PALAEONTOLOGICAL IMPACT ASSESSMENT REPORT FOR A MANGANESE MINE

Farms York 279, Devon 277 and Telele 312, near Hotazel Town in the John Toalo Gaetsewe District Municipality in the Northern Cape Province

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EXECUTIVE SUMMARY

This report forms part of the Environmental Impact Assessment Report for the Kudumane Manganese Mining Project. This report complies with the requirements for a Phase 1 Palaeontological Impact Report as required from SAHRA (Environmental Impact Assessments required in terms of the National Environmental Management Act, Act 107 of 1998, or of the Environment Conservation Act, Act 73 of 1989 and Heritage Impact Assessments called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority).

Kudumane Manganese Resources (Pty) Ltd. proposes to develop a new manganese mine near Hotazel town in the John Taolo Gaetsewe District Municipality in the Northern Cape Province (Figure 2.1). In broad terms the proposed project will include the establishment of an opencast and future underground mining operation, associated residue handling and disposal facilities, a crushing and screening plant, water management facilities, rail and road transport infrastructure and various support infrastructure and services.

The proposed mining site is underlain by claystone, calcrete and dune sand of the Cretaceous to Tertiary Kalahari Formation, which in its turn is underlain by remnants of the Dwyka tillite of the Karoo Supergroup and Proterozoic aged Hotazel Iron Formation and underlying Ongeluk lava Formation.

The Cretaceous to Tertiary Kalahari Formation overlies the entire study area and outcrops of the more resistant limestone are restricted to the banks of the GaMogara River and the large excavation of the abandoned York Mine. No conclusive evidence of fossils could be found in either of the red claystone, conglomeratic limestone, calcareous sandstone or sand dunes of this formation and only two “pseudo-bone” remains have been recorded after two days of field investigations.

It is recommended that the Environmental Control Officer be informed of the possibility of pseudo-bone fragments in the limestone and that it will be necessary to note any structure that might indicate bone material to a qualified Palaeontologist, who must then inform SAHRA of such a find. If such a find is recorded it will be necessary to research and compile a Phase II palaeontological report during the excavation of the open cast mine.

The Proterozoic aged Hotazel Formation contains micro-stromatolite structures and due to a lack of outcrops in the area that will be mined, these are only visible in borehole core samples. The Environmental Control Officer must be aware of these structures and report the presence of stromatolites to the Mine Management and to SAHRA.

It is recommended that, if recorded during open cast mining operations, a representative sample of at least $1m^3$ be collected before a permit is issued for the destruction of the stromatolites during future mining activities. Due to the very specific targeting of Manganese ore bodies during future underground mining activities, the impact on stromalite structures will be negligible.

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1. INTRODUCTION

This report forms part of the Environmental Impact Assessment Report for the Kudumane Manganese Mining Project. This report complies with the requirements for a Phase 1 Palaeontological Impact Report as required from SAHRA (Environmental Impact Assessments required in terms of the National Environmental Management Act, Act 107 of 1998, or of the Environment Conservation Act, Act 73 of 1989 and Heritage Impact Assessments called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority).

Following a Phase 0 desk top study, reported to SAHRA during September 2009, a request for a Phase 1 Palaeontological Assessment report was received. Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports*" the following Terms of Reference applies: i) Desk top investigation, ii) Site visit and verification of desk top information and iii) To complete a Phase 1 Palaeontological Impact Report

2. PROJECT DESCRIPTION

Kudumane Manganese Resources (Pty) Ltd. proposes to develop a new manganese mine near Hotazel town in the John Taolo Gaetsewe District Municipality in the Northern Cape Province (Figure 2.1). In broad terms the proposed project will include the establishment of an opencast and future underground mining operation, associated residue handling and disposal facilities, a crushing and screening plant, water management facilities, rail and road transport infrastructure and various support infrastructure and services. The proposed project will take place on the farms York A 279, Devon 277 and Telele 312 (Figure 2). The aspects of the mine and proposed project are outlined in Table 1.1.

