# PALAEONTOLOGICAL ASSESSMENT: DESKTOP STUDY

# Farm 980, Farm 961/1 and Remaining Extent of Farm 1243, Cove Rock, East London, Buffalo City Municipality, Eastern Cape

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## 1. SUMMARY

The company NPM PLANNING cc., 7 King Street, Southernwood, East London, is applying to Buffalo City Municipality, Eastern Cape, for the Consolidation, Rezoning, Subdivision and Temporary Departure of Farm 860, Farm 961/1 and the Remaining extent of Farm 1243, East London (total area 80.2 hectares). The application is for the development of a residential estate, inclusive of business sites and other land uses associated with the development.

The proposed development footprint overlies potentially fossiliferous sedimentary rocks of the Middleton Formation (Lower Beaufort Group / Adelaide Subgroup, Karoo Supergroup) of Late Permian age. Elsewhere in the Main Karoo Basin these ancient fluvial sediments are known to contain a range of Late Permian vertebrate fossils (reptiles, therapsids, amphibians and fish), trace fossils, non-marine bivalves and plant remains (*e.g.* petrified wood), with several historical records in the East London area. However, the impact significance of the proposed Cove Rock development as far as fossil heritage is concerned is rated as LOW because:

- The potentially fossiliferous bedrocks here are probably mantled in thick soils and are highly weathered. Substantial excavation of potentially fossiliferous fresh (unweathered) bedrock is therefore not anticipated;
- Baking of sediments during dolerite intrusion may have compromised their fossil content;
- Fossil abundance within the Lower Beaufort Group in the Eastern Cape might be lower than that of equivalent beds in the western Karoo (This is still to be established, however).

In view of the overall low impact significance of the proposed development on palaeontological heritage resources, it is concluded that no further palaeontological heritage studies or specialist mitigation are required for this project near East London, pending the exposure of any substantial fossil remains (*e.g.* vertebrate bones and teeth, large blocks of petrified wood, vertebrate trackways) during the construction phase. In this case, negative impacts on local fossil heritage can be effectively mitigated by appropriate ECO monitoring and – where necessary – by professional palaeontological mitigation.

Fresh exposures of Beaufort Group sediments created during the construction phase of the development should be inspected at intervals by the responsible Environmental Control Officer (ECO). It is also strongly recommended that the ECO for this development visit a Karoo palaeontological display (*e.g.* at the Albany Museum, Grahamstown, or the East London Museum) before the start of operations so that they acquire some familiarity with the appearance of typical Beaufort Group and younger fossil material. Well-illustrated and accessible accounts of Karoo fossils that may help in the recognition of Beaufort Group fossils have been published by Cluver (1978), MacRae (1999) and McCarthy and Rubidge (2005).

Should *loose* fossils be encountered during excavations, they should be carefully collected, with adherent matrix where necessary, given a provisional reference number (*e.g.* marked on masking tape) and carefully wrapped in newspaper. It is *essential* that the locality where the fossil is found

be accurately marked on a 1: 50 000 map or recorded by GPS. Specimens without locality information are of limited scientific value. The fossils should be submitted for inspection by a professional palaeontologist at the earliest opportunity. Some of this material may be of scientific interest - in which case it should be deposited ultimately in an approved repository (*e.g.* Albany Museum, Grahamstown or East London Museum) – while other specimens may be of educational value and might be donated for display purposes.

If *in situ,* articulated skeletons or other substantial fossil remains are encountered during borrow pit excavation, they should *NOT* be informally excavated since this will almost invariably lead to damage and loss of useful contextual information (*e.g.* taphonomy – data on mode of death and burial of animals). If feasible, they should be photographed (with scale), covered with a protective layer of loose sediment, and the site marked and carefully recorded (GPS / 1: 50 000 map / aerial photograph). The Environmental Control Officer should immediately inform SAHRA or a suitably qualified palaeontologist so that specimens can be examined, recorded and, if necessary, professionally excavated.

It should be noted that provided appropriate mitigation measures are implemented, the professional recording and collection of new fossil material represents a *positive* impact in terms of our understanding of Eastern Cape fossil heritage.

