

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

## **BORROW PIT NEAR BEAUFORT WEST, CENTRAL KAROO DISTRICT MUNICIPALITY, WESTERN CAPE**

**John E. Almond PhD (Cantab.)**  
*Natura Viva cc,*  
PO Box 12410 Mill Street,  
Cape Town 8010, RSA  
naturaviva@universe.co.za

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### **1. EXECUTIVE SUMMARY**

It is proposed to develop a borrow pit for road material situated on the north side of the DR2303 some 40 km WSW of Beaufort West, Central Karoo District Municipality, Western Cape. The extensive existing pit is excavated into mudrocks of the Abrahamskraal Formation (Lower Beaufort Group) that are famous for their rich fossil record of terrestrial vertebrates (e.g. reptiles and therapsids) of Middle Permian age.

A number of robust, disarticulated postcranial bones of large-bodied reptiles and / or therapsids were recorded weathered out at-surface within the pit site during field assessment. The specimens were mostly weathered and sun-cracked, and probably unidentifiable to a specific fossil animal.

The palaeontological sensitivity of this site is rated as MODERATE and it is likely that further vertebrate remains may be exposed during further excavation of the pit area. However, the anticipated low density of fossil material in the subsurface does not warrant special mitigation measures or further studies.

No further palaeontological heritage 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 situated on the north side of the DR2303 some 40 km WSW of Beaufort West, Central Karoo District Municipality, Western Cape (Fig. 1). The pit site in question (DR02308/36.6/0.05L, located at 32°24' 58" S, 22° 8' 25.29" E) lies 1.2 km northeast of the Rietkuil farmstead and 17.75 km north of the N1 trunk road.

A previous desktop basic assessment of the pit site by the author assessed its palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Lower Beaufort Group. A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC case ref. no. 110928JB27, Interim comment 3 October 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: 3<sup>rd</sup> 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. 35 and NID ref. no. 3. Fieldwork for this project was carried out on 17 February 2012.

