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PALAEONTOLOGICAL IMPACT ASSESSMEMT REQUESTED IN TERMS OF SECTION 38 OF THE NATIONAL HERITAGE RESOURCES ACT NO 25/1999 FOR THE PROPOSED MINE PROSPECTING ON A PORTION OF FARM 393, BARKLY WEST DISTRICT, NORTHERN CAPE PROVINCE

Prepared by

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DECLARATION OF INDEPENDENCE

AHSA is an independent consultancy: I hereby declare that I have no interest, be it business, financial, personal or other vested interest in the undertaking of the proposed activity, other than fair remuneration for work performed, in terms the National Heritage Resources Act (No 25 of 1999).

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1. INTRODUCTION

This study is a desktop palaeontological impact assessment conducted on a Portion of the Farm 393 (hereinafter the property) situated on the Ghaap Plateau in Barkley West District in the Northern Cape Province (Fig i). The Ghaap Plateau is a high plain rising in the east from a flat valley through which the Harts River flows in a south-western course to join with the Vaal River. Palaeontological heritage resources, commonly called fossils, are unique and non-renewable. They are therefore protected under Section 35 of the National Heritage Resources Act (Act No. 25 of 1999). This desktop assessment of the impact of the proposed development is therefore necessary to ensure that fossil materials are identified, recorded and are either rescued or preserved *in situ*.

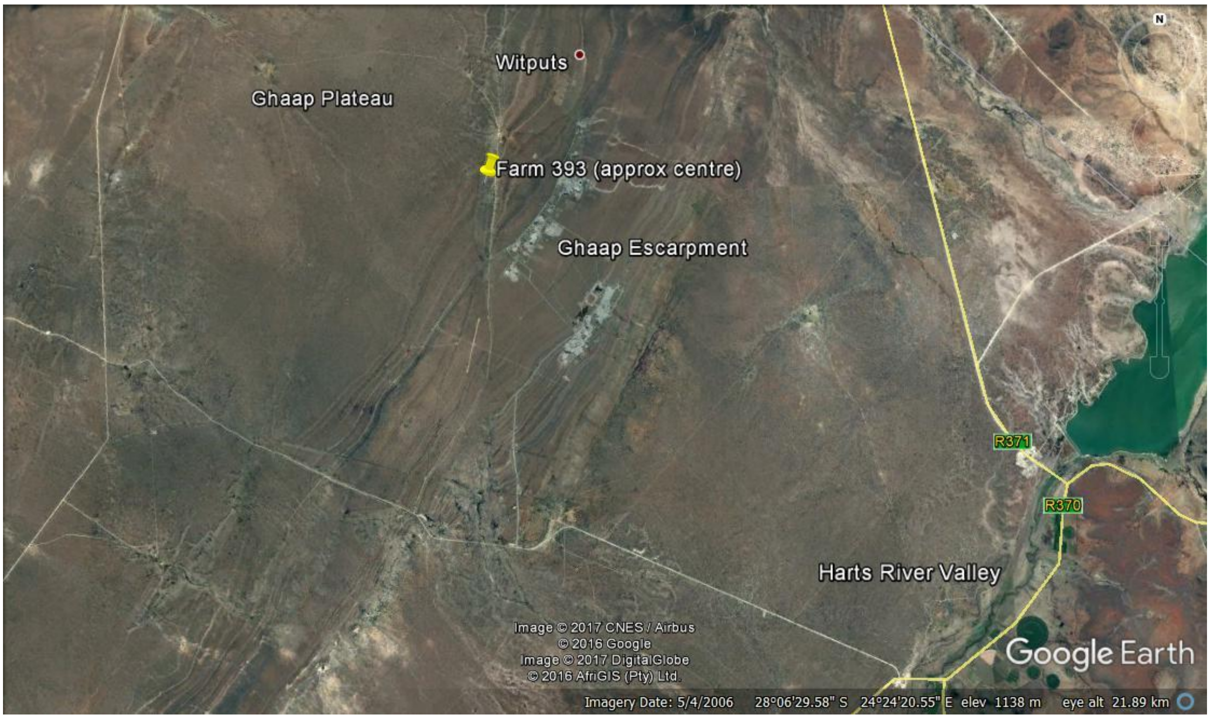

Fig i. Google-Earth map show the location of property on the Ghaap Plateau.

