PHASE 1 PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE INTIBANE COLLIERY NEAR THE TOWN OF DELMAS IN MPUMALANGA PROVINCE

For:

HIA CONSULTANTS

DATE: 25 October 2013

By

GIDEON GROENEWALD

EXECUTIVE SUMMARY

Gideon Groenewald was appointed by PSG Heritage and Grave Relocation Consultants to undertake a Phase 1 PIA, assessing the potential palaeontological impact of the Intibane Coalliery project near the town of Delmas, Delmas Local Municipality, Nkangala District Municipality, Mpumalanga Province. The Mine is already in production and this study refers to proposed mining areas where the palaeontology might have been impacted on by the mining activities as well as areas where mining will be extended to.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development.

The study area is underlain by sedimentary rocks of the Permian aged Vryheid Formation (PV), Ecca Group, Karoo Supergroup. The Vryheid Formation Consists predominantly of grey sandstone with interbedded prominent coal beds and lenses of shale and grit. The sediments are interpreted as having been deposited on a sandy shoreline, beyond which lay vast swamplands. The Vryheid Formation is well-known for abundant accumulation of plant material within these swamps, forming the coal deposits that are mined today.

Dr Gideon Groenewald, Sue Groenewald and David Groenewald, experienced fieldworkers, visited the site of the Intibane Colliery on Friday 18 October 2013.The topography of the study area is undulating, with the coal deposits associated with near horizontal bedding of coarse-grained sandstone and interbedded, dark-grey shale. The two currently mined areas were investigated.

The Intibane Colliery is underlain by Permian aged sandstone and interbedded shale as well as very well developed coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup. Minor trace fossils are present in the deeply weathered coarse-grained sandstone layers. Well-defined plant remains were observed in the less-coalified deposits, mainly associated with the contact zones between shale beds and coal seams. These plant remains are small and relatively sparse. They are thus not deemed to have a high palaeontological significance. The potential for finding well-defined plant fossils remains high, and the sections of the study area that still need to be exposed have thus been allocated a Moderate sensitivity for palaeontology. The mining of coal is, by definition, the mining of fossil plant material.

It is recommended that:

1. The ECO of the project be informed of the possibility of finding well-defined plant fossils in the remainder of the proposed mining area, and that the mining of coal is, in essence, the mining of fossil plant material.
2. An application for a collection and destruction permit be made to SAHRA to allow for the collection and destruction of plant fossils during mining operations.
3. If any exceptionally well-defined fossils are observed during further mining operations, the developer must employ a qualified palaeontologist to record these fossils and collect representative samples of these fossils for further study at an appropriate institution, such as the Bernard Price Institute for Palaeontology at WITS University.

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1. INTRODUCTION

1.1. Background

Gideon Groenewald was appointed by PSG Heritage and Grave Relocation Consultants to undertake a Phase 1 PIA, assessing the potential palaeontological impact of the Intibane Coalliery project near the town of Delmas, Delmas Local Municipality, Nkangala District Municipality, Mpumalanga Province. The Mine is already in production and this study refers to proposed mining areas where the palaeontology might have been impacted on by the mining activities as well as areas where mining will be extended to.

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Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

1.1. Aims and Methodology

Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (2628 East Rand) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage was determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself. The different sensitivity classes used are explained in Table 1.1 below.

Table 1.1 Palaeontological Sensitivity Analysis Outcome Classification

Sensitivity	Description
Low Sensitivity	Areas where a negligible impact on the fossil heritage is likely. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. A field-based assessment by a professional palaeontologist is usually warranted.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

1.2. Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and
- where feasible, examination of fossil collections from the study area (e.g. museums).
- do an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation should focus on the sites where bedrock excavations would definitely require palaeontological monitoring.

The results of the field investigation are then used to predict the potential of buried fossil heritage within the development footprint. In some investigations this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

The project involves the extension of the operational Intibane Colliery open cast mine as well as a stockpile area and areas where offices, crushing and screening plant, overburden dumps and a pollution control dam will be locate (Figure 2.1). The development is located on Farm Vlakvarkfontein 213 I.R., Portion 16 near the town of Delmas, Mpumalanga Province.

