

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

PROPOSED EXTENSION OF AN EXISTING BORROW PIT ON FARM WELGUNST 34 NEAR CALITZDORP, OUDTSHOORN DISTRICT, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The large existing DR01674/4.5/0.05L borrow pit, situated on the farm Welgunst 34 at the junction of the DR1674 and DR1688 dust roads, some 11.7 km SSE of the small town of Calitzdorp, Oudtshoorn District, Little Karoo, is excavated into deeply-weathered, cleaved mudrocks of the Tra Tra Formation (Lower Bokkeveld Group / Ceres Subgroup) of Middle Devonian age. Elsewhere in the Western Cape these marine sediments contain low to moderately diverse shelly invertebrate and trace fossil assemblages (e.g. trilobite burrows). Most of the original fossils in the pit area have been distorted or destroyed by weathering and tectonic deformation, with only occasional moulds of nuculid bivalves and crinoidal material now recognisable.

Older alluvial deposits mantling the Tra Tra bedrocks within the southern portion of the study area contain calcretised cylindrical burrows and / or root casts (rhizoliths). Occasional large calcretised termitaria embedded within the near-surface Bokkeveld mudrocks are probably also Quaternary in age and are well-known in the Calitzdorp area. The flatter northern portion of the study area is mantled by younger silty alluvium while the steeper hill slopes to the south of the existing pit are covered with coarse colluvial gravels. The latter include occasional fossiliferous float blocks (crinoidal debris, fossil burrows) that have probably been downwasted from the Hexrivier Formation sandstones building the rocky ridge above.

The sparse fossil remains recorded at the DR01674/4.5/0.05L borrow pit site are either poorly-preserved or represent very widespread forms. The palaeontological sensitivity of the site is therefore assessed as LOW and no further studies or mitigation of palaeontological heritage for this borrow pit 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 and extend a large existing borrow pit **DR01674/4.5/0.05L**, situated on the farm Welgunst 34 at the junction of the DR1674 and DR1688 dust roads, some 11.7 km SSE of the small town of Calitzdorp, Oudtshoorn District in the Little Karoo Region (33°38'19.22" S, 21°43'24.21" 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 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 131011GT27, Interim Comment 13 November 201s) 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. 282, considered in NID No. 197. Fieldwork for this project was carried out on 22 April 2014.



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 DR01674/4.5/0.05L borrow pit located on the northern flanks of the Gamkaberg c. 11.7 km SSE of Calitzdorp in the Little Karoo (blue dot). The pit lies at the junction of the DR1674 and the DR1688 unpaved roads.

3. GEOLOGICAL HERITAGE

The geology of the Little Karoo study area to the south of Calitzdorp is shown on 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) and is illustrated here in Fig. 3. A short sheet explanation has been published by Theron *et al.* (1991) and the area is also addressed by the geological report on the Gamkaberg – Rooiberg conservation area by Almond (2005).

As seen in the satellite image (Fig. 2) the extensive DR01674/4.5/0.05L borrow pit study area lies within one kilometre of the Gamka River at an elevation of 220 to 240 m amsl on the northern flank of a prominent west-east trending sandstone ridge that is assigned to the Hexrivier Formation. Mudrocks excavated in the existing pit can therefore be identified as belonging to the overlying **Tra Tra Formation (Dt, Lower Bokkeveld Group / Ceres Subgroup)**. This is a mudrock-dominated succession of offshore marine rocks that were deposited on the offshore continental shelf in Middle Devonian (Eifelian) times. Details of the sedimentology and palaeontology of the Tra Tra

succession are provided by Theron *et al.* (1991), Gresse and Theron (1992) and more recently by Almond (2005, 2009b). The Tra Tra succession typically contains several thin, prominent-weathering sandstone packages (tops of upward-shallowing parasequences).

