

**Palaeontological Impact Assessment for the proposed  
Prospecting and Mining rights Applications for  
Katlani 236, west of Douglas,  
Northern Cape Province**

**Desktop Study**

**For**

**Dr Edward Matenga**

**Archaeological and Heritage Service Africa (Pty) Ltd**

**31 July 2019**

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## Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf  
Experience: 30 years research; 22 years PIA studies

## Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Dr Edward Matenga, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

## **Executive Summary**

A palaeontological Impact Assessment was requested for the Prospecting Rights and Mining Rights on the Farm Katlani 236, west of Douglas, Siyancuma Local Municipality, Northern Cape Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed project.

The proposed site lies on the non-fossiliferous Namaqua-Natal metamorphosed rocks, and on the potentially fossiliferous Dwyka Group mudstones (minor component) and on Kalahari sands. The latter only preserve fossils in special conditions, namely palaeo-pans. None has been recorded from the area. Nonetheless a Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that the geologist or responsible person overseeing the prospecting activities looks out for fossils and report their occurrence. No palaeontological site visit is required until fossils are found, and the prospecting right be granted. If no fossils are found the project can continue.

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# 1. Background

A palaeontological Impact Assessment was requested for the Prospecting Rights and Mining Rights on the Farm Katlani 236, west of Douglas, Siyancuma Local Municipality, Northern Cape Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed project.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2017)