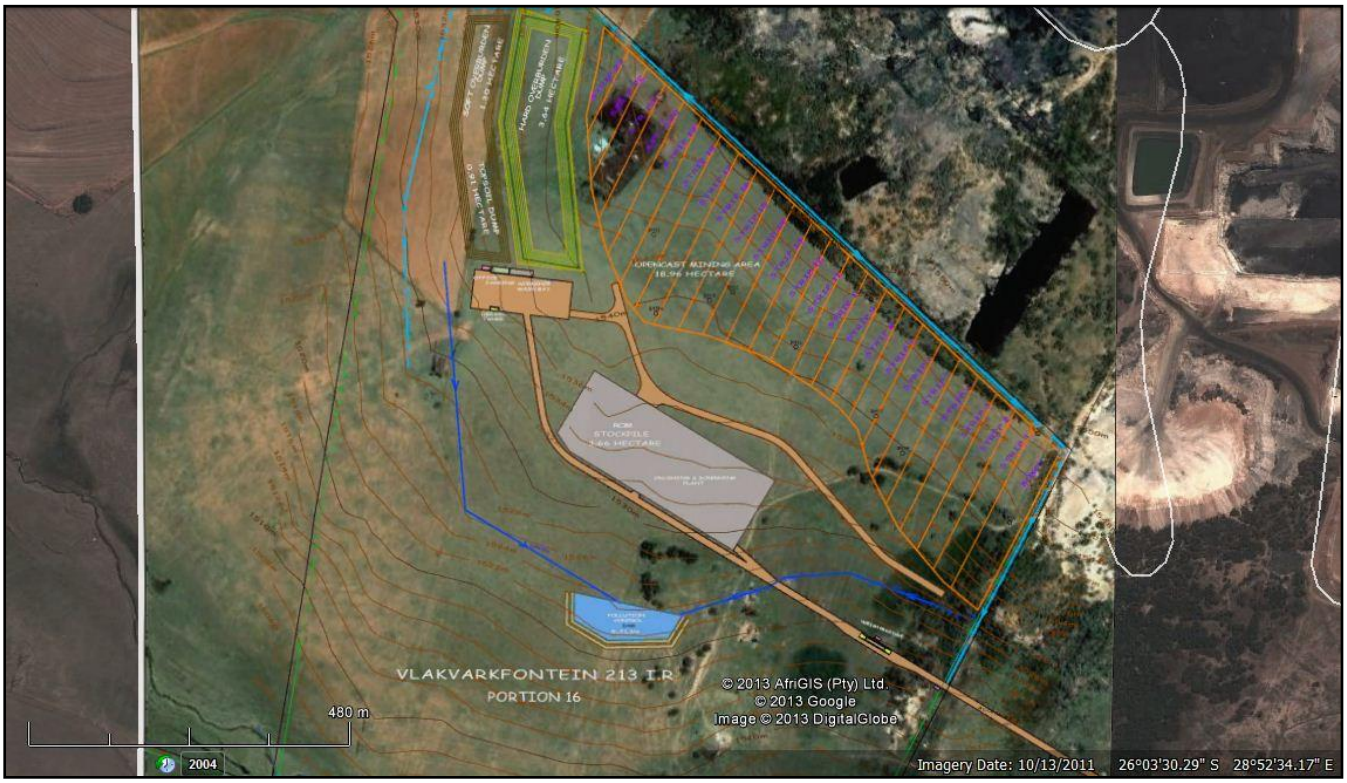