The Lower Bokkeveld Group rocks in the study area lie on the southern limb of a major west-east trending synclinal structure on the northern margins of the Gamkaberg – Rooiberg mega-anticline (Almond 2005). As mapped, the Bokkeveld bedrocks are unconformably overlain in Late Jurassic conglomerates of the Enon Formation (Ultenhage Group; J-Ke, orange in Fig. 3). However, these Mesozoic sediments are in fact not apparent in the field (they might be buried at depth in the northern portion of the site) and the surface sediments represented here comprise various sorts of colluvial (slope) and alluvial (river) sediments.

The Bokkeveld bedrocks exposed in the main pit area comprise greyish-green, grey, buff, purplish to multi-hued, weathered silty mudrocks, dipping to the north (Fig. 4). Primary sedimentary structures include ripple cross-lamination and horizontal lamination. Occasional poorly-exposed beds of purplish-brown wacke are also present. The bedrocks are intensely veined by quartz or secondarily ferruginised. In some sections the rocks are cut by closely spaced joints and cleaved at a steep angle to the horizontal. Ferruginous diagenetic nodules are common.

The steeper hill slopes to the south of and above the main pit are mantled with poorly sorted, polymict colluvial gravels, composed predominantly of Bokkeveld wackes but also including vein quartz and occasional pale quartzite clasts (Fig. 9).

Shallow trenches along the northern edge of the pit expose older semi-consolidated, orange-brown sandy alluvium that is related to the Gamka River floodplain. Embedded within this are poorly-sorted polymict gravels including well-rounded TMG quartzite, vein quartz, Bokkeveld wackes (often ferruginised), dark mudrocks, hornfels and occasional exotic Cango Group lithologies (*e.g.* dark greenish greywackes). The quartzite clasts often anthropogenically flaked (MSA, rare ESA; the latter sometimes with adherent calcrete suggesting reworking from older consolidated fluvial gravels upstream). There are also some displaced oversized, well-rounded quartzite boulders with superficial impact crescents along northern edge of pit. Vertical sections through thick, pale buff, well-calcretised, gravelly older alluvium are visible along the northern edge of the pit (Fig. 11) and a well-consolidated nodular hardpan is developed in some horizons.

The older alluvial deposits are overlain by finer-grained younger silty alluvium and downwasted surface gravels (Fig. 12). The younger, finer-grained river sediments mantle the lower, flatter-lying portions of the pit study area, beyond the main pit itself (Fig. 14). Here fine, quartz-rich sheet wash surface gravels overlie thick, pale brown, silty alluvial soils containing sparse floating quartz clasts and thin gravel lenticles, as seen in shallow stream gullies. In many areas these younger alluvial deposits are disturbed by agricultural activity. No older bedrock exposure was seen in the northern portion of the study area and there is no evidence for *in situ* Enon conglomerates such as shown on the geological map (Fig. 3).

4. PALAEOLOGICAL HERITAGE

Shelly fossils from the **Tra Tra Formation** (Dt, Middle Devonian / Eifelian) in the Worcester and adjacent Ladismith sheet areas are generally scarce (Gresse & Theron 1992, Theron *et al.*, 1991, Table III, Almond 2009b). The only area in the Western Cape where diverse marine invertebrate assemblages have been recorded from this unit is on or near the Wageboomberg / Theronberg Pass near Ceres (Oosthuizen 1984, Gresse & Theron 1992). Well-preserved trilobite trace fossils (*Cruziana* / *Rusophycus*) have also been collected from the Tra Tra Formation of the Ceres region. Moderately abundant, well-preserved shelly assemblages have recently been recorded from borrow pits within the lowermost Tra Tra Formation on the Sanbona and Anysberg Nature Reserves in the western Klein Karoo (Almond 2009b, unpublished observations 2011 & 2012). Fossils moulds here are fairly well preserved and comprise a small range of bivalves (*Palaeoneilo*, *Nuculites* and unidentified forms), plectonotid bellerophonids, orbiculoid inarticulate brachiopods,

occasional articulate brachiopods, disarticulated crinoids, tentaculitids and simple, horizontal, mudlined, secondarily mineralised burrows. Sparse nuculid bivalves and possible vertical burrows are recorded from the Tra Tra Formation near Prince Alfred Hamlet (Almond, pers. obs. 2012).



