

**PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT &
RECOMMENDATION FOR EXEMPTION FROM FURTHER STUDIES &
MITIGATION**

**EXISTING BORROW PIT ALONG THE DR01646 NEAR OUDTSHOORN,
WESTERN CAPE**

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1. EXECUTIVE SUMMARY

It is proposed to re-excavate and extend an existing borrow pit for road material along the DR01646, situated some 30 km southeast of Oudtshoorn in the Little Karoo region of the Western Cape. The pit is excavated into mudrocks of the Gydo Formation (Lower Bokkeveld Group), a rock unit that is well known for its rich fossil heritage – especially shelly invertebrates – from the Early Devonian Period.

The Bokkeveld mudrocks in pit DR01646/7.9/R are highly cleaved and deeply weathered. It is likely that most or all the fossils originally present within these rocks have been completely destroyed by cleavage and weathering. Those that have survived will be highly distorted and poorly preserved, with high levels of disruptive secondary mineralisation (e.g. iron and manganese compounds). Their palaeontological sensitivity is correspondingly LOW. No further specialist palaeontological studies or mitigation are recommended for this project.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from an existing borrow pit along the unsealed road DR01646, as well as to extend the pit. The pit in question (DR01646/7.9/R, located at 33° 46' 34.67" S, 22° 25' 52.00" E) is situated along the northern margin of the Outeniquaberge mountain range some 30 km southeast of the town of Oudtshoorn and 8.2 km east of the N12 tar road in the southern Little Karoo (Fig. 1). A narrow pass (Perdepoort) through the mountains south of the pit leads to the small village of Herold.

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 mudrocks of the Lower Bokkeveld Group. A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC case ref. no. 111124JL20, 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). This is Vidamemoria pit no. 114 and NID ref. no. 37. Fieldwork for this project was carried out on 14 February 2012.