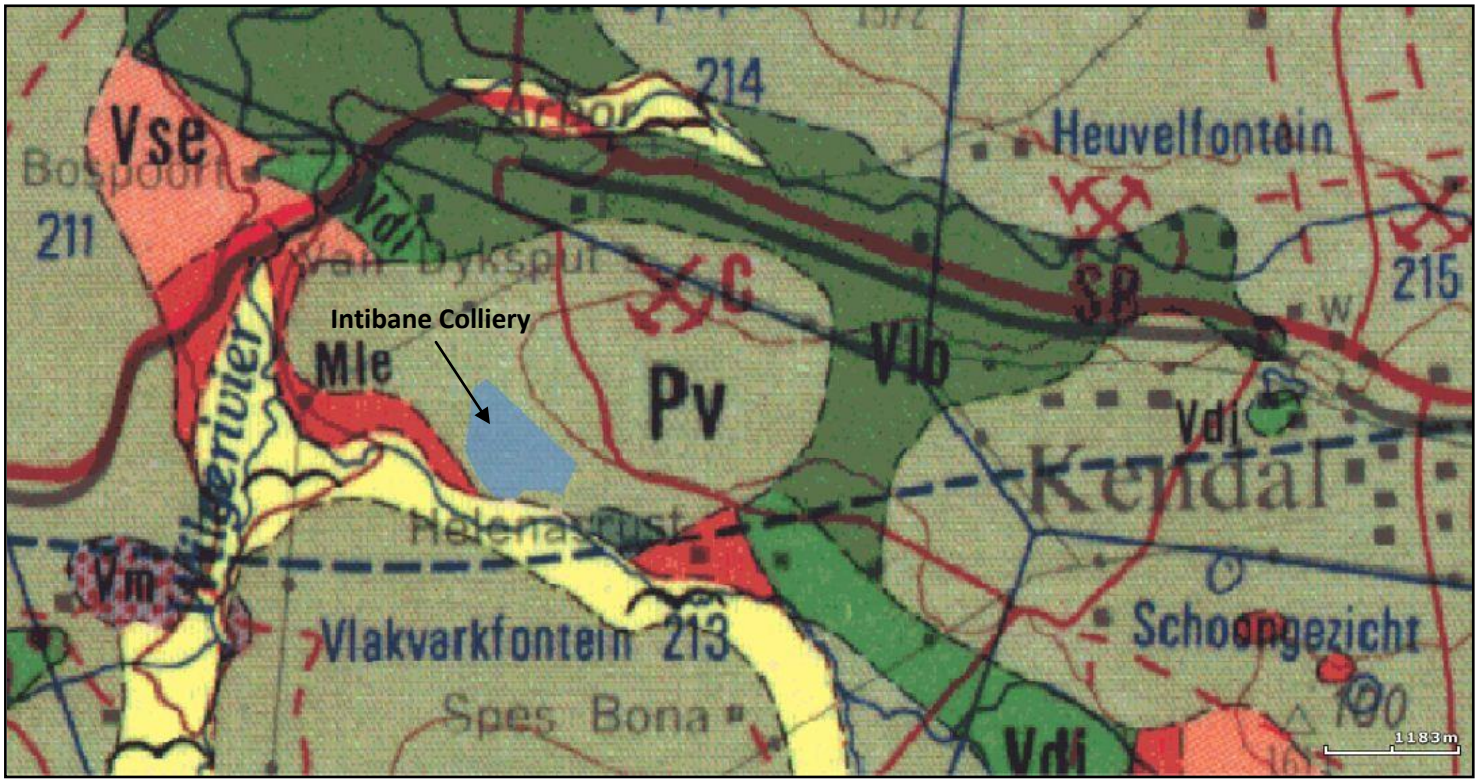


