SAHRA Case ID: 11907

BRIEF PALAEONTOLOGICAL ASSESSMENT (DESKTOP STUDY)

EXPANSION OF DIAMOND COAST AQUACULTURE FARM PORTION 1 OF FARM KLEINZEE 654, KLEINZEE, NORTHERN CAPE

Nama Khoi Municipality, Namakwaland Magisterial District

By

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Prepared at the Request of

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31 JANUARY 2018

DECLARATION OF INDEPENDENCE

BRIEF PALAEONTOLOGICAL ASSESSMENT (DESKTOP STUDY)

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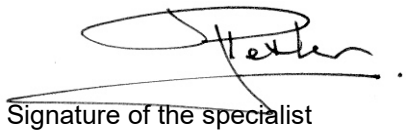
Terms of Reference

This assessment forms part of the Heritage Assessment and it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area.

Declaration

I …**John Pether**……, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in the compilation of the above report;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
- have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist

Date: 31 JANUARY 2018

CURRICULUM VITAE

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)

Independent Consultant/Researcher recognized as an authority with 37 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine). At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~250 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Association of Professional Heritage Practitioners (APHP), Western Cape. Accredited Member No. 48.

Past Clients Palaeontological Assessments

AECOM SA (Pty) Ltd.	Guillaume Nel. Env. Management Consultants.
Agency for Cultural Resource Management (ACRM).	Klomp Group.
AMATHEMBA Environmental.	Megan Anderson, Landscape Architect.
Anél Blignaut Environmental Consultants.	Ninham Shand (Pty) Ltd.
Arcus Gibb (Pty) Ltd.	PD Naidoo & Associates (Pty) Ltd.
ASHA Consulting (Pty) Ltd.	Perception Environmental Planning.
Aurecon SA (Pty) Ltd.	PHS Consulting.
BKS (Pty) Ltd. Engineering and Management.	Resource Management Services.
Bridgette O'Donoghue Heritage Consultant.	Robin Ellis, Heritage Impact Assessor.
Cape Archaeology, Dr Mary Patrick.	Savannah Environmental (Pty) Ltd.
Cape EAPrac.	Sharples Environmental Services cc
CCA Environmental (Pty) Ltd.	Site Plan Consulting (Pty) Ltd.
Centre for Heritage & Archaeological Resource Management	Strategic Environmental Focus (Pty) Ltd.
Chand Environmental Consultants.	UCT Archaeology Contracts Office (ACO).
CK Rumboll & Partners.	UCT Environmental Evaluation Unit
CNdV Africa	Urban Dynamics.
CSIR - Environmental Management Services.	Van Zyl Environmental Consultants
Digby Wells & Associates (Pty) Ltd.	ENVIRO DINAMIK.
Enviro Logic	Wethu Investment Group Ltd.
Environmental Resources Management SA (ERM).	Withers Environmental Consultants.
Greenmined Environmental	

Stratigraphic consulting including palaeontology

Afri-Can Marine Minerals Corp	Council for Geoscience
De Beers Marine (SA) Pty Ltd.	De Beers Namaqualand Mines.
Geological Survey Namibia	IZIKO South African Museum.
Namakwa Sands (Pty) Ltd	NAMDEB

CONTENTS

1 BACKGROUND

Diamond Coast Aquaculture (Pty) Ltd (DCA) owns and operates a land-based marine aquaculture farm on Portion 1 of Farm Kleinzee 654, situated just north of Kleinzee in the Northern Cape (Figure 1), on land previously owned and mined for diamonds by De Beers Namaqualand Mines Division (DBNM). DCA proposes to significantly increase production of aquaculture products by expanding the facilities, the construction of which triggers the requirement for an Environmental Authorization (EA) from the Northern Cape Department of Environment and Nature Conservation. DCA has appointed Anchor Environmental Consultants (Pty) Ltd (Anchor) to undertake the Basic Assessment (BA) process for the EA Application. A Heritage Impact Assessment (HIA) must be conducted as part of the EA Application in terms of NEMA 1998 and the 2017 NEMA EIA Regulations and Sections 38(3) and 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA). This report forms part of the Heritage Assessment and its brief is to inform about the palaeontological sensitivities of the geological formations which occur on Portion 1 of Kleinzee 654.