Table 2.1 *Aspects and Detail of the Kudumane Manganese Project*

Aspect	**Detail**
Province & Magisterial district	Northern Cape - John Taolo Gaetsewe
Local district	John Taolo Gaetsewe District Municipality Management Area
Municipal ward	John Taolo Gaetsewe District Municipality Management Area Ms M. Shuping
Farms on which the project will be located	York A 279, Devon 277 and Telele 312
Nearest residential areas	Hotazel (±3km to the north-east), Kuruman (±50km south east) and Kathu (±50km south)
Catchment and water management area	Orange River Basin – Quaternary catchment D41K
Presence of servitudes	Rail, R380, R31, D3336, Power lines and Telkom lines
Topographic landmarks	The project site is situated within a flat area located close to the GaMogara River.
Co-ordinates of project area	25º 41' 25.22" South and 27º 43' 47.51" East
Geological Setting	Proterozoic Hotazel Iron Formation, Voelwater Subgroup, Transvaal Supergroup, Overlying Cretaceous to Tertiary Kalahari Formation
Palaeontology	Stromatolites and algal structures in Proterozoic dolomites and possible vertebrate remains in Cretaceous and Tertiary deposits

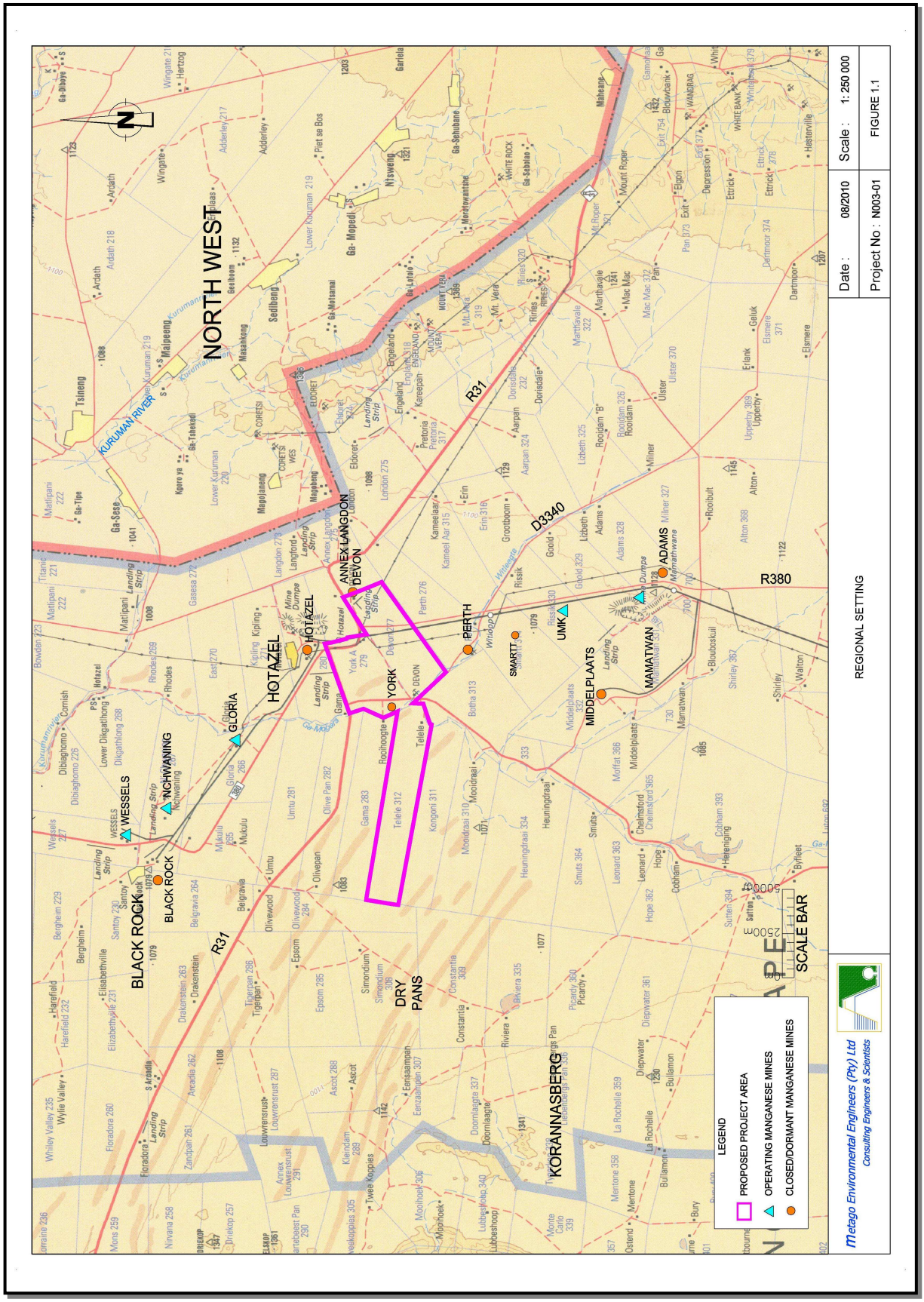

Figure 2.1 *Regional setting of the Kudumane Manganese Project in the North West Province*

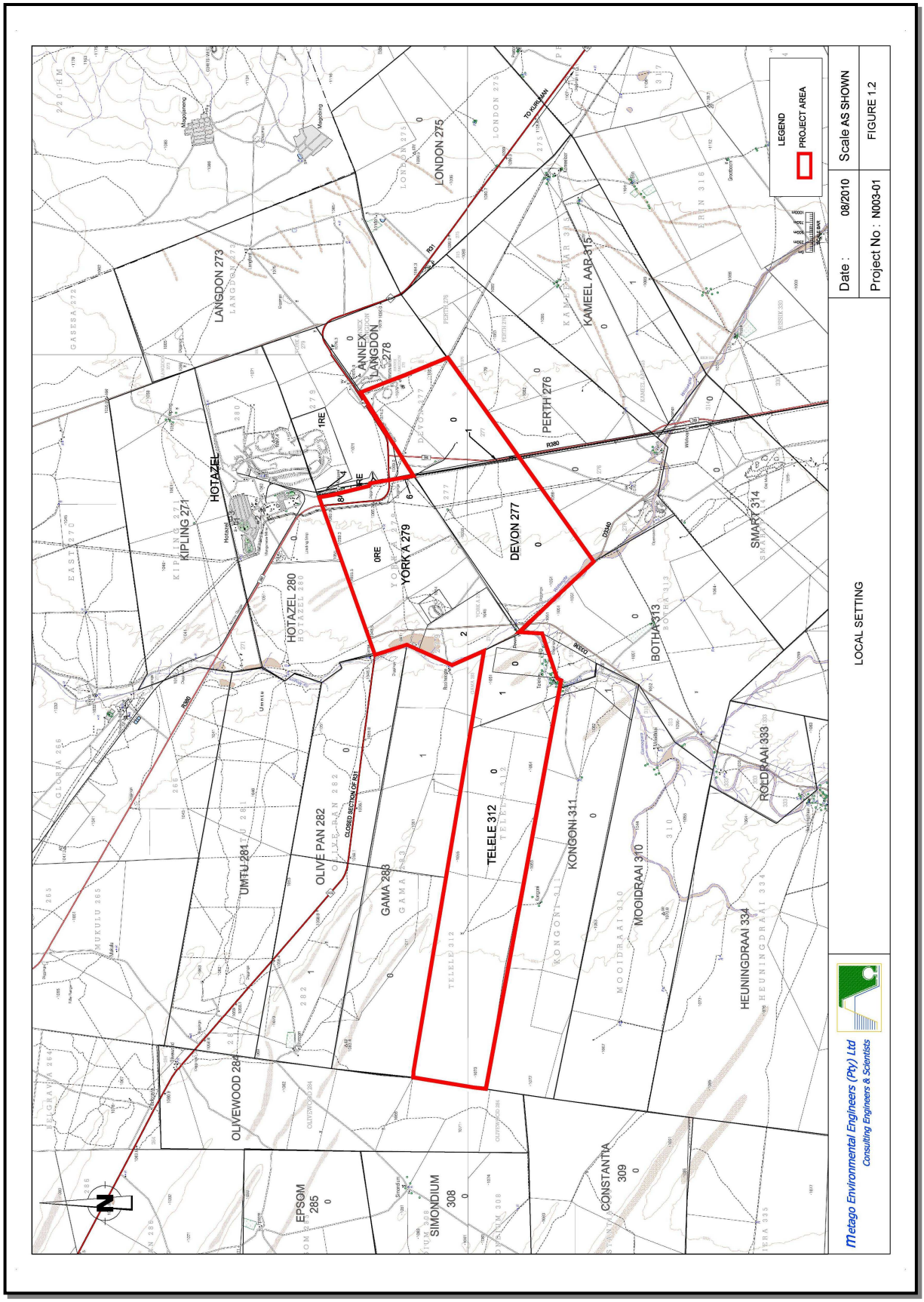

Figure 2.2 *Local setting of the Kudumane Manganese Project close to Hotazel in the Northern Cape Province*