Figure 2.1 Location and layout of the Intibane Colliery

3. GEOLOGY

The study area is underlain by sedimentary rocks of the Permian aged Vryheid Formation (PV), Ecca Group, Karoo Supergroup (Figure 3.1). The Vryheid Formation consists predominantly of grey sandstone with interbedded prominent coal beds and lenses of shale and grit. The sediments are interpreted as having been deposited on a sandy shoreline, beyond which lay vast swamplands. The plant material that accumulated within these swamps formed the coal deposits that are mined today (Johnson et al, 2006).



Geological Legend

Period	Supergroup	Group	Formation	
PERMIAN PERM	OPEENVOLGING KAROO SEQUENCE	ECCA	Vryheid	Pv

Figure 3.1 Geology of the study area

4. PALAEONTOLOGY OF THE STUDY AREA

The Vryheid Formation is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) from the Vryheid Formation are; *Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Glossopteris > 20 species, Hirsutum 4 spp., Scutum 4 spp., Ottokaria 3 spp., Estcourtia sp., Arberia 4 spp., Lidgetonnia sp., Noeggerathiopsis sp. and Podocarpidites sp.*

According to Bamford (2011), little data has been published on these potentially fossiliferous deposits. Good fossil material is likely around the coal mines and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites. In the interests of heritage and science, however, such sites should be well recorded, sampled and the fossils kept in a suitable institution.

Although no vertebrate fossils have been recorded from the Vryheid Formation, invertebrate trace fossils have been described in some detail by Mason and Christie (1986). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which is the earliest known reptile from the Karoo Basin, as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that Mesosaurus could be found in the Vryheid Formation.

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation of Natal. The Karoo sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine. In KwaZulu-Natal a shallow basin margin accommodated a prograding fluviodeltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1986).

5. PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity can be described as significant due to the potential abundance of Permian aged plant fossils known to occur within the Vryheid Formation. The mining of coal will by definition be the mining of fossil plant material, although the best specimens are expected in the layers of rock between the coal seams.

6. FIELD INVESTIGATION

Dr Gideon Groenewald, Sue Groenewald and David Groenewald, experienced fieldworkers, visited the site of the Intibane Colliery on Friday 18 October 2013.The topography of the study area is undulating, with the coal deposits associated with near horizontal bedding of coarse-grained sandstone and interbedded, dark-grey shales. Two of the currently mined areas were investigated (Figures 6.1 and 6.2). Observations made during the investigation include:

- Poorly defined trace fossils associated with coarse-grained sandstone of the Vryheid Formation (Figure 6.3). No attempt was made to identify these structures, other than recording them as possible trace fossils.
- Several well-defined plant fossils including stems of a reed-like plant, possibly a horse tail (Figure 6.4), as well as well-defined leaves of *Glossopteris* (Figure 6.5). These fossils are associated with the less coalified sections of the deposit.
- No plant fossils could be identified in the highly coalified seams.
- No plant fossils were observed within the interbedded shale layers.
- Trace fossils of a possible root structure were observed in highly weathered claystone of the Vryheid Formation. These structures are extremely fragile and would be impossible to sample for collection purposes (Figure 6.6).
- Well defined snuff-box weathering was observed in the coarse-grained sandstone and it is possible that the dendritic pattern caused by this weathering can be incorrectly interpreted as trace fossil remains (Figure 6.7).

Figure 6.2 View of the current western mining area (GPS: S26° 03’ 39.1’ E28° 53’ 06.0”)

Figure 6.1 View overlooking the current eastern mining area (GPS: S26° 03’ 50.0” E28° 53’ 22.5”)

Figure 6.4 Trace fossils associated with the coarse-grained sandstone of the Vryheid Formation (GPS: S26° 03’ 36.6” E28° 53’ 09.3”)

Figure 6.3 Well defined fossil of a reed-like plant (GPS: S26° 03' 51.3" E28° 53' 26.8")

Figure 6.6 Well-defined fossilized leaf, possibly of *Glossopteris*. (GPS: S26° 03' 54.4" E28° 53' 27.2")

Figure 6.5 Trace fossil, possibly of a root structure (GPS: S26° 03' 38.5" E28° 53' 09.1")

Figure 6.7 Snuff-box weathering in the coarse-grained sandstone of the Vryheid Formation (GPS: S26° 03' 41.5" E28° 53' 07.5")

7. PALAEONTOLOGICAL SENSITIVITY AND SIGNIFICANCE

The desktop study suggests that the study area is underlain by sedimentary deposits of the Permian aged Vryheid Formation of the Ecca Group, Karoo Supergroup, and it was expected that it would thus be highly sensitive from a palaeontological heritage perspective. However, the field investigation results indicate that only minor trace fossils occur in the sandstone layers and , although plant fossils associated with the coal seams were observed, they are not abundant in the areas covered by this investigation. It is therefore recommended that the study area maintains a Moderate palaeontological sensitivity, as illustrated in Figure 7.1, for the areas that still need to be uncovered during the mining process and that any well-defined plant fossils that are observed during ,mining operations be reported to the ECO.

