PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

EXISTING BORROW PIT DR1377 NEAR ROBERTSON, LANGEBERG MUNICIPALITY, WESTERN CAPE

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August 2012

1. EXECUTIVE SUMMARY

The small existing DR01377/2.54/L/50/A/R69 borrow pit on the south-western side of the DR1377 some 12.5 km northwest of Robertson, Langeberg Municipality, is excavated into Early Permian carbonaceous mudrocks of the Whitehill Formation (Ecca Group). Elsewhere in the Worcester-Robertson Karoo this distinctive rock unit has yielded important fossils of aquatic mesosaurid reptiles, crustaceans and insects. However, the finely-laminated to thinly-bedded mudrocks in this pit are generally highly deformed, locally quartz veined and deeply weathered so good fossil preservation is unlikely here.

The palaeontological sensitivity of the site is low and, pending the discovery of new fossil material such as articulated mesosaurid reptile remains, no further mitigation of fossil heritage for this borrow pit is recommended.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from a small existing borrow pit along the unsealed road DR1377 in the Worcester – Robertson Karoo (Langeberg Municipality). Pit DR01377/2.54/L/50/A/R69 (33º 45' 31.0" S, 19º 45' 36.6" E) on Robertson Farm No. 50 (De Hex River) is situated at *c*. 290m amsl on the southwest side of the DR1377 road and some 12.5 km northwest of the town of Robertson(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 known fossiliferous sediments of the Whitehill Formation (Ecca Group). A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC Case Ref. 111124JB44, 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). Fieldwork for this project was carried out on 13 May 2012.

