

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

**TWO BORROW PITS ALONG THE MR268 NEAR MALGAS, OVERBERG
DISTRICT MUNICIPALITY, WESTERN CAPE**

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1. EXECUTIVE SUMMARY

The proposed new borrow pit MR00268/40.0/0.02R on Farm Oudekraal near Malgas, Overberg District Municipality, will be excavated into mudrocks and impure sandstones of the Ceres Subgroup (Lower Bokkeveld Group) that elsewhere are well known for their rich fossil heritage – especially shelly invertebrates – from the Devonian Period. However, the Bokkeveld sandstones exposed in this area are highly folded, cleaved, quartz veined and weathered, and their palaeontological sensitivity is correspondingly very low. The Bokkeveld bedrocks are mantled with thick gravelly colluvial deposits of very low palaeontological significance, including reworked quartzitic cobbles from nearby Tertiary High Level Gravels.

The existing large gravel pit MR00268/46.65/0.15L on Farm Melkhoutrivier near Malgas overlies weathered quartzitic fluvial sandstones of the Rietvlei Formation (uppermost Table Mountain Group) that are overlain by a thick layer of ferruginised gravels.

No fossil remains of any kind were recorded at the two study sites during field assessment. The palaeontological sensitivity of these two sites is rated as VERY LOW and no further palaeontological heritage studies or mitigation are recommended for these projects.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from two sites adjacent to the MR268 dust road between Malgas and Cape Infanta, Overberg District Municipality, Western Cape.

The proposed site of pit MR00268/40.0/0.02R is located on the Farm Oudekraal on the west side of the dust road some 3.3 km south of Malgas and 1.3 km west of the Breede River (Fig. 1, 34°19'39.00"S 20°35'18.96" E). The site is a gravelly field with sparse renosterveld vegetation that slopes appreciably downwards from about 45 to 25 m amsl towards a small west bank tributary of the Breede River in the south (Fig. 3). There is a small but fairly deep existing pit on the northern side of the site. The proposed new pit will be initially 15 600 m² in area and following exploitation will be rehabilitated using stockpiled surface sediments to re-create a self-draining cultivatable field.

The large existing gravel pit MR00268/46.65/0.15L on the Farm Melkhoutrivier lies at around 70 m amsl on an ancient pediment surface on the north side of the MR268 about 8.5 km southeast of Malgas and 1.4 km distant from the Breede River (34°21'55.80"S 20°37'45.84" E). The shallow pit is surrounded by alien infested fynbos and slopes gently towards the east. The proposed extended pit will have an area of approximately 24 600 m² and after exploitation will be rehabilitated using stockpiled topsoil to create a stock watering feature.

A previous desktop basic assessment of the two Malgas pit sites by the author assessed their palaeontological heritage sensitivity as moderate to high due to the inferred presence in both instances of potentially fossiliferous mudrocks of the Lower Bokkeveld Group (Ceres Subgroup), with the caveat that the bedrock here is probably highly weathered (In fact, as outlined below, one of the pits is actually underlain by Table Mountain Group bedrocks of moderate to low palaeontological sensitivity). A palaeontological field assessment of the two pits as part of an HIA was requested by Heritage Western Cape (HWC case ref. no. 120130JL05, Interim comment 15 February 2012) in accordance with the requirements of the National Heritage Resources Act, 1999 (Section 38).

The present palaeontological heritage field assessments 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). These are Vidamemoria pit nos. 74 (MR00268/40.0/0.02R) and 75 (MR00268/46.65/0.15L) and NID ref. no. 57. Fieldwork for this project was carried out on 31 May 2012.



Fig. 1. Extract from topographical sheet 3429 Riversdale (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the two proposed borrow pit developments MR00268/40.0/0.02R and MR00268/46.65/0.15L near Malgas, Overberg District Municipality, Western Cape (blue dots).

3. GEOLOGICAL CONTEXT

As shown on the 1: 250 000 geological map 3420 Riversdale (Council for Geoscience, Pretoria; Malan *et al.* 1994) (Fig. 2) the gently hilly *rûens* region of the Overberg region near Malgas is largely underlain by marine sediments of the Early to Middle Devonian **Bokkeveld Group**. The new pit MR00268/40.0/0.02R will be excavated into mudrocks and subordinate impure sandstones (wackes) of the **Ceres Subgroup** (Lower Bokkeveld Group, **Dc**).