## 2. INTRODUCTION & BRIEF

The company NPM PLANNING cc., 7 King Street, Southernwood, East London, is applying to Buffalo City Municipality, Eastern Cape, for the Consolidation, Rezoning, Subdivision and Temporary Departure of Farm 860, Farm 961/1 and the Remaining extent of Farm 1243, East London (total area 80.2 hectares) for the development of a residential estate, inclusive of business sites and other land uses associated with the development. The land parcels concerned are situated within 1,8 km or less of the southeast coast and to the south of the R72 on Prince George Circuit, just north of the existing Cove Rock Country Estate. The southern suburbs of East London lie some 3 km to the northeast (Fig. 1).

According to the Final Motivation Report prepared by NPM PLANNING cc (July 2011), the application is for:

• The **Consolidation** of Farm 980, Farm 961/1 and Farm 1243, East London;
• The **Rezoning** of the consolidated property from Agricultural Zone 1 to Residential Zone 4, Transport Zone 2, Residential Zone 6, Business Zone 2, Institutional Zone 2 and Open Space Zone 3;
• The **Subdivision** of the consolidated Erf into 284 portions (Business Zone, Institutional Zone, Residential Zone, Private Roadway, Public Road, Conservation, Future Development);
• A **Temporary Departure** in terms of Section 15(1)(a)(ii) of the Land Use Planning Ordinance (No. 15 of 1985).

The main aims of this development are to:

• Provide a development that puts emphasis on the natural environment and the conservation thereof;
• Create a low density residential development;
• Create an economically sustainable development;
• Create an extension of the existing Cove Rock Country Estate.

The proposed development footprint overlies potentially fossiliferous sedimentary rocks of the Lower Beaufort Group (Adelaide Subgroup, Karoo Supergroup) of Late Permian age. A desktop study of the potential impact of the proposed development on palaeontological heritage has therefore been commissioned on behalf of the developer by Imithi Services, Gonubie, as part of a broader-ranging HIA, in accordance with the requirements of the National Heritage Resources Act, 1999. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

### 2.1. Approach to this desktop palaeontological assessment (PIA)

This desktop PIA report provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations for specialist palaeontological mitigation where this is considered necessary. The report is based on (1) a review of the relevant scientific literature, including earlier palaeontological impact assessments for the East London – King William's Town region (*e.g.* Almond 2011a, 2011b, 2012); (2) published geological maps and accompanying sheet explanations, as well as (3) the author's field experience with the formations concerned and their palaeontological heritage.

When preparing a palaeontological desktop assessment the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area are determined from geological maps. The currently recorded fossil heritage within each unit is determined from the published scientific literature and the author's field experience. This data is then used to asses the palaeontological sensitivity of each rock unit to development (*N.B.* A tabulation of palaeontological sensitivity of all formations in the Eastern Cape has already been compiled by Almond *et al*., 2008).

The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the rock units concerned and (2) the nature of the development itself, most notably the extent of fresh bedrock excavation envisaged. Adverse palaeontological impacts normally occur during the construction rather than operational phase. Mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) – is usually most effective during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority (*e.g.* SAHRA for the Eastern Cape). It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

### 2.2 Assumptions made for the PIA desktop study

Note that while fossil localities recorded within the study area itself are obviously highly relevant, most fossil heritage is buried beneath the land surface or obscured by surface deposits (soil, alluvium *etc*) and vegetation cover. The hidden fossil resources therefore have to be inferred from palaeontological observations made within the same formations elsewhere in the region, or even further afield (*e.g.* an adjacent province). Here it is assumed that fossil heritage is fairly uniformly distributed throughout the outcrop area of a given formation. Experience shows that this assumption does not always hold. This is because the original depositional setting across a formation that may extend over hundreds of kilometres may vary significantly, with palaeoecological implications (*e.g.* from a shallow to deeper water environment), while fossils are often patchy in their occurrence. Furthermore, the levels of tectonic deformation (folding, cleavage development *etc*), as well as the intensity and nature of metamorphism and weathering experienced by a given formation may change markedly across its outcrop area. These factors may seriously compromise the preservation of fossil remains present within the original sedimentary rock.

The main limitation on this desktop study is our limited understanding of the palaeontology of the East London area in general (See Fig. 3), mainly due to lack of bedrock exposure and high levels of bedrock weathering in the region.