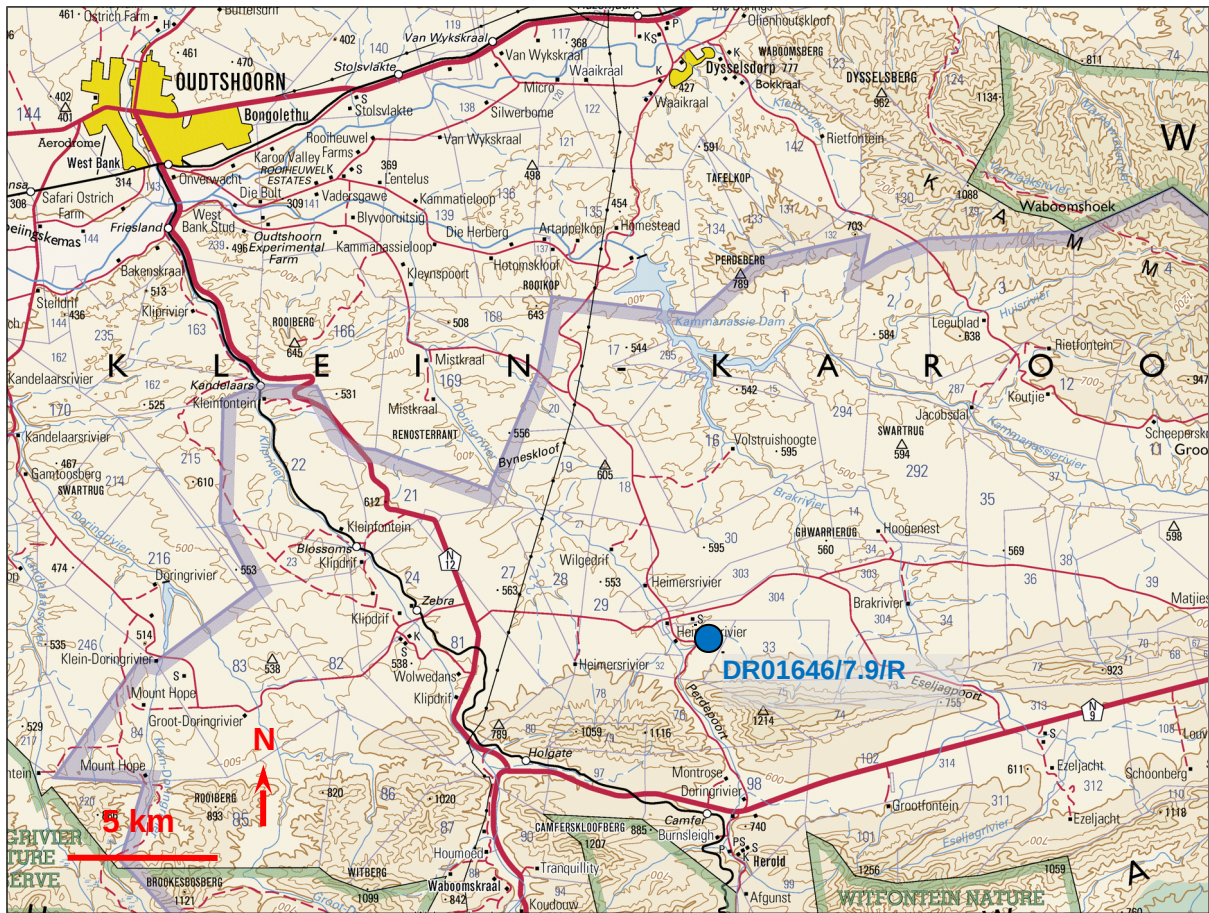


Fig. 1. Extract from topographical sheet 3322 Oudtshoorn (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the DR01646/7.9/R borrow pit some 30 km southeast of Oudtshoorn, Western Cape (blue dot).

3. GEOLOGICAL CONTEXT

The geology of the borrow pit study area is shown on 1: 250 000 sheet 3322 Oudtshoorn (Council for Geoscience, Pretoria) (Fig. 2). The pit is situated at c. 510m amsl within rolling hilly, *rûens*-like terrain along the northern margin of the Outeniquaberge (Fig. 3). This area is underlain by mudrocks of the **Gydo Formation (Dg)** (Lower Bokkeveld Group, Cape Supergroup) of Emsian or Early Devonian age, some 400 million years old (Theron 1999, Theron & Johnson 1991, Thamm & Johnson 2006). This formation consists of an upward-coarsening, shallowing succession of dark grey to black mudrocks, fine-grained sandstones and medium-grained wackes (dark, impure sandstones). These sedimentary rocks were deposited in a cool shallow seaway, the Agulhas Sea, on the south-western margins of Gondwana some 400 million years ago. Offshore mudrocks were deposited in quiet, deeper waters and may be massive or well-laminated. Pyrite-rich horizons indicate episodes of anoxia at or shortly below the sea floor. Near-shore sandstones were laid down in more turbulent settings and often show the influence of major storms (e.g. well-developed wave ripples, hummocky cross-stratification). The Gydo Formation is consistently the most fossil-rich formation within the Bokkeveld Group (Section 4). The overlying sandstone-dominated **Gamka Fm (Dga)** is more resistant weathering. It crops out as a series of subdued ridges just to the north of the borrow pit study area.

East-west trending anticlines of Gamka Formation sandstones mapped in the study area indicate high levels of folding of the Lower Bokkeveld Group rocks here. Dips within the Lower Bokkeveld Group rocks may well be especially high close to the Outeniqua mountain front itself, where the underlying TMG beds may be subvertical. As a result of the high levels of tectonic deformation

within this sector of the Permo-Triassic Cape Fold Belt the clay-rich mudrocks of successions such as the Gydo Formation have often been subjected to intense cleavage (e.g. Fig. 4) that has in turn promoted chemical weathering. These weathering processes have operated over long time intervals and are especially pronounced beneath ancient pediment surfaces, a series of which are clearly seen along the northern front of the Outeniquaberge to the south of the borrow pit area (Fig. 3). The alluvial deposits mantling the pediment surfaces here are extensively silcretised, while the Bokkeveld mudrocks beneath the silcrete cappings are typically highly weathered and leached to form a “pallid zone”. The Gydo mudrocks in the borrow pit form the exhumed lower part of such a highly weathered pallid zone.