The objective of the study is to determine the impact on potential palaeontological material in the area under study. Palaeontological Scientists have used fossils to construct the long history of life on Earth. Humanity is now concerned about the likely negative impacts of climate change; palaeontological fossils can show evidence of climate change. In the Southern Africa palaeontological studies can provided evidence to support the Continental Drift Theory (McCarthy and Rubidge 2005).

Palaeontological evidence makes it possible to understand how life on Earth has changed, through comparison of fossils and living organisms. The fossil record is always rare and incomplete as a small fraction of organisms that have existed in the Earth's history has been preserved. This underlines the importance of palaeontological impact assessments in areas where they are likely to be affected by development. Fossils are often described in the context of geologic time, a simplified framework of which is presented in the following table (Fig ii):

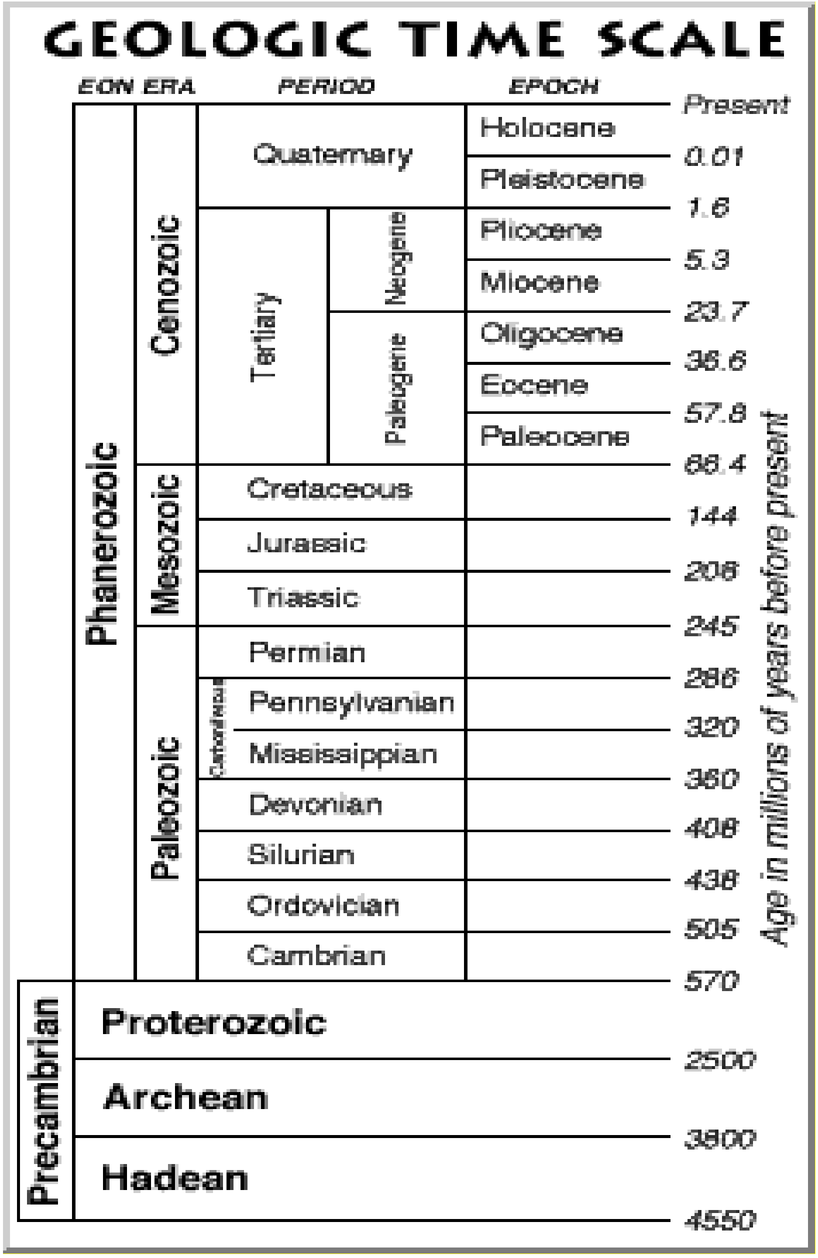

Fig ii. Geologic timescale.

