

PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

EXISTING BORROW PIT ALONG THE DR1452 SWARMOED PASS ROAD NEAR CERES, WITZENBERG DISTRICT, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The shallow existing pit DR01452/13.4/L/10 located along the DR1452 Swaarmoed Pass road on the Remainder of Farm No. 404 (Lakenvlei), some 21.75 km ENE of Ceres, Western Cape is excavated into mudrocks of the Middle Devonian Voorstehoek Formation (Lower Bokkeveld Group / Ceres Subgroup). In the Warm Bokkeveld region these marine sediments often contain abundant, well-preserved moulds of molluscs, trilobites, echinoderms and other shelly invertebrates, as currently seen in another larger borrow pit only one kilometre to the northeast. However, fossil remains – mainly nuculid bivalves and homalonotid trilobites - appear to be sparse near surface in the immediate study area. The palaeontological sensitivity of the site is therefore assessed as MODERATE and no further studies or mitigation of palaeontological heritage for this project are recommended.

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 DR1452 Swaarmoed Pass road in the Warm Bokkeveld region to the east of Ceres, Western Cape. Pit **DR01452/13.4/L/10** (= Vidamemoria Pit No. 124) on the Remainder of Ceres Farm No. 404 (Lakenvlei) is situated at a high elevation along the pass (c. 1100 m amsl) between an old and new road alignment some 4.5 km northwest of the Lakenvallei Dam and 21.75 km ENE of Ceres (33° 20' 26.8" S, 19° 32' 37.7" E) (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 Voorstehoek Formation (Lower Bokkeveld Group, Ceres Subgroup). A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (**HWC case 1933 – 2046 ref 120726TS25, Interim Comment 15 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). Fieldwork for this project was carried out on 30 December 2012.