2 LOCATION

Portion 1 of Farm Kleinzee 654 is situated just north of the Buffelsrivier and the previously private DBNM mining town of Kleinzee (Figure 1). Previously a part of Klein Zee 193 which in the literature about the DBNM operation is referred to by the older name “Annex Kleinzee”.

1:50 000 Topo-cadastral Sheet 2916DB & 2917CA KLEINSEE.

Point in the middle of the oyster ponds area: -29.664861°S; 17.047305°E. WGS84.

3 LOCALITY PLAN

See Figure 2.

4 DESCRIPTION OF THE PROPOSED DEVELOPMENT

DCA currently produces about 150 tonnes (t) of abalone and 200 t of seaweed.annually. DCA propose to expand their facilities to achieve an annual production capacity of 1000 t of abalone, 2000 t of finfish, 5000 t of seaweed, 300 t of oysters, sea urchins and/or sea cucumbers (Figure 2). DCA also propose to install a small wind farm (10-20 megawatts) in the area of overburden dumps in the eastern part of the property (Figure 2, unrehabilitated mine area).

Figure 3, a screen grab from the video available at the parent company website, shows the earth works required (http://www.vikingaquaculture.co.za/abalone/farming/), chiefly entailing the construction of level platforms made up of older, yellow sands with a pedogenic clay content which is thus compactable.

5 HERITAGE RESOURCES IDENTIFIED

The bedrock slope of the eastern portion of the Project Area consists of unfossiliferous granite and gneiss (Figure 4). To the west is a flat marine platform formed on bedrock of the steeply-dipping, pale, flaggy quartzites and interbedded conglomerates of the **Vredefontein Formation** (**Gariep Supergroup**, **Port Nolloth Group**, **Stinkfontein Subgroup**). These metasediments were deposited in a shallow, near-shore environment about 740-730 Ma (Ma = million years ago) (Marais *et al.*, 2001; Gresse *et al.*, 2006). Very early, microscopic life forms were present by this time, such as complex microfossils with organic walls called acritarchs (from the Greek meaning “of uncertain origin”), but are not of concern here.

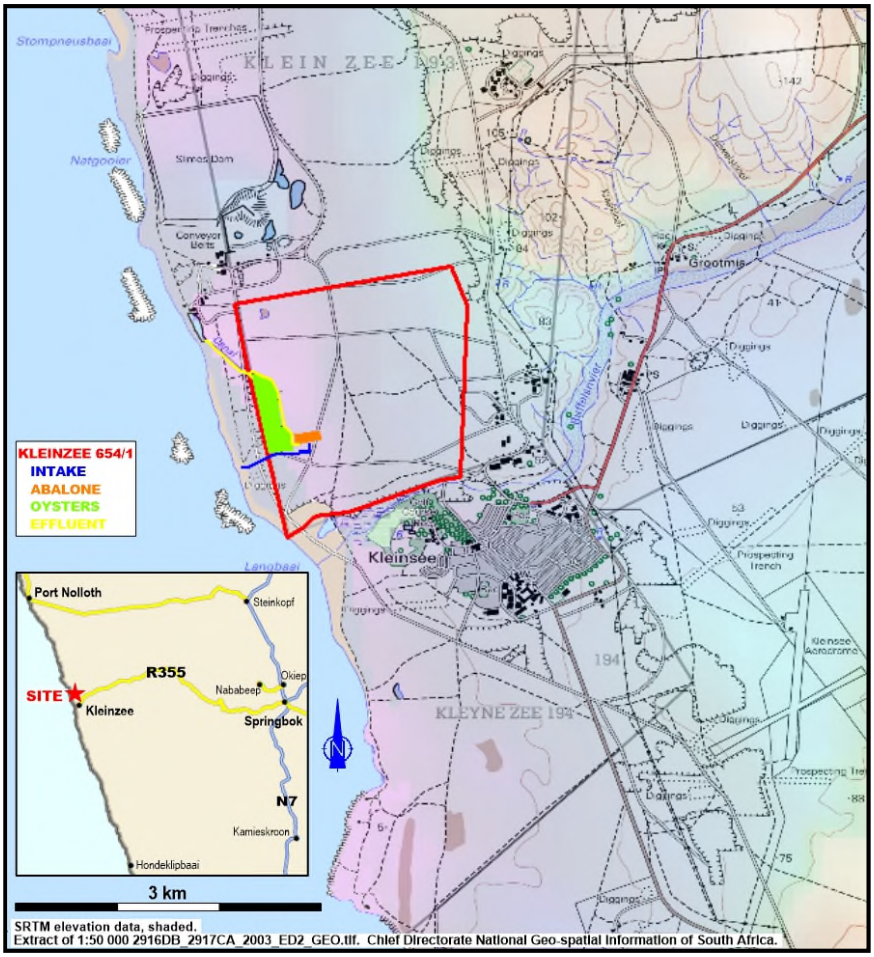


Figure 1. Location of Portion 1 of Kleinzee 654 showing current basic layout.