2. RELEVANT LEGISLATION

Palaeontological objects and materials, meteorites and rare geological specimens are recognised as part of the National Estate in Section 3 of the National Heritage Resources Act (NHRA)(25/1999). This also includes geological sites of scientific or cultural importance. This desktop palaeontological impact assessment (PIA) was conducted as part of an Environmental Impact Assessment. In Section 32.1(a) of the NHRA fossils are treated as a category of heritage – palaeontological heritage - and are regarded as part of the National Estate.

Sections 35 and 38 of the National Heritage Resources Act (No 25 of 1999) form the legal context in which Heritage Impact Assessments are prescribed. As statutory reference they guided fieldwork and preparation of this report. The PIA has been conducted in tandem with a Heritage Impact Assessment (HIA) to locate sites of heritage significance and assess potential adverse or positive impacts of the proposed mining.

Section 38 of the NHRA states the nature and scale of development which triggers a HIA:

38. (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50 m in length;

(c) any development or other activity which will change the character of a site— exceeding 5 000 m2 in extent2; or

(ii) involving three or more existing erven or subdivisions thereof; or

(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

(*iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;*

(d) the re-zoning of a site exceeding 10 000 m2 in extent; or

(e) any other category of development provided for in the regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating

such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

Section 35 (4) of the NHRA prohibits the destruction of archaeological, palaeontological and meteorite sites:

No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

3. APPROACHES AND METHODS

A desktop study was conducted to assess the potential risk to palaeontological material (fossils, trace fossils) in the proposed areas of development. Documentary materials on geology and palaeontology of the study area were consulted, principally previous palaeontological assessments in the area. Topographical and geological maps of the area were also studied.

3.1. Assumptions and Limitations

The assumption that fossils exist in the development area is based on the presence of such fossils in the same rock units elsewhere. It was assumed that palaeontological sensitivity of rock units underlying the study area and from field and other data obtained outside the study area is fairly uniformly distributed. This is however, will be limited by factors such as variations in the deposition setting across a formation, tectonic deformation as well as the intensity and nature of metamorphism and weathering experienced by a given formation may change markedly across its outcrop area. A scoping survey may thus fail to predict variations present within a sedimentary rock unit so that there might be highly fossiliferous localities where the rating has been determined to be low, or low sensitivity localities where the rating has been determined to be high (Almond and Pether 2009).

4. GEOLOGICAL CONTEXT

The locality falls within the Campbell Rand Subgroup (previously included within the Ghaaplato Formation) of the Ghaap Group (Almond, 2012). The Campbell Rand succession has been subdivided into a series of formations, some of which were previously included within the older Schmidtsdrift Formation or Subgroup (Eriksson, et *al.* 2006).

This Subgroup (Campbell Rand) is a very thick (1.6-2.5 km) carbonate platform succession of dolomites, dolomitic limestones, chert cobbles and pebbles that were derived from Proterozoic Kanguru Member with minor tuffs that were deposited on the shallow submerged shelf of the Kaapvaal Craton, roughly 2.6-2.5 Ga (billion years ago) (McCarthy & Rubidge, 2005; Smit, 1975) (Figs iii - iv). A range of shallow water facies, often forming depositional cycles reflecting sea level changes, including stromatolitic limestones and dolostones, oolites, oncolites, laminated calcilutites, cherts and marls, with subordinated siliclastics (shales, siltstones) and minor tuffs, can be seen (Almond, 2014). Exposure levels of these rocks are often very low due to their solubility and low resistance to weathering (Almond, 2012).