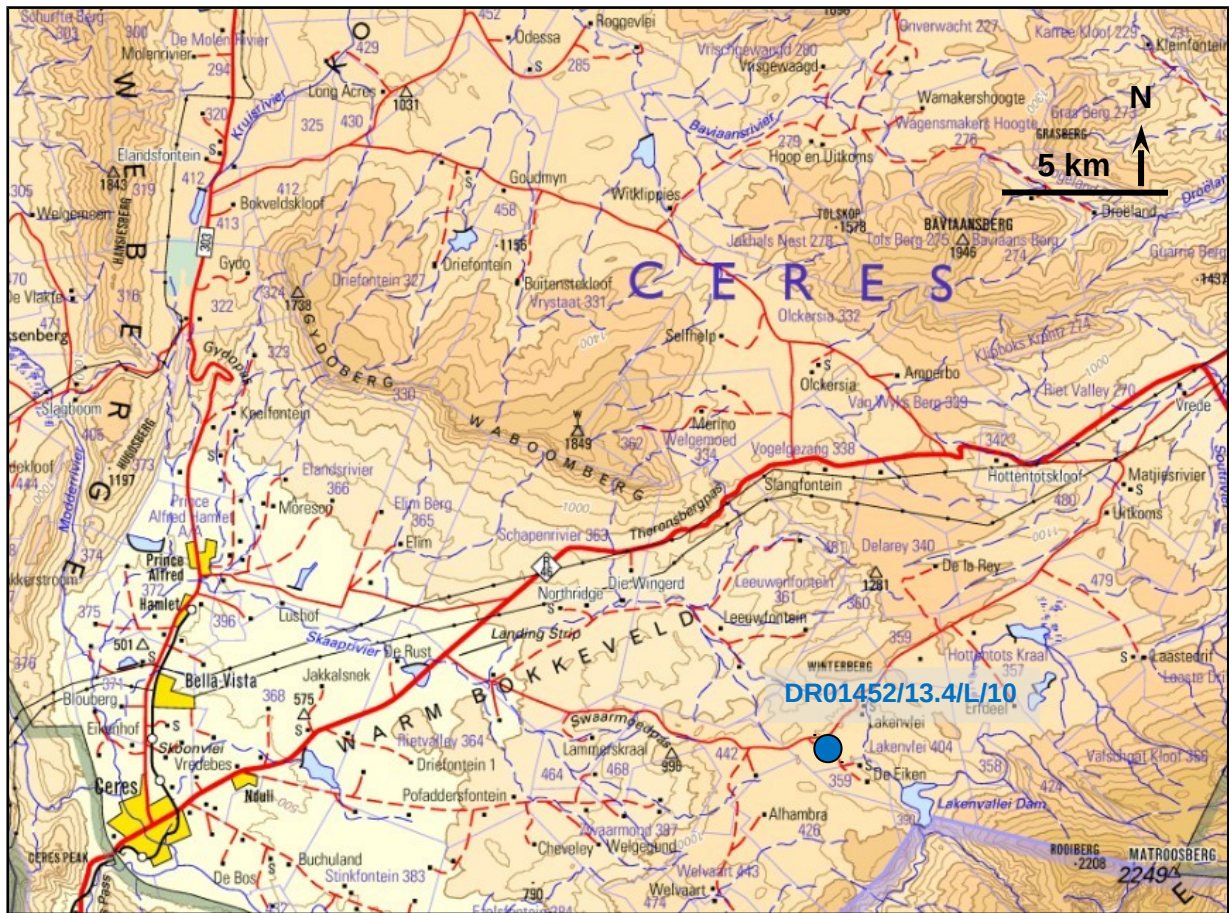


Fig.1. Extract from topographical sheets 3119 Worcester (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the existing DR01452/13.4/L/10 borrow pit located along the Swaarmoed Pass road c. 21.75 km ENE of Ceres (blue dot).



Fig. 2. Google earth© satellite image of the Warm Bokkeveld study area along the Swaarmoord Pass ENE of Ceres showing the location of the existing DR01452/13.4/L/10 pit (pink symbol) located between old and new road alignments just to the east of the Lakenvallei Dam turn off. The yellow triangle marks a nearby highly fossiliferous borrow pit excavated into the Voorstehoek Formation about one kilometre NE of the study area.

3. GEOLOGICAL HERITAGE

The geology of the Warm Bokkeveld study area near Ceres is shown on 1: 250 000 geology sheet 3319 Worcester (Council for Geoscience, Pretoria) and is illustrated here in Fig. 3. A short sheet explanation has been published by Gresse & Theron (1992; see also the older 1: 125 000 Worcester- Hermanus map and sheet explanation by De Villiers *et al.* 1964).

The existing DR01452/13.4/L/10 pit is excavated into marine mudrocks of the **Voorstehoek Formation (Dv, Lower Bokkeveld Group / Ceres Subgroup)** of Middle Devonian (Eifelian) age (and not into the Gamka Formation as stated in the geotechnical report for this pit). The sedimentology of this unit has been briefly described by Gresse and Theron (1992) and in more detail by Theron (2003). It comprises an upward-coarsening, shallowing succession of grey-green and grey mudrocks that are increasingly interbedded with wave-rippled wackes (impure sandstones) of tempestite origin towards the top. The Voorstehoek Formation is about 200 m thick in the Koue Bokkeveld and Hex River Valley area.

The Cape Supergroup rocks in the Warm Bokkeveld study region, to the NW of the Hex River Mountains, show a complex pattern of tectonic deformation related to the Cape syntaxis where the western and southern branches of the Cape Fold Belt intersect. The Lower Bokkeveld Formations here – notably the Hexrivier and underlying Voorstehoek Formations - are folded along SW-NE trending axes in a down-faulted block bounded by two major WNW-ESE fault planes (Fig. 3). Despite this pattern of deformation, the Voorstehoek bedrocks in the study pit as well as nearby pits to the northeast are not highly cleaved, contributing markedly to the excellent fossil preservation seen here. The sediments here largely consist of grey to greyish-green, massive

siltstone which is dissected by near surface by joints lined with rusty and metallic grey iron and manganese minerals (Fig. 5). Mottling of some horizons indicates high levels of bioturbation. The bedrocks are overlain by up to 20cm thick gravelly soils of colluvial origin.

Quantities of ripped-up Voorstehoek bedrock are available in the existing pit but some of the stock piles seen here comprise rock material from other stratigraphic units (e.g. Table Mountain Group quartzites, dark grey mudrocks from the Gydo Formation), some of which may be fossiliferous (Fig. 4). There is therefore a danger that fossils recorded from the pit may be assigned to the wrong formation.

