

PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

EXISTING BORROW PIT ALONG THE MR0294 ROAD ON FARM BYLSHOEK NO. 73, MONTAGU DISTRICT, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The small MR00294/36.06/L/90 borrow pit located on farm Bylshoek No. 73 in the western Klein Karoo region, c. 27 km to the northeast of Montagu, is excavated into dark marine mudrocks 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. Fresher samples might yield organic-walled microfossils such as acritarchs that would be of value for dating purposes. However, the rocks in the study area are 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 MR0294 in the Montagu District, Western Cape. Pit MR00294/36.06/L/90 (33° 39' 09.1" S, 20° 21' 39.7" E) on farm Bylshoek No. 73 is situated about 27 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. 120130JL26, Interim Comment 15 February 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). 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 MR294/36.06/L/90 located c. 27 km northeast of Montagu on farm Bylshoek No 73, Montagu District, Western Cape (blue dot).

3. GEOLOGICAL BACKGROUND

The small existing MR00294/36.06/L/90 pit (Fig. 3) is located at the northern edge of a gravel-capped pediment surface at c. 800 m amsl and less than 100m north of the unpaved MR0294 road between the top of the Ouberg Pass and the Anysberg Nature Reserve. 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 grey siltstones of the **Waboomberg Formation (Dw)**. 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. The Waboomberg Formation mudrocks and overlying sandstones of the Wuppertal Formartion form a single coarsening-upwards cycle reflecting shallowing of the Agulhas Sea in early Middle Devonian times. A thick succession of dark mudrocks at the base of the Waboomberg succession, as seen here, represent a significant sea level rise (high stand) in Mid Devonian times (Cooper 1986).

Mudrocks exposed in the existing pit comprise hackly, grey-weathering siltstones that are dark grey to black when fresh. In some areas a well-developed cleavage is present. Spheroidal, pebble-

sized (up to 4cm) ferruginous diagenetic nodules are common (Fig. 4). There are no sandstone event beds within the few meter – thick mudrock succession exposed here. Well-jointed tabular bedded, buff wackes (impure sandstones) are seen just to the west and south of the pit (Fig. 5). They show primary current lineation and are locally quartz veined. They may belong to the Boplaas Formation that directly underlies the basal Waboomberg mudrocks, but the stratigraphy here requires clarification.

The Waboomberg bedrocks are mantled with polymict pediment gravels with clasts dominated by platy Bokkeveld wackes, subrounded quartzites, vein quartz and rounded ferricrete pebbles (Fig. 8). In some areas the bedrocks are covered with finer-grained superficial deposits consisting of a slurry of small Bokkeveld mudrock flakes in a sandy matrix (Fig. 6). Locally these demonstrate a well-developed system of polygonal cracks (polygons c. 30 cm diameter) (Fig. 7). The cracks, possibly related to repeated desiccation or freeze-thaw processes, penetrate several dm into the sediment and are marked by double “walls” of resistant-weathering, grey silty material.