In some parts of the property there are Late Caenozoic superficial deposits mainly Quatenary to recent calcretes (pedogenic limestones) and down-wasted rubble of a relatively young age can be seen which are deemed of low palaeontological sensitivity (Almond 2011: 1) (Fig v).

Remnants of diamond bearing fluvial gravels of the Cretaceous age have been preserved on the Ghaap Plateau Reivilo. According to Smit (1975), the alluvial deposits contain well preserved fossil woods representing four periods: Post Permian (Upper Karoo), Early Cretaceous, Late Cretaceous and Tertiary.

A specimen is reported to have been derived from the Beaufort Group sediments, eroded from the Ghaap Plateau. At Mahura Muthla (80km NW of the study area) at the start of the Cretaceous the area was covered by sandstones of the Beaufort Group with overlying flood basalts of the Drakensberg Group.[1]

According to De Wit *et al.* (2009), the Transvaal dolomites have also been recorded on the Ghaap Group. The geology of the project area can also be described as consisting of flat lying dolomites and limestones of the Reivilo Formation in the Campbell Rand Subgroup (Ghaap Group) of the palaeo- Proterozoic Transvaal Supergroup (Erickson *et al.* 2006). It also consists of the Allanridge Formation of the Ventersdorp Supergroup occurring 30km north of Mahura Muthla. The Fairfield Formation of the Campbell Rand Subgroup overlies the Kanunguru Member in the south. Carbonates of the Reivilo Formation comprise mainly fine grained dolomites (Fig iii) with giant stromatolites domes interciated with cycles of columnar stromatolites and fenestral facies (De Wit 2009; Eriksson *et al.* 2006). Oolitic beds are intercalated in places. According to Beukes (1983), limestone occurs in the lower sections with chert and chert breccias towards the top. It also contains jasper and red chert bands and forms a very important marker on the Ghaap Plateau (Beukes 1983).

The Kanunguru Member is overlain by Fairfield Formation clastic carbonate beds passing upwards into columnar stromatolites and fenetsrated laminates (Ericksson *et al.* 2006). Ongeluka Formation extrusive igneous rocks occurring at the tap of the Transvaal Supergroup.

[1]The significance of the cretaceous diamondiferous gravel deposit at Mahura Muthla, Northern Cape Province, South Africa, at: http://sajg.geoscienceworld.org/content/112/2/89 (consulted 5 May 2017).

Fig iii. Solid exposures of dolomite occur on Portion of the Farm 393 (photo: E. Matenga).