**Fig. 1. Google Earth© satellite image of the study region to the southwest of East London, Eastern Cape, showing the location of the proposed development on the coastal patform just inland from the existing Cove Rock Country Estate (red polygon).**

## 3. GEOLOGICAL BACKGROUND

The Cove Rock study area is situated on a low-lying, gently-sloping coastal platform at about 50-70m amsl that is incised into Palaeozoic sedimentary bedrocks along the coast to the southwest of East London. The winding, densely-vegetated valley of the Hickman's River runs to the east and a small river course runs along the southwestern boundary of the area, downstream of the Rockcliff Dam.

The geology of the study area to the southwest of East London is outlined on 1: 250 000 geology sheet 3326 Grahamstown (Fig. 2; Council for Geoscience, Pretoria). A short geological explanation for this sheet has been published by Johnson and Le Roux (1994), and there is a useful separate geology report by Mountain (1974) on the geology of the East London area.

The study area is underlain by Late Permian continental (fluvial) sediments of the Lower Beaufort Group (**Adelaide Subgroup, Pa**). Due to poor exposure, the Adelaide Subgroup outcrop area has often not been clearly subdivided at the formational level in the East London region (Mountain 1974, Johnson & Caston 1979). However, according to the 1: 250 000 geological map, only the **Middleton Formation** (**Pm**) is represented in the study area. The Beaufort Group beds here have a regional low dip to the south-southwest and lie on the northeastern edge of a large, dish-shaped synclinal structure within the Karoo Supergroup rocks. This syncline is centred approximately near Christmas Rock, some 20 km down the coast to the southwest of Cove Rock, and has Triassic sediments of the Upper Beaufort Group (Katberg Formation) at its core.