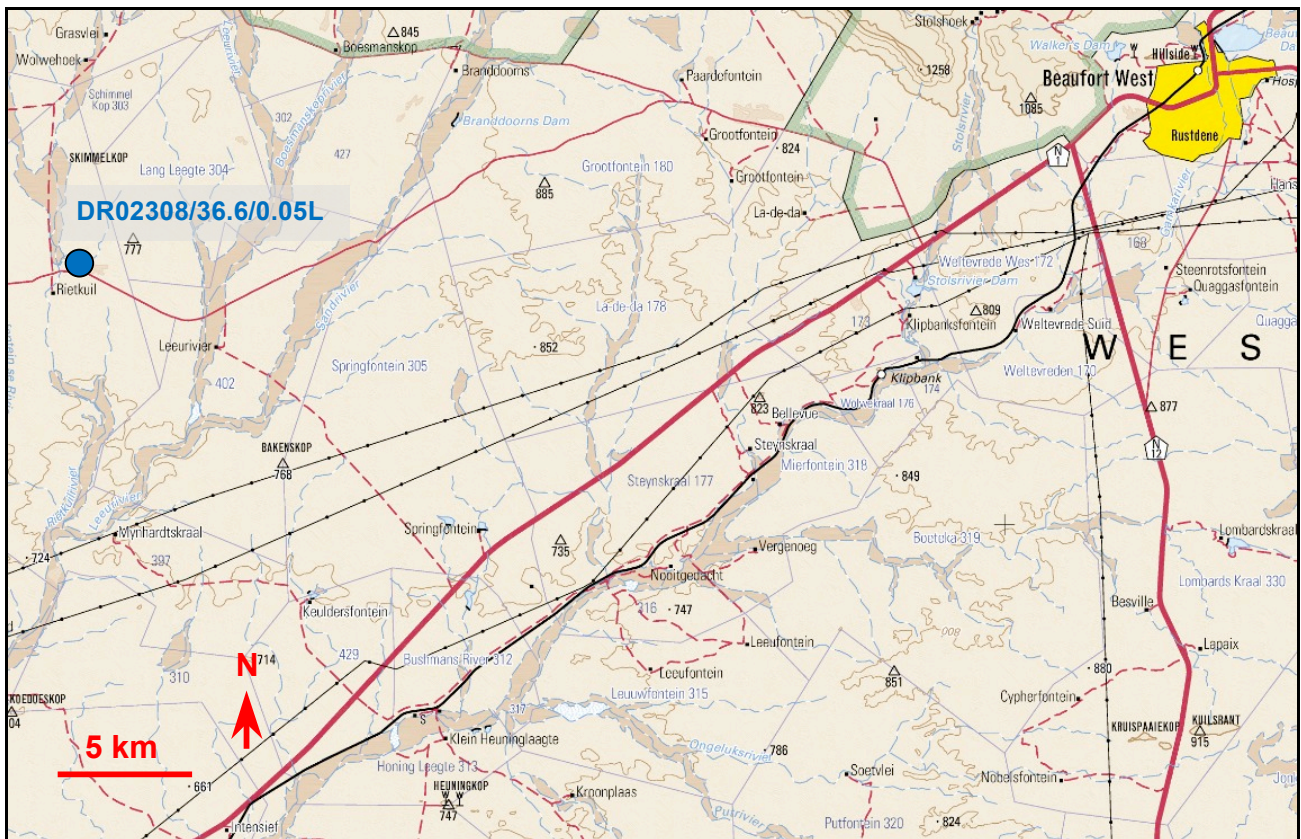


Fig. 1. Extract from topographical sheet 3222 Beaufort West (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the DR02308/36.6/0.05L borrow pit near Rietkuil farmstead c. 40 km WSW of Beaufort West, Central Karoo District Municipality, Western Cape (blue dot).

### 3. GEOLOGICAL CONTEXT

The DR02308/36.6/0.05L borrow pit site is situated on an erosionally dissected Karoo landscape characterised by prominent ridges of Beaufort Group sandstones and intervening *vlaktes* and gentle slopes underlain by overbank mudrocks. Several south-flowing tributaries of the Gamka drainage system, including the Rietkuilsrivier 1 km to the east of the pit site, traverse the area. The pit is underlain by mudrocks and overlooked along the north-western edge by WSW-ENE trending sandstone ridge. Hackly-weathering, grey-green and purplish mudrocks are exposed in the slopes underlying the sandstone ridge as well as in the borrow pit floor, though in the latter case they are widely obscured by recent silts, muds (current sun-cracked) and colluvial gravels. Coarse blocky sandstone gravels mantle the greater part of the ridge slopes and have been dispersed by sheet wash along and away from its foot (Fig. 3).

The geology of the study area is shown on 1: 250 000 sheet 3222 Beaufort West (Fig. 2) (Johnson & Keyser 1979). 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 pedoconcrete 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, Lock *et al.*, 1994, Johnson *et al.*, 2006).

The Rietkuil Farm area is well known for the important sandstone-hosted uranium ore occurrences here that have been known since the 1970s and that are exposed in test mining pits situated south of the DR2308 and about 300m south of the study area (Cole *et al.* 1998 and ref. therein). Of

relevance for the present palaeontological assessment is that the uranium mineralisation is often associated with fossil plant debris. The uranium-hosting sandstone body at Rietkuil has been assigned to the **Moordenaars Member** of the Abrahamskraal Formation (Cole *et al.* 1998). The immediately overlying mudrocks at the study site probably belong to the same stratigraphic subunit (*cf* also Look *et al.* 1994).

