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

THREE BORROW PITS BETWEEN LAINGSBURG & MERWEVILLE, LAINGSBURG DISTRICT, WESTERN CAPE (FARMS SPRINGFONTEIN 60, SKOPPELMANSKRAAL 54 & DIKBOOM 53)

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1. EXECUTIVE SUMMARY

The three proposed borrow pit sites along the MR374 dust road between the N1 and Merweville in the Koup region of the Great Karoo (Laingsburg District, Western Cape) are to be excavated into potentially fossiliferous fluvial sediments of the Abrahamskraal Formation (Lower Beaufort Group). The projects involve a new pit MR00374/19.5/0.25L on the Farm Springfontein 60, the extension of an existing pit site MR00374/29.9/0.05R on the Farm Dikboom 53, and a new pit site MR00374/35.8/0.05L on the Farm Schoppel Maay Kraal 54 (Skoppelmanskraal).

The Abrahamskraal Formation bedrocks at all three sites are extensively mantled in Quaternary to Recent colluvial and fluvial gravels of low fossil heritage interest. Given the paucity of fossil material observed during field assessment in the limited available exposures of Beaufort Group bedrocks here, the palaeontological sensitivity of all these three sites is assessed as LOW. While it is possible that vertebrate and other fossil remains may be exposed during excavation of the pit areas, tthe anticipated low density of fossil material subsurface does not warrant special mitigation measures or further studies.

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 three proposed borrow pit sites in the Koup region of the Great Karoo (Laingsburg District, Western Cape). The sites lie alongside the MR374 dust road that runs between the N1 trunk road and the small town of Merweville (Fig. 1). In all cases the terrain is typical semi-arid Karoo *veld* with rocky ridges and valleys drained by intermittently flowing water courses.

Pit site MR00374/19.5/0.25L on the Farm Springfontein 60 is situated at *c*. 815 m amsl on the north side of the MR374 and about 42 km southwest of Merweville (32˚ 59' 12.28" S, 21˚ 15' 19.68" E). The proposed area for exploitation lies between the road and a small east bank tributary stream of the Bloedrivier whose main course runs 0.66 km to the southwest (Fig. 3). A sizeable existing pit is situated just to the west of the proposed new pit area.

Pit site MR00374/29.9/0.05R on the Farm Dikboom 53 is situated at *c.* 710 m amsl on the eastern side of the MR374 and about 32 km southwest of Merweville (32°55'32.52" S, 21°20'44.88" E). The existing shallow pit lies at the foot of the prominent hill Vlaebakenskop (Fig. 6).

Pit site MR00374/35.8/0.05L on the Farm Schoppel Maay Kraal 54 (Skoppelmanskraal) is situated at *c.* 680 m amsl on the western side of the MR374 and at the confluence of two west bank tributaries of the Dwyka River, some 30 km southwest of Merweville (32°53'12.48"S, 21°20'29.04" E). The proposed new site lies on the densely vegetated, gravelly floodplain of a small, intermittently flowing stream that is bounded in the south by a low cliff of Beaufort Group rocks (Fig. 9).

A previous desktop basic assessment of the three pit sites by the author assessed their palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Lower Beaufort Group (Abrahamskraal Formation). A palaeontological field assessment of the three pit sites as part of an HIA was requested by Heritage Western Cape (HWC case ref. no. 111124JB49, Interim comment 1 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). These are Vidamemoria pit nos. 110 (MR00374/19.5/0.25L), 112 (MR00374/29.9/0.05R) and 113 (MR00374/35.8/0.05L) and NID ref. no. 44. Fieldwork for this project was carried out on 2 June 2012.

