PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

PROPOSED EXTENSION OF AN EXISTING BORROW PIT ALONG THE MR282 NEAR BONNIEVALE, SWELLENDAM DISTRICT, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The existing MR00282/16.8/L/10/A/R2 pit, situated some two km south of Bonnievale, is excavated into non-marine sandstones and mudrocks of the Middle Devonian Adolphspoort Formation (Upper Bokkeveld Group) that elsewhere are well-known for their Middle Devonian fish fauna, molluscs, vascular plants and trace fossils. However, the Bokkeveld sediments in the study area are highly cleaved and show no evidence of fossiliferous ferruginous nodules. The palaeontological sensitivity of the site is correspondingly LOW and, pending the discovery of substantial new fossil material such as shelly fossil, fish or plant remains, no further studies or mitigation of fossil heritage for this borrow pit and its possible expansion to the northwest are considered necessary.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to extend and exploit road material from an existing borrow pit located just to the south of the town of Bonnievale in the Worcester – Robertson Karoo region (Swellendam District). Pit MR00282/16.8/L/10/A/R2 (33º 57' 26.9" S, 20º 06' 02.4" E) on Swellendam Farm No. 575 (Bonnita), is situated at the junction of the MR282 and MR289 roads some two km south of Bonnievale, Western Cape (Figs. 1 & 2).

A previous desktop basic assessment of the pit by the author assessed its palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Adolphspoort Formation (Upper Bokkeveld Group, Traka Subgroup), but noted that fossil preservation here might be compromised by tectonic cleavage. A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC Case Ref. 1914 - 2021 120726JL29E, Interim Comment 8 August 2012) in accordance with the requirements of the National Heritage Resources Act, 1999 (Section 38). The present palaeontological heritage field assessment and short report were accordingly commissioned by Vidamemoria Heritage Consultants, Cape Town (Address: 3rd Floor, Guarantee House, 37 Burg Street, Greenmarket Square, Cape Town; tel: 021-424 8432; e-mail: Quahnita@vidamemoria.co.za). This is Vidamemoria pit no. 156. Fieldwork for this project was carried out on 16 September 2012.