The Bokkeveld Group, the middle unit of the Cape Supergroup, is a thick (c. 1.5 to 3.5km) succession of fossiliferous sedimentary rocks which was deposited in shallow marine to coastal settings during the Early to Middle Devonian Period, about 400 to 375 million years ago. These sediments accumulated on an area of continental shelf – the Cape Basin – which then lay towards the southern edge of the supercontinent Gondwana at moderately high palaeolatitudes (c. 70°S). Key accounts of Bokkeveld Group geology and sedimentology are given by Theron (1972), Tankard and Barwis (1982), Theron and Looek (1988), Theron and Thamm (1990), Theron and Johnson (1991), Broquet (1992) as well as Thamm and Johnson (2006). An outline of the Lower Bokkeveld Group rocks in the Riversdale sheet area is given by Malan *et al.* (1994). Due to extensive drift cover (alluvium, lag gravels, soils) as well as deep weathering and tectonic deformation, outcrops of fresh Bokkeveld bedrock are not available in this area. For these reasons, as well as the southwards thinning of key sandstone marker horizons, it has not proved possible to distinguish individual formations within the Ceres Subgroup for mapping purposes. However, two sandstone-dominated zones are differentiated on the 1: 250 000 geology map (stippled areas, Fig. 2). The Bokkeveld Group rocks in the study area are folded on both large and small scales and also transected by faults. As a consequence of the Cape-age folding and these faults, high levels of tectonic deformation are widespread in the southern Overberg region. Chemical weathering processes beneath an ancient coastal land surface (pediment), capped elsewhere in the Malgas area by cobbly alluvial gravels and silcretes, have been facilitated by tectonic cleavage development as well as high levels of groundwater movement through the fault zone. As a result, the originally dark mudrocks have been extensively altered, in some cases to white-weathering kaolinite (China clay), and impregnated with secondary iron / manganese minerals.

Pit MR00268/40.0/0.02R overlies a Late Tertiary pediment surface situated along the northern flanks of the Potberg Range (TMG / Table Mountain Group rocks) that is characterised by deep chemical weathering of the Lower Bokkeveld Group bedrocks to a pallid zone saprolite (Fig. 3). As seen on the geological map, the pediment surface is locally capped by relict patches of alluvial conglomerates (“High Level Gravels”) associated with the Breede River drainage system and, to the southwest, by small areas of silcrete. Reddish-brown, moderately consolidated Tertiary alluvial gravels are well exposed in road cuttings less than 200m north of the proposed pit site. Here well-sorted, well-rounded cobbles and pebbles of Table Mountain Group quartzites predominate, accompanied by occasional clasts of ferruginous sandstone and silcrete.

The Lower Bokkeveld Group (**Ceres Subgroup**) sediments underlying the study area are not exposed here but are well seen in the small pit just to the north (Fig. 4) as well as road cuttings along the MR268 less than 100 m to the southeast. Here the Bokkeveld Group succession consists of grey-green to pale brown, thin- to medium-bedded, fine-grained, well-laminated wackes and siltstones, with occasional intervals of cyclical rhythmites (Fig. 5). The mudrocks are often micaceous, and almost phyllitic in appearance. These Palaeozoic bedrocks show evidence of high levels of tectonic deformation in the form of extensive convolute folding, quartz veining (the veins often themselves folded), a well-developed cleavage and small faults.

Within the study area itself the Bokkeveld bedrocks are entirely mantled by colluvial and downwasted gravelly soils and surface gravels that according to the geotechnical report by Aurecon are up to 60cm or more thick (Figs. 3 and 7). Surface gravels on site are dominated by well-rounded TMG cobbles and pebbles with occasional small boulders, *plus* angular vein quartz, laminated Bokkeveld wackes and rare silcretes (sometimes gravelly). Finer, more angular, poorly sorted gravels predominate down slope while TMG cobbles and pebbles are commoner upslope,

close to the relict patches of *in situ* High Level Gravels to the north. Outsized boulders and blocks have been heaped up by farmers.

Pit MR00268/46.65/0.15L is in fact underlain by quartzitic sediments of the **Rietvlei Formation** (uppermost Table Mountain Group / TMG, Dr), contrary to the information originally provided by the present author to HWC at the NID stage. These TMG rocks run along the northern flanks of the Potberg Range and have been planed off by Late Tertiary fluvial incision to form an extensive, weathered pediment surface (Fig. 2).

The Rietvlei Formation consists of pale, flat-laminated to current cross-laminated sandstones and quartzites. Pebbly layers and lenses, principally composed of small vein quartz and black chert clasts, are common. Bedding thickness is less than in the underlying Skurweberg Formation and for this reason, as well as the more frequent occurrence of softer, feldspar-rich wackes and mudrock interbeds, the Rietvlei Formation typically has a topographically subdued outcrop (Theron & Basson 1989). The bulk of the Rietvlei succession in the study region is interpreted as a braided fluvial deposit with occasional marine-influenced intervals, especially towards the top of the succession. The contact with the overlying fully marine Ceres Subgroup is a gradational one in the Malgas – Cape Infanta region (Malan *et al.* 1994).