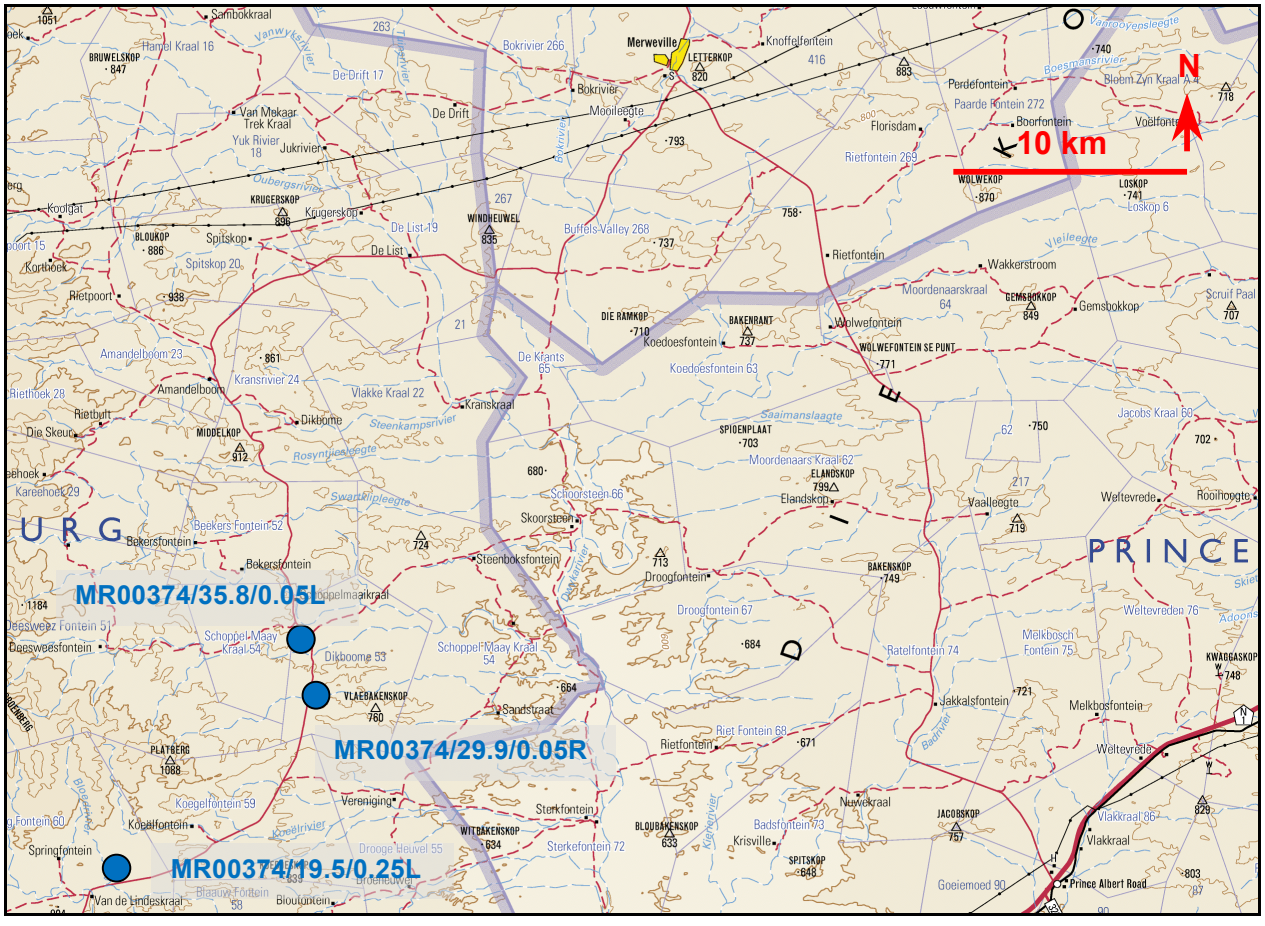

Fig. 1. Extract from topographical sheet 3220 Sutherland (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the three borrow pit study sites along the MR374 dust road linking the N1 trunk road and Merweville, Laingsburg District, Western Cape (blue dots).

3. GEOLOGICAL CONTEXT

The geology of the study area is shown on 1: 250 000 sheet 3220 Sutherland (Fig. 2) (Theron 1983, Cole & Vorster 1999). It is underlain by continental sedimentary rocks of the **Abrahamskraal Formation** (**Pa**) (Lower Beaufort Group / Adelaide Subgroup, Karoo Supergroup) of Middle Permian age. The Abrahamskraal succession consists of a wide range of fluvial deposits, including river channel sandstones and minor intraformational breccio-conglomerates, well-bedded floodplain mudrocks with common pedocrete horizons (ancient soils) and sheet-like crevasse splay sandstones, as well as more localized playa lake deposits (*e.g.* laminated mudrocks) (Rossouw & De Villiers 1952, Johnson & Keyser 1979, Smith & Keyser 1995, Loock *et al*., 1994, Johnson *et al*., 2006).