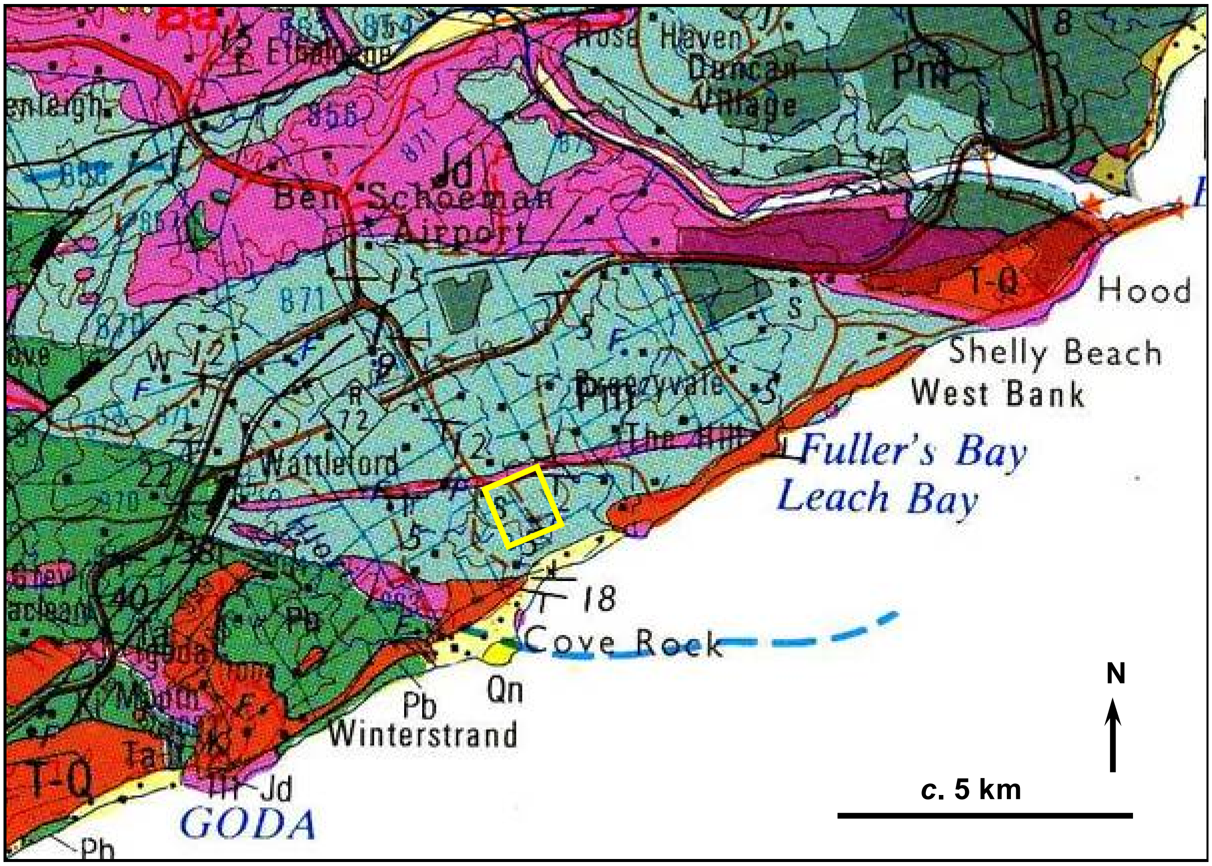


**Fig. 2. Extract from 1: 250 000 geological map sheet 3326 Grahamstown (Council for Geoscience, Pretoria) showing *approximate* location (yellow square) of the study area at Cove Rock, some 3 km southwest of East London. Key geological units:**

**Pink (Jd) = Jurassic Karoo Dolerite Suite**
**Pale blue-green (Pm) = Middleton Formation of the Lower Beaufort Group (Adelaide Subgroup, Karoo Supergroup**
**Dark Green (Pb) = Balfour Formation of the Lower Beaufort Group**
**Orange-Brown (T-Q) = Nanaga Formation (Algoa Group)**

A representative vertical section through the Beaufort Group in the East London region of the Eastern Cape is given by Johnson *et al*. (2006, Fig. 16 therein). Since dips of the Beaufort Group beds here are generally very shallow, low levels of tectonic deformation are expected. Brief descriptions of Adelaide Subgroup sediments in the Eastern Cape are given in sheet explanations for geology sheets King William's Town (printed on 1: 250 000 geology map), Kei Mouth (Johnson & Caston 1979) and Grahamstown (Johnson & Le Roux 1994). In this area of the Eastern Cape the contact between the Balfour and the underlying Middleton Formation is often difficult to map, given the scarcity of good outcrops and their broadly similar lithologies. Satellite images of the region show that in general relief is low and few natural exposures of the Beaufort Group bedrock are present. It is likely that the Beaufort Group bedrock, especially the potentially fossil-bearing mudrock component, is deeply weathered here. The common occurrence of ferricretes within the superficial cover in this region indicates deep weathering under humid, tropical climates. Excavations of less than several meters depth made during construction are therefore unlikely to involve the disturbance of fresh (unweathered) Karoo Supergroup bedrock. Fresher, potentially fossiliferous bedrocks might be intersected by deeper excavations, however.

The **Middleton Formation** (**Pm**) forms the middle portion of the Adelaide Subgroup east of 24°E, including the peripheral portions of the large coastal synclinal structure on the Grahamstown sheet described earlier (Mountain 1974, Johnson & Le Roux 1994, Johnson *et al*. 2006). Since the contact with the overlying Balfour Formation is mapped just to the west (Fig. 2), it is inferred that the rocks beneath the study area belong to the uppermost portion of the Middleton succession. The fluvial Middleton succession comprises greenish-grey to reddish overbank mudrocks with subordinate resistant-weathering, fine-grained channel sandstones deposited by large meandering river systems. Because of the dominance of recessive-weathering mudrocks, the Middleton Formation erodes readily to form low-lying *vlaktes* and hilly terrain while extensive exposures of fresh (unweathered) bedrock are generally rare.

In the East London region the Lower Beaufort Group sediments have been extensively intruded and baked by dolerite sills in the Early Jurassic (183 Ma) **Karoo Dolerite Suite** (**Jd**) (Duncan & Marsh 2006). Of particular relevance to the present study area is the narrow west-east trending dolerite dyke that runs close to its northern edge towards Fuller's Bay on the coast (Fig. 2). Such major intrusions are likely to have thermally metamorphosed the country rock for a considerable distance on either side of their edges.

The outer edge of the coastal platform to the southwest and northeast of the Cove Rock study afrea is mantled by Pleistocene aeolianites (wind-blown dune sands) of the **Nanaga Formation** (**T-Qn**, Fig. 2). These are not mapped in the study area itself, however, and are generally sparsely fossiliferous (Le Roux 1992), so they will not be considered further here.