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A

m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

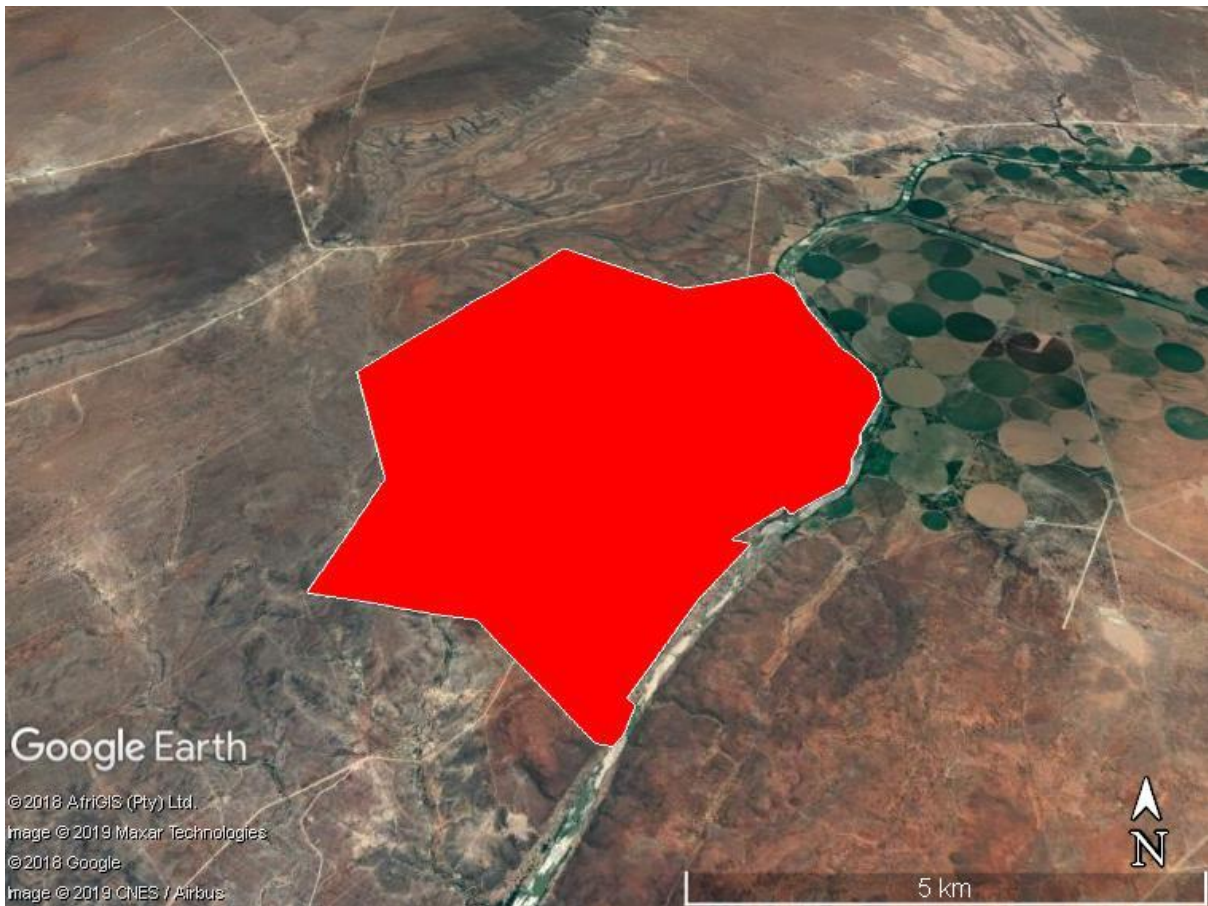


Figure 1: Google Earth map of the proposed prospecting rights and mining rights on the Farm Katlani 236, west of Douglas, Northern Cape Province. The area is shown by the red polygon. Map supplied by E matenga.

## 2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

## 3. Geology and Palaeontology

### i. Project location and geological context

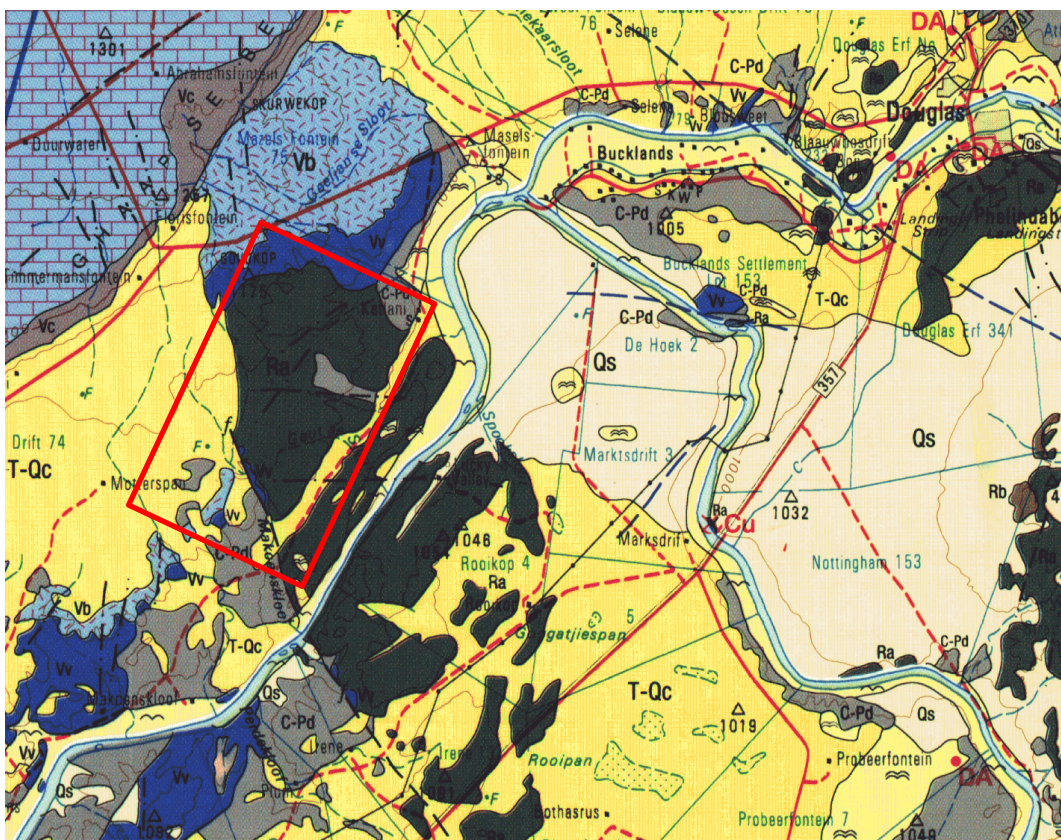


Figure 2: Geological map of the area around Douglas and Katlani Farm. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2922 Prieska.

Table 2: Explanation of symbols for the geological map and approximate ages (Cornell et al., 2006 Erikssen et al., 2006. Johnson et al., 2006; McCarthy et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Kalahari Group, Gordonia sand	Sand and sandy soil	Quaternary, last 2.5 Ma
T-Qc	Kalahari Group	calcrete	
C-Pd	Dwyka Group, Karoo SG	Tillite, sandstone, mudstone, shale	Late Carboniferous to Early Permian ca 300 Ma
Mba	Namaqualand Metamorphic Province	Intrusive rocks	unknown
Vu	Ulco Fm, Campbell Rand Subgroup, Ghaap Group, Transvaal SG	Dolomitic limestone	>2500 Ma
Vc	Clearwater Fm, Schmidtsdrif Subgroup, Ghaap Group, Transvaal SG	Shale with dolomite and andesite lenses	>2610 Ma
Vb	Boomplaas Fm, Schmidtsdrif Subgroup, Transvaal SG	Oolitic and stromatolitic limestone, flowstone and shale	>2620 Ma
Vv	Vryburg Fm, Transvaal SG	Quartzite, shale, grit and conglomerate	>2640 Ma

The Farm Katlani 236 lies on the west bank of the Orange River and predominantly on ancient intrusive rocks of the Namaqualand Metamorphic Province that are volcanic in origin. To the north of the farm are basal rocks of the Transvaal Supergroup, namely the two formations of the Schmidtsdrift Subgroup (the Boomplaas and Clearwater Formations). These are carbonate rocks with minor volcanic components.

There are some exposures of the Dwyka Group tillites that were deposited much later than the Transvaal Supergroup rocks. The tillites are around 300 million years old and are the n of the retreating Gondwana ice sheets.

Sands and calcretes of the Kalahari Group, less than 2.5 million years old, overlie these ancient rocks.

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for prospecting and mining is predominantly on the in the Namaqua sector of the Natal-



Namaqua Province and is rich in many economically important minerals such as zinc, lead, copper and silver (Cornell). The rocks are intrusive volcanic rocks and have been metamorphosed over time. They do not preserve fossils.

The stromatolitic dolomites of the Boomplaas, Clearwater and Ulco Formations were formed by algal colonies in ancient warm, shallow seas, however, they are described as stromatolitic dolomites, rather than as stromatolites. This means that clear domal or laminar structures are not present. Stromatolites are trace fossils and of interest for palaeoenvironmental reconstructions, but they are of limited interest to palaeontologists because the algal cells are only very rarely preserved within the structures. These rocks, however, are to the north of the prospecting footprint.

There are some outcrops of Dwyka tillites and these could potentially be fossiliferous, with fragments of plants from the early glossopterid flora (Anderson and Anderson, 1985; Plumstead, 1969) that had been entrained in the melting ice sheets but the tillites themselves do not preserve fossils. Only the mudstones are known to preserve or retain some fossils (Johnson et al., 2006).

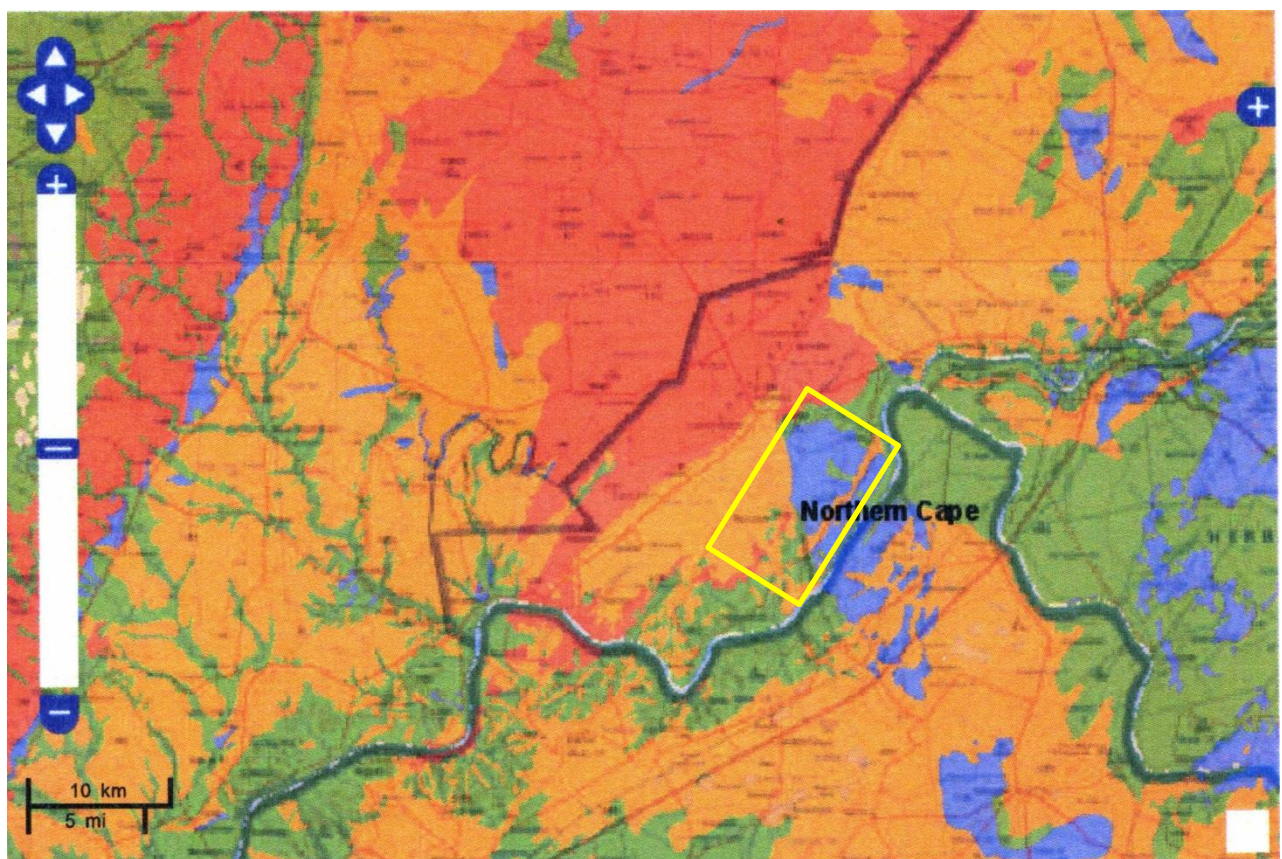


Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed prospecting and mining rights application, Katlani 236 shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The rest of the area, mainly the south and western parts, are covered by Kalahari sands and calcretes. They are much younger and many plants and animals were present on the earth at that time but aeolian and fluvial sands do not generally retain fossils. Fossils might be cemented into the calcretes that formed around palaeo-pans, such is evident at Kathu pan near Kuruman (Walker et al., 2014). From the google imagery, however, there are no pans evident in this area, and none has been recorded.

From the SAHRIS map above the area is indicated as highly sensitive (orange) for the Kalahari sands, and moderately sensitive (green) for the Dwyka Group tillites, so a desktop palaeontological assessment is presented here.

## 4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

**TABLE 3A: CRITERIA FOR ASSESSING IMPACTS**

<b>PART A: DEFINITION AND CRITERIA</b>		
<b>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</b>	<b>H</b>	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	<b>M</b>	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	<b>L</b>	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	<b>L+</b>	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	<b>M+</b>	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	<b>H+</b>	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
<b>Criteria for ranking the DURATION of impacts</b>	<b>L</b>	Quickly reversible. Less than the project life. Short term
	<b>M</b>	Reversible over time. Life of the project. Medium term
	<b>H</b>	Permanent. Beyond closure. Long term.
<b>Criteria for ranking the SPATIAL SCALE of impacts</b>	<b>L</b>	Localised - Within the site boundary.
	<b>M</b>	Fairly widespread – Beyond the site boundary. Local
	<b>H</b>	Widespread – Far beyond site boundary. Regional/ national
<b>PROBABILITY (of exposure to impacts)</b>	<b>H</b>	Definite/ Continuous
	<b>M</b>	Possible/ frequent
	<b>L</b>	Unlikely/ seldom

**TABLE 3B: IMPACT ASSESSMENT**

<b>PART B: ASSESSMENT</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	Loose sands do not preserve any fossils; so far there are no records from the area. The Dwyka Group sediments are tillites, not mudstones which are more likely to retain fossils; none has been recorded from this area. The impact would be very unlikely.

PART B: ASSESSMENT		
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the possible fossils within the area would be fossil plants from the <i>Glossopteris</i> flora in the Dwyka mudstones, or young fossils in palaeopans, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the tillites or loose sand that will be disturbed. Nonetheless a chance find protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are either much too old to contain fossils or are igneous. Furthermore, the material to be mined is the ancient metamorphosed igneous rocks of the Namaqua-Natal Province, but may be overlain by the younger rocks and sands. Since there is an extremely small chance that fossils from the Dwyka Group mudstones, if present, or Kalahari Group sands may be disturbed by the prospecting drilling, trenching or excavations, a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

## 5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and may contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the loose sands of the Quaternary. There is very small chance that fossil may occur in the mudstones of the Dwyka Group tillites so a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

## 7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Cornell, D.H., Thomas, R.J., Moen, H.F.G., Reid, D.L., Moore, J.M., Gibson, R.L., 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 325-379.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Walker, S.J.H., Lukich, V., Chazan, M., 2014. Kathu Townlands: A High Density Earlier Stone Age Locality in the Interior of South Africa. PLoS ONE 9(7): e103436. doi:10.1371/journal.pone.0103436

## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the prospecting, drilling, trenching and excavations begin.**

1. The following procedure is only required if fossils are seen on the surface and when excavations/mining commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone) should be put aside in a suitably protected place. This way the mining activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 4, 5). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are

removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

## Appendix A – Examples of fossils.

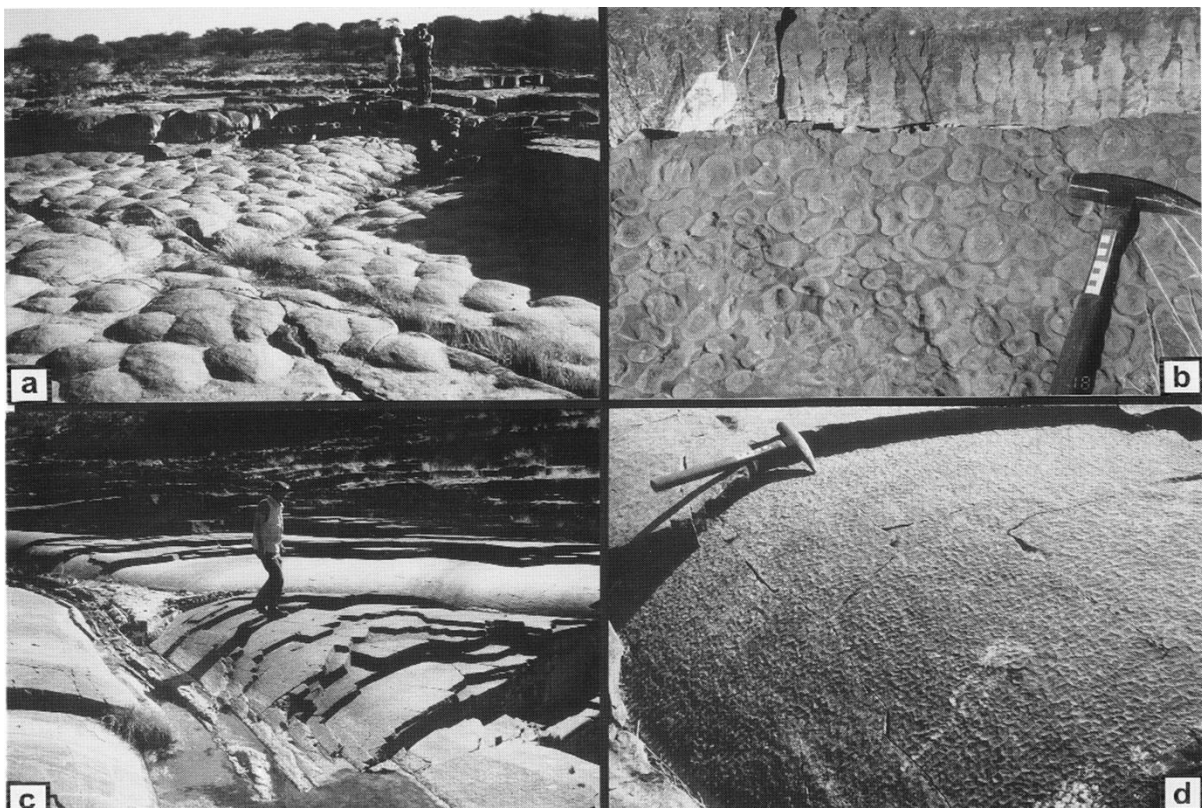
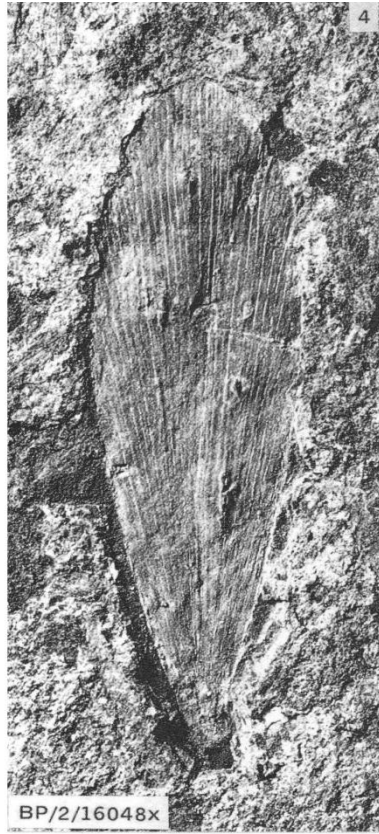