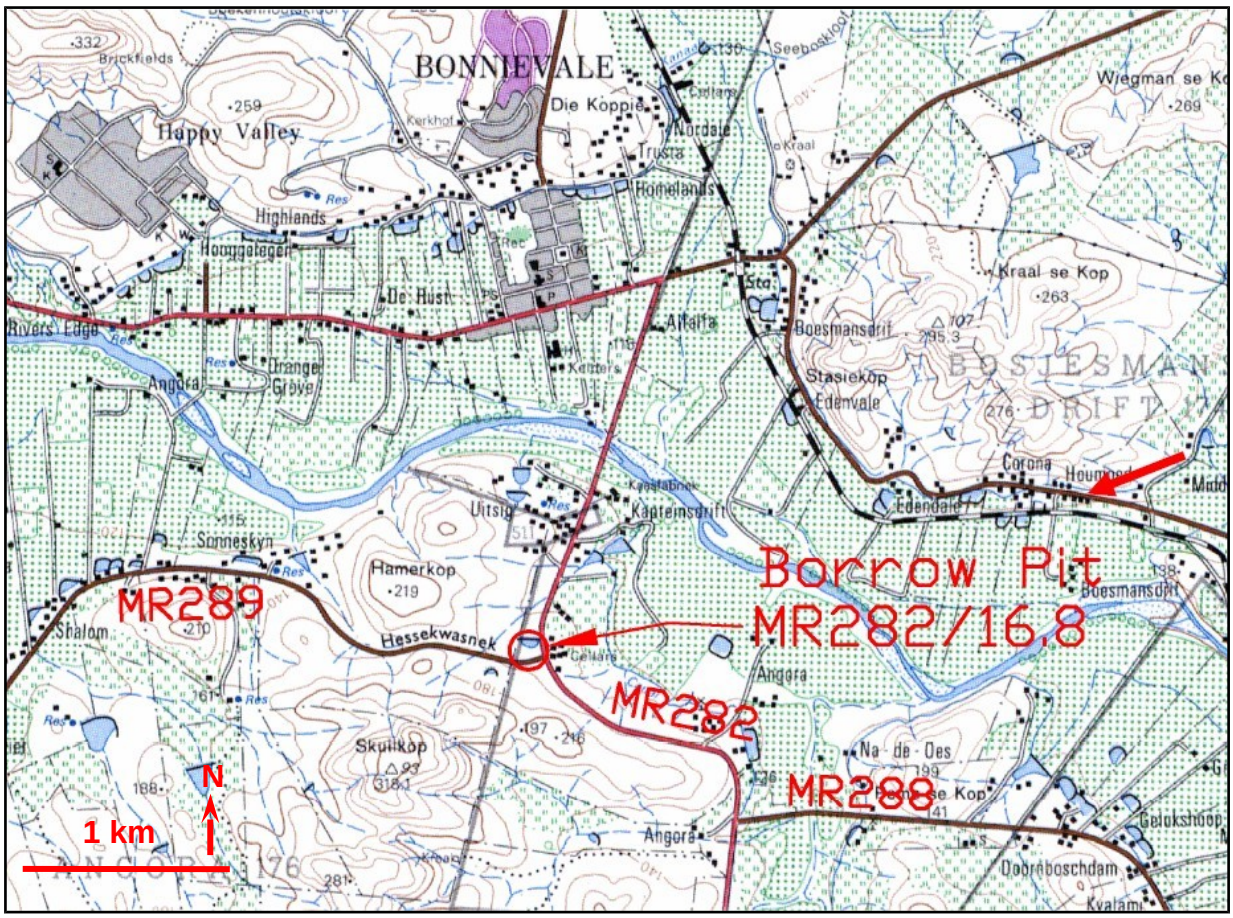

Fig.1. Extract from 1: 50 000 topographical sheet 3320 CC (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the existing pit MR00282/16.8/L/10/A/R2 at the junction of the MR282 and MR289 on Swellendam Farm 575 (Bonnita), Western Cape (Image abstracted from geotechnical report by Aurecon).

Fig. 2. 2003 Google earth© satellite image of the study area south of Bonnievale and the Breede River showing the location of the existing MR00282/16.8/L/10/A/R2 pit at the junction of the MR282 and MR289 on Swellendam Farm 575 (Bonnita) (yellow arrow).

3. GEOLOGICAL HERITAGE

The geology of the study area near Bonnievale is shown on 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) and is shown here in Fig. 3. A short sheet explanation has been published by Theron *et al.* (1991).

The existing pit is situated at *c*. 150 m amsl in gently hilly terrain to the south of the Breede River in the eastern portion of the Worcester – Robertson Karoo region (Figs. 2, 4). The pit is excavated into Middle Devonian sediments of the **Adolphspoort Formation** (**Da**, Upper Bokkeveld Group / Traka Subgroup. *N.B.* The Traka Subgroup succession in this area is not subdivided into several formational subunits). The succession youngs northwards towards the contact with the Witteberg Group to the north of Bonnievale. The Devonian bedrocks are mantled with Late Caenozoic alluvium of the Breede River just to the north of the borrow pit study area (pale yellow area in Fig. 3). The sedimentology and palaeontology of the Adolphspoort Formation in the Ladismith sheet area, dominated here by greyish micaceous siltstones and wackes, have been summarised by Theron *et al.* (1991) as well as Almond (2005, 2009). The depositional setting of these marginal marine sediments has not yet been resolved, although some authors favour a restricted delta platform setting.

Adolphspoort Formation rocks exposed on the gently sloping southern and steeper south-western faces of the MR00282/16.8/L/10/A/R2 pit consist of thin- to medium-bedded greyish, grey-green and brown weathering siltstones and wackes. They contain occasional lenticular, rusty-hued to purplish-green ferruginous carbonate diagenetic concretions that are apparently unfossiliferous. Primary sedimentary structures include horizontal lamination and wave ripple lamination, locally

disrupted by bioturbation. The sediments are transected by a pervasive, E-W striking tectonic cleavage that dips steeply south (Fig. 5) and are locally affected by small-scale folds. Almost no primary bedding planes are available for inspection. Weathering is not markedly advanced so the rocks are still well consolidated. Float blocks at surface are bounded by cleavage surfaces and therefore do not readily reveal fossil remains.

The Bokkeveld bedrocks are sharply overlain by a meter or more of orange-brown, sandy to gravelly surface deposits of colluvial origin containing poorly-sorted, angular gravel clasts, mainly composed of Adolphspoort wackes (Fig. 6).