## 4. PALAEONTOLOGICAL HERITAGE

The overall palaeontological sensitivity of the Beaufort Group sediments is high (Almond *et al*. 2008). These continental sediments have yielded one of the richest fossil records of land-dwelling plants and animals of Permo-Triassic age anywhere in the world (MacRae 1999, Rubidge 2005, McCarthy & Rubidge 2005. A chronological series of mappable fossil biozones or assemblage zones (AZ), defined mainly on their characteristic tetrapod faunas, has been established for the Main Karoo Basin of South Africa (Rubidge 1995). Maps showing the distribution of the Beaufort assemblage zones within the Main Karoo Basin have been provided by Kitching (1977), Keyser and Smith (1979) and Rubidge (1995, 2005). An updated version based on a comprehensive GIS fossil database is currently in press (Van der Walt *et al*. 2010).

Most maps showing the distribution of the Beaufort assemblage zones within the Main Karoo Basin show that their boundaries remain uncertain in the near-coastal region of the Eastern Cape (Rubidge 1995, 2005), although some of these ambiguities may be resolved by the latest map of Van der Walt *et al.* (2010). GIS databases show that the density of fossil sites recorded within the East London area remain very low (Nicolas 2007, Fig. 3 herein). This is probably due to factors such as low levels of outcrop, deep bedrock weathering, and extensive dolerite intrusion, although palaeoenvironmental factors may also have played a significant role here. Without further fossil collecting, it is therefore not yet possible to positively identify the specific Beaufort fossil assemblage zone(s) involved at many development sites in this region, and therefore the particular fossil taxa (species, genera) that might be encountered there during construction. As explained earlier, it is inferred that the Cove Rock study area lies within the uppermost Middleton Formation. Any fossil remains recovered from these pits are therefore likely to belong to the *Cistecephalus* Assemblage Zone (Rubidge 1995). Given the current paucity of palaeontological data from the East London region, any new well-localized, identifiable fossil finds here are of considerable scientific value.