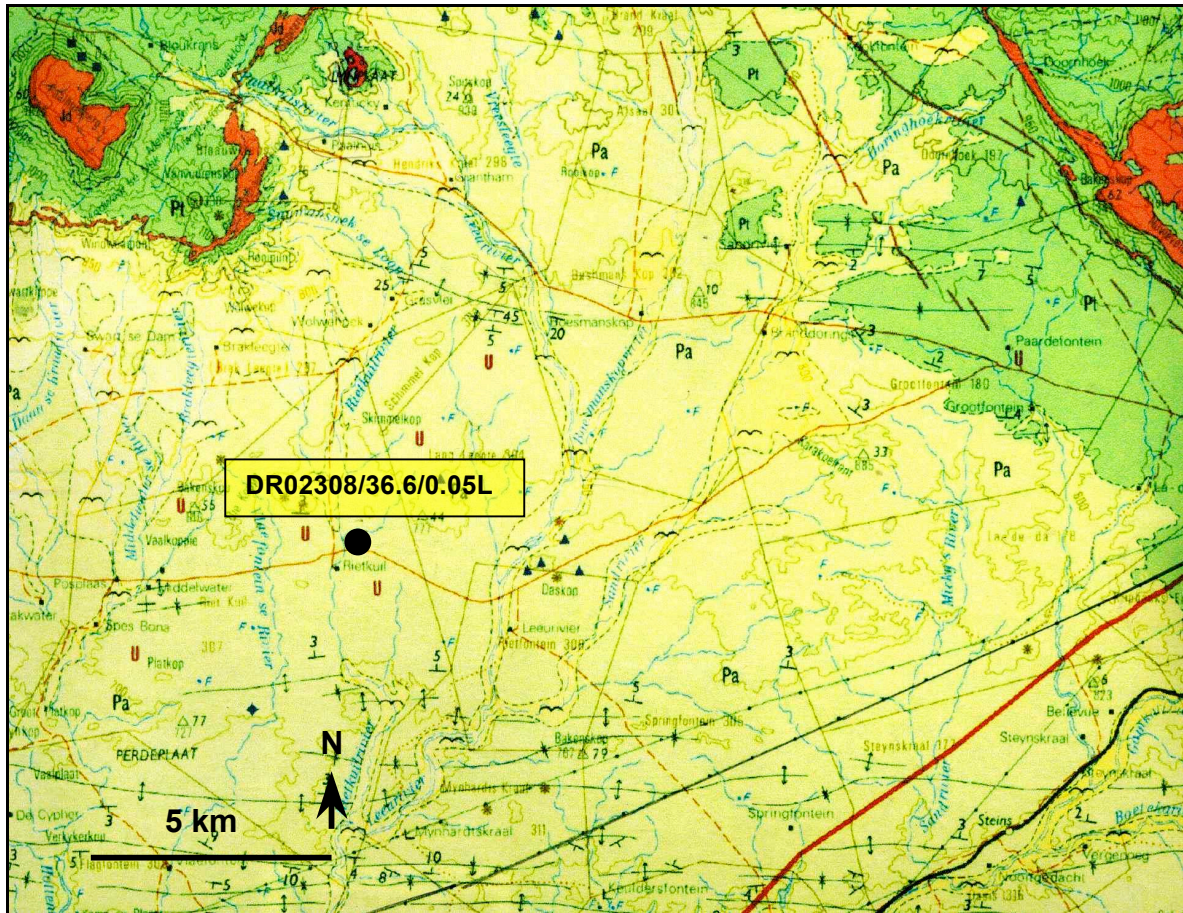


Fig. 2. Extract from 1: 250 000 geology sheet 3222 Beaufort West (Council for Geoscience, Pretoria) showing location of the borrow pit DR02308/36.6/0.05L some 40 km WSW of Beaufort West. The pit is excavated into mudrocks within the upper part of the Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group) (Pa, yellow-green). The map indicates fossil sites of the *Tapinocephalus* Assemblage Zone c. 7 km to the SW of the pit site (diamond symbol) and a cluster of fossil sites of the *Pristerognathus* Assemblage Zone c. 7 km to the east (triangular symbols). The brown “U” symbol refers to uranium ore localities. The uranium test mining pit on Rietkuil is situated less than half a km south of the study area.