Pit site MR00374/19.5/0.25L (Farm Springfontein 60) is characterized at surface by mixed alluvial and colluvial gravelly deposits overlying a river-cut pediment of Lower Beaufort Group sediments (Fig. 3). The pediment is incised by a small stream on the northern side (Fig. 3). Exposures of the Beaufort Group rocks are limited to the banks of the stream (Fig. 4), but they are also well seen in the existing pit to the west of the study area as well as on the south side of the MR374 dust road. The mainly comprise dark grey-green, hackly-weathering, splintery overbank mudrocks, thin-bedded and dipping gently to the NW. More extensive mudrock exposures east of the study area display local concentrations of sphaeroidal to irregular nodules of ferruginous calcrete that are typically associated with palaeosol horizons (Fig. 5). Prominent ridges of buff channel or crevasse splay sandstones are seen north of the stream, and extensive lenticular channel sandstones are evident south of the road. The superficial deposits are dominated by angular to subangular clasts of fine-grained Beaufort Group sandstones with subordinate *koffieklip* (ferruginous limestone), vein quartz and calcrete. Coarser gravels have been concentrated at surface by downwasting. Good sections through poorly sorted colluvial deposits mantling the ridge to the north of the site are seen in the walls of the existing pit.

Pit site MR00374/29.9/0.05R on the Farm Dikboom 53 is largely excavated into alluvial outwash and colluvial gravels of Beaufort Group sandstones on the lower footslopes of Vlaebakenskop (Fig. 6). Lower Beaufort Group bedrocks exposed in the floor of the pit include grey-green, hackly weathering mudrocks with sparse gypsum pseudomorphs as well as subordinate well-jointed, mottled sandstones. Good exposures of grey-green and and purple-brown mudrocks are seen some 150 m to the NE (Fig. 7). Here well-developed palaeosols associated with calcrete nodules and sparse fossil remains are seen (Fig. 8).

Pit site MR00374/35.8/0.05L on the Farm Schoppel Maay Kraal 54 lies on the floodplain of a modern intermittently flowing stream (Fig. 9) that is covered in poorly sorted alluvial gravels of probable Quaternary to Recent age, dominated by angular to subangular blocks of Beaufort Group sandstone (Fig. 10). The Lower Beaufort succession here is very well exposed in the low cliff along the southern side of the stream. Here can be seen excellent vertical sections through grey-green to purple-brown, tabular bedded overbank mudrocks that are incised by lenticular, single to multi-storey channel sandstones with locally highly erosive bases (gullying) (Fig. 11).