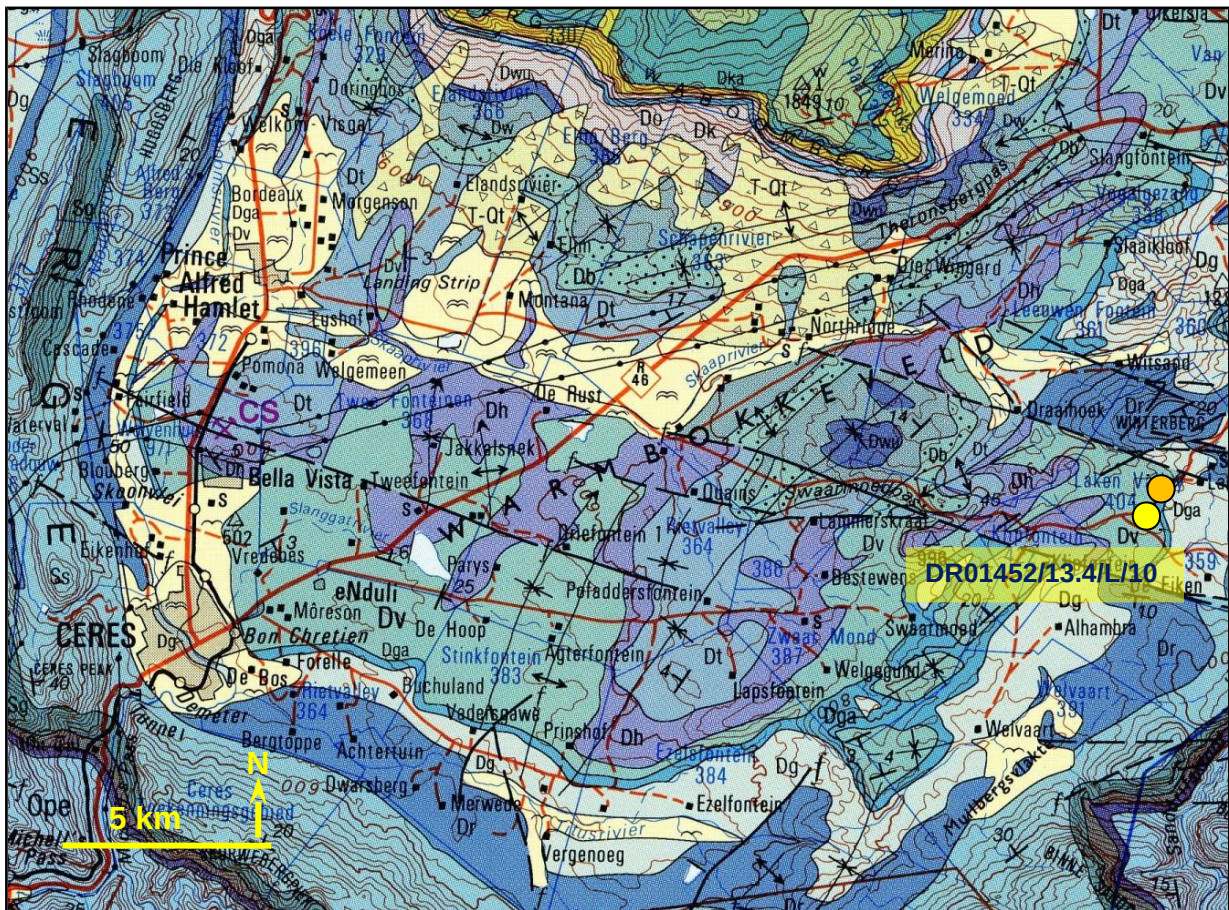


Fig. 3. Extract from 1: 250 000 geology sheet 3119 Worcester (Council for Geoscience, Pretoria) showing location of the DR01452/13.4/L/10 borrow pit along the Swarmoed Pass road c. 21.75 km ENE of Ceres (yellow dot). The pit is excavated into mudrocks of the Voorstehoek Formation (Dv, pale blue), Lower Bokkeveld Group. The orange dot shows the location of a nearby existing pit excavated into highly fossiliferous mudrocks of the same formation.



Fig. 4. View eastwards across borrow pit DR01452/13.4/L/10 with the new Swaarmoed Pass road seen on the left and the Hex River Mountains in the background. Note heaps of exotic rock material from other formations dumped in the pit at centre.



Fig. 5. Massive greyish-green siltstones of the Voorstehoek Formation cut by joints lined with iron and manganese minerals (Hammer = 33 cm).

4. PALAEOONTOLOGICAL HERITAGE

The fossil record of the mudrock-dominated **Voorstehoek Formation** (Dv, Middle Devonian / Eifelian) has been summarised by Oosthuizen (1984), Almond *et al.* (1996), Gresse and Theron (1992), Theron (2003) and Almond (2008, 2010). Generally fossil assemblages in this unit are much sparser and less diverse than in the underlying Gydo Formation, and they are correspondingly less well known. Rich trace fossil assemblages in the northern outcrop area attest to the presence of a flourishing invertebrate fauna at the time (Almond *in De Beer et al.* 2002). Abundant shelly fossils are recorded from mudrocks in the lower half of this stratigraphic unit in the southwestern outcrop area including the Warm Bokkeveld, Matroosberg and Theron's Pass region (Theron 1972, Oosthuizen 1984, Gresse & Theron 1992, Theron 2003). Borrow pits along the Swaarmoed Pass in particular have yielded a wealth of well-preserved shelly fossils in recent decades, including important material of some rare taxa (Gresse & Theron 1992, Almond *et al.* 1996).