**Fig. 3.** View north-westwards towards the sandstone ridge bordering the pit study area. Scattered, reworked fossil bones occur among the coarse surface gravels in this region.



**Fig. 4.** Detail of poorly-sorted, coarse colluvial gravels seen in previous photo with two reworked fossil limb bone fragments arrowed (Hammer = 32 cm).



**Fig. 5.** Close-up of collection of fragmentary fossil bones made at the locality illustrated above. Note poor preservation suggests that these specimens have been exposed for a considerable length of time and also reworked by sheetwash or stream processes.



**Fig. 6.** Close-up of large fossil bone fragment (8 cm long) showing distinctive lilac hue and extensive surface cracking. The latter probably reflects protracted exposure of the bone on a semi-arid flood plain before original burial in Middle Permian times, as well as recent weathering.

#### 4. PALAEOLOGICAL 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 biostratigraphically 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 and 1: 250 000 sheet 3222 Beaufort West, as well as maps in Keyser & Smith (1979) and Lock et al. (1995).

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.

As noted above, 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). Well-developed *koffieklip* occurrences within or below the main sandstone ridge at the study site were associated with calcrete nodules and examined for fossil plant remains, but without success.

The palaeontology of the Moordenaars Member towards the top of the Abrahamskraal Formation has been discussed by Lock et al. (1994) who recorded dinocephalians, therocephalians, dicynodonts as well as pareiasaurs in the lower half of the unit but relatively few taxa higher up. The 1: 250 000 Beaufort West geology map (Fig. 2) indicates fossil sites of the *Tapinocephalus* Assemblage Zone c. 7 km to the SW of the pit site (diamond symbol) and also a cluster of fossil sites of the younger *Pristerognathus* Assemblage Zone c. 7 km to the east (triangular symbols).

During the present field assessment a number of disarticulated fossil bone specimens, mostly sun-cracked, weathered and fragmentary, were recorded along the western edge of the borrow pit area (Figs. 4 to 6). Several show a distinctive lilac hue (Fig. 6). The bones were found among coarse surface gravels of sandstone (Fig. 3) and had clearly been reworked by sheetwash and gravity processes, and / or downwasted from above. No *in situ* or articulated skeletal material or petrified wood was seen. A single occurrence of fossil bone was observed on the sandstone plateau to the north of the ridge crest, well outside the study area (M. Tusenius, pers. Comm.). The postcranial fossil bones found clearly belong to large-bodied tetrapods, perhaps dinocephalian therapsids and / or pareiasaur reptiles, but have not been identified more precisely. A few of the bones might be fragments of cranial material; this still needs to be confirmed.

Although several vertebrate fossil specimens were recorded in the pit area, these have clearly been reworked and are not of major palaeontological value. It is quite possible that further

(perhaps articulated) vertebrate fossils may be exposed once the borrow pit is excavated further. However, these remains are likely to be sparse.

The palaeontological sensitivity of this site is consequently assessed as MODERATE.

## 5. CONCLUSIONS & RECOMMENDATIONS

The palaeontological sensitivity of this site is rated as MODERATE and it is likely that further vertebrate remains may be exposed during further excavation of the pit area. However, the 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 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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#### **APPENDIX: GPS LOCALITY DATA FOR FOSSIL SITES**

All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84.

<b>LOC</b>	<b>SOUTH</b>	<b>EAST</b>	<b>COMMENT</b>
57	32 24 59.9	22 08 07.0	Weathered bone on surface
58	32 24 59.2	22 08 06.8	Weathered bone on surface (cranial?)
59	32 24 59.2	22 08 06.8	Weathered bone on surface
60	32 24 59.7	22 08 05.5	Limb long bone
61	32 24 59.8	22 08 04.7	Limb long bone
62	32 24 59.7	22 08 04.2	Concentration of fossil bones in surface gravels



## 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.



**Dr John E. Almond**  
**Palaeontologist**  
***Natura Viva* cc**