Fig. 2. Google earth© satellite image of the study area to the south of Calitzdorp showing the location of the DR01674/4.5/0.05L borrow pit study area (Vidamemoria Pit 282) on the eastern side of the Gamka River and the northern slopes of a prominent E-W ridge that is assigned to the Hexrivier Formation (Lower Bokkeveld Group). Table Mountain Group rocks build the Gamkaberg to the south. Mudrocks cropping out along the northern side of the Hexrivier Formation ridge belong to the Tra Tra Formation. Pale brown areas to the north represent Mesozoic sediments of the Uitenhage Group (mapped as Enon Formation) that are mantled by alluvium.

Excavated blocks of Tra Tra mudrocks on the floor of the existing DR01674/4.5/0.05L pit near Calitzdorp often contain abundant complex hollows that are partially infilled with purplish to black secondary minerals (Fig. 5). At least some of these structures represent deformed, diagenetically-altered and weathered fossil moulds (e.g. crinoid stems, bivalves such as *Palaeoneilo*, trace fossils) but they are barely recognisable as such (Figs. 6 & 7). Moulds of disarticulated crinoid columnals observed in occasional sandstone float blocks within the colluvial gravels above the pit might have been downwasted from the Hexrivier Formation building the ridge to the south (Fig. 8). The same may apply to occasional wacke float blocks with mottled bioturbated textures, sometimes containing discrete but vague fossil burrows (Fig. 10). The palaeontological sensitivity of the Bokkeveld mudrocks underlying the study area is assessed as LOW due to profound chemical weathering and cleavage development.

The calcretised older alluvial deposits along the northern pit margin are characterised locally by abundant cylindrical to irregular structures that are probably calcretised fossil burrows and / or root casts (rhizoliths) (Fig. 11). Portions of sizeable (meter-scale), ring-shaped sections through

calcretised termitaria are seen embedded *in situ* within mudrocks towards the southern pit margin, where they have been superimposed by burrowing termites from above (Fig. 13). These subfossil termitaria of probable Quaternary age are well known in Calitzdorp area (where they are occasionally abused as plant pots!), as discussed by Almond (2005). Dense spotting seen on satellite images of the Calitzdorp area testifies to the high density of subfossil termitaria in this part of the Little Karoo.