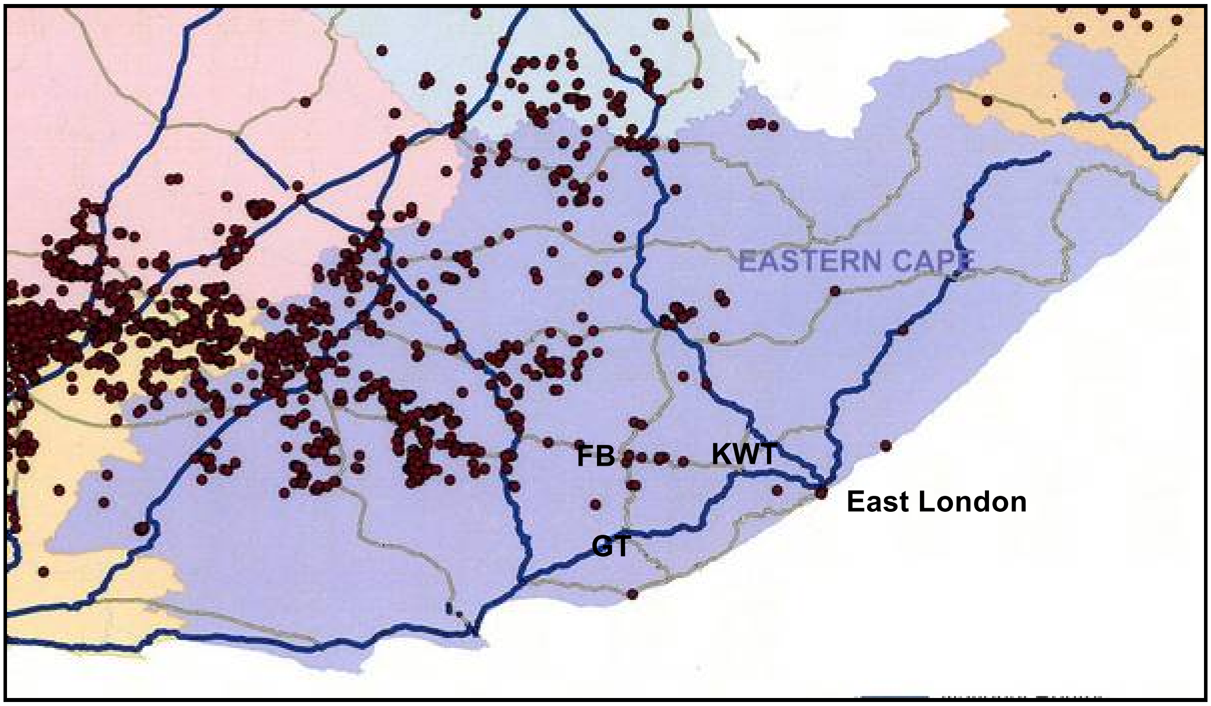


**Fig. 3. Distribution of fossil sites in the Beaufort Group in the Eastern Cape (Modified from Nicolas 2007). Note the scarcity of sites recorded in the East London area and along the coast to the southwest. KWT = King William's Town. FB = Fort Beaufort. GT = Grahamstown.**

### 4.1. Middleton Formation

The Middleton Formation comprises portions of three successive Beaufort Group fossil assemblage zones (AZ) that are largely based on the occurrence of specific genera and species of fossil therapsids. These are, in order of decreasing age, the *Pristerognathus*, *Tropidostoma* and *Cistecephalus* Assemblage Zones (Rubidge 1995). The three biozones have been assigned to the Wuchiapingian Stage of the Late Permian Period, with an approximate age range of 260-254 million years (Rubidge 2005). According to published maps showing the distribution of the Beaufort assemblage zones within the Main Karoo Basin (Keyser & Smith 1979, Hill 1993, Rubidge 1995, Van der Walt *et al.* 2010), the upper Middleton Formation succession lies within the ***Cistecephalus* Assemblage Zone** (= upper *Cistecephalus* Biozone or *Aulacephalodon-Cistecephalus* Assemblage Zone of earlier authors; see table 2.2 in Hill 1993).

The following major categories of fossils might be expected within *Cistecephalus* AZ sediments in the study area (Keyser & Smith 1979, Anderson & Anderson 1985, Hill 1993, Smith & Keyser *in* Rubidge 1995, MacRae 1999, Cole *et al*., 2004, Almond *et al*. 2008, Nicolas & Rubidge 2010):

- isolated petrified bones as well as rare articulated skeletons of **terrestrial vertebrates** such as true **reptiles** (notably large herbivorous pareiasaurs, small insectivorous owenettids) and **therapsids** or "mammal-like reptiles" (*eg* diverse herbivorous dicynodonts, flesh-eating gorgonopsians, and insectivorous therocephalians) (Fig. 4)
- aquatic vertebrates such as large **temnospondyl amphibians** (*Rhinesuchus*, usually disarticulated), and **palaeoniscoid bony fish** (*Atherstonia*, *Namaichthys*, often represented by scattered scales rather than intact fish)
- freshwater **bivalves** (*Palaeomutela*)
- **trace fossils** such as worm, arthropod and tetrapod burrows and trackways, coprolites (fossil droppings)
- **vascular plant remains** including leaves, twigs, roots and petrified woods ("*Dadoxylon*") of the *Glossopteris* Flora (usually sparse, fragmentary), especially glossopterid trees and arthrophytes (horsetails).

As far as the biostratigraphically important tetrapod remains are concerned, the best fossil material is generally found within overbank mudrocks, whereas fossils preserved within channel sandstones tend to be fragmentary and water-worn (Rubidge 1995, Smith 1993). Many fossils are found in association with ancient soils (palaeosol horizons) that can usually be recognised by bedding-parallel concentrations of calcrete nodules.