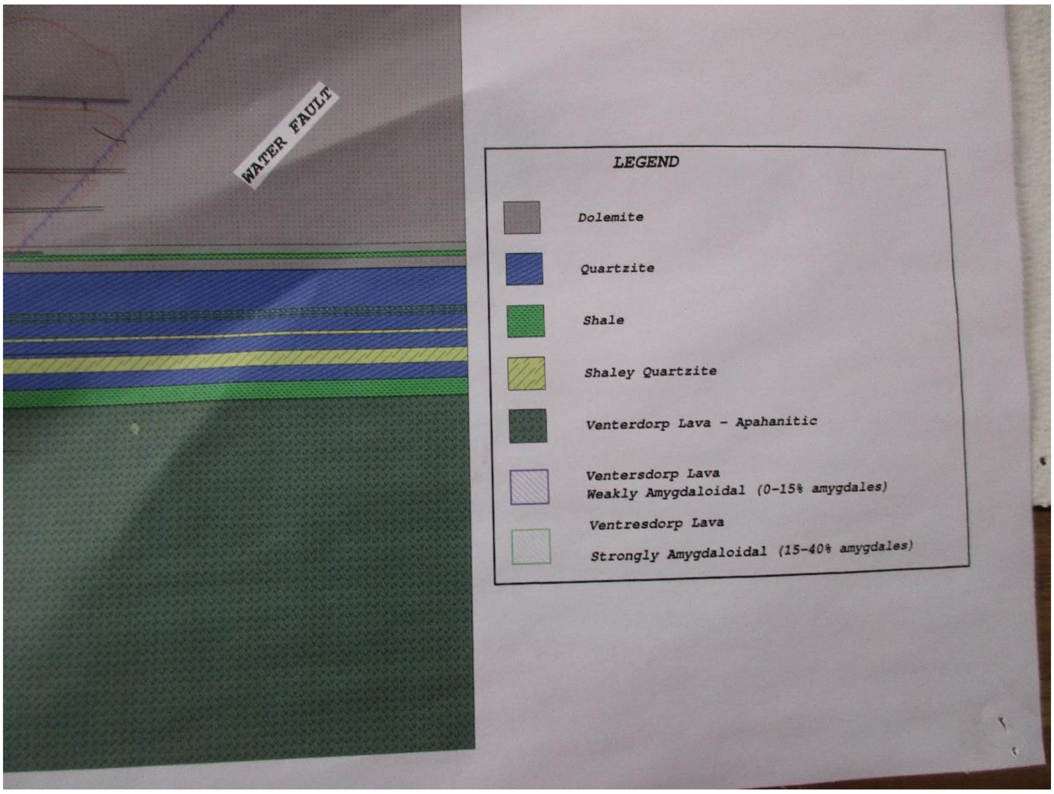

Figure iv: Photo showing the geological stratigraphy of the area (courtesy of Sedibeng Mines (JV)).

Fig v. Superficial calcretes on a western portion on the property (photo: E. Matenga).

5. PALAEONTOLOGICAL CONTEXT

The area is underlain by Early Precambrian marine sediments of the Ghaap Group (Campbell Rand subgroup) comprising dolomites, shales and cherts and late Caenozoic calcretes. The former provenances are potentially fossiliferous rock units containing microbial mounds or stromatolites (Almond 2011; Almond and Pether 2009; De Wit 2009; Eriksson *et al*. 2006). Some stromatolite occurrences which have been observed on the Ghaap Plateau are well preserved (Eriksson, *et. al.* 2006). The Tsineng Formation at the top of the Campbell Rand carbonate succession has yielded both stromatolites which were previously assigned to the Tsineng Member of the Gamohaan Formation, as well as filamentous microfossils named *Siphonophycus* (Altermann & Schopf, 1995).

6. CONCLUSION AND RECOMMENDATIONS

The findings of the desktop palaeontological study indicate that the Campbell Rand Subgroup is rich in fossils (Almond 2011; Almond and Pether 2009; De Wit 2009; Erriksson *et al.* 2006). A wealth of well-preserved stromatolites as well as filamentous microfossils have been found elsewhere in the Campbell Subgroup. There is possibility to strike good material in the area under study. The impact of prospecting on fossil resources is likely to be minimal. However when mining commences, and if good exposures are uncovered, these should be safeguarded wherever possible *in situ*. It is further recommended that the Environmental Control Officer (ECO) responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all substantial excavations into sedimentary bedrock for fossil remains. In the case of any significant fossils (e.g. vertebrate teeth, bones, burrows, and petrified wood) being found during construction, they must be safeguarded and the relevant heritage management authority (SAHRA) be informed so that a professional palaeontologist may be consulted in order to facilitate the necessary rescue operations.

6.1. Fossil Finds Procedure (FFP)

A **Fossil Finds Procedure** is appended to this report.

7. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

The author specialised in Palaeobotany which is a branch of palaeontology dealing with the recovery and identification of plant remains from geological contexts, and their place in the reconstruction of past environments and the history of life. Palaeobotany includes the study of terrestrial plant fossils as well as the study of marine autotrophs, such as algae. A closely related field to palaeobotany is palynology, the study of fossil and extant spores and pollen. My PhD thesis focused on the application of palaeoecology and anthracology at Great Zimbabwe. Paleoecology uses data from fossils and subfossils to reconstruct the ecosystems of the past. It includes the study of fossil organisms in terms of their life cycle, their living interactions, their natural environment, their manner of death, and their burial.

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