Palaeontological Heritage Assessment for Upgrading the N10/4, Middelberg

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Contents:

Geology

The study area is underlain by mudstones and sandstones of the Late Permian to Early Triassic Balfour Formation of the Beaufort Group (Karoo Supergroup) (Fig. 2, 6).

The strata of the Karoo Supergroup were deposited within the Karoo sedimentary Basin, which resulted from shortening and thickening of the southern margin of Africa, with coeval folding and uplift of the Cape Supergroup strata along its southern margin. The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this interval the basin evolved from an inland sea, to a giant lake fed by seasonal meandering (and at times braided) rivers. This lake steadily shrank as it filled with sediment and the basin's rate of subsidence stabilised. The land became increasingly arid and was covered with wind blown sand towards the end of its cycle. Finally the subcontinent was inundated with basaltic lava that issued from widespread linear cracks within the crust, to form the capping basalts of the Drakensberg Group.

The sediments of the mid Beaufort Group were deposited at a time when the Karoo Sea was largely silted up and rivers arising in the Cape Fold Belt Mountains, to the south, meandered across extensive flood planes into an inland lake. Sands were deposited along the river channels whereas periodic flooding deposited muds on the flood planes. These in time came to form the interbedded sandstones and mudstones of the Beaufort Group.

Whereas sedimentary rocks to the north of Middleberg are associated with the *Dicynodon* (biostratigraphic) Assemblage Zone (Fig. 2), those to the south are associated with the *Lystrosaurus* Assemblage Zone (Fig. 6).

The area exhibits a number of dolerite dykes and sills intruded during formation of the Drakensberg Group (Fig. 1).

In more geologically recent times the poor drainage of the low gradient plain to the south of Middleberg has resulted in deposition of isolated calretised palaeosols associated with former brak pans (Figs 4, 5).

Palaeontology

The flood planes of the Beaufort Group provide an internationally important record of life during the diversification of reptiles. This includes the evolution of the Therapsids, which would ultimately give rise to the mammals.

It is subdivided into a series of biostratigraphic units on the basis of its faunal content. The *Dicynodon* and Lystrosaurus Assemblage Zones being represented in the study area. The *Dicynodon* Assemblage Zone is characterised by presence of the Dicynodont Therapsid, *Dicynodon* together with the Therocephalid Therapsid, *Theriognathus*.

Other Therapsids reported from the *Dicynodon* Assemblage Zone include a wide range of Dicynodontia, Biarmosuchia, Gorgonopsia, Therocephalia and Cynodontia. Fish, Amphibia and Reptilia of the Captorhinida and Eosuchia have also been described.

A single species of bivalve mollusc has been described. Diverse insects are known from this assemblage zone in Natal. Plants are represented by *Dadoxylon* (fossil wood), *Glossopteris* and *Schizoneura*. Trace Fossils include Arthropod trails and worm burrows (Fig. 3).

A marked faunal change occurs between the *Dicynodon* and *Lystrosaurus* Assemblage Zones, corresponding with the major extinction event associated with the Permo-triassic boundary.

The *Lystrosaurus* Assemblage Zone rocks are dominated by a single genus of dicynodont, *Lystrosaurus* (Fig 8. A), which together with the captorhinid reptile, *Procolophon* (Fig. 8. B), characterise this Assemblage Zone. Though less abundant, a moderate range of other Reptilia have also been reported, as well an therocephalian and cynodontian synapsids, and Amphibia. Plant fossils, a species of millipede and a range invertebrate trace fossils, as well as vertebrate burrows have also been described.

Dolerite, being an intrusive igneous rock contains no fossils.

Calcrete hardpans may contain the remains of mammal species differing from those of today, in addition, potentially, to the remains of early *Homo sapiens*. Though of little importance, rhizoliths formed by the calcretisation of plant roots are also common.

Site Visit

A site visit to the Middelberg South interchange and associated borrow pits was carried out on 18 September 2010. With the exception of borrow pit 16 to the north of Middelberg, all borrow pits situated to the south of Middelberg together with the section of road to be upgraded are situated within the *Lystrosaurus* Assemblage Zone of the Beaufort Group.

Borrow pit 16 north of Middelberg is situated in the uppermost part of the *Dicynodon* Assemblage Zone. It was found, on inspection, to have been used as a source of aggregate in the form of weathered dolerite (Fig. 1) - derived from a sill that is topographically represented by an adjacent range of hills. Only in the north-westerly corner are greenish mud stones, with thin interbedded sandstones exposed. These show a mottled appearance due to small-scale metamorphosis resultant from their proximity to the dolerite dyke. A washout exposing greenish mudstones and thin sandstones immediately to the North of the existing quarry (Fig. 2) was explored, however, no body fossils were found. Small invertebrate burrow traces were, however, noted. (Fig. 3).

Two borrow pits situated in close vicinity to the Middelberg south interchange are situated at a short interval from each other along a dolerite dyke, from which all the aggregate removed seems to be derived.

Borrow pit 6 (Fig. 4) hardly impinges on Karoo rocks. It appears to have been used for extracting aggregate consisting of geologically recent calcareous hardpan. Nearer the surface where in all probability calcretisation of topsoil is still occurring, the profile is characterised by abundant rhizoliths (Fig. 5). Although the exposed profiles of calcrete at a deeper level were carefully examined, no suggestion of quaternary mammal bones or middle stone-age artefacts was apparent.

Borrow pit 5 is a small borrow pit clearly used for extracting calcrete, containing rhizolyths and embedded grits of Karoo origin.