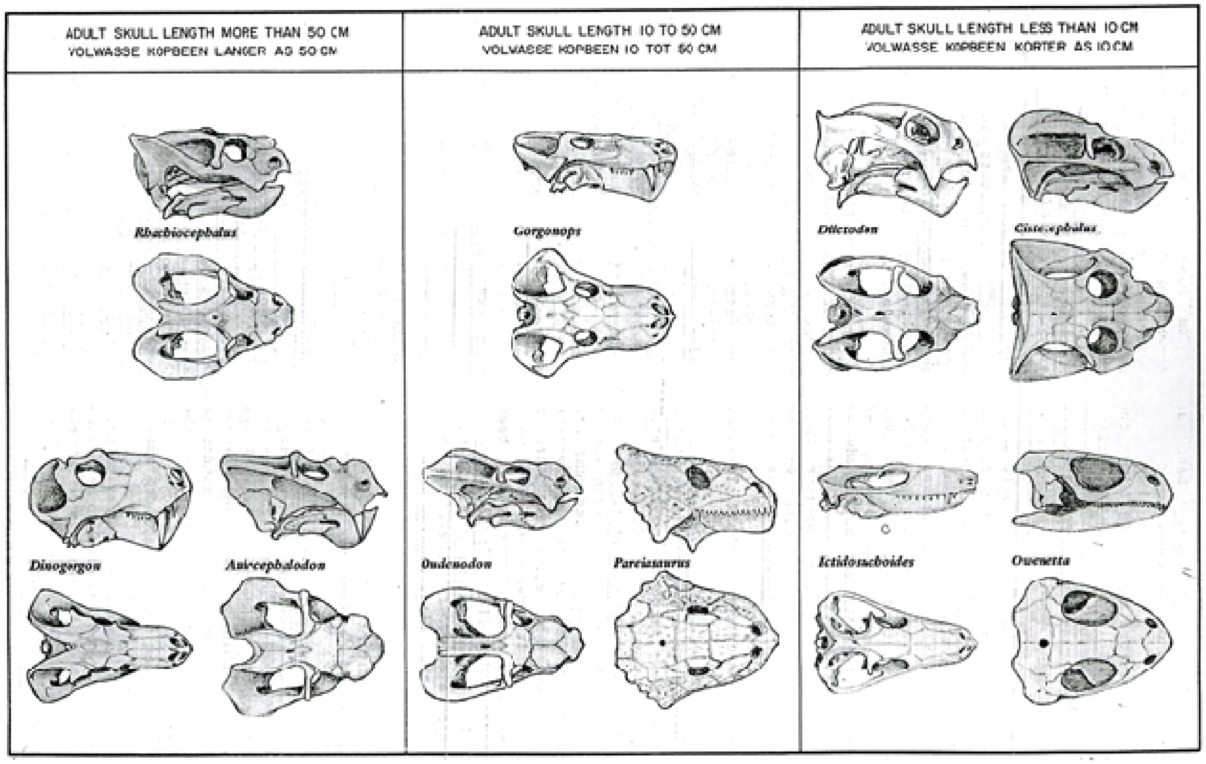


**Fig. 4. Skulls of characteristic fossil vertebrates from the *Cistecephalus* Assemblage Zone (From Keyser & Smith 1979). *Pareiasaurus* a large herbivore, and *Owenetta*, a small insectivore, are true reptiles. The remainder are therapsids or "mammal-like reptiles". Of these, *Gorgonops* and *Dinogorgon* are large flesh-eating gorgonopsians, *Ictidosuchoides* is an insectivorous therocephalian, while the remainder are small- to large-bodied herbivorous dicynodonts.**

The generally very low levels of exposure of Lower Beaufort Group seen in the East London area is due to deep post-Gondwana weathering as well as extensive soil development and high levels of vegetation cover in modern humid, pluvial climates. Roadcuts (*e.g.* along the N2 freeway) and steep-sided river valleys (*e.g.* in East London itself) mainly feature the more resistant dolerites and channel sandstones while the potentially more highly fossiliferous Beaufort Group mudrock horizons are very poorly exposed (Almond 2011a, 2011b). For these reasons alone, the Late Palaeozoic fossil record of the East London area is very poorly known, with most records coming from the better exposed coastal zone (*e.g.* Mountain 1974, Kitching 1977, Nicolas 2007).

Older data on Lower Beaufort Group fossil records in the East London area has been provided by Mountain (1974, p. 12) and Kitching (1977, pp. 53, 62). It is notable that many of these early records explicitly refer to badly preserved specimens. Poorly preserved therapsids, mostly dicynodonts referable to the *Cistecephalus* Assemblage Zone, as well as unidentified plant remains were collected near East London (on the left bank of the Buffalo River and on the shore) in the eighteenth century by George Gordon McKay. The dicynodont *Oudenodon*, which ranges through the *Cistecephalus* and *Dicynodon* Assemblage Zones, is recorded from close to the Qolora River Mouth, some 60km north-east of East London (Rogers & Schwarz 1902, p. 54).