3. GEOLOGY

The proposed mining site is underlain by claystone, calcrete and dune sand of the Cretaceous to Tertiary Kalahari Formation, which in its turn is underlain by remnants of the Dwyka tillite of the Karoo Supergroup and Proterozoic aged Hotazel Iron Formation and underlying Ongeluk lava Formation (Table 2.1) (Beukes, 1983 in Van der Merwe, 1997).

Table 3.1 *Generalised Stratigraphic Column and Associated Geology*

<table>
<tr><th colspan="4">Stratigraphy</th><th>Lithology</th></tr>
<tr><td colspan="4">Kalahari Formation</td><td>Sand, Clay, Limestone</td></tr>
<tr><td colspan="4">Karoo Supergroup</td><td>Dwyka Tillite</td></tr>
<tr><td colspan="3" rowspan="2">Olifantshoek Supergroup</td><td>Lucknow Formation</td><td>Quartzite</td></tr>
<tr><td>Mapedi Formation</td><td>Red and grey shale</td></tr>
<tr><td rowspan="9">Transvaal Supergroup</td><td rowspan="9">Postmansburg Group</td><td rowspan="8">Voelwater Subgroup</td><td>Mooidraai Formation</td><td>Dolomite</td></tr>
<tr><td rowspan="7">Hotazel Formation</td><td>Iron formation</td></tr>
<tr><td>Upper Mn ore body</td></tr>
<tr><td>Middle Mn ore body</td></tr>
<tr><td>Iron formation</td></tr>
<tr><td>Lower Mn ore body</td></tr>
<tr><td>Mn-rich iron formation</td></tr>
<tr><td>Iron formation</td></tr>
<tr><td colspan="2">Ongeluk Formation</td><td>Basaltic lava</td></tr>
</table>

3.1. Kalahari Formation

The Kalahari Formation is characterised by extensive sand dune deposits, with extensive outcrops of limestone along the banks of the GaMogara River (Figure. 3.1). The sequence of dune sand, calcareous sand, limestone and red claystone is evident as illustrated in Figure 3.2 at the old York Mine excavation on the Farm York 279. The limestone is interbedded with prominent calcareous conglomerate beds with predominantly clasts of Ongeluk lava and scattered clasts of banded iron stone and Jaspelite as illustrated in Figure 3.3.

Figure 3.1 *Limestone outcrops and sand dunes of the Kalahari Formation along the GaMogara River – GPS 27 14 15,4 S; 22 55 46,3 E*

Figure 3.2 *Excavation into the Kalahari Formation at the old York Mine. Exposure of sand dunes, calcareous sand, limestone and red clay stone*

Figure 3.3 *Conglomerate with poorly rounded pebbles of mainly Ongeluk lava in the calcareous Kalahari Formation*

3.2. Pre-Kalahari Geology

The underlying geology of the Karoo and Transvaal Supergroups is not exposed, and borehole evidence confirms that the area is underlain by rocks of the Ongeluk lava and banded iron formations as illustrated in Figure 3.4.