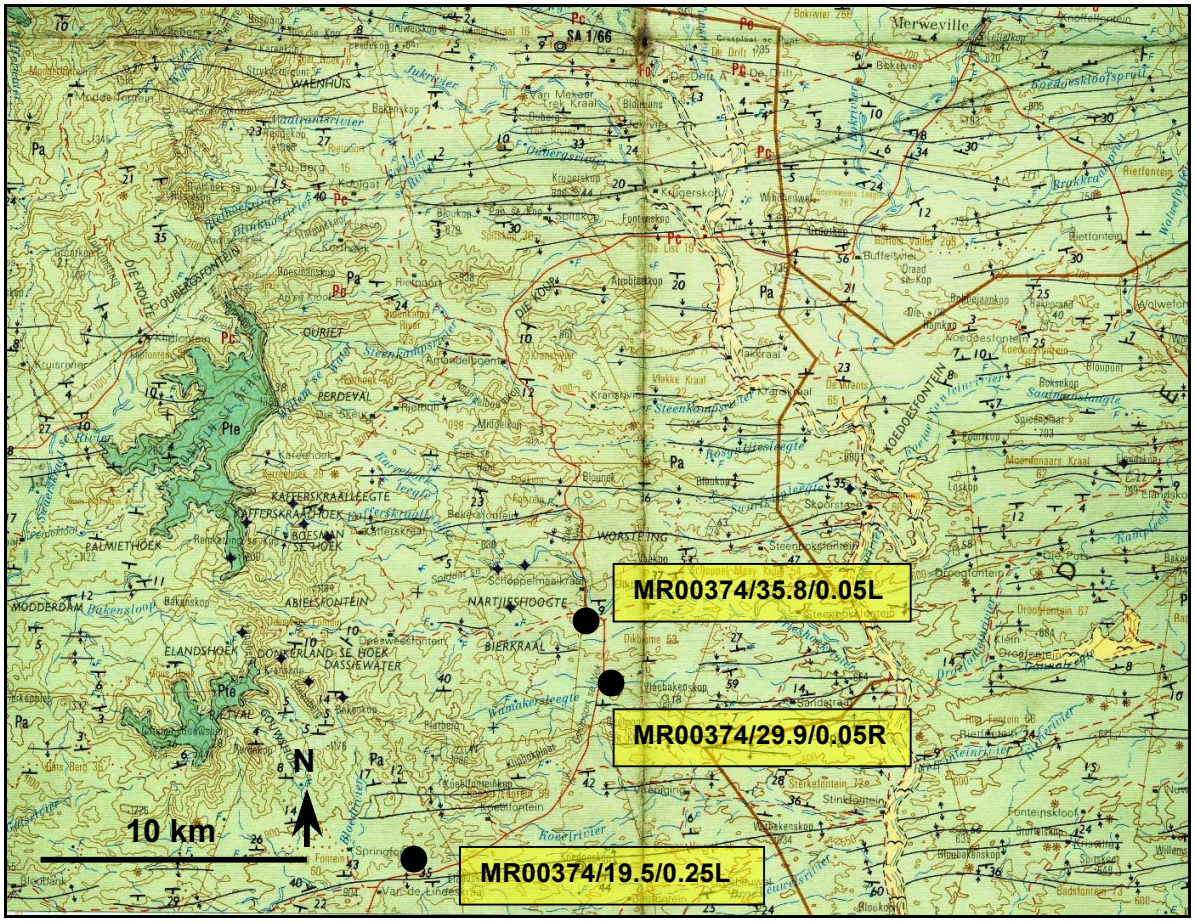

Fig. 2. Extract from 1: 250 000 geology sheet 3220 Sutherland (Council for Geoscience, Pretoria) showing location of the three borrow pit study sites along the MR374 between the N1 and Merweville (town shown on the NE edge of map). The pits will all be excavated into mudrocks within the Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group) (Pa, yellow-green). The map indicates several vertebrate fossil sites of the *Tapinocephalus* Assemblage Zone, especially to the west of the pit sites (diamond symbols).