Borrow pit 4 contained large amounts of purple mudstones of the *Lystrosaurus* biostratigraphic zone (Fig. 6). A partially disassociated *Lystrosaurus* skeleton was found (Figs 7, 8), excavated (Fig. 9) and deposited in the Albany Museum.

Borrow pit 8 is a long deep pit used for extracting dolerite aggregate. A small amount of Karoo Supergroup rock (consisting of sandstones with some mudstones) has been intercepted, presumably by accident, in the north of the quarry. It displays some heat alteration.

Borrow pit 2 has been used for mining calcrete that overlies dolerite.

Borrow Pit 3 has also been used for mining calcrite.

The 23.5 kilometre stretch of road, earmarked for upgrading, lies along a flat stretch of plain, and is chiefly raised, above a bed of very recent alluvium.

Conclusions and Recommendations

1. It is extremely unlikely that any Palaeontological material will be exposed or disturbed during work on the road itself.

2. As borrow pits 8, 16, and the two unnumbered pits immediately south of the interchange are used for mining dolerite, no fossils may be expected to be disturbed by resumed excavation. A negligible chance that fossils may be disturbed in the adjacent mudstone host rock is insignificant.

3. A slight chance exists that quaternary mammal bones and early human remains could be located in calcareous pan deposits such as those mined at borrow pits 2, 3, 5 and 6. **Should** any of these borrow pits be reactivated, or other **pan deposits** of this type **be mined** in the case of these pans having been worked out, **the environmental management officer should specifically inform the site officer to be on the lookout for large mammal bones, avoid their destruction and report their find**.

4. **The reactivation of borrow pit 4 would, very likely, lead to the exposure of more vertebrate fossils, potentially including important material. Some collaboration with a palaeontologist would be recommended. At minimum the borrow pit should be visited by a palaeontologist at least twice:**

4.1 firstly, shortly after commencement of excavation, in order to provide information and guidelines to those employed on the site and,

4.2 secondly, towards the end of the quarrying phase, before rehabilitation of the pit, in order to check for fossils in the newly exposed outcrops, and in order to collect any material isolated by those working at the quarry. (some small material inducement might help to facilitate the collaboration of the quarrymen).

4.3 Should concentrations of vertebrate material be encountered during excavations the site officer should immediately inform the palaeontologist by phone and concentrate on a different area pending a decision regarding the material.

Photographs:

Figure 1: Dolerite exposed in Borrow Pit 16

Figure 2: Dicynodon Assemblage zone greenish mudstones to the north of Borrow Pit 16

Figure 3: Invertebrate burrow traces in Dicynodon Assemblage zone strata north of Borrow Pit 16

Figure 4: Borrow Pit 6 - an excavated hardpan deposit

Figure 5: Calcareous rizoliths at Borrow Pit 6

Figure 6: Purplish mudstones of the Lystrosaurus Assemblage zone at Borrow Pit 4

Figure 7: Unexcavated lystrosaurus head and neck at Borrow Pit 4

Figure 8: Lystrosaurus head compared to illustration

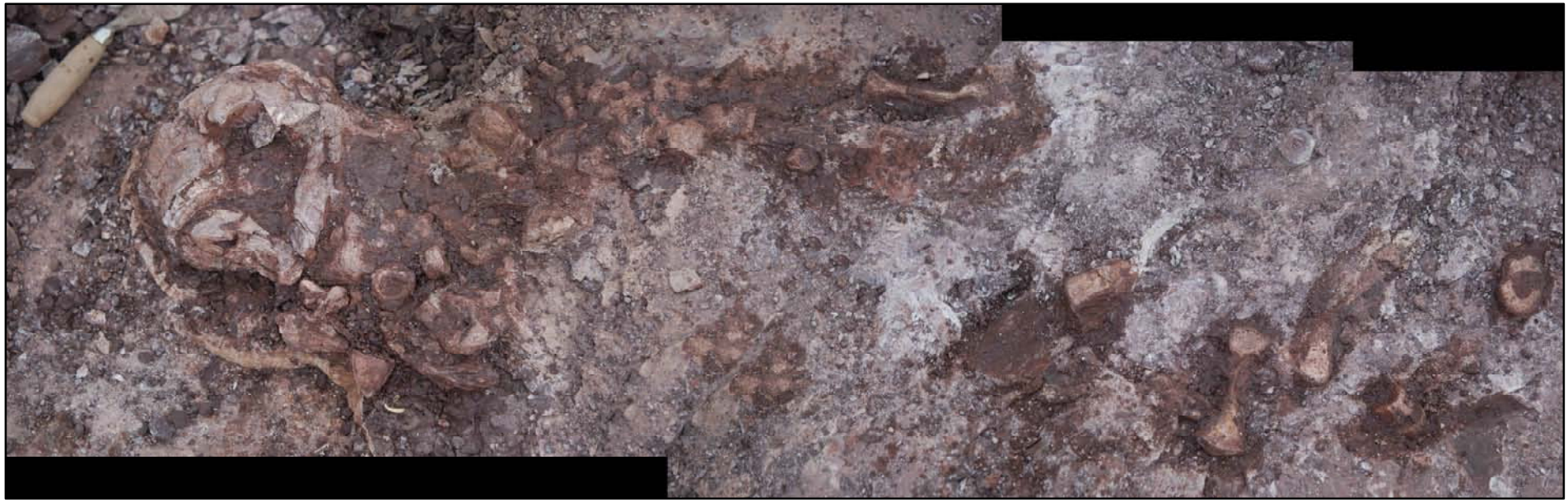

Figure 9: Lystrosaurus photomontage