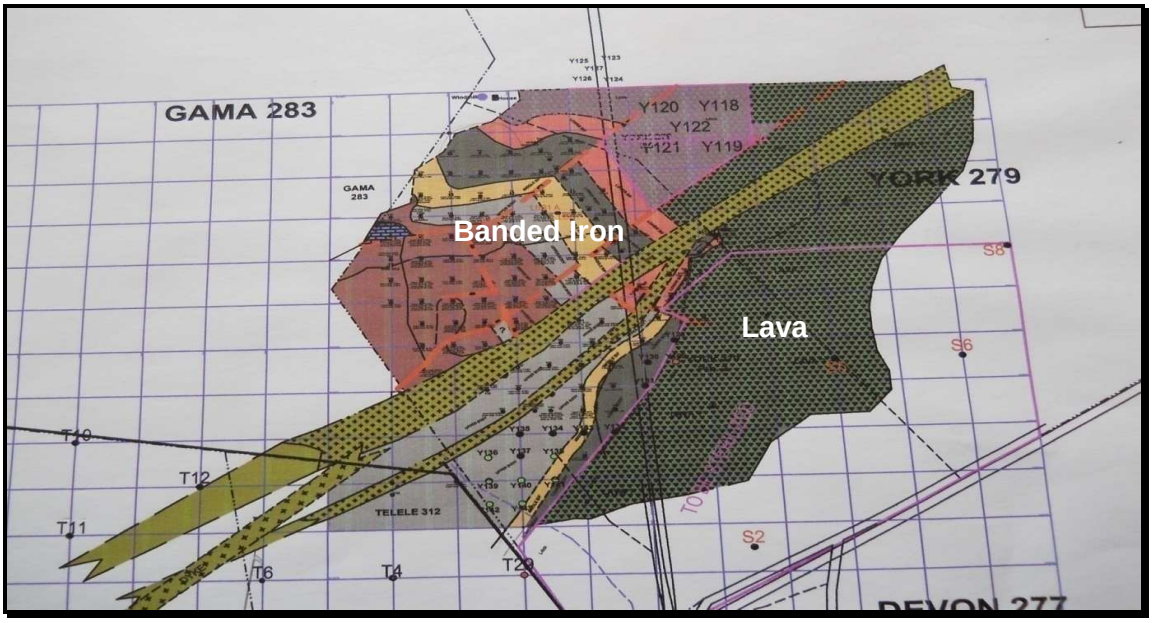

Figure 3.4 *The geology underlying the Kalahari Formation. Confirmation of Pre-Kalahari geological formations in borehole data on the farm York 279*

Generalised plan of the geology of the Transvaal Supergroup is provided by Beukes (1983) and Van der Merwe (1997) (Figure 3.5).

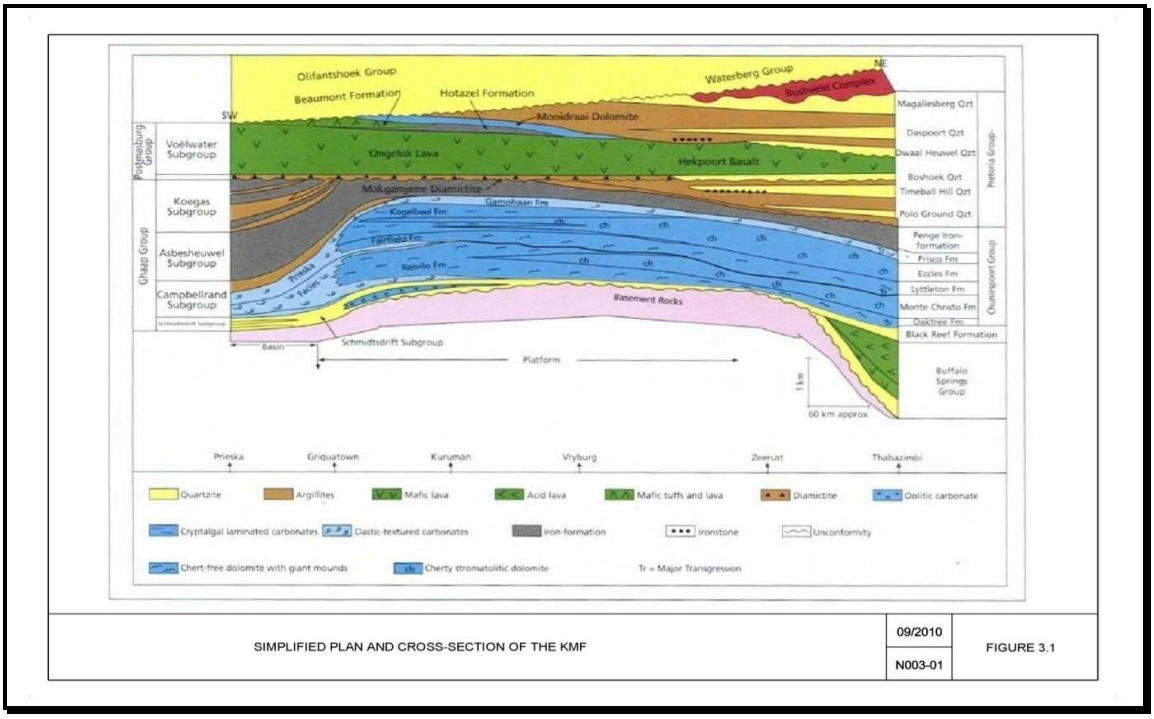

Figure 3.5 *Generalised geological interpretation of the Transvaal Supergroup (Beukes, 1983, Kudumane EIA, 2010)*

