

PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

EXISTING BORROW PIT ALONG THE DR1382 ROAD IN THE MONTAGU DISTRICT, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The extensive DR01382/4.5/R/40/A/R19 borrow pit located 5.5 km to the northeast of Montagu, Western Cape, is excavated into marine sediments of the Waboomberg Formation (Upper Bokkeveld Group) of Middle Devonian age. Elsewhere in the Little Karoo region this rock unit has yielded locally abundant but low diversity shelly invertebrate faunas and trace fossils. However, the rocks in the study area are highly weathered and cleaved, so their palaeontological sensitivity is LOW. Therefore, pending the discovery of substantial new fossil material such as shelly fossil, fish or plant remains, no further mitigation of fossil heritage for this borrow pit is recommended.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from, and to extend, an existing borrow pit along the unsealed road DR1382 in the Montagu District, Western Cape. Pit DR01382/4.5/R/40/A/R19 (33° 46' 06.8" S, 20° 10' 24.4" E) on Montagu Farm No. 213 (Helpmekaar) is situated about 5.5 km northeast of the town of Montagu, Western Cape (Fig. 1).

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 Waboomberg Formation (Upper Bokkeveld Group, Bidouw Subgroup). A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC Case Ref. 111124JL15, Interim Comment 7 December 2011) 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). Fieldwork for this project was carried out on 19 August 2012.



Fig.1. Extract from topographical sheets 3320 Ladismith (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the existing pit DR01382/4.5/R/40/A/R19 located c. 5.5 km northeast of Montagu, Western Cape (blue dot).

3. GEOLOGICAL BACKGROUND

The DR01382/4.5/R/40/A/R19 pit is an extensive excavation at c. 300 m amsl along the south side of the DR1382 in the valley of the Steenboksrivier, a tributary of the Kingna River (Fig. 3). The deeply incised channel of the Steenboksrivier runs less than 100m to the north of the pit which is excavated into the steep northern slopes of a koppie. A well developed river-cut pediment surface at c. 300 m amsl. is well seen on satellite images to the north of the river. The Bokkeveld bedrocks underlying this surface to the north and west of the pit site, as well as locally in the pit area (Fig. 4), show pale kaolinitic hues, suggesting high levels of chemical weathering in this region.

The geology of the study area near Montagu is shown on 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria; Theron *et al.* 1991) and is shown here in Fig. 2. This dissected, hilly region of the western Klein Karoo is underlain by marine to marginal marine / estuarine sediments of the Upper Bokkeveld Group (Bidouw Subgroup) of Middle Devonian age. In this region the Bokkeveld rocks are often, but not invariably, intensely folded, faulted and cleaved. The pit is excavated into sediments of the **Waboomberg Formation** (Dw) as mapped on the Ladismith geology sheet (Fig. 2). This is a mudrock-dominated unit overlying the Boplaas sandstones in the western Little Karoo. It is of early Middle Devonian age (Eifelian, c. 390-395 Ma). The succession includes intervals of claystone (fine-grained mudrock, including laminated shales) and siltstone, with occasional thin micaceous sandstones (Theron *et al.* 1991). Interbedded dark grey mudstones and siltstones occur towards the top of the succession, which is locally fossiliferous.

Note that the sandstone-dominated parts of the upper succession at this locality are quite possibly equivalent to the sandy **Wuppertal Formation (Dwu)** rather than the Waboomborg Formation *sensu stricto* (Almond 2009). These two units are not differentiated on the geological map in the study area, although Theron *et al.* 1991 state that thin intermittent sandstone equivalents of the Wuppertal Formation can be traced as far east as the Warmwaterberg. The Waboomborg mudrocks and Wuppertal sandstones form a single coarsening-upwards cycle reflecting shallowing of the Agulhas Sea in early Middle Devonian times.

The sediments exposed in pit DR01382/4.5/R/40/A/R19 are mainly grey-green to grey, weathered micaceous siltstones and wackes. High levels of bioturbation are indicated by mottling and disruption of primary sedimentary structures such as wavy lamination. The Waboomborg beds are pervasively transected by a steeply SW-dipping spaced tectonic cleavage so that primary bedding planes are not exposed (Fig. 5). This applies equally to the sandstone-dominated package on the hill slopes directly above the pit (possible Wuppertal Formation) (Fig. 6).