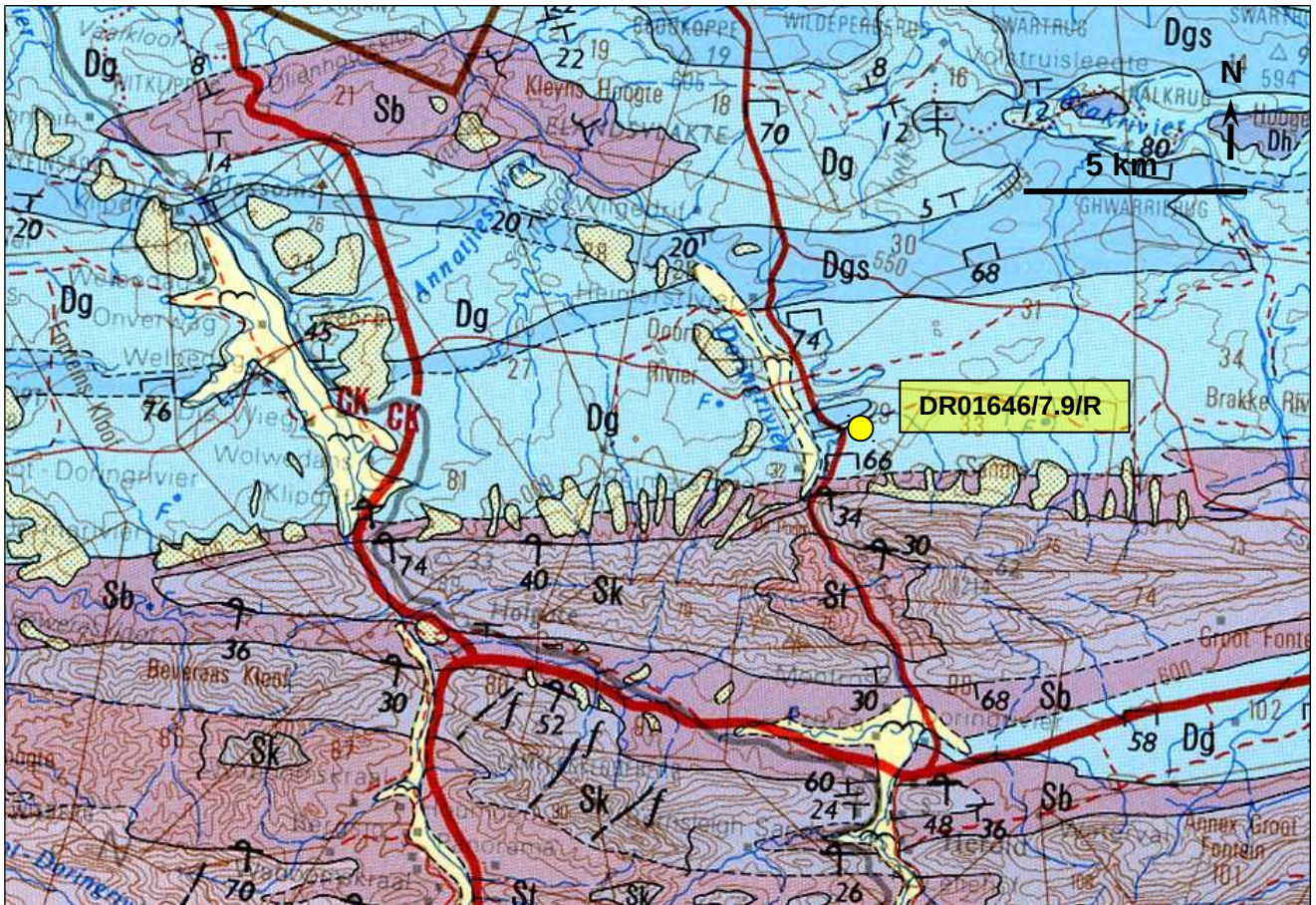


Fig. 2. Extract from 1: 250 000 geology sheet 3322 Oudtshoorn (Council for Geoscience, Pretoria) showing location of the existing borrow pits along the DR01646 dust road along the northern margin of the Outeniquaberg Range. The pit is excavated into offshore marine mudrocks of the Early Devonian Gydo Formation (Dg, pale blue) at the base of the Bokkeveld Group. Sandstones of the Gamka Formation (Dgs) crop out just to the north. Note numerous small patches of silcretised pediment gravels along the northern front of the Outeniquaberge about 1 km south of the study area (pale yellow with fine stipple).



Fig. 3. View towards the southwest across existing borrow pit DR01646/7.9/R showing gently north-sloping, silcrete-capped pediment surface extending from the Outeniquaberge in the distance.



Fig. 4. Blocks of highly cleaved and weathered Gydo Formation mudrocks excavated from the borrow pit DR01646/7.9/R (Hammer = 32 cm). Such rocks are unlikely to contain well-preserved fossils.

4. PALAEOLOGICAL HERITAGE

The lower part of the **Bokkeveld Group** in the Western Cape (Ceres Subgroup *plus* lowermost Bidouw Subgroup) – and in particular the **Gydo Formation** - is known for its rich fossil assemblages of shallow marine invertebrates of the Malvinokaffric Faunal Province of Gondwana (Cooper 1982, Oosthuizen 1984, Hiller & Theron 1988, Theron & Johnson 1991, MacRae 1999, Almond *in De Beer et al.* 2002, Thamm & Johnson 2006, Almond 2008). Key fossil groups here include trilobites, brachiopods, various subgroups of molluscs (bivalves, gastropods, nautiloids *etc*), and echinoderms (starfish, brittle stars, crinoids, carpoids, sea cucumbers *etc*), with several minor taxa including corals, conulariids, tentaculitids and rare fish remains, among others (Almond 1997, Anderson *et al.* 1999). These shelly fossil assemblages – generally preserved as impressions or moulds, but occasionally in the Gydo Formation also embedded within phosphatic or siliceous nodules – are especially abundant within the mudrock-dominated units such as the Gydo, Voorstehoek and Waboomberg Formations in their more distal (offshore) outcrop areas. Thin lenticles of shelly debris, known as *coquinas*, have been concentrated by storm activity and mainly consist of disarticulated specimens.