4. PALAEONTOLOGY

Literature reviews and reports associated with Heritage Conservation (Kudumane EIA 2010) make no mention of any palaeontological finds in the Kalahari Formation in this region. Although it is known that certain facies in the Dwyka Formation contains trace fossils and vertebrate fossils, highly breciated nature of the formation in this area will exclude fossils. Algal growth structures, known as “Stromatolites” are well-known fossil structures, described from the dolomites of the Transvaal Supergroup.

4.1. Methodology

Field work for this investigation included a site visit of three days during which outcrops of specifically the Kalahari Formation was intensively surveyed for traces of vertebrate fossils in the limestone and calcareous sandstone. Outcrops of the red claystone, present in the deep excavation on York 279, were too dangerous to inspect during this field visit. Several borehole logs were investigated to confirm algal structures and stromatolites in the dolomite and Banded Iron Formation (BIF) of the Mooidraai and Hotazel Formations

4.2. Kalahari Formation

No record could be found of fossils from the Kalahari Formation close to Hotazel. Following intensive surveying over two days, mainly on outcrops of limestone on

the banks of the GaMogara River (GPS 27 11 31,2 S; 22 55 14,7 E) (Figure 4.1) and at the York Mine (GPS 27 14 35,7 S; 22 56 06,0 E) (Figure 4.2) as well as the western part of York 279 (GPS 27 14 15,4 S; 22 55 46,3 E) (Figure 4.3), no obvious fossil remains were recorded in the formation.

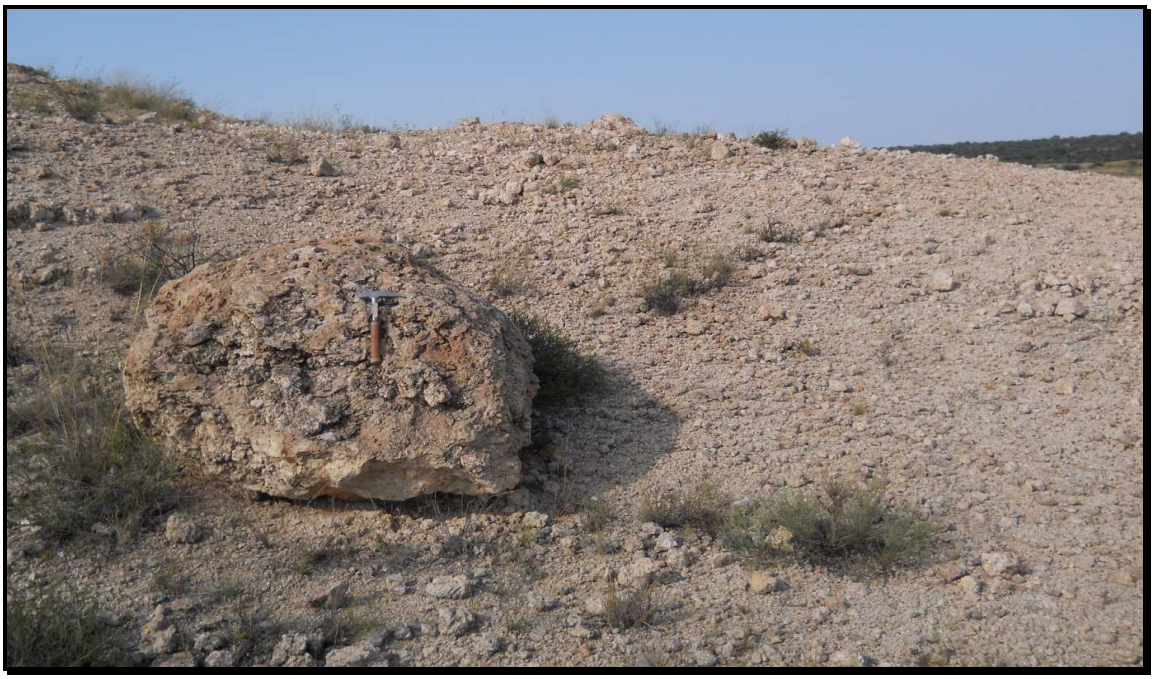

Figure 4.1 *Typical outcrops of the Kalahari limestone on the banks of the GaMogara River near Hotazel.*