The formations which overlie the bedrock of the Namaqualand coastal plain are collectively called “The West Coast Group”. The Project Area is situated on the outer edge of the coastal plain and thus only the marine formations and the younger aeolian formations are of potential concern.

The oldest marine formation is the **Kleinzee Formation** which occupies the inner, high part of the coastal bevel and extends seawards from ~90 m asl. (also called the 90 m Package). It was deposited during the decline from the high sea level of the warm **Mid-Miocene Climatic Optimum** ca. 17 to 15 Ma. The previous Miocene marine beds were eroded during rising sea-level of the **Early Pliocene Warm Period** and the **Avontuur Formation** (the 50 m Package) was deposited 5-4 Ma as sea-level receded from the transgression maximum of about 50 m asl. and the shoreline prograded seawards. The Avontuur Formation in turn was eroded by yet another rising sea-level associated with the **Mid-Pliocene Warm Period** ~3 Ma. The **Hondeklipbaai Formation** or 30 m Package was deposited as sea level declined from a high of about 30-33 m asl. and a substantial, prograded marine formation built out seawards. This formation, up to a few km wide, underlies the outer part of the coastal plains of the West Coast.

Fossil shells are found in places in these Miocene and Pliocene marine formations and each contains warm-water species and also important extinct fossil shell species which are characteristic of that formation and which facilitate correlation of formations over wide regions.

Figure 2. Proposed expansion of the production facilities at Diamond Coast Aquaculture. Adapted from Fig. 2 of Anchor Environmental Consultants, Nov. 2017.

Figure 3. The existing abalone farm and solar dam, showing yellow made ground.