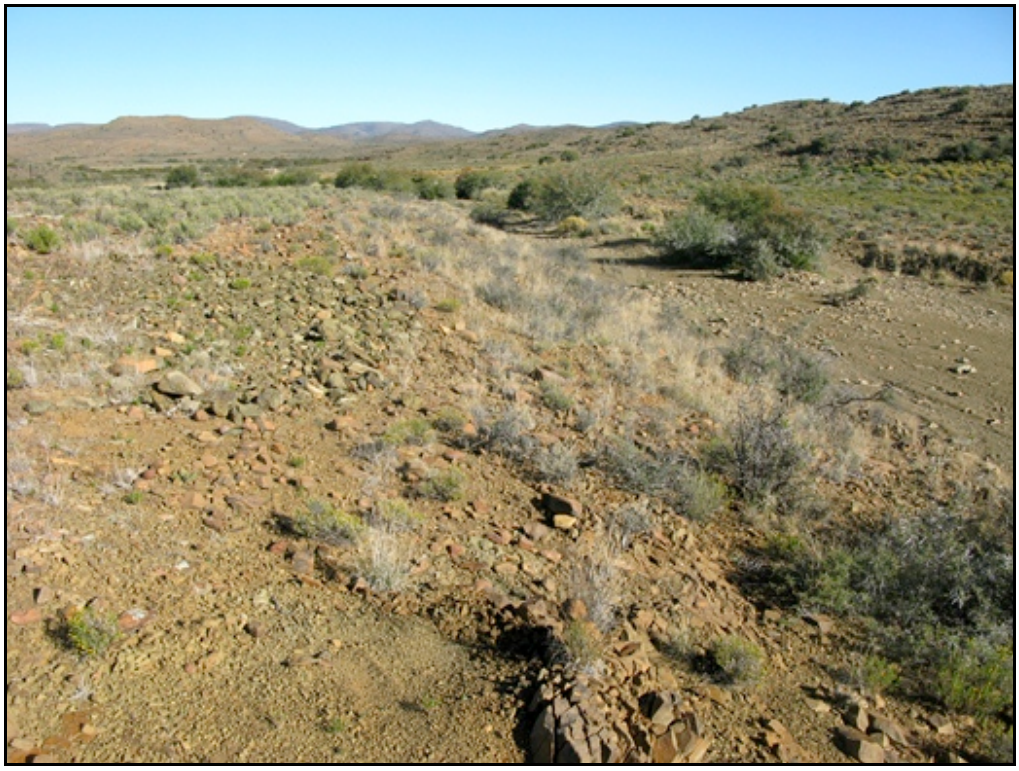

Fig. 3. View towards the west along the northern margin of the study area MR00374/19.5/0.25L. The raised, gravel-mantled pediment surface on the left (south) is underlain by Lower Beaufort Group mudrocks and channel sandstones.

Fig. 4. Hackly weathering, grey overbank mudrocks of the Lower Beaufort Group overlain by poorly sorted, angular colluvial and alluvial gravels as exposed along the banks of the dry water course seen in the previous figure.

Fig. 5. Concentrations of ferruginous calcrete nodules associated with an ancient soil horizon and now weathering out of overbank mudrocks of the Lower Beaufort Group just to the east of the MR00374/19.5/0.25L study area (Hammer = 27 cm).

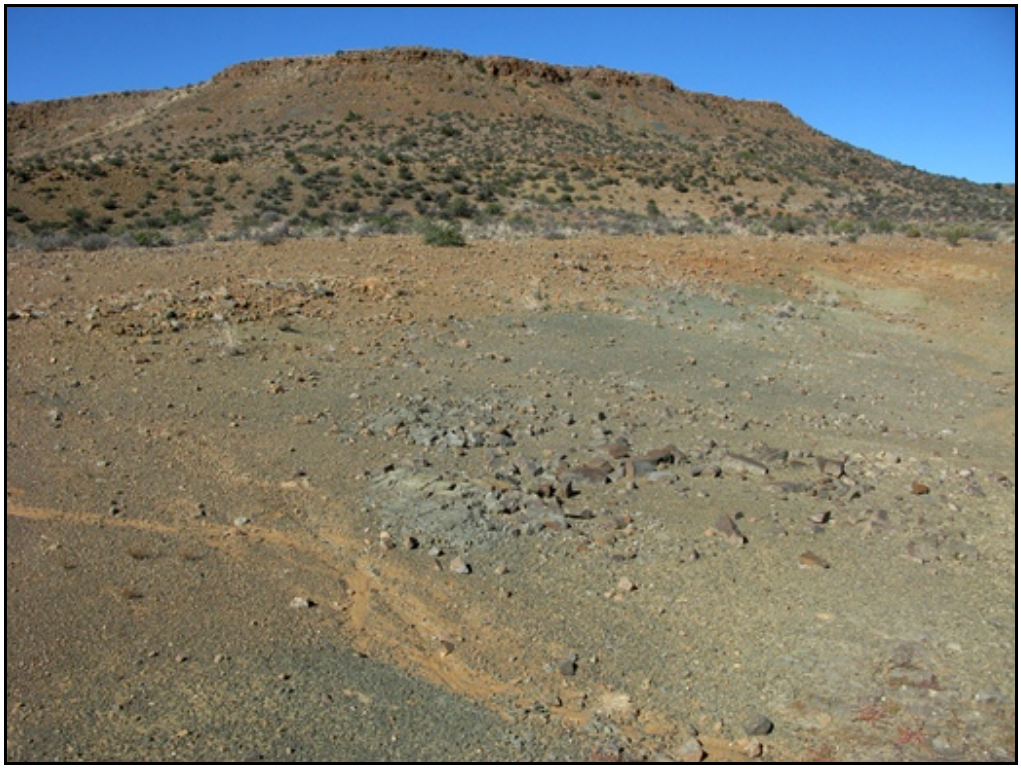

Fig. 6. View westwards across existing pit site MR00374/29.9/0.05R showing mudrocks and thin sandstones of the Lower Beaufort Group in the floor of the pit mantled by brownish weathering alluvial outwash gravels. The hill in the background is Vlaebakenskop.

Fig. 7. Good exposures of Beaufort Group mudrocks some 150 m NE of the main MR00374/29.9/0.05R pit site.

Fig. 8. Well-developed palaeosols within Beaufort Group overbank mudrocks at the site seen in the previous figure (Hammer = 27 cm). The calcrete nodules here are associated with sparse vertebrate fossils.