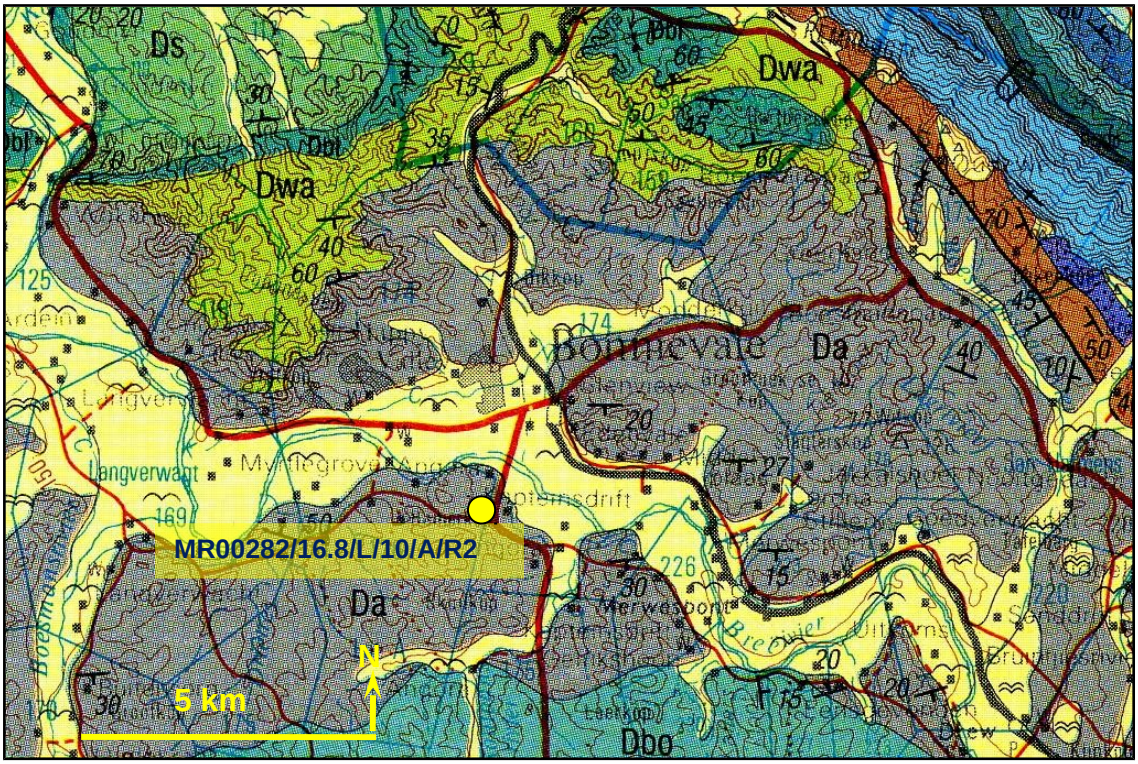

Fig. 3. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing location of the MR00282/16.8/L/10/A/R2 pit south of Bonnievale. The pit and its proposed NW extension are excavated into highly cleaved sandstones and siltstones of the Adolphspoort Formation (Da, Upper Bokkeveld Group) (dark grey).

Fig. 4. View southwestwards across the existing water-filled pit showing steep cut face in the SW with the low hill Skuilkop in the background.

Fig. 5. Greyish siltstones and wackes of the Adolphspoort Formation exposed on the steep SW face of the pit showing pervasive steeply-dipping spaced tectonic cleavage (Hammer = 29 cm).

Fig. 6. Thick sandy and gravelly colluvial deposits overlying the cleaved Bokkeveld Group bedrocks exposed in an erosion gully on the south-western edge of the existing pit (Hammer = 29 cm).

4. PALAEONTOLOGICAL HERITAGE

An important, albeit low-diversity, non-marine fossil biota has been recorded from the Middle Devonian sediments of the Adolphspoort Formation of the Traka Subgroup in the Ladismith sheet area (Plumstead 1977, Chaloner *et al.* 1980, Anderson & Anderson 1985, Almond 1997, Anderson *et al.* 1999a, 1999b, Anderson *in* MacRae 1999, Almond 2005, 2008a, 2008b, 2009). The Adolphspoort fossil assemblages are mainly preserved as moulds and comprise:

- Fragmentary vascular plants, including several species of lycopods (the club mosses *Archaeosigillaria*, *Haplostigma*) *plus* possible psilopsids;
- Non-marine, thin-shelled bivalves (possibly unionids), often preserved in dense clumps;
- Rare marine invertebrates (*e.g.* the articulate brachiopod *Australospirifer*);
- A limited variety of trace fossils including rare trilobite burrows (*Cruziana*), and unusually small versions of the complex helical burrow *Spirophyton*;
- A low-diversity assemblage of bony and cartilaginous fish, including acanthodians ("spiny sharks"), several primitive sharks, bony-plated jawed fish known as placoderms (Fig. 7), and rare crossopterygians (lobe-finned bony fish). These important Middle Devonian fossil fish have been described and illustrated in detail by Chaloner *et al.* (1980), Almond (1997), Anderson *et al.* (1999a, 1999b) and Long *et al*. (in prep). General accounts of Devonian fish groups from Gondwana are given by Anderson *in* MacRae (1999) and Long (1995).