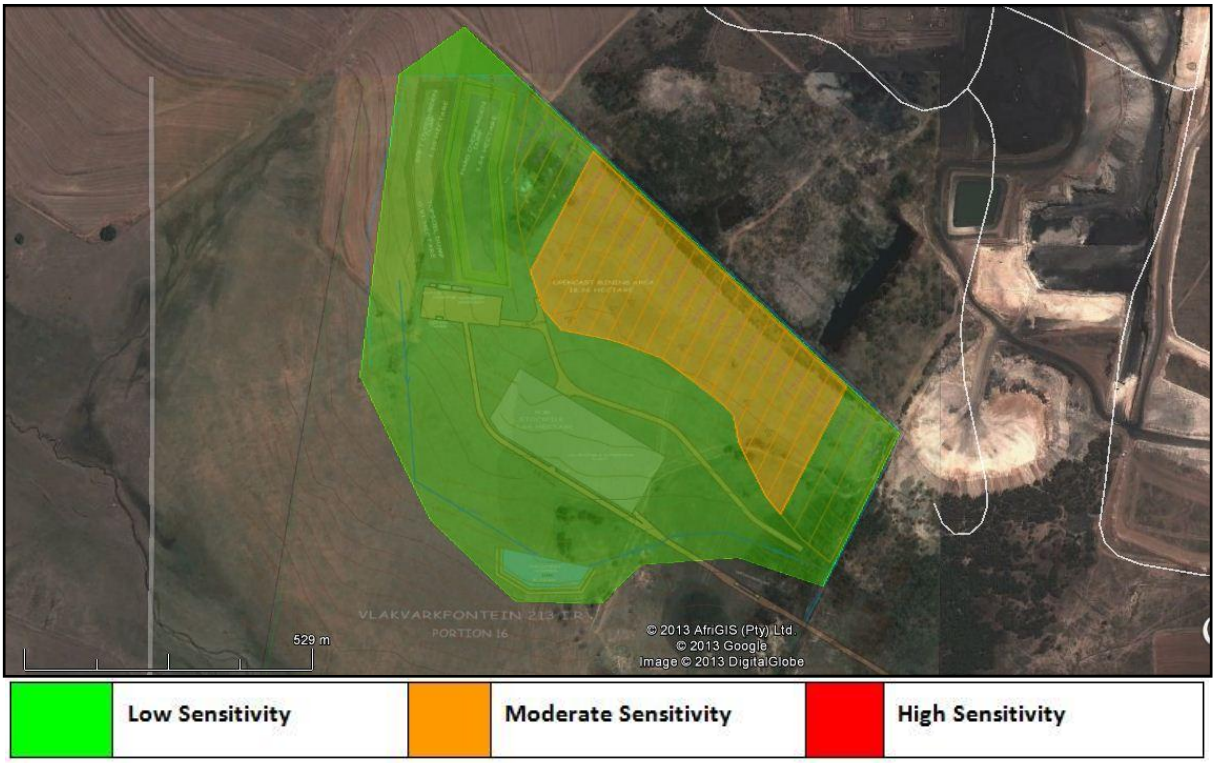


Figure 7.1 Palaeontological sensitivity of the Intibane Colliery.

8. CONCLUSION AND RECOMMENDATIONS

The Intibane Colliery is underlain by Permian aged sandstone and interbedded shale as well as very well developed coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup. Minor trace fossils are present in the deeply weathered coarse-grained sandstone layers. Well-defined plant remains were observed in the less-coalified deposits, mainly associated with the contact zones between shale beds and coal seams. These plant remains are small and relatively sparse. They are thus not deemed to have a high palaeontological significance. The potential for finding well-defined plant fossils still remains high, and the sections of the study area that still need to be uncovered have thus been allocated a Moderate sensitivity for palaeontology. The mining of coal is, by definition, the mining of fossil plant material.

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9. REFERENCES

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10. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

11. DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Dr Gideon Groenewald
Geologist