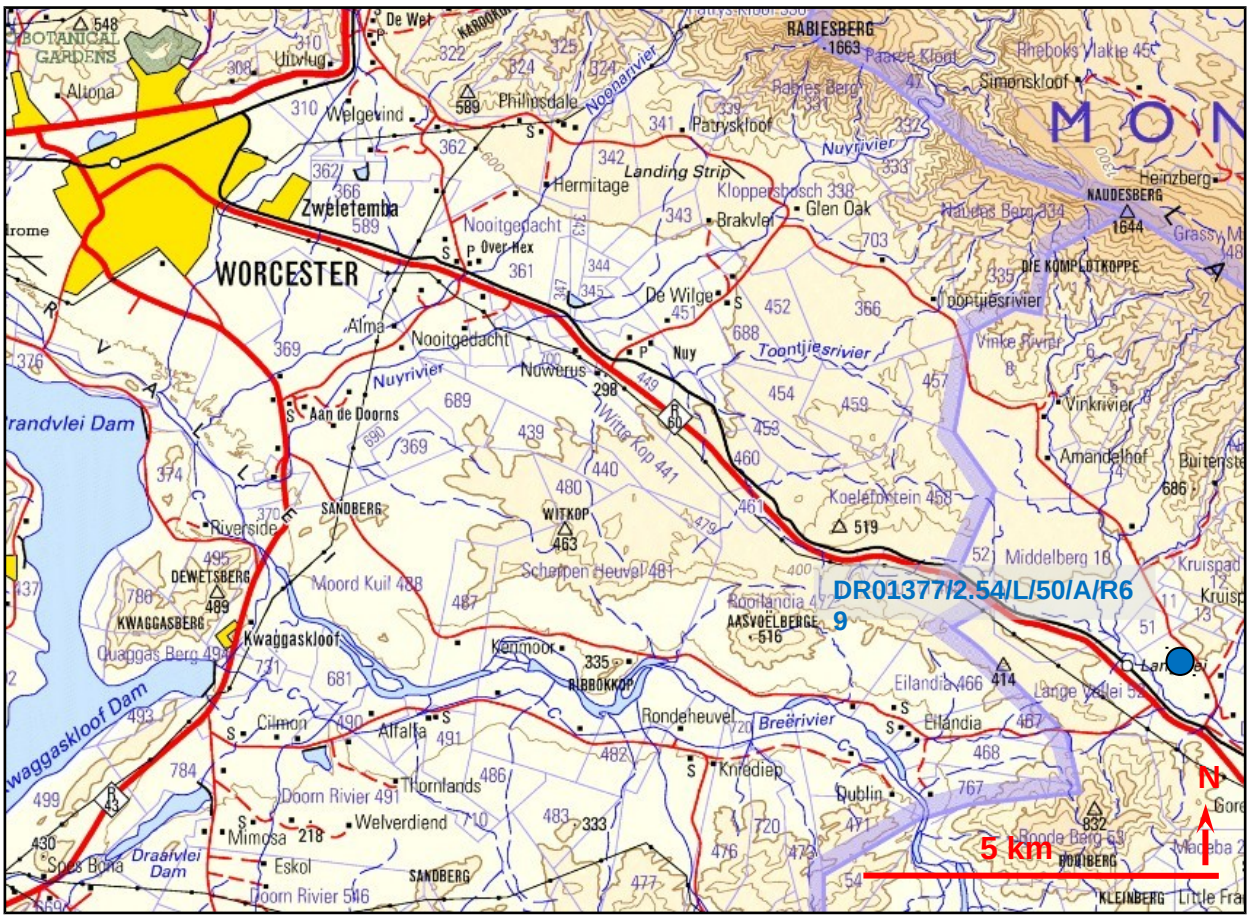

Fig. 1. Extract from topographical sheets 3119 Worcester (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the existing DR01377/2.54/L/50/A/R69 pit *c*. 12.5 km NE of Robertson in the Langeberg Municipality, Western Cape (blue dot).

Fig. 2. 2004 Google earth© satellite image of the study area showing the small existing DR01377/2.54/L/50/A/R69 pit on the south side of the DR1377 (yellow arrow) and the larger existing pit, also in the Whitehill Formation, some 800m to the WNW. The large pale area adjacent to the R60 tar road is the Cape Lime limestone processing facility. The yellow scale bar = *c.* 1 km.

3. GEOLOGICAL HERITAGE

The geology of the Robertson study area is shown on 1: 250 000 geology sheet 3319 Worcester (Council for Geoscience, Pretoria) and is shown 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 study area lies within the Worcester-Robertson outlier, an erosionally-isolated patch of Karoo Supergroup sediments embedded within the outcrop area of much older Cape Supergroup rocks in the heart of the Cape Fold Belt. The present road project area is underlain by marine sediments of the Ecca Group (Karoo Supergroup) that were deposited within the Ecca Sea, an extensive salty to freshwater, largely land-locked water body located on the south-western margins of Gondwana in Early to Middle Permian times (Johnson *et al.* 2006). The Ecca Group rocks here form a broad, folded synclinal structure with northwestward dips in the study area itself.

The small existing DR01377/2.54/L/50/A/R69 pit is situated on a gentle NE-facing hill slope at about 290m amsl, some 1.86 km north of the R60 Worcester- Robertson tar road (Fig. 4). This hilly region is drained by the Vinkrivier and Hexrivier systems that are northbank tributaries of the Breede River. Pale grey-weathering laminated mudrocks of the Whitehill Formation are exposed in the study pit as well as a more extensive second pit some 800m to the WNW (Fig. 2). There is a small roadside exposure of the underlying Prince Albert Formation mudrocks about 400m to the southeast of the study pit.