Voorstehoek shelly fossils have often been concentrated by storm winnowing and currents into thin shelly lenses or *coquinas*. Fossil biotas are dominated by shelly invertebrates such as trilobites, articulate brachiopods, crinoids, ophiuroids, bivalves, bellerophontid "gasteropods", orthocone nautiloids, and problematic conical-shelled groups such as hyolithids and tentaculitids (Theron 1972, Oosthuizen 1984, Gresse & Theron 1992, Theron 2003, Almond 2008). Heterolithic, tempestite-dominated successions within the Voorstehoek Formation, especially in its northern outcrop area, have yielded rich shallow marine trace fossil assemblages of the *Cruziana* Ichnofacies (Almond 1998, Almond *in De Beer et al.* 2002, Theron 2003, Almond 2008).

The usually fairly impoverished Voorstehoek fossil assemblages are dominated by brachiopods and molluscs, with rarer echinoderms, trilobites, gastropods and nautiloids (Theron 2003). Fossils are often concentrated in thin coquinas and are usually, but far from invariably, disarticulated due to current action, notably by storm waves in nearshore sediments. Mudrocks often show high levels of bioturbation, *i.e.* churning by burrowing, sediment-feeding invertebrates such as homalonotid trilobites, nuculid bivalves, bellerophontid gastropods and other, unidentified invertebrate taxa. Remobilisation and re-suspension of soupy shelf muds may have limited or excluded larval settling and / or feeding by suspension-feeding taxa such as crinoids and brachiopods that are poorly represented in many offshore Voorstehoek fossil assemblages (Almond *et al.* 1996). Occasional thin, dense fossil *Lagerstätte* dominated by fully-articulated echinoderms (brittlestars, starfish, carpoids *etc*) are recorded from lower Bokkeveld mudrock units of the Warm Bokkeveld, Hex River Valley region and further east (Theron 1972, Oosthuizen 1984, Jell & Theron 1999). These so-called "starfish beds" are attributed to *obrution* or sudden smothering of benthic invertebrates by storm re-suspended muds and provide useful, albeit biased "snapshots" of offshore marine life on the Early Devonian seabed.

During the present field assessment fossils appeared to be fairly sparse and of low diversity within the DR01452/13.4/L/10 pit area. However, bedrock exposure levels here are currently low and since fresher sedimentary material below surface appears to be well-consolidated and uncleaved, there is a reasonably good chance that well-preserved shelly fossil assemblages may be exposed once the pit is re-excavated. The palaeontological sensitivity of the site is therefore rated as MODERATE. The main fossils were recorded here were disarticulated to articulated nuculid bivalves of the genera *Palaeoneilo* and *Nuculites* (Figs. 6 and 7), local concentrations of bellerophontid molluscs (*Plectonotus*) as well as occasional fragments of the burrowing homalonotid trilobite *Burmeisteria*. Trace fossils are represented by indeterminate horizontal burrows and mottled bioturbated horizons. Recent excavation of fresh Voorstehoek Formation mudrocks in a second, much larger borrow pit about one kilometre to the northeast along the DR1452 Swaarmoed Pass road (triangle in Fig. 2) has exposed a wealth of beautifully preserved shelly fossils. These include well-articulated, often complete trilobites (mainly *Burmeisteria* and *Metacryphaeus*, but also rarer taxa such as *Frankovichia*), nuculid bivalves, articulated starfish and others.



Fig. 6. Articulated specimen of the nuculid bivalve *Palaeoneilo*, probably preserved in life position (Scale in 0.5 cm).



Fig. 7. Isolated valve of the nuculid bivalve *Palaeoneilo* (scale in mm).

5. CONCLUSIONS & RECOMMENDATIONS

The shallow existing pit DR01452/13.4/L/10 located along the DR1452 Swaarmoed Pass road on the Remainder of Farm No. 404 (Lakenvlei), some 21.75 km ENE of Ceres, Western Cape is excavated into mudrocks of the Middle Devonian Voorstehoek Formation (Lower Bokkeveld Group / Ceres Subgroup). In the Warm Bokkeveld region these marine sediments often contain abundant, well-preserved moulds of molluscs, trilobites, echinoderms and other shelly invertebrates, as currently seen in another larger borrow pit only one kilometre to the northeast. However, fossil remains – mainly nuculid bivalves and homalonotid trilobites - appear to be sparse near surface in the immediate study area. The palaeontological sensitivity of the site is therefore assessed as MODERATE and no further studies or mitigation of palaeontological heritage for this project are recommended.

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 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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