowledge that Namaqualand has a good mining potential.

2.2.6 Seismology

Seismic activity of the area is generally low and acceleration times are estimated at 0,1lg (refer to "Aardbewinggevaar in Suidelike Afrika"). Seismic activities (VI on Mercalli scale) occur approximately 70 - 80 kilometres inland on the extension lines of major north-south striking faults between Vredendal and Springbok.

2.2.7 Geological Suitability for Power Station Erection

Favourable geological factors are:-

- (a) Reasonable bed rock strengths;
- (b) Relatively low lying and flat terrain;
- (c) Relatively shallow overburden;
- (d) Low seismicity;
- (e) Quartzite can be tested for aggregate suitability;

Unfavourable geological factors are:-

- (a) Absence of surface and underground potable water;
- (b) Unknown fault pattern;
- (c) Deep weathering of schistose rocks;
- (d) Diamond mining activities.

2.3 SHEET 3 - CALVINIA

2.3.1 Rock Exposures

Rock exposures are mainly confined to the water line and includes:-

- (a) Granite-gneiss, biotite gneiss, migmatite and other metamorphic rocks (Gr) of the Namaqualand metamorphism and granitization.
- (b) Quartzite/meta-quartzites/arkose (NQ), limestones/marble (NC) and schistose sediments (NSc) of the Nama/Malmesbury/Gariep Groups, Damara Super Group.
- (c) Sandstone and quartzite (CQ) of Table Mountain Group, Cape Super Group.

The dips of the Damara and Cape Super Group sediments varies from 5° to 60° predominantly eastwards (landwards). Local folding and small scale faulting was observed.

2.3.2 Overburden

Dune sands are limited to St. Helena Bay, Elandsbaai and Lamberts Bay whilst the remainder of the area is characterised by shallow sandy soil to soil cover ranging in thickness from approximately 1 metre to 10 metres.

2.3.3 Geomorphology

Except for a few cliffs on the water line near Baboon point and Cliff point vicinity the region is characterised by low lying flats, sometimes with a single dune feature separating very low lying "vlei" areas from the sea.

2.3.4 Geohydrology

The Olifantsrivier, Jakkalarivier, Verlorenvlei and Groot Bergrivier are the surface water suppliers of the region. Underground water supply appears to be limited and a few windmills were observed along the river valleys.

2.3.5 Mining

Alluvial diamond deposits were always believed to occur along the coastline, north of the Olifants River, but diamond concessions are apparently also going to be allocated to the south of the Olifants River. Diamond mining takes place at Olifantskliphogte and Duiwegat. (Vredendal district).

2.3.6 Seismology

Seismic activity is of a low order in the northern portion of this region and is estimated to increase in a southern direction from 0,10g to 0,12g at Vredendal and to 0,16g at St. Helena Bay. This is mainly due to a VI intensity occurrence (Mercalli scale) at Saldanha and proximity to the Ceres/Tulbach seismic active area.

2.3.7 Geological Suitability for Power Station Erection

Favourable geological factors are:

- (a) Predominantly low lying ground;
- (b) Shallow overburden;
- (c) Reasonable bed rock strengths;
- (d) Low seismic activity in the north;
- (e) Table Mountain quartzites and Damara quartzites can be tested for aggregate uses.

Unfavourable geological factors are:

- (a) Increased seismic activity towards the south;
- (b) Unknown faulting;
- (c) Relatively deep weathering of schistose sediments.

3. SOUTH COAST

3.1 SHEET 4 - OUDTSHOORN

3.1.1 Rock Exposures

Rock exposures along the water line from Cape Agulhas to Mossel Bay and again along Tsitsikamma coast are predominantly quartzites (CQ) with minor shales (CS) of the Table Mountain Group, Cape Super Group.

The quartzites are folded along east-west foldaxes and dips thus range from 10° to vertical either seawards or landwards. A feature of these quartzites is the pronounced steeply inclined jointing.

The Table Mountain quartzites and shales are overlain by:-

- (a) Calcified sand dunes (QQ) - Cape Agulhas to Morris Point.
- (b) Tertiary sandy limestone (TL) - Stilbaai to Mossel Bay.
- (c) Unconsolidated sand - first dune, Struisbaai, Ryspunt and Vleesbaai area.
- (d) Vegetated, semi consolidated sand dunes - Visbaai.
- (e) Cretaceous sediments (CR) near Mosselbaai.

The calcified sand dunes (QQ) and Tertiary limestone (TL) are not recommended for heavy structure buildings as they occur in various stages of consolidation (depending on the amount of sea shells (CaCO_3) present) and are vulnerable to groundwater attack.