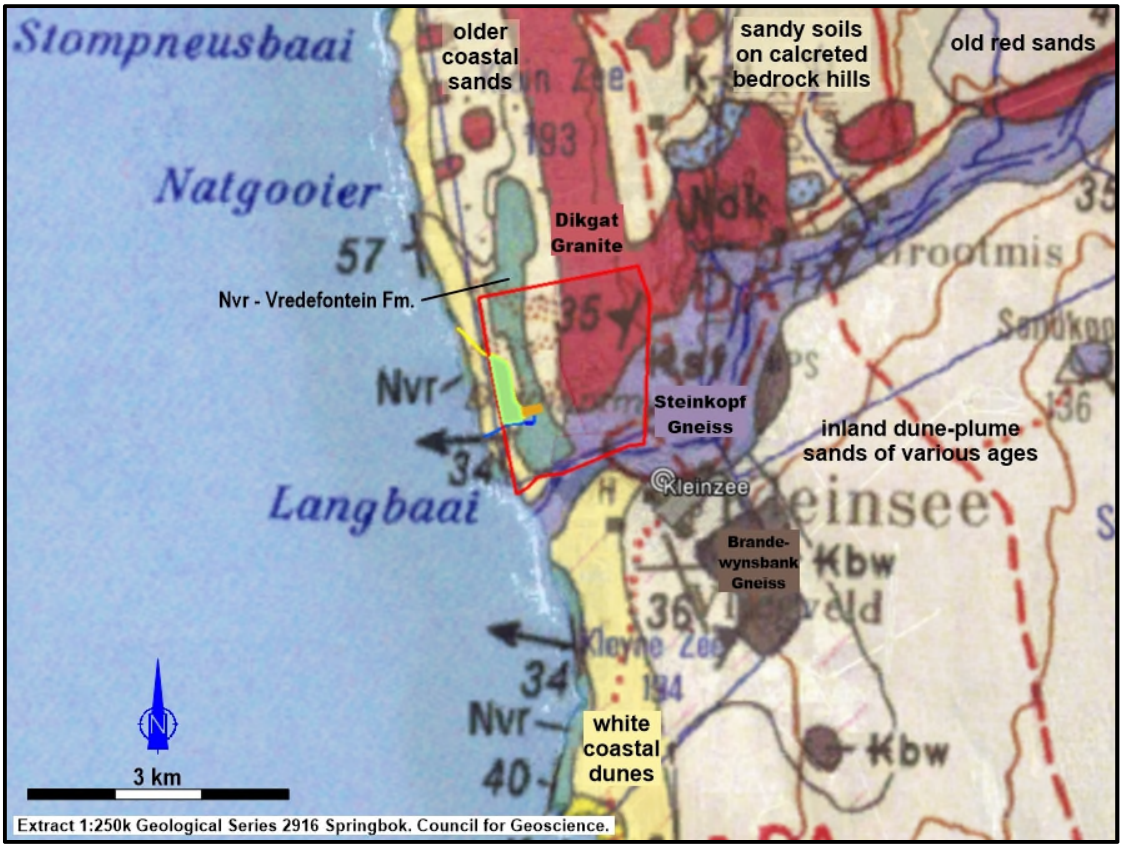


Figure 4. Geology in the vicinity of Kleinzee.

Close to the seaside, the Hondeklipbaai Formation is eroded and overlain by the younger, Quaternary "raised beaches" that extend up to about 12-15 m asl. The name name **Curlew Strand Formation** has been proposed for this composite of old beaches, equivalent to the Velddrif Formation of the SW Cape Coast. It comprises the **8 - 12 m Package** (~400 ka), the **4 - 6 m Package** of the Last Interglacial (LIG) ~125 ka and the **2 - 3 m Package** (mid-Holocene High 6-4 ka) (ka = thousand years ago). The fossil shells in these "raised beaches" are predominantly the cold-water fauna of modern times.

The older marine deposits have been extensively eroded, mainly by wind deflation, and have also been subjected to decalcification, pedogenic reddening and the formation of pedocretes beneath palaeosurfaces. A variety of terrestrial deposits overlie the eroded tops of the marine sequences. For the most part these are extensive aeolian dune and sandsheet deposits. The writer has recognized aeolian formations of later Miocene, mid-Pliocene, late Pliocene and various Quaternary ages. Locally interbedded in the aeolianites are colluvial (sheetwash) and ephemeral stream deposits associated with nearby hill slopes. Sometimes these underlie or are interbedded between the marine formations. Formed within these terrestrial sequences are pedocretes and palaeosols of a variety of types, compositions and degrees of development. Interbedded pan deposits also occur. Fossil bones occur sparsely on palaeosurfaces within the aeolian deposits and are more abundant in the vicinity of buried, fossil pans, sometimes with associated archaeological material.

Whereas the youngest aeolian sands are loose or slightly consolidated and of pale hues (white, grey, yellow, pink), the older terrestrial deposits are compact, yellow-brown or reddened sands with a hard surface under the loose coversands, colloquially termed "dorbank". The younger, white to lightly-reddened coversands and dunes have been cored by Chase & Thomas (2007), whom applied optically stimulated luminescence (OSL) dating techniques to establish the timing of sand accumulation. Their results indicate

activity/deposition at various times during the last ~80 ka (63–73, 43–49, 30–33, 16–24 and 4–5 ka). Underlying sandy soils produced dates from ~150 to ~300 ka, reflecting the accumulation of sand sheets during the middle Quaternary (the compact, yellow to red "dorbank" sands).

6 ANTICIPATED IMPACTS ON PALAEONTOLOGICAL HERITAGE RESOURCES

The early Pliocene Avontuur Formation maximum palaeoshoreline at ~50 m asl is in the north-eastern corner of the Project Area, where gullied granite bedrock and a low cliff are present, and these marine deposits mantled the bedrock slope to lower elevations. The Late Pliocene Hondeklipbaai Formation lapped in from the west over the bedrock and preceding deposits and mainly occupied the flatter marine platform area formed on the Vredefontein quartzites bedrock. The mid-Quaternary (~400 ka) raised beach just lapped into the western edge of the Project Area. The Last Interglacial and Holocene High raised beaches are under the coastal dune cordon just outside the Project Area in State Land.