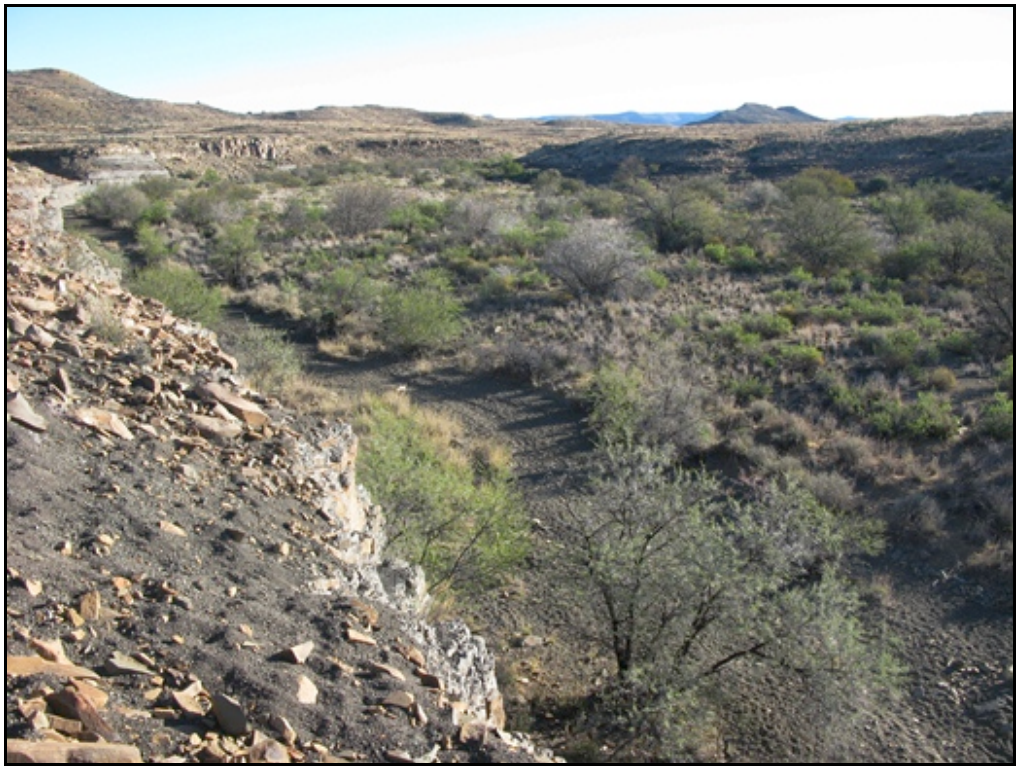

Fig. 9. View westwards across the proposed new MR00374/35.8/0.05L pit site on the northern bank of an intermittently flowing stream bed.

Fig. 10. Poorly sorted alluvial gravels mantling the MR00374/35.8/0.05L study site (foreground) with low cliff of Beaufort Group sediments in the background.

Fig. 11. Well-exposed vertical section through the Lower Beaufort Group showing lenticular channel sandstones (brown) incised into grey-green and purple-brown overbank mudrocks.

4. PALAEONTOLOGICAL HERITAGE

Apart from the uppermost 50m or so of beds directly underlying the Poortjie Member sandstones, the Abrahamskraal Formation has been assigned in biostratigraphical terms to the *Tapinocephalus* Assemblage Zone, dated to around 266-260 Ma (Rubidge 1995, 2005). The fossil biota of the *Tapinocephalus* Assemblage Zone, with particular reference to the biostatigraphically important tetrapod fauna, has been reviewed by Smith and Keyser *in* Rubidge (1995) as well as in earlier works by Rossouw and De Villiers (1952), Boonstra (1969), Keyser and Smith (1979) and others (See also MacRae, 1999 for a well-illustrated popular account). Many individual fossil localities are indicated on published geological maps such as 1: 125 000 sheet 198 Merweville, 1: 250 000 sheets 3222 Beaufort West and 3220 Sutherland, as well as maps in Keyser & Smith (1979) and Loock *et al*. (1995) (See diamond symbols in Fig. 2).