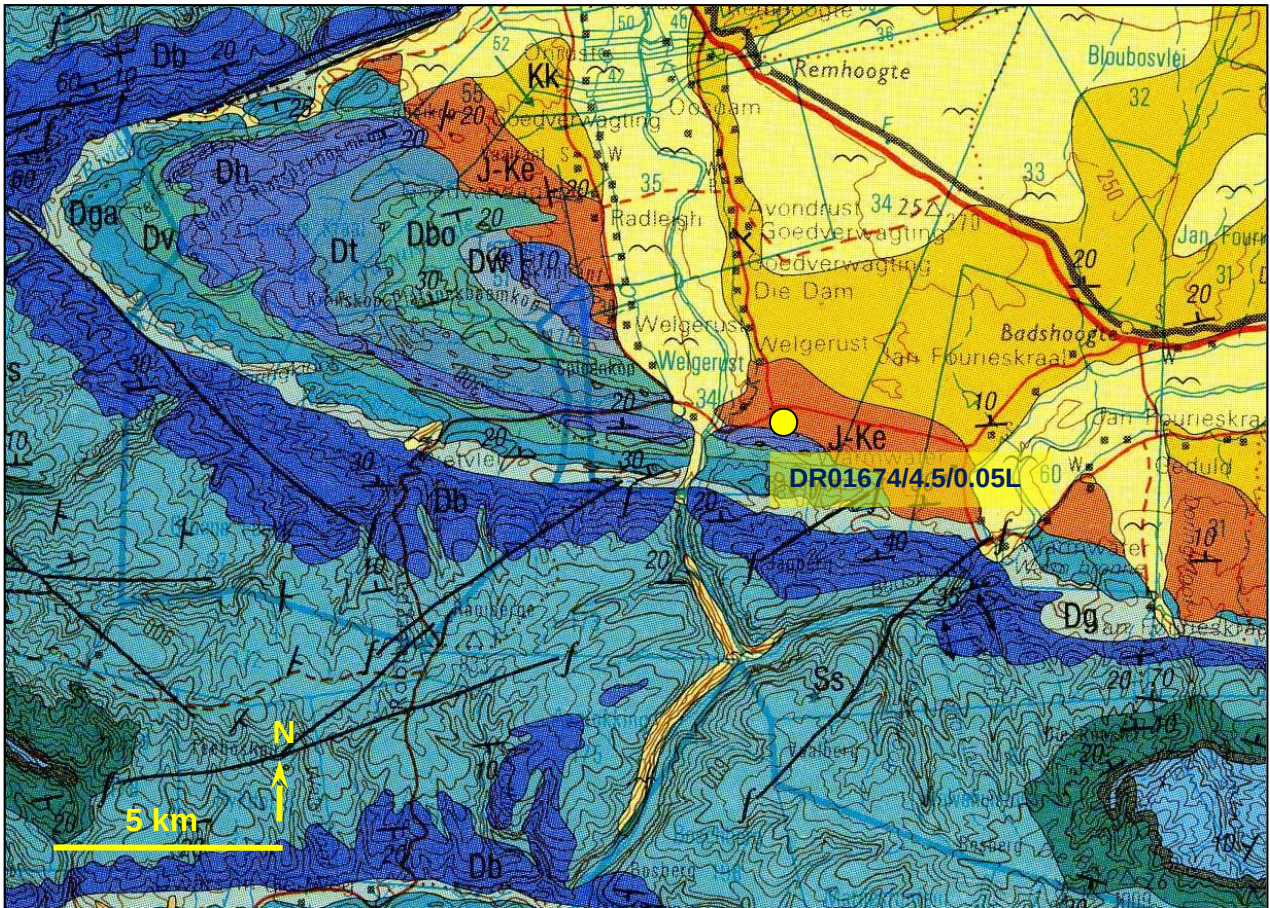


Fig. 3. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing location of the existing DR01674/4.5/0.05L borrow pit c. 11.7 km SSE of Calitzdorp, Little Karoo (yellow dot). The pit is excavated into mudrocks of the Tra Tra Formation (Dt, middle blue) (Lower Bokkeveld Group / Ceres Subgroup). The Bokkeveld bedrocks here are mapped as covered with Late Jurassic conglomerates of the Enon Formation (Uitenhage Group) (J-Ke, orange) but appear in fact to be mantled only by Late Caenozoic alluvium (pale yellow with “flying bird” symbol on map).



Fig. 4. View towards the SE across the existing DR01674/4.5/0.05L borrow pit, excavated into Tra Tra Formation mudrocks on the northern face of a sandstone ridge built by the Hexrivier Formation.