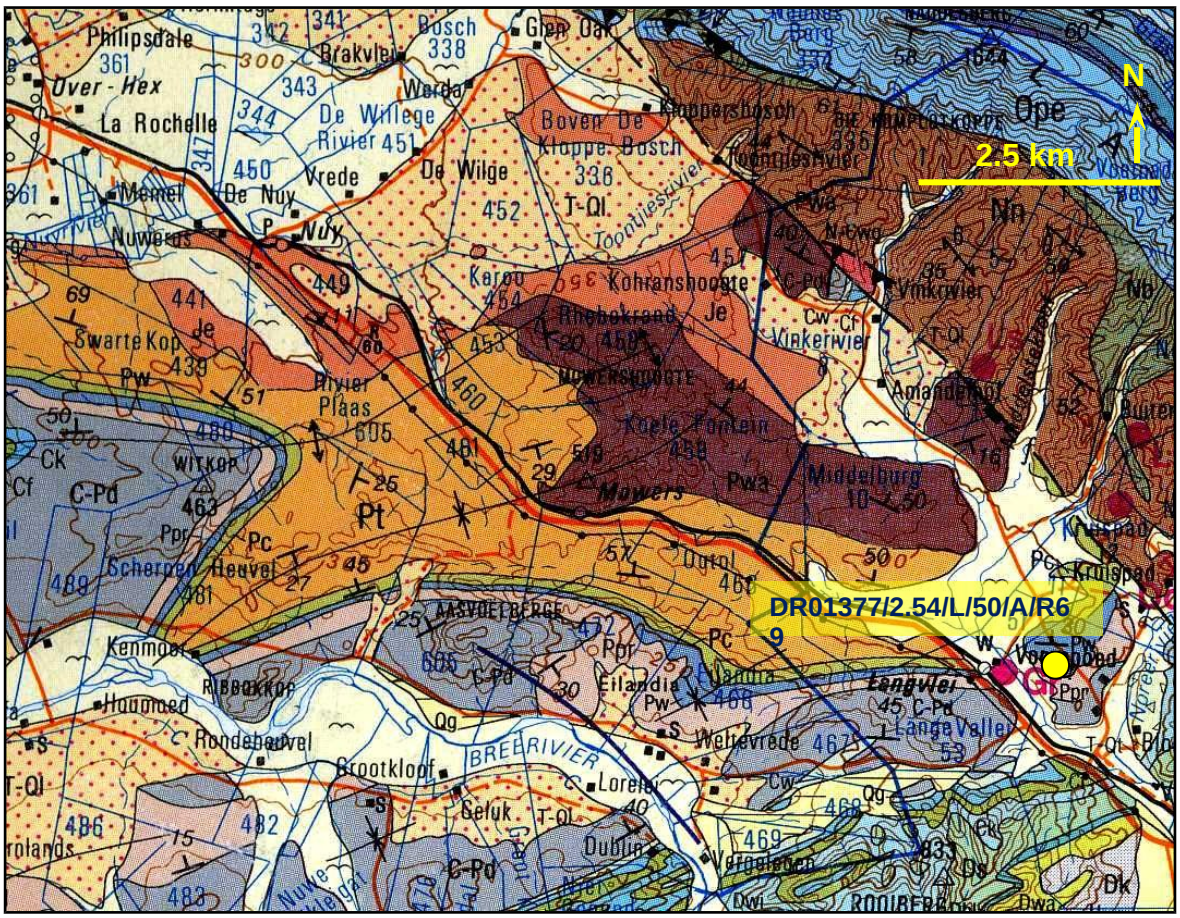

Fig. 3. Extract from 1: 250 000 geology sheet 3119 Worcester (Council for Geoscience, Pretoria) showing location of the DR01377/2.54/L/50/A/R69 borrow pit *c*. 12.5 km NW of Robertson. The existing pit is excavated into finely laminated carbonaceous mudrocks of the Whitehill Formation (Pw, Ecca Group), indicated here by the grey-blue line area.

The **Whitehill Formation** (**Pw**) is a thin (*c*. 30m) succession of well-laminated, carbon-rich mudrocks of Early Permian (Artinskian) age that forms part of the lower Ecca Group. These sediments were laid down about 278 Ma in an extensive shallow, brackish to freshwater basin – the Ecca Sea – that stretched across southwestern Gondwana, from southern Africa into South America (McLachlan & Anderson 1971, Oelofsen 1981, 1987, Visser 1992, 1994, Cole & Basson 1991, MacRae 1999, Johnson *et al*. 2006). Fresh Whitehill mudrocks are black and pyritic due to their high content of fine-grained organic carbon, probably derived from persistent or seasonal phytoplankton blooms that promoted anoxic conditions on the Ecca Sea bed. Near-surface weathering of the pyrite leads to the formation of gypsum, lending a pale grey colour to the Whitehill outcrop (hence informally known as the "*Witband*") (This is clearly seen in satellite images). Large (meter-scale) diagenetic nodules and lenses of tough, greyish dolomite are common and often display a stromatolite-like fine-scale banding.