The fauna of the *Tapinocephalus* Assemblage Zone is dominated by two groups of large-bodied tetrapods. The dinocephalians are primitive therapsids that include the large-bodied, thick-skulled herbivorous or omnivorous tapinocephalids (*e.g. Moschops*) as well as much rarer carnivorous anteosaurs (*Anteosaurus*). Pareiasaurs are a group of heavily-armoured herbivores belonging to the primitive reptile subgroup, the Captorhinida (*e.g. Bradysaurus*). Some 18 genera and 30 species of dinocephalians alone have been described from this assemblage zone. However, many of these taxa are based on very incomplete or deformed material, and ongoing research is likely to whittle down their true biodiversity to more realistic levels, particularly when ontogenetic variation and sexual dimorphism are taken into account). Other important tetrapod taxa represented in the same Lower Beaufort Group assemblages are (c) two groups of carnivorous therapsids, the therocephalians and gorgonopsians, the former of which are quite common and diverse; (d) small-bodied herbivorous dicynodonts, including some primitive toothed genera as well as the long-ranging *Diictodon*, (e) rare varanopid pelycosaurs (primitive synapsids, *e.g. Elliotsmithia*), biarmosuchians (primitive therapsids), the tortoise-like captorhinid *Eunotosaurus*, and large, crocodile-like temnospondyl amphibians (*Rhinesuchus*). Since the brief faunal review by Smith and Keyser *in* Rubidge (1995), a number of new tetrapod taxa have been described from the Abrahamskraal Formation, notably by Professor Bruce Rubidge of the BPI (Wits University,

Johannesburg) and colleagues. Concentrations of transported plant debris are sometimes associated with uranium minerals within the Abrahamskraal sandstones. These plant-rich zones are often also enriched in ferruginous carbonate forming a dark brown rock locally known as *koffieklip* (Cole *et al.* 1998).

The only fossil material recorded at pit site MR00374/19.5/0.25L (Farm Springfontein 60) was the impression of an isolated fragment of plant stem – probably a sphenophyte fern (horsetail) – embedded in a sandstone float block (Fig. 12).

At pit site MR00374/29.9/0.05R (Farm Dikboom 53) was found a single isolated float fragment of limb bone of an unidentified tetrapod (Fig. 13) while some 150 m to the northeast a small phosphatic coprolite (fossilised faeces, or perhaps regurgitate) containing tooth fragments was associated with well-developed palaeosol calcretes (Fig. 14).

No fossil material was recorded from pit site MR00374/35.8/0.05L (Farm Schoppel Maay Kraal 54), despite locally excellent and extensive exposure here of the Beaufort Group mudrocks.

Fig. 12. Fragmentary stem impression of a sphenophyte (horsetail fern) preserved within a sandstone float block, surface gravels at site MR00374/19.5/0.25L. Stem is 0.5 cm across.

Fig. 13. Isolated fragment of petrified vertebrate bone from pit site MR00374/29.9/0.05R (30˚ 55' 33.7" S, 21˚ 20' 48.5" E) (Scale in cm and mm).

Fig. 14. Phosphatised coprolite (fossil dropping) associated with well-exposed palaeosol horizon *c*. 150m to the NE of pit site MR00374/29.9/0.05R (30˚ 55' 30.0" S, 21˚ 20' 52.1" E). The specimen is *c*. 5 cm long and contains small tooth fragments.

5. CONCLUSIONS & RECOMMENDATIONS

The three proposed borrow pit sites along the MR374 dust road between the N1 and Merweville in the Koup region of the Great Karoo (Laingsburg District, Western Cape) are to be excavated into potentially fossiliferous fluvial sediments of the Abrahamskraal Formation (Lower Beaufort Group). The projects involve a new pit MR00374/19.5/0.25L on the Farm Springfontein 60, the extension of an existing pit site MR00374/29.9/0.05R on the Farm Dikboom 53, and a new pit site MR00374/35.8/0.05L on the Farm Schoppel Maay Kraal 54.

The Abrahamskraal Formation bedrocks at all three sites are extensively mantled in Quaternary to Recent colluvial and fluvial gravels of low fossil heritage interest. Given the paucity of fossil material observed during field assessment in the available exposures of Beaufort Group bedrocks here, the palaeontological sensitivity of all these three sites is assessed as LOW. While it is possible that vertebrate and other fossil remains may be exposed during excavation of the pit areas, tthe anticipated low density of fossil material subsurface does not warrant special mitigation measures or further studies.

No further palaeontological heritage studies or mitigation are recommended for these projects.

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 grateful to Madelon Tusenius for assistance and companionship in the field.

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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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