Adolphspoort fish fossils mainly consist of disarticulated placoderm plates as well as isolated teeth and fin spines of antarctilamnid sharks and acanthodians. The fossils are found scattered throughout the succession within silty mudrocks and occasionally within ferruginous carbonate-rich concretions. Thin conglomeratic layers of transported mudflakes mixed with fish teeth, spines and other skeletal elements are recorded from the stratigraphically equivalent mid to upper Klipbokkop Formation in the Cederberg region and elsewhere. Those parts of the succession with unionid-like bivalves, low-diversity trace assemblages dominated by small *Spirophyton*, vascular plants and

fish fossils are considered to be non-marine in origin, perhaps accumulated on an extensive delta platform or prograding (advancing) shoreline zone. A mixture of fish originally from brackish to freshwater bodies near to the coastline (estuaries, lagoons, rivers. lakes) as well as salinity-tolerant marine forms may be represented in the fossil assemblages.

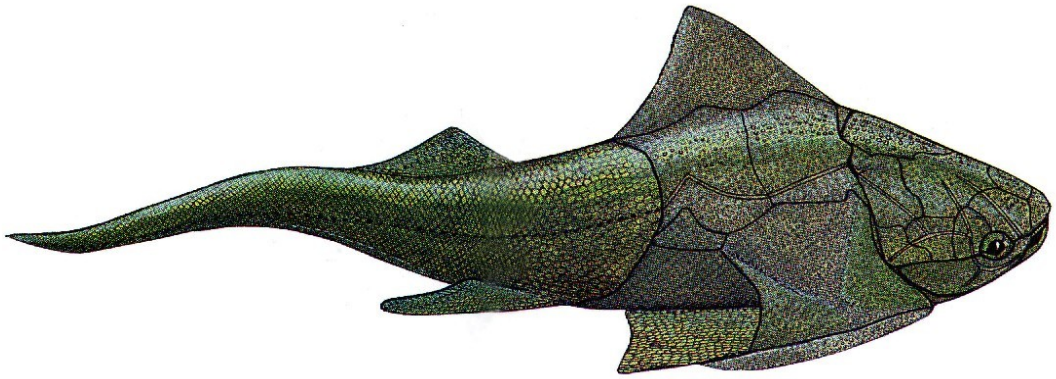

Fig. 7. Reconstruction of the armour-plated placoderm fish *Groenlandaspis*, which is recorded from Middle to Late Devonian sediments worldwide, including the Bidouw and Traka Subgroups of South Africa (From Long 1995).

No body fossils were recorded within the MR00282/16.8/L/10/A/R2 borrow pit study area and to the author's knowledge there are no previous records of Adolphspoort Formation fossils from the Bonnievale area. Ferruginous nodules observed within the existing pit are apparently unfossiliferous. There is evidence for extensive bioturbation of some horizons (*e.g.* colour mottling), but discrete trace fossil ichnogenera were not recognised.

5. CONCLUSIONS & RECOMMENDATIONS

The existing MR00282/16.8/L/10/A/R2 pit situated some two km south of Bonnievale is excavated into non-marine sandstones and mudrocks of the Middle Devonian Adolphspoort Formation (Upper Bokkeveld Group) that elsewhere are well-known for their Middle Devonian fish fauna, molluscs, vascular plants and trace fossils. However, the Bokkeveld sediments in the study area are highly cleaved and show no evidence of fossiliferous ferruginous nodules. The palaeontological sensitivity of the site is correspondingly LOW and, pending the discovery of substantial new fossil material such as shelly fossil, fish or plant remains, no further studies or mitigation of fossil heritage for this borrow pit and its possible expansion to the northwest are considered necessary.

6. ACKNOWLEDGEMENTS

Ms Quahnita Samie of Vidamemoria Heritage Consultants, Cape Town, is thanked for commissioning this specialist study and for kindly providing the necessary background information. I am also very grateful to Ms Madelon Tusenius for logistical support and assistance with these borrow pit projects.

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8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Assessment Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed borrow pit project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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