Figure 4.2 *The York Mine works on the farm York 279 where limestone boulders were investigated for possible fossil content.*

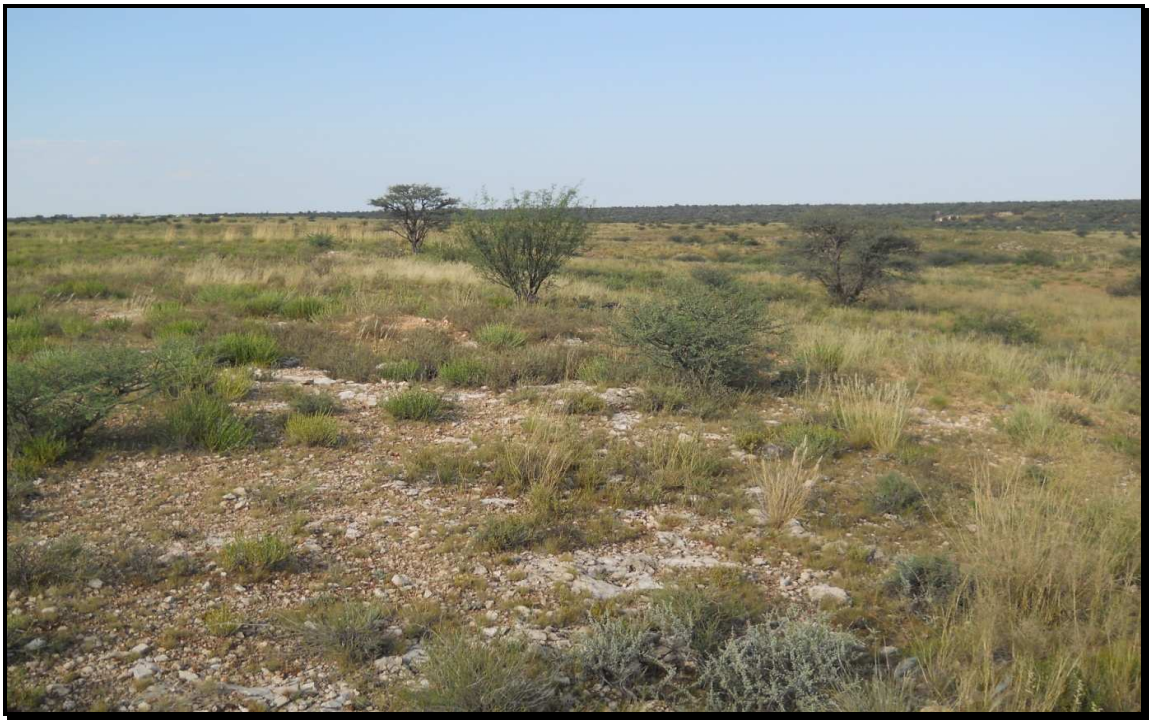

Figure 4.3 *Limestone outcrops of the Kalahari Formation on the banks of the GaMogara River.*

Relicts of possible bone structure might be present in the conglomerate (Figures 4.4 and 4.5), but the structures are completely replaced by calcium and silica, making it virtually impossible to determine with any certainty what the original material was.

Figure 4.4 *Relict of possible bone structure preserved in Kalahari limestone at the York Mine.*

Figure 4.5 *Possible relict of a bone structure, completely replaced by calcium and silica in the Kalahari Formation conglomerate on the farm York 279 (GPS 27 14 15,4 S; 22 55 46,3E).*

Closer observation of the limestone during exposure, when the open cast mine is developed, will reveal more conclusive evidence of what the structures represents.