Fossils from various localities in the Gydo Formation within the broader Swartberg – Little Karoo study region have been treated by Oosthuizen (1984), Theron *et al.* (1991) and Almond (2005), among others.

The DR01646/7.9/R borrow pit / farm dam has not been re-excavated for some time, but a few heaps of weathered, pale grey Gydo mudrocks are still present, especially towards the eastern end of the site (Fig. 4). Blocks of excavated mudrock here show pervasive, closely-spaced cleavage and multi-hued secondary mineralisation indicating high levels of weathering. It is likely that most or all the fossils originally present within these rocks have been completely destroyed by cleavage and weathering. Those that have survived will be highly distorted and poorly preserved, with high levels of disruptive secondary mineralisation (*e.g.* iron and manganese compounds).

The palaeontological sensitivity of this site is therefore rated as VERY LOW.

5. CONCLUSIONS & RECOMMENDATIONS

The existing DR01646/7.9/R pit under consideration is excavated into mudrocks of the lower Gydo Formation that elsewhere is well known for its rich fossil heritage – especially shelly invertebrates – from the Devonian Period.

The Bokkeveld mudrocks in pit DR01646/7.9/R are highly cleaved and their palaeontological sensitivity is correspondingly very low. No further palaeontological heritage studies or mitigation are recommended for this project.

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.

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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, Gauteng, Limpopo and Free State 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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