However, the entire area of Farm 654/1 has been mined for diamonds and *in situ* deposits with fossils are unlikely to remain. Furthermore, the marine deposits exposed in trenches just north of the Project Area, including both the Hondeklipbaai Formation and the mid-Quaternary (~400 ka) raised beach, are very decalcified and consequently of low to negligible fossil shell potential (personal observations) and this condition likely applied to most of the mined-away deposits of the Project Area.

It is possible that fossil bones in the various deposits ended up in the overburden dumps and could be discovered during earth moving for construction and rehabilitation. The context of the Project Area, directly adjacent to the mouth of a major drainage, renders it more probable that the fossil bones of terrestrial animal carcasses were present in the deposits in greater abundance than is generally the case. Indeed, the first major fossil bone find on the Namaqualand coast was discovered in this area. Stromer (1931) described a small vertebrate assemblage from river deposits overlying the early Pliocene marine beds at ~35 m asl. on the immediate north bank of the Buffelsrivier, *i.e*. in the vicinity of the south-eastern corner of the Project Area. The extinct species included an hyaena, a giant otter and a mongoose, fossils of which were later also found in the early Pliocene deposits at Langebaanweg. Only the illustrations of the Kleinzee fossils remain as the material was taken to Germany and was lost during WW II (Hendey, 1984; Pickford & Senut, 1997).

A new pump station will be constructed at the shore and additional pipelines will traverse the dune-covered State Land area (Figure 2). The shell content of the underlying raised beaches of low palaeontological sensitivity. Here the concern is the possible occurrence of bones in the beach deposits and in the overlying dunes where archaeological material also occurs.

7 RECOMMENDATIONS

In summary, there is a distinct possibility that displaced, scientifically valuable fossil bones may occur in the overburden dumps. Fossil bones and archaeological material may be exposed in the seaside dune area, but intended subsurface disturbance there is limited.

It is recommended that a requirement to be alert for possible fossil materials and buried archaeological material be included in the Environmental Management Plan (EMP) for the proposed construction operations.

8 FOSSIL FINDS PROCEDURE

As part of pre-prospecting Environmental and Health & Safety awareness training, personnel must be instructed to be alert for the occurrence of fossil bones, archaeological material and of unrecorded burials.

In the event of a find of fossil bones in the overburden heaps or in the seaside dunes, work must cease at the site and the works foreman and the Environmental Control Officer (ECO) for the project must be informed immediately. Scattered, unearthed parts/fragments of the find must be retrieved and returned to the main find site which must be protected from further disturbance.

The ECO or representative must then inform SAHRA immediately and provide:

- A description of the nature of the find.
- Detailed images of the finds (with scale included).
- Position of the find (GPS) and depth.
- Digital images of the context. *i.e*. the excavation (with scales).

SAHRA and an appropriate specialist palaeontologist will assess the information and liaise with the developer, the environmental consultants and the ECO and a suitable response will be established.

9 REFERENCES

Anchor Environmental Consultants, Nov. 2017., Background Information Document, Expansion Of Diamond Coast Aquaculture Development, Northern Cape.

Chase, B.M. & Thomas, D.S.G. 2007. Multiphase late Quaternary aeolian sediment accumulation in western South Africa: timing and relationship to palaeoclimatic changes inferred from the marine record. Quaternary International 166: 29–41.

Gresse, PG., Von Veh, MW. & Frimmel, HE. 2006. Namibian (Neoproterozoic) to Early Cambrian successions. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The Geology of South Africa. Geological Society of South Africa, Marshalltown. 395-420.

Hendey, Q.B. 1984. Southern African late Tertiary vertebrates. In: Klein, R.G. (ed.), Southern African Prehistory and Paleoenvironments: 81 106. Rotterdam, A.A. Balkema.

Marais, JAH., Agenbacht, ALD., Prinsloo, M. & Basson, WA. 2001. The Geology of the Springbok Area. Explanation to 1:250000 Geology Sheet 2916 Springbok. Council for Geoscience, Pretoria. 103 pp.

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Stromer, E. 1931. Reste süsswasser-und land-bewohnender Wirbeltiere aus den Diamantfeldern Klein-Namaqualandes (Südwes-Afrika). Sitzungsberichte Bayerische Akademie der Wissenschaften 1931: 17 47.

10 APPENDIX 1. PALAEONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

HIGH: Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

MODERATE: Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

LOW: Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

MARGINAL: Formations that are composed either of volcaniclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcaniclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

NO POTENTIAL: Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.