

**Palaeontological Heritage Study for Melkhout Windfarm electrical transmission
lines extending from near Oyster Bay to Humansdorp**

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Stratigraphy, Age, Origin and Palaeontology of Strata

- Stratigraphy is the sequence of rock layers, from the lowest (oldest) to the highest (youngest). Conformably deposited rocks are ones which are continually deposited, layer upon layer, with only limited periods of disruption or erosion between them.
- A syncline is a fold in (once horizontal) geological strata in which the strata are thrust down in the middle and up on the sides. If this is cut through, along a horizontal plane, younger rocks are exposed in the middle flanked by progressively older ones

The study area is situated within strata of the Cape Supergroup. More specifically, upper portions of the Table Mountain and lower portions of the Bokkeveld Group are represented. These rocks represent sediments deposited in the Agulhas Sea, which had opened to the south of the current southern African landmass in response to early rifting between Africa and South America.

The Table Mountain Group constitutes the first of three subdivisions of the Cape Supergroup. It consists of quartzitic sandstones derived from coarse sands deposited within the Agulhas Sea, and along its coastal plane. It was deposited during the Ordovician, Silurian and earliest Devonian Periods, approximately 500-400 million years ago.

The Bokkeveld Group, constituting the middle subdivision of the Cape Supergroup conformably overlies the Table Mountain Group. Bokkeveld strata consist largely of shales and thin interbedded sandstones derived from marine continental slope muds of early to mid Devonian (+/- 400 - 370 myo) age – which were deposited within the basin of the Agulhas Sea.

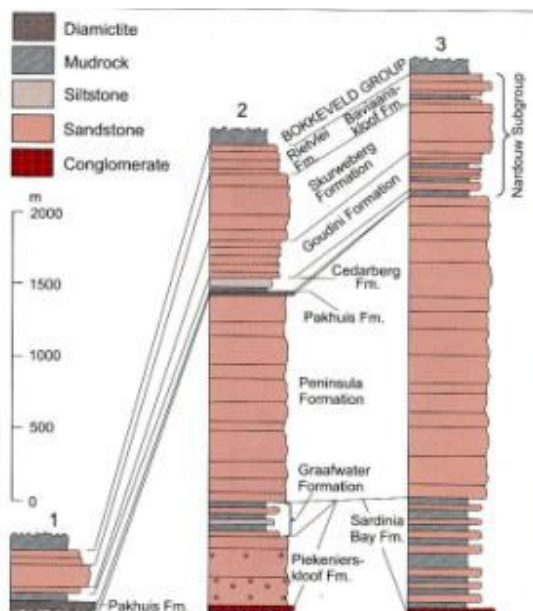


Fig. 1. Stratigraphy of the Table Mountain Group, 3 represents the Eastern Cape (Johnson *et al.*, 1999)

The study area spans a large roughly east-west trending syncline, bounded in the north and south by rocks of the Peninsular Formation of the Table Mountain Group, with progressively younger formations of the Table Mountain Group outcropping towards the centre of the syncline, in which shales of the Ceres Subgroup of the Bokkeveld Group are exposed.

Very rare trace fossils have been recorded from the sandier units of the Table Mountain Group in the Western Cape.

More importantly, shale and mudstone interbeds within the Table Mountain Group are known to contain rare records of early Agulhas Sea life. Significantly the Soom and Disa shales, which comprise the Cederberg Formation provide an extremely valuable record of latest Ordovician life. The Soom shale exhibits soft tissue preservation, and has yielded specimens of primitive jawless fish, eurypterids, trilobites, orthocone nautiloids, brachiopods and molluscs. A brachiopod dominated invertebrate fauna has also been recorded from the somewhat sandier overlying Disa Formation. In addition to brachiopods this fauna includes trilobites, bryozoans, crinoids, tentaculitids and crustaceans. Due to poor outcrop, fossil faunas of this unit have not yet been uncovered in the Eastern Cape.

The Baviaanskloof Formation, uppermost unit of the Table Mountain Group has been recorded, particularly within the Klein Karoo, to contain concentrated lenses of invertebrate fossils which help to establish an earliest Devonian age for this Formation. They provide very early examples of the cold water marine Malvinokaffric invertebrate faunas that characterised the near polar Agulhas Sea during deposition of the Bokkeveld Group and its equivalents in south eastern South America. The Baviaanskloof Formation fossil record is dominated by brachiopods, but also includes the remains of trilobites, bivalves, gastropods and tentaculitids. Some burrow fills are also known

Lower Bokkeveld Group strata have yielded abundant fossil evidence of a range of early to mid Devonian deep water invertebrate faunas comprised of diverse brachiopods, molluscs, echinoderms and trilobites. In addition a few very localised but exciting fish fossils have been described. Plants and trace fossils are also known.