No fossil remains have been observed in the red claystone calcareous sandstone or dune sands on this site. There is a potential to find fossils in these lithological units during excavation for the open pit mining, and the observation of any possible fossils must be brought to the attention of the Environmental Control Officer of the Kudumane Manganese Project and SAHRA.

4.3. Pre-Kalahari Formations

The palaeontological importance of the Proterozoic Transvaal Supergroup is mainly associated with well-defined stromatolite structures in the dolomite deposits (Figure 4.6).

There are no outcrops of Pre-Kalahari Dwyka or older Transvaal Supergroup rocks in the study area and outcrops of the banded shale and thin dolomite zones that crop out on the main road between Hotazel and Kuruman shows very poorly defined algal structures that probably represent micro-stromatolites (Figure 4.7).

Small scale algal structures were observed in borehole logs made available on site (Figure 4.8). The structures in the borehole logs are mostly of small (cm) scale and associated with banded iron formation or dolomite of the Hotazel Formation.

Figure 4.6 *Typical stromatolite structures usually associated with dolomite deposits such as the dolomite of the Mooidraai Formation that overlies the Hotazel Formation. It is highly likely that structures such as in this photograph, might be exposed during exposure of the dolomite and Banded Iron Units in the Hotazel Formation (Photograph from Wikipedia 201)* en.wikipedia.org/wiki/**Stromatolite.**

Figure 4.7 *Poorly defined algal structures in outcrops of the Transvaal Supergroup between Hotazel and Kuruman.*

Figure 4.8 *Algal structures associated with banded iron units in the Hotazel Formation, as seen in some of the borehole logs in the study area.*

5. CONCLUSIONS

The Cretaceous to Tertiary Kalahari Formation overlies the entire study area and outcrops of the more resistant limestone are restricted to the banks of the GaMogara River and the large excavation of the abandoned York Mine.

No conclusive evidence of fossils could be found in either of the red claystone, conglomeratic limestone, calcareous sandstone or sand dunes of this formation and only two “pseudo-bone” remains have been recorded after two days of field investigations.

The Proterozoic aged Hotazel Formation within the Kalahari Manganese Basin is host to the world’s largest land based manganese deposit. Three manganese-rich units are present within a banded iron formation (BIF) (Van der Merwe, 1997).

The mineralogical associations within the different iron formation facies reflect the chemistry of the environment during precipitation, leading to the formation of stromatolite structures when associated with algal growth.

After careful observation it is concluded that stromatolites might be present in the banded iron units of the Mooidraai Formation. From borehole log information it appears that the structures are poorly developed and are representative of micro-stromatolites if compared to the well-developed stromatolites in the dolomites of the Transvaal Supergroup.

6. RECOMMENDATIONS

6.1. Kalahari Formation

Palaeontological evidence is restricted to a few pseudo-bone structures that are preserved in the limestone. No evidence of any fossil material was collected from the rest of the Kalahari Formation.

It is recommended that the Environmental Control Officer be informed of the possibility of pseudo-bone fragments in the limestone and that it will be necessary to note any structure that might indicate bone material to a qualified Palaeontologist, who must then inform SAHRA of such a find. If such a find is recorded it will be necessary to research and compile a Phase II palaeontological report during the excavation of the open cast mine.

Underground mining activities will not have any impact on the Kalahari Formation.

6.2. Pre-Kalahari Formations

Palaeontological evidence is confined to micro-stromatolite structures in dolomites of the upper Mooidraai Formation and the banded iron units of the Hotazel Formation. The Environmental Control Officer must be aware of these structures and report the presence of stromatolites to the Mine Management and to SAHRA. It is recommended that, if recorded during open cast mining operations, a representative sample of at least $1m^3$ be collected before a permit is issued for the destruction of the stromatolites during future mining activities.

Due to the very specific targeting of Manganese ore bodies during future underground mining activities, the impact on stromalite structures will be negligible.

7. ACKNOWLEDGEMENTS

The author appreciates the assistance from Jonathan Mograbi at Metago Environmental Engineers (Pty) Ltd and the directors of Kudumane Manganese Project for their support in this study. Mr Solly van der Merwe and Sarel van der Merwe provided much needed information on the geology of the Hotazel Formation. Mr Deon Pieterse, a director of Kudumane Manganese, and the team at Kudumane Lodge provided much needed logistical support that is highly appreciated.

8. BIBLIOGRAPHY

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