The existing large borrow pit MR00268/46.65/0.15L is excavated into a 1.5m or thicker veneer of ferruginised gravels overlying the planed-off pediment surface (Fig. 8). The medium to coarse gravels at surface here mainly consist of angular clasts of reddish- to purplish-brown ferruginous sandstone, quartzite and ferricrete with an admixture of rarer vein quartz and silcrete (Fig. 9). This material is locally derived from the underlying TMG bedrock and according to the geotechnical report produced by Aurecon infills a hollow in the pediment surface. Heaps of oversized clasts of TMG sandstone, silcrete and quartz are present along the northern edge of the pit. Low ridges of more resistant Rietvlei Formation quartzites, striking approximately E-W, are visible among the alien infested fynbos to the north of the pit area. The TMG rocks here are pale, cross-bedded quartzites that locally are highly ferruginised, jointed, and weathered (Fig. 10).

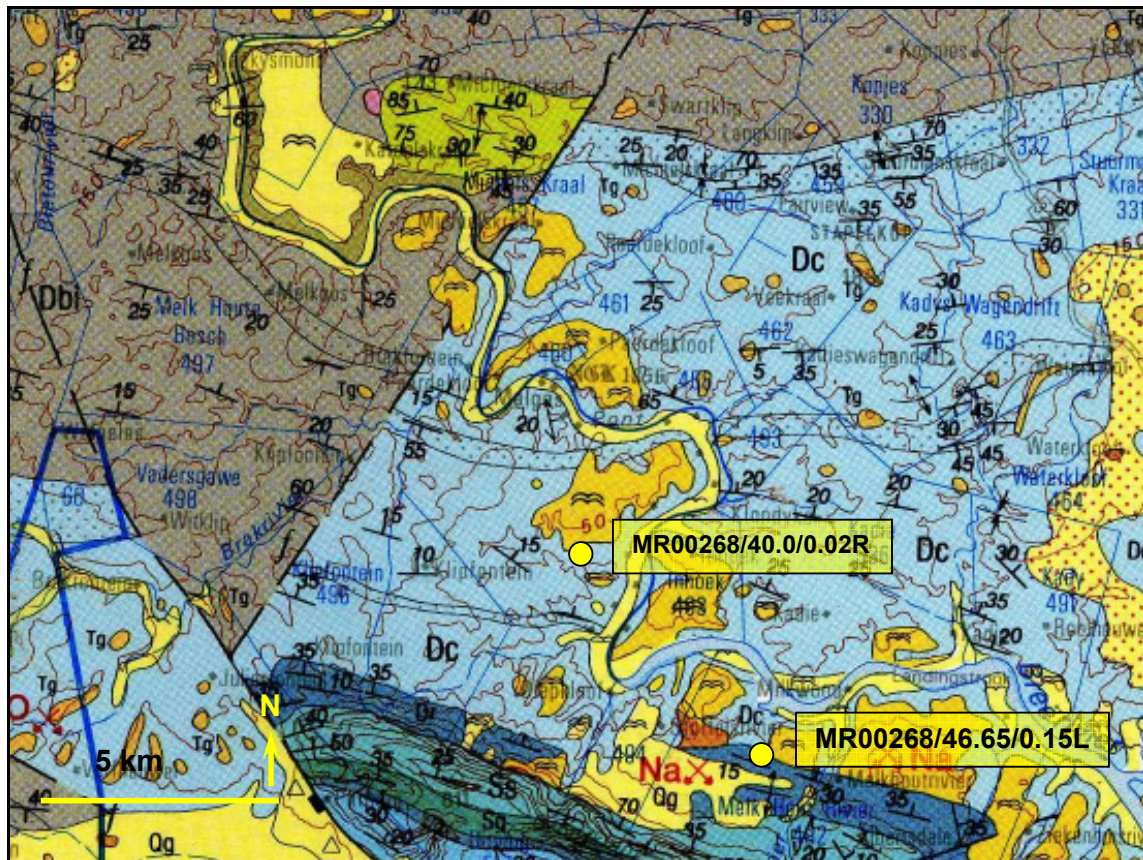


Fig. 2. Extract from 1: 250 000 geology sheet 3420 Riversdale (Council for Geoscience, Pretoria) showing the approximate location of the two proposed borrow pit developments near Malgas, Overberg District Municipality (yellow dots). Note the numerous extensive patches of Tertiary High Level Gravels and ferricrete gravels associated with the course of the Breede River (dark yellow with double flying bird symbol). Small relict patches of Tertiary silcrete are mapped to the west of the study area (dark yellow, Tg). Pit MR00268/40.0/0.02R will be excavated into marine sediments of the Lower Bokkeveld Group / Ceres Subgroup (Dc, pale blue) that are capped by alluvial gravels just to the north. Pit MR00268/46.65/0.15L is excavated into ferricrete gravels overlying Table Mountain Group bedrocks (Rietvlei Formation, Dr, dark blue).