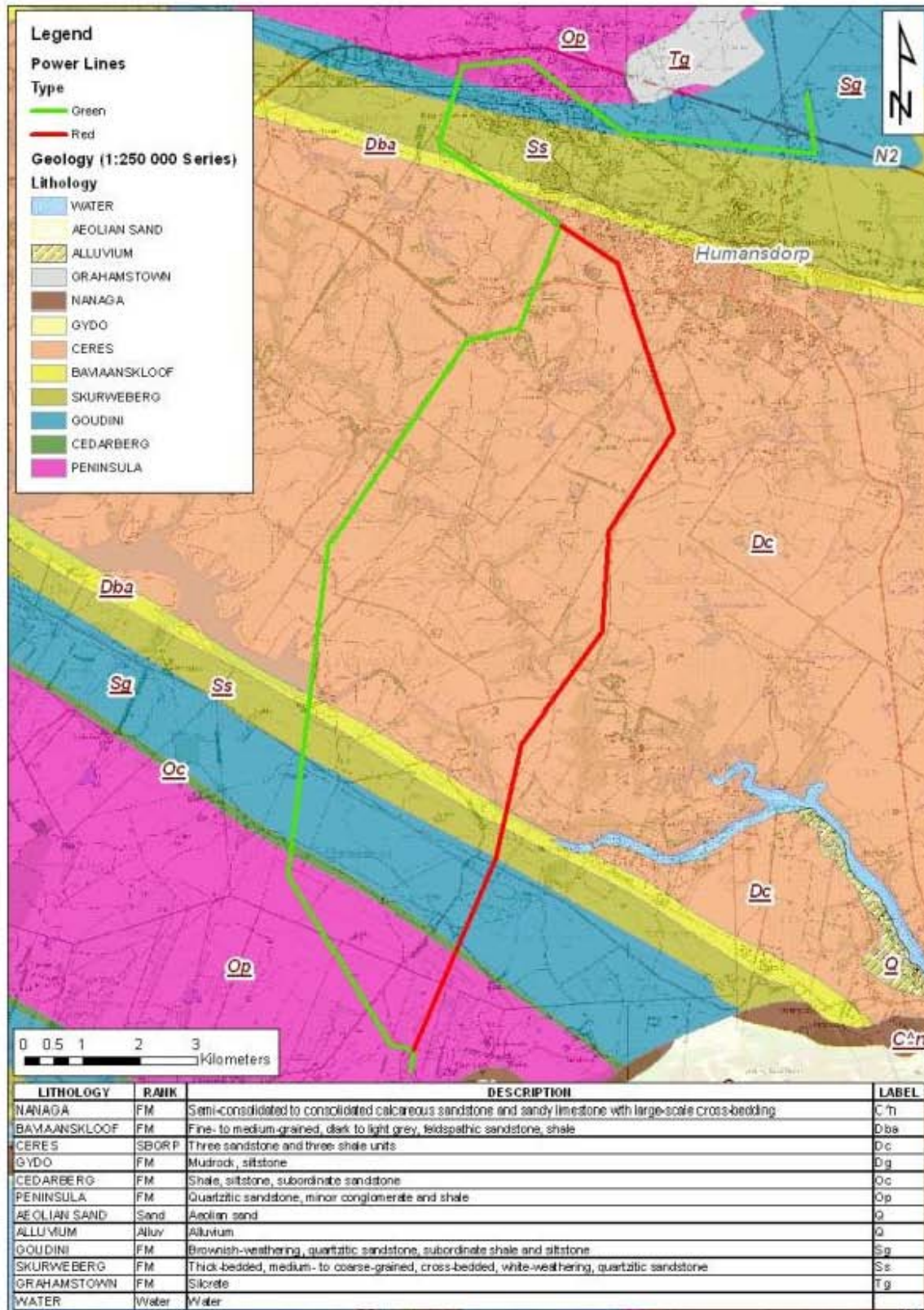


Fig. 2. Proposed electrical transmission lines (green and red) superimposed on a geological map

Site Visit

The proposed electrical transmission routes and adjacent strata were surveyed on the 26th and 27th of February 2011. The route was explored by vehicle and on foot with all suitable outcrops examined on foot.

In the south of the area, both proposed routes are initially situated across strata of the peninsular formation. Good outcrops of Peninsular Formation top the ridge in the south of the study area, which has formed due to the resilient response of this unit to erosion. The Peninsular Formation has only ever been known to produce rare trace fossils. No fresh outcrop occurs on this ridge. And no palaeontological material was found.



Fig.3. Peninsular Formation exposed in the south of the study area.