Where the Table Mountain quartzites are not covered by younger formations except thin soil cover, they form steep coastal cliffs, eg. Cape Infanta, Cape St. Blaize and Tsitsikamma.

Old granites and granite-gneisses (Gr) are present near George.

3.1.2 Overburden

From Cape Agulhas to Mossel Bay area the surface feature inland is generally surface calcrete varying in thickness from a few centimetres to approximately 2 metres.

3.1.3 Geomorphology

The geomorphology of the region vary considerable. Generally it can be described as undulating to rugged coastal highs with relatively deep river incisions.

3.1.4 The main rivers in the region are:

Heuningnes, Bree, Duiwenshok, Kafferkuils, Gourits, Klein Brak, Groot Brak, Keurboom, Bloukrans, Elandsbos, and Storms rivers.

Underground water is generally present.

3.1.5 Mining

No significant mining activities are evident near the coast line.

3.1.6 Seismology

Seismic activity of the area is generally very low and acceleration times are estimated at 0,080g, Mossel Bay area, with an increase to 0,120g in the Cape Agulhas region due to proximity to the Ceres/Tulbach seismic active area. (Refer to "Aardbewinggevaar in Suidelike Afrika").

3.1.7 Geological Suitability for Power Station Erection

Favourable geological factors are:-

- (a) Low seismicity;
- (b) Shallow overburden and strong bedrock on Table Mountain quartzites at Cape Infanta, Ystervarkpunt, Mossel Bay and Tsitsikamma;
- (c) Shallow rising coast line in vicinity of Ystervarkpunt;
- (d) Table Mountain quartzites can be tested for concrete aggregate suitability.

Unfavourable geological factors are:

- (a) Cliff fronts on water edge from Skipskop (20°27'E to Bloukrans 21°38'E) Mossel Bay to George and Tsitsikamma area.
- (b) Expected unreliability of calcified sand dunes and limestones for foundation purposes, and

- (c) Costly operations to blast and remove calcified sand dunes or limestones.

3.2 SHEET 5 - PORT ELIZABETH

The area around Port Elizabeth was not included in the programme for investigation, but is inserted on the geological maps to indicate the continuity of coastal geology.

3.2.1 Rock Exposures

Steeply inclined quartzites (CQ) of the Table Mountain Group, Cape Super Group dominate the water line exposures from Tsitsikamma to Port Elizabeth.

The quartzites are overlain by huge, (up to 180m high), east-west striking, vegetated, semi-consolidated sand dunes near Cape St. Francis and by Cretaceous sediments, Tertiary and Recent arenaceous limestones from Jeffreys Bay to Port Elizabeth.

No bedrock formations could be detected underneath the wind blown sand dunes on the coastline from Port Elizabeth to Cape Padrone (26°30'E). The Cretaceous, Tertiary and Recent sediments occur inland.

From Cape Padrone to the Ciskei Border bedrock formations consist of quartzites, sandstones and shales of the Bokkeveld (C₂S) and Witteberg (C₃Q) Groups, Cape Super Group. Inland these rocks are capped in parts by arenaceous limestones (QQ) and on the coastlines by wind blown sand dunes.

Folding and small scale faulting can be seen locally.

3.2.2 Overburden

Soil overburden, where sand dunes are absent is generally thin, surface calcrete occur locally.

3.2.3 Geomorphology

High level coastal cliffs with deep river incisions characterise the coastal regions from Tsitsikamma to Cape St. Francis. From Port Elizabeth eastwards the coast is dominated by wide, relatively high sand dunes near the water edge with undulating low to medium high ground inland.

3.2.4 Geohydrology

The main rivers in the areas examined are:

Groot, Tsitsikamma, Krom, Seekoei, Berg, Kowie and Great Fish rivers.

Underground water appears to be abundant as numerous windmills and drinking holes were detected.

3.2.5 Mining

No significant mining activities are evident near the coastline.

3.2.6 Seismology

Seismic activity of the region is generally very low and acceleration times of 0,080g are estimated. (Refer to "Aardbewingevaar in Suidelike Afrika").

3.2.7 Geological Suitability for Power Station Erection

Favourable geological factors are:-

- (a) Very low seismicity;
- (b) Reasonably strong bedrock formations;
- (c) Shallow rising coastal terrain in places near Port Alfred.

Unfavourable geological factors are:-

- (a) The sea front cliffs from Tsitsikamma to Cape St. Francis.
- (b) Extensive sand dune development east of Port Elizabeth.



L.M.J. van Rensburg
FUEL & WATER
PRODUCTION ASSETS

10 March 1983