Highly-weathered, grey, locally veined or secondarily ferruginised (lilac to ochreous hued) laminated mudrocks of the Whitehill Formation are exposed in the walls of the fairly deep trench-like eastern portion of the DR01377/2.54/L/50/A/R69 pit (Fig. 5). Intense tectonic deformation of the Karoo succession here is shown by highly variable dips, convolute bedding and quartz veining. This deformation is probably of Cape (Permo-Triassic) age, but it may also be significant that the major Worcester Fault line runs only 200m or so to the northeast of the pit (Fig. 3). A low bench of fresher-looking, pale grey Whitehill sediments towards the northwestern end of the pit demonstrates gently dipping, thinly interbedded claystone and siltstone facies that is an unusual feature of the two Whitehill pits in this area (Fig. 6). It is of interest as possibly pointing towards a shallower, nearshore setting for these beds - in contrast to the finely laminated offshore facies that

typifies the Whitehill Formation elsewhere in the Worcester Robertson Karoo and further afield (Almond *et al.* 1996). The presence of horizontal burrows within the coarser, siltier beds (Fig. 8) supports a shallower, better-oxygenated depositional environment. Thicker bedded greyish siltstones are exposed in test pits in the western portion of the study area. Also of interest here are thin, flattened dark grey concretions, probably of secondary chert, within the Whitehill mudrocks here.

The Whitehill Formation outcrop area is mantled with silty soils and polymict surface gravels, many of which last have downwasted from the Ecca Group rocks in the region. They include greyish dolomite, ferricretes, vein quartz as well as Table Mountain quartzites (Fig. 7).

Fig. 4. View towards southeast across main portion of existing DR01377/2.54/L/50/A/R69 borrow pit.