Moving northwards both transmission line routes pass over the Cedarberg and Goudini Formations. Due to their less resilient nature, these two units have been weathered into a valley, which is floored by deep alluvium. As a result no suitable outcrops were found for palaeontological sampling.



Fig. 4. Looking southwards over deeply weathered valley formed by erosion of Goudini Fm.

To the north of the Goudini Formation the land rises into a ridge formed from the resilient quartzitic strata of the Skuurweberg Formation. No palaeontological material was observed in the abundant outcrops of Skuurweberg quartzites.



Fig. 5. Quartzites belonging to the Skuurweberg Formation

To the north of the ridge formed by the Skuurweberg Formation quartzites the land descends steeply towards the valley of the Kouga River, which is constrained in a course parallel to the coast, by the presence of this ridge.

This steeper topography, which was cut more recently than the formation of the coastal plain, facilitates outcrop of the Baviaanskloof Formation, which stratigraphically overlies the Skuurwehoek Formation. The Baviaanskloof Formation was found during this survey to be locally (unexpectedly) rich in palaeontological material, including fossil invertebrates and trace fossils. Invertebrate fossils noted included brachiopods, bivalves, tentaculitids and trilobite fragments. Important new fossil localities were discovered in close proximity to the more easterly route.



Fig.6. Outcrop of the Baviaanskloof Formation



Fig. 7. Brachiopod fossils in the Baviaanskloof Formation



Fig. 8. Trilobite tail in the Baviaanskloof Formation.

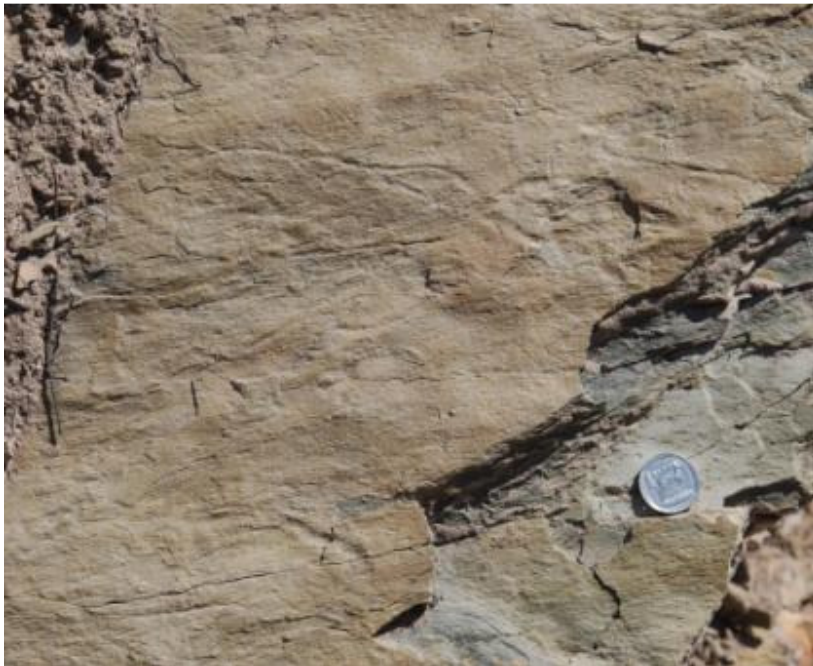


Fig. 9. Trace fossils on rippled surface in the Baviaanskloof Formation.

The middle portion of the study area consists of shales of the Bokkeveld group. These have been metamorphosed and often (though not invariably) cross jointed during the formation of the Cape Fold belt approximately 300 million years ago. Although in some areas, shale could be split along original bedding, and although bioturbation was observed, no fossils were located in the Bokkeveld Group during this survey.



Fig. 10. Metamorphic cleavage overprinting bedding in Bokkeveld shales of the Ceres Subgroup

In the vicinity of Humansdorp and Kruisfontein the transmission line routes once more cross strata of the uppermost Table Mountain Group. A high degree of weathering, combined with a more even topography in this northern part of the area results in very poor outcrop of the Table Mountain Group. Outcrop is restricted to small areas of resilient quartzite that were not found to be fossiliferous.

To the east of Kruisfontein, the deeply weathered land surface is capped with iron rich hardpan deposits.

Conclusions and Recommendations

1. **Important palaeontological resources are present** along the outcrop area of the Baviaanskloof Formation in the southern part of the study area. These are extremely likely to be damaged during the construction phase of the transmission lines and are, particularly, situated in close proximity to the eastern route.
2. Should this project continue, and **should either route be accepted**, once the final route plan has been finalised a **phase two palaeontological assessment and rescue** should be carried out by a qualified palaeontologist. This should include precise logging of palaeontological material and removal of appropriate samples for curation and study at a suitable institution such as the Albany Museum.

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