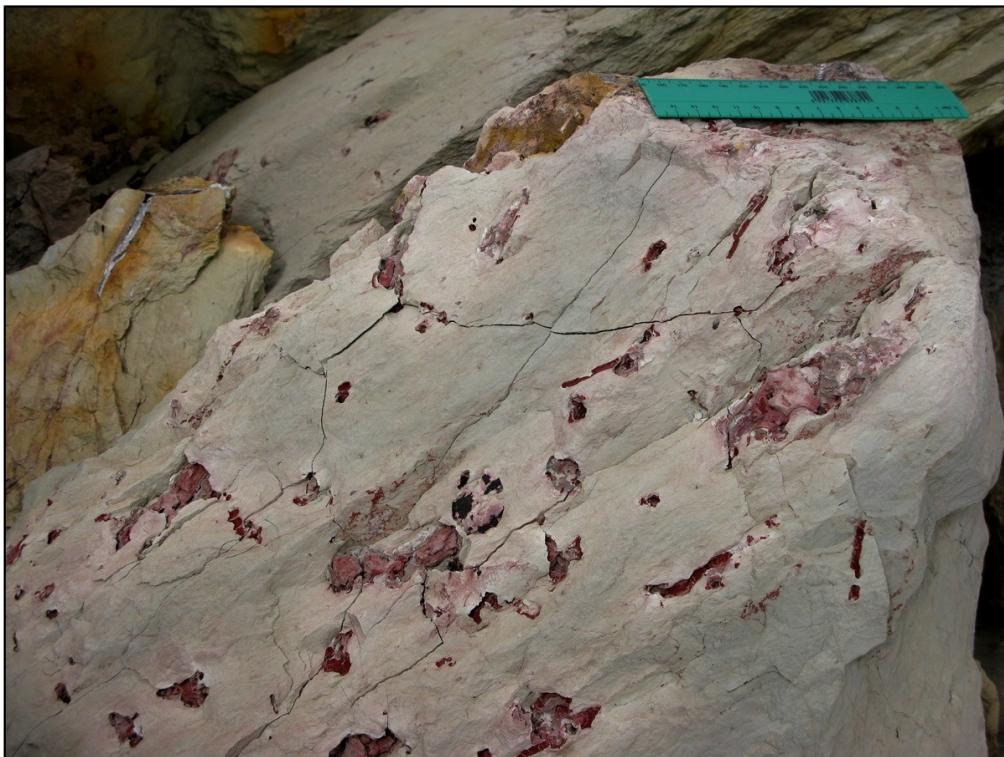


Fig. 5. Pale, weathered mudrocks of the Tra Tra Formation showing a high density of complex hollows lined with ferruginous minerals. Some of these hollows are fossil moulds (Scale in cm).



Fig. 6. Secondarily mineralised internal mould of the bivalve *Palaeoneilo* (c. 4.5 cm long) within weathered Tra Tra siltstones.



Fig. 7. Partially mineral-infilled mould of an articulated crinoid stem, weathered Tra Tra mudrocks (Scale in cm).



Fig. 8. Float block of grey Bokkeveld siltstone or wacke containing disarticulated crinoidal debris (Hammer head for scale) (Photo courtesy of Hedi Stummer).



Fig. 9. Poorly-sorted, coarse, angular colluvial gravels (mainly Bokkeveld wacke, vein quartz and minor quartzite) mantling the hillslopes behind the existing DR01674/4.5/0.05L pit.



Fig. 10. Float block of Bokkeveld wacke (probably downwasted Hexrivier Formation) containing vague fossil burrows (Scale in cm).



Fig. 11. Calcretised older alluvial deposits exposed along the northern pit margin containing cylindrical to irregular casts of subfossil burrows and / or rootlets (rhizoliths) (Hammer = 30 cm).



Fig. 12. Semi-consolidated, orange-brown older alluvial deposits containing polymict gravel clasts, including flaked quartzite artefacts (Hammer = 30 cm).



Fig. 13. Fragment of a large calcretised termitarium embedded within near-surface, weathered Bokkeveld mudrocks, south-eastern pit margin (Scale in cm).



Fig. 14. Thick orange-brown, silty modern alluvial soils and fine quartz-rich gravels mantling the flatter northern portion of the DR01674/4.5/0.05L borrow pit study area.

5. CONCLUSIONS & RECOMMENDATIONS

The large existing DR01674/4.5/0.05L borrow pit, situated on the farm Welgunst 34 at the junction of the DR1674 and DR1688 dust roads, some 11.7 km SSE of the small town of Calitzdorp, Oudtshoorn District, Little Karoo, is excavated into deeply-weathered, cleaved mudrocks of the Tra Tra Formation (Lower Bokkeveld Group / Ceres Subgroup) of Middle Devonian age. Elsewhere in the Western Cape these marine sediments contain low to moderately diverse shelly invertebrate and trace fossil assemblages (e.g. trilobite burrows). Most of the original fossils in the pit area have been distorted or destroyed by weathering and tectonic deformation, with only occasional moulds of nuculid bivalves and crinoidal material now recognisable.

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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 has been 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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