The Waboomborg bedrocks are mantled with colluvial deposits including downwasted gravels of platy Bokkeveld wackes, angular clasts of vein quartz, blocky jointed wackes and impermanent calcrete development. A several meter thick wedge of ferruginised, orange-brown, well-bedded, coarse gravely colluvial breccias is exposed in the pit itself (Fig. 7).

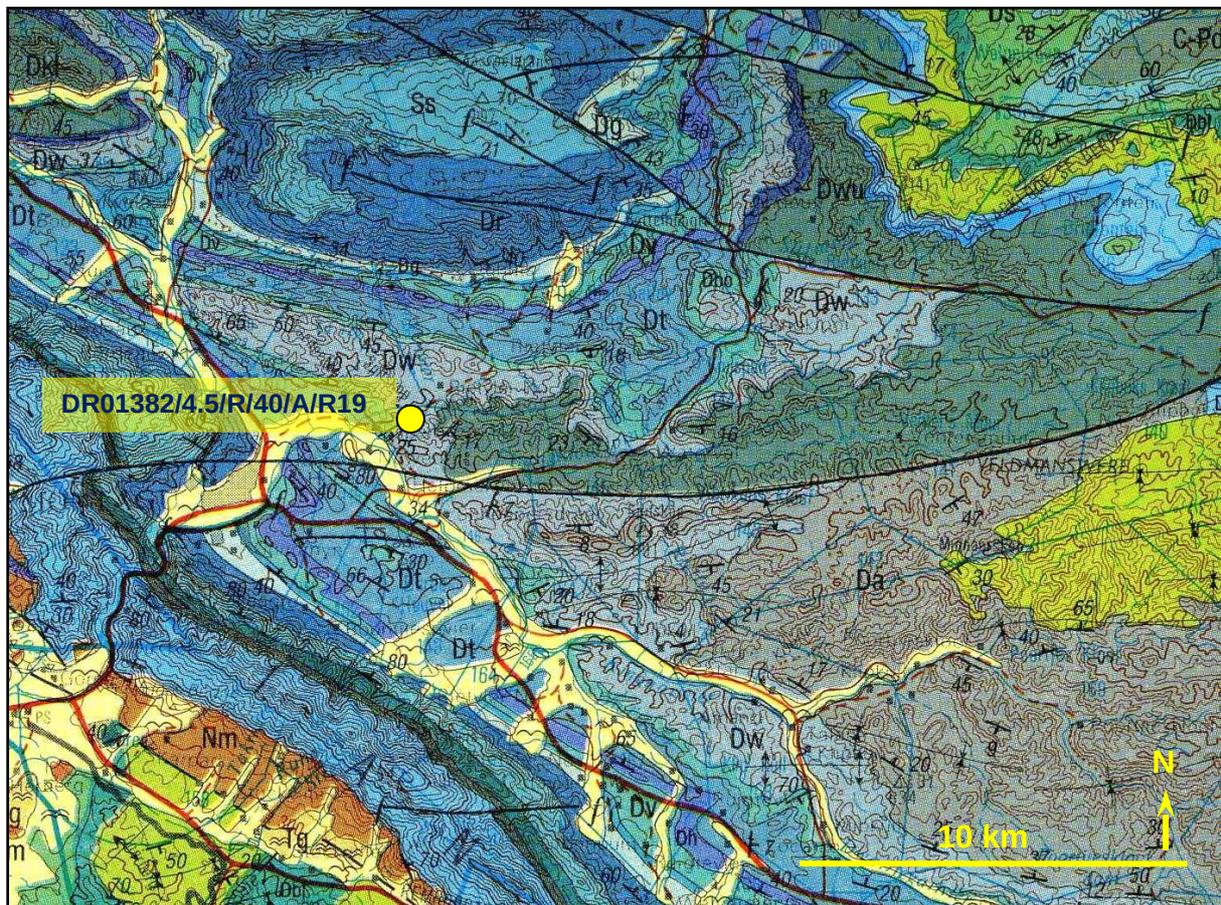


Fig. 2. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing location of the DR01382/4.5/R/40/A/R19 borrow pit c. 5.5 km NE of Montagu, Western Cape. The pit is excavated into cleaved mudrocks of the Waboomborg Formation (Dw, grey) (Upper Bokkeveld Group / Bidouw Subgroup).



Fig. 3. View towards the southeast of the western portion of the extensive existing borrow pit DR01382/4.5/R/40/A/R19 which is to be extended away from the DR1382 road in the foreground.



Fig. 4. Pale, kaolinitised Waboomberg Formation sediments indicating high levels of chemical weathering associated with a 300m amsl pediment surface.



Fig. 5. Bokkeveld wackes showing pervasive steeply SW-dipping spaced cleavage (Hammer = 29 cm). The original bedding here is obscured.



Fig. 6. Highly-cleaved interval of Bokkeveld wackes forming a cliff or *kran* on the hillslope above the borrow pit.



Fig. 7. Thick wedge of feruginised gravelly colluvium exposed within the pit (Hammer = 29 cm).

4. PALAEOLOGICAL HERITAGE

The palaeontology of the Middle Devonian (Eifelian) Waboomberg Formation in the Little Karoo region and elsewhere has been summarized by Almond (2010). Unusually rich faunas of shelly invertebrates have been collected from dark, very fine-grained mudrocks of the this unit in the western branch of the Cape Fold Belt (Ceres area; Oosthuizen 1984, Gresse & Theron 1992). The excellent preservation here of fully-articulated trilobites, intact echinoderms (*e.g.* brittle stars, crinoids) and several groups of delicate, rare invertebrates (*e.g.* ostracods, bryozoans) is attributed to sudden smothering of living seabed communities by a blanket of fine-grained, anoxic mud, a process technically known as *obrution*. Comparable obrution faunas have not yet been identified in the Ladismith sheet area, where only a few fossiliferous localities within the Waboomberg Formation are known (Theron *et al.*, 1991). These include two localities near Prince Albert, another south of Touwsrivier, and a small shelly biota from the northern edge of the Sanbona Nature Reserve, about 14km to the north of the Warmwaterberg.

At the last site, some 50 km to the ENE of the present borrow pit study area, the sandstones are cut through by an irregular, steeply-dipping, spaced cleavage so that preservation is generally poor. The fossils occur in thin (few cm) lenticles and carpets of shells, often associated with mudflakes and metallic grey secondary manganese staining. The mudflakes (or rip-up clasts) indicate transport and sorting of shells by powerful currents or waves; most specimens are disarticulated. Small *pseudomorphs* of cubical pyrite minerals (*ie* replicas now converted to shiny brown iron minerals) are common. Since pyrite only forms in the absence of oxygen, this suggests that the seabed sediments were at least intermittently anoxic. Identifiable invertebrate fossils recorded from the Waboomberg Formation at Sanbona include:

brachiopods: *Australocoelia*, *?Derbyina*

bivalves : *Palaeoneilo*, *Nuculites*, *?Grammysioidea*, *?Cardiomorpha* and other forms

crinoids: *Ophiocrinus* and another form

others: tentaculitids

trace fossils: simple lined horizontal burrows (*Palaeophycus*)

The relative abundance of diversity of bivalves (mostly infaunal – ie burrowing into the seabed) compared with brachiopods (mostly epifaunal, living on the sea bed) is notable here. As with the thicker coquinas in the Gamka Formation, the Waboomberg / Wuppertal shelly lentils were probably accumulated during storms. Moderately diverse shallow marine to inshore trace fossil assemblages are recorded from the Wuppertal sandstones in its western outcrop area. For example near the Brakriver of the Little Karoo region U-shaped vertical burrows (*Diplocraterion*) and almond-shaped bivalve burrows (*Lockeia*) occur with thin mudflake conglomerate horizons within wave-rippled purplish-brown sandstones.

Apart from unidentified burrows, no fossils were recorded from the Bokkeveld beds at pit DR01382/4.5/R/40/A/R19 near Montagu. The rocks here are highly cleaved and weathered and their palaeontological sensitivity is correspondingly LOW.

5. CONCLUSIONS & RECOMMENDATIONS

The extensive DR01382/4.5/R/40/A/R19 borrow pit located 5.5 km to the northeast of Montagu is excavated into marine sediments of the Waboomberg Formation (Upper Bokkeveld Group) of Middle Devonian age. Elsewhere in the Little Karoo region this rock unit has yielded locally abundant but low diversity shelly invertebrate faunas and trace fossils. However, the rocks in the study area are highly weathered and cleaved, so their palaeontological sensitivity is LOW. Therefore, pending the discovery of substantial new fossil material such as shelly fossil, fish or plant remains, no further mitigation of fossil heritage for this borrow pit is recommended.

6. ACKNOWLEDGEMENTS

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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 AHP (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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