Unnamed tetrapod fossils were recorded from the Morgans Bay area (just southwest of the Kei Mouth) to the northeast of East London by Plumstead (Mountain 1974, p.12). A *Cistecephalus* Assemblage Zone fossil biota including the dicynodonts *Dicynodon* (this genus ranges down below the *Dicynodon* AZ itself; Rubidge 1995) and *Oudenodon* as well as other, unidentified small- and medium-sized dicynodonts, the gorgonopsian *Lycaenops* and plant fossils of the *Glossopteris* flora (*Glossopteris* spp., sphenophytes) was collected by Kitching from intertidal coastal exposures intruded by dolerite at "Morgans Bay, Komga" in 1954 (Mountain 1974, p. 12; Kitching 1977, p. 62). Kitching (1977, p. 53) records the following therapsid genera from "small, scanty exposures next to the Nahoon River towards Arnoldton and Kidd's Beach", *i.e.* along the coast to the southwest of East London: the dicynodonts *Aulacephalus* [= *Aulacephalodon*?], *Pristerodon* and *Oudenodon* as well as an indeterminate theriodont ("*Lycosuchus*"). Kitching referred this biota to "strata below the *Cistecephalus* band. The "*Cistecephalus* Band" is a potential acme zone that occurs high up within the *Cistecephalus* Assemblage Zone and so Kitching's fauna may well belong to the latter assemblage zone. Petrified (siicified) wood material showing well-developed seasonal growth rings occurs fairly frequently in the Beaufort Group in the King William's Town – East London region (Almond 2011a, 2011b). It has been provisionally referred to the basket-genus *Dadoxylon* and is probably of gymnospermous affinities for the most part (*cf* Bamford 1999, 2004).

Much of the fossil material mentioned above is probably curated in the collections of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg. Small displays of local Beaufort Group and other fossils are also presented at the Amatole Museum (previously Kaffrarian Museum), King William's Town, and the East London Museum.

### 4.2. Karoo Dolerite Suite

The dolerite outcrops in the Eastern Cape study region are in themselves of no palaeontological significance since these are high temperature igneous rocks emplaced at depth within the Earth's crust. As a consequence of their proximity to large dolerite intrusions in the East London – King William's Town area, the Beaufort Group sediments here often been thermally metamorphosed or "baked" (*i.e*. recrystallised, impregnated with secondary minerals). Embedded fossil material of phosphatic composition, such as bones and teeth, is frequently altered by baking - bones in the East London area are typically black, for example - and may be very difficult to extract from the hard matrix by mechanical preparation (Smith & Keyser, p. 23 *in* Rubidge 1995). Thermal metamorphism by dolerite intrusions therefore tends to *reduce* the palaeontological heritage potential of neighbouring Beaufort Group sediments.

## 5. CONCLUSIONS & RECOMMENDATIONS

The Late Permian continental sediments of the Middleton Formation (Lower Beaufort Group, Karoo Supergroup) that underlie the whole study area are generally considered to be of high palaeontological sensitivity due to their rich fossil record of terrestrial vertebrates (notably various "mammal-like reptiles", trace fossils and plant remains. However, the impact significance of the proposed Cove Rock development as far as fossil heritage is concerned is rated as LOW because:

- The potentially fossiliferous Karoo bedrocks on the coastal platform here are probably mantled in thick soils and highly weathered. Substantial excavation of potentially fossiliferous fresh (unweathered) bedrock is therefore not anticipated;

- Baking of sediments during dolerite intrusion may have compromised their fossil content;

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In view of the overall low significance of the proposed development on palaeontological heritage resources, it is concluded that no further palaeontological heritage studies or specialist mitigation are required for the Cove Rock project near East London, pending the exposure of any substantial fossil remains (*e.g.* vertebrate bones and teeth, large blocks of petrified wood, vertebrate trackways) during the construction phase. In this case, negative impacts on local fossil heritage can be effectively mitigated by appropriate ECO monitoring and – where necessary – by professional palaeontological mitigation.

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## 6. ACKNOWLEDGMENTS

Ms Karen van Ryneveld of ArchaeoMaps, Beacon Bay, as well as Mr Brett Dustan of Imithi Services, Gonubie are both thanked for commissioning this report and for providing the necessary background information.

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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, Limpopo, Gauteng and the Free State for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage 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 development 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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