Fig. 3. View southwards across the MR00268/40.0/0.02R study area with pallid zone weathering beneath a pediment surface in the middle ground and Table Mountain Group rocks of the Potberg Range in the background.



Fig. 4. Good exposure of highly folded, cleaved sediments of the Ceres Subgroup in an existing pit just north of the MR00268/40.0/0.02R study area (Hammer = 27 cm). Note refolding of quartz veins.



Fig. 5. Close up of Lower Bokkeveld Group exposure shown in the previous figure showing highly folded, quartz-veined and cleaved sediments (Hammer = 27 cm).



Fig. 7. Downwasted surface gravels of well-rounded Table Mountain Group pebbles and small angular vein quartz clasts within upper part of MR00268/40.0/0.02R study area (Hammer = 27 cm).



Fig. 8. View eastwards across the ferruginous gravel pit MR00268/46.65/0.15L.



Fig. 9. Close up of ferruginised gravels showing variable degree of rounding (Hammer = 27 cm).



Fig. 10. Low ridge-like exposures of Rietvlei Formation cross-bedded quartzites among fynbos vegetation on the northern margin of the existing pit.

4. PALAEONTOLOGICAL HERITAGE

The lower part of the **Bokkeveld Group** in the Western Cape (Ceres Subgroup *plus* lowermost Bidouw Subgroup) 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.

Although the western outcrop area of the Rietvlei Formation is predominantly fluvial in origin, marine influence increases markedly towards the east where fully marine, low diversity shelly faunas dominated by thick-shelled pleurothyrellid brachiopods are recorded (Almond 2008 and refs. therein). These invertebrates are the first representatives of the cool-water Malvinokaffric Realm biotas within the Cape Basin and establish an Early Devonian (Lochkovian / Pragian) age for the formation (Boucot 1999). As elsewhere within the Table Mountain Group, mudrock-rich intervals within the Rietvlei Formation are associated with low diversity ichnoassemblages – mainly vertical “pipe rock” burrows of filter-feeding invertebrates - that imply intermittent shallow marine transgressions over the sandy, near coastal braid plain (e.g. Malan *et al.* 1994).

No shelly fossils were observed during the field studies of Lower Bokkeveld Group sandstones and mudrocks in the Swellendam area, some 30 km NNW of Malgas, by Almond (2010a, 2010b). Malan *et al.* (1994) only record lycopod (clubmoss) and psilophyte plant impressions, indeterminate trace fossils and occasional crinoid moulds within sandstones of the Ceres

Subgroup in the Riversdale sheet area. The rarity of Bokkeveld fossil records here may be attributed to several factors, notably:

- deep chemical weathering of sediments beneath the “African Surface” which has obliterated fossil moulds;
- intensive tectonic deformation of the Bokkeveld succession, with pervasive cleavage formation within the normally fossiliferous mudrocks (*N.B.* Most fossils are preserved and seen on bedding planes, which are rarely exposed here, rather than secondary cleavage planes which cut across fossil-rich layers);
- the extensive mantle of drift deposits (including lag gravels, soil and pedocretes) covering the Bokkeveld bedrock

No shelly or trace fossils were observed within the Cape Supergroup sediments at either of the two MR268 pit sites near Malgas during field assessment.

The palaeontological sensitivity of these two sites is rated as VERY LOW.

5. CONCLUSIONS & RECOMMENDATIONS

The proposed new borrow pit MR00268/40.0/0.02R near Malgas, Overberg District Municipality, will be excavated into mudrocks and impure sandstones of the Ceres Subgroup (Lower Bokkeveld Group) that elsewhere are well known for their rich fossil heritage – especially shelly invertebrates – from the Devonian Period. However, the Bokkeveld sandstones exposed in this area are highly folded, cleaved, quartz veined and weathered, and their palaeontological sensitivity is correspondingly very low. The Bokkeveld bedrocks are mantled with thick gravelly colluvial deposits of very low palaeontological significance, including reworked quartzitic cobbles from nearby Tertiary High Level Gravels.

The existing large gravel pit MR00268/46.65/0.15L near Malgas overlies weathered quartzitic fluvial sandstones of the Rietvlei Formation (uppermost Table Mountain Group) that are overlain by a thick layer of ferruginised gravels.

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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 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 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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