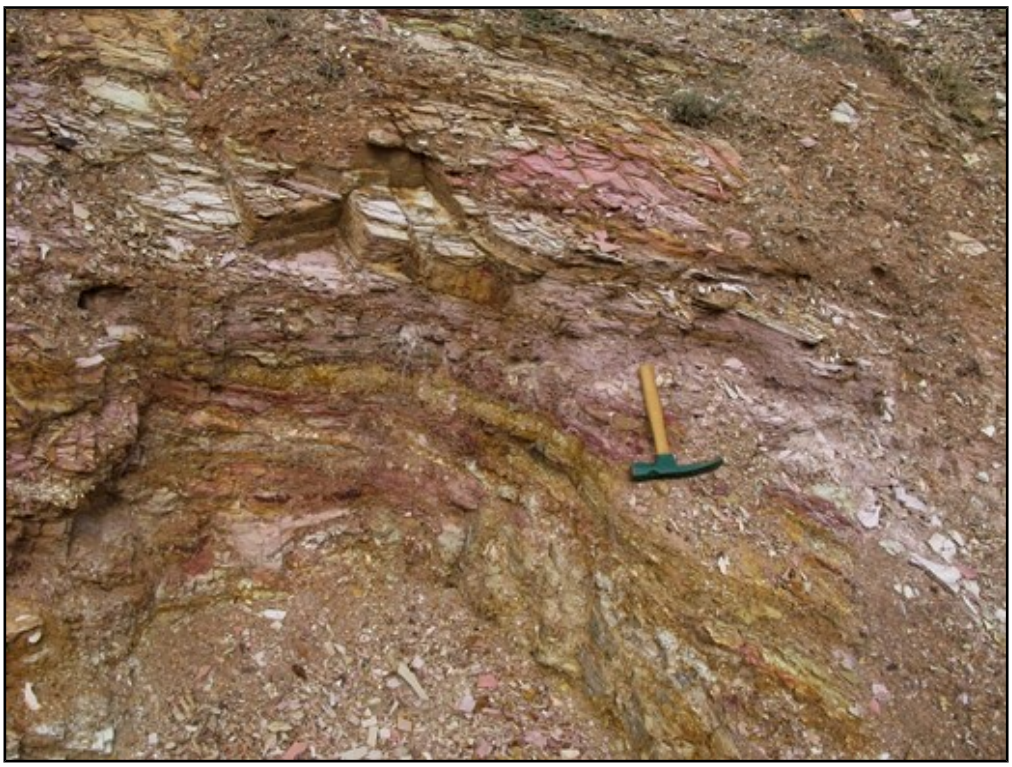

Fig. 5. Highly weathered, secondarily ferruginised and gently dipping laminated mudrocks of the Whitehill Formation in the south-eastern portion of the pit (Hammer = 27 cm).

Fig. 6. Thicker bedded to cryptically laminated grey-weathering Whitehill Formation mudrocks in the north-western portion of the pit (Hammer = 27 cm).

Fig. 7. Pinkish-brown silty soils and fine downwasted surface gravels overlying Whitehill Formation bedrocks in the western part of the study area (Hammer = 27 cm).

4. PALAEONTOLOGICAL HERITAGE

The fossil record of the Ecca Group outlier in the Worcester-Robertson area is still poorly known (Gresse & Theron 1992) and much of the available data is unpublished (Almond *et al.* 1996, Almond, pers. obs.).

In palaeontological terms the Whitehill Formation is one of the richest and most interesting stratigraphic units within the Ecca Group (Almond 2008a, 2008b and refs. therein). In brief, the main groups of Early Permian fossils found within the Whitehill Formation include:

- small aquatic mesosaurid reptiles (the earliest known sea-going reptiles)
- rare cephalochordates (ancient relatives of the living lancets)
- a variety of palaeoniscoid fish (primitive bony fish)
- highly abundant small eocarid / notocarid crustaceans (bottom-living, shrimp-like forms)
- insects (mainly preserved as isolated wings, but some intact specimens also found)
- a low diversity of trace fossils (*e.g.* king crab trackways, possible shark coprolites / faeces)
- palynomorphs (organic-walled spores and pollens)
- petrified wood (mainly of primitive gymnosperms)
- other sparse vascular plant remains (*Glossopteris* leaves, lycopods *etc*).

The stratigraphic distribution of the most prominent fossil groups – mesosaurid reptiles, palaeoniscoid fishes and notocarid crustaceans – within the Whitehill Formation has been documented by several authors, including Oelofsen (1987), Visser (1992) and Evans (2005).

Apart from low diversity assemblages of horizontal burrows within siltier facies (Fig. 8), no fossil material was observed in the Whitehill Quarry on Robertson Farm No. 50. A variety of important fossils have been recorded from the upper part of the much larger Scherpenheuwel Whitehill

quarry located in the western Worcester- Robertson Karoo some 16 km to the west of the present study site. These fossils include several mesosaurid reptiles (some possible juveniles), locally super-abundant compressions of notocarid crustaceans, rare insect remains (mainly wings) as well as possible ferruginised network burrows (See Almond *et al.* 1996; also Geertsema *et al*. 2002 and refs. therein in for insect fossils). Grey diagenetic nodules elsewhere in the Whitehill outcrop area (*e.g.* near Prince Albert) have yielded well-preserved, three dimensional crustacean fossils but these fossils have not been recorded from the Worcester – Robertson Karoo exposures, including Scherpenheuwel Quarry and the present borrow pit.

Fig. 8. Simple horizontal burrows preserved as hollow channels on the tops of siltier beds within the north-western portion of the borrow pit (Scale in cm).

5. CONCLUSIONS & RECOMMENDATIONS

The small existing DR01377/2.54/L/50/A/R69 borrow pit on the south-western side of the DR1377 is excavated into Early Permian carbonaceous mudrocks of the Whitehill Formation (Ecca Group). Elsewhere in the Worcester- Robertson Karoo this rock unit has yielded important fossils of aquatic mesosaurid reptiles, crustaceans and insects. However, the finely-laminated to thinly-bedded mudrocks in this pit are generally highly deformed, locally quartz veined and deeply weathered so good fossil preservation is unlikely here.

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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 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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