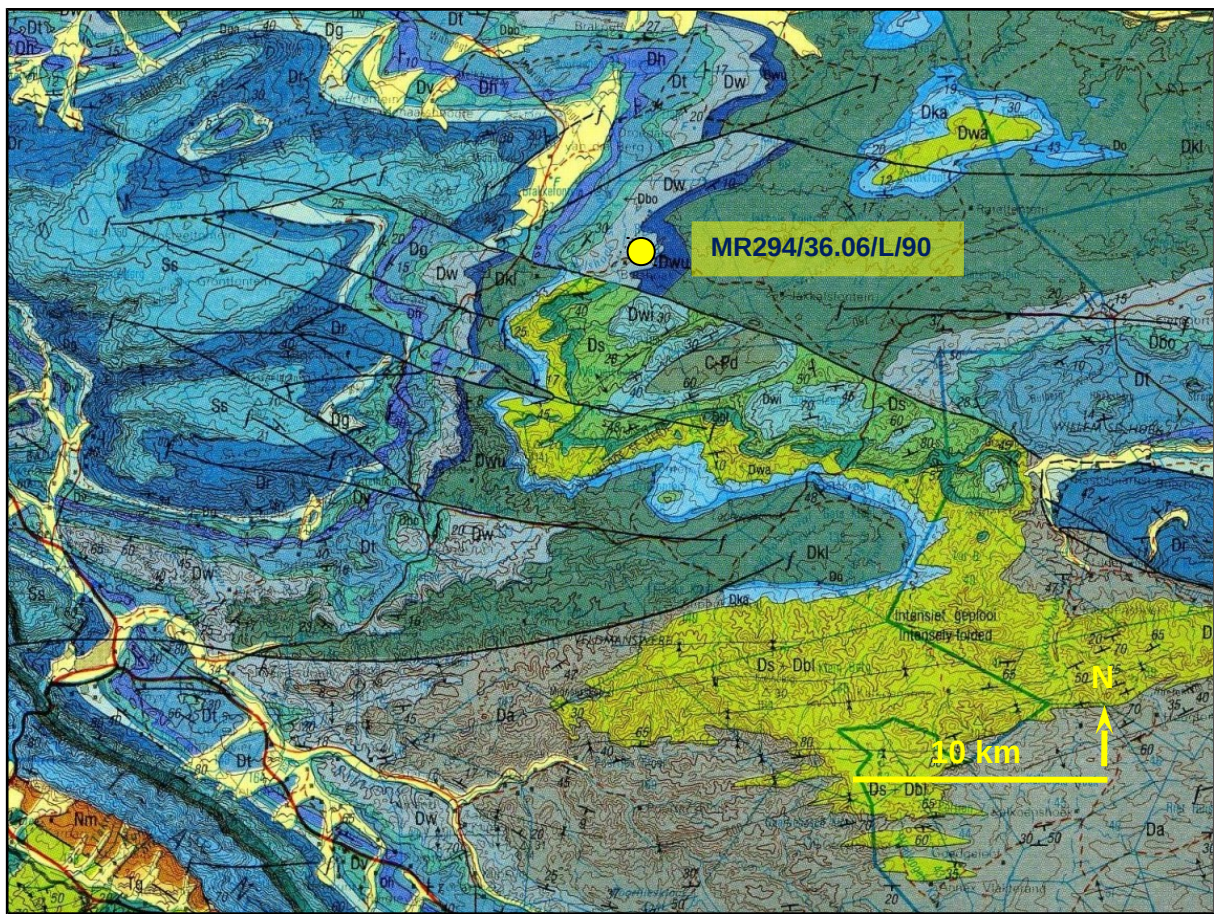


Fig. 2. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing location of the MR294/36.06/L/90 borrow pit c. 27 km NE of Montagu, Western Cape. The pit is excavated into cleaved mudrocks of the Waboomberg Formation (Dw, grey) (Upper Bokkeveld Group / Bidouw Subgroup).



Fig. 3. View towards the southeast across the existing MR00294/36.06/L/90 pit showing grey Waboomberg siltstones that are mantled in the foreground by coarse pediment gravels.



Fig. 4. Grey-weathering, hackly siltstones of the Waboomberg Formation with sporadic rusty-coloured ferruginous nodules (Hammer = 29 cm).



Fig. 5. Northwards-dipping flaggy sandstones exposed to the southeast of the pit, possibly belonging to the Boplaas Formation underlying the Waboomberg basal mudrocks (Hammer = 29 cm).



Fig. 6. Finer-grained colluvial and / or alluvial deposits of small mudrock flakes overlying the Bokkeveld bedrocks exposed in an erosion gully (Hammer = 29 cm).



Fig. 7. Penetrative polygonal crack system developed within fine gravelly superficial deposits on the existing pit margin (Hammer = 29 cm).



Fig. 8. Polymict pediment gravels overlying the Bokkeveld bedrocks with clasts of buff Bokkeveld wackes, paler quartzites vein quartz and ferricrete pebbles (Hammer = 29 cm).

4. PALAEOONTOLOGICAL HERITAGE

The palaeontology of the Middle Devonian (Eifelian) Waboomberg Formation in the Little Karoo region and elsewhere has been summarized by Almond (2009). Unusually rich faunas of shelly invertebrates have been collected from dark, very fine-grained mudrocks within 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 (Almond 2009).

At the last site, some 20 km to the east of the present borrow pit study area, the Waboomberg 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 (*i.e.* 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 or diversity of bivalves (mostly infaunal – *i.e.* 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 lenticles 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.

No fossil remains were recorded at the MR00294/36.06/L/90 pit site. The ferruginous diagenetic nodules are apparently unfossiliferous. The very dark Waboomberg mudrocks may contain organic-walled microfossils such as acritarchs that would be of value for biostratigraphic (dating) purposes. In general the Bokkeveld Group mudrocks here are highly cleaved and weathered and their palaeontological sensitivity is correspondingly LOW.

5. CONCLUSIONS & RECOMMENDATIONS

The small MR00294/36.06/L/90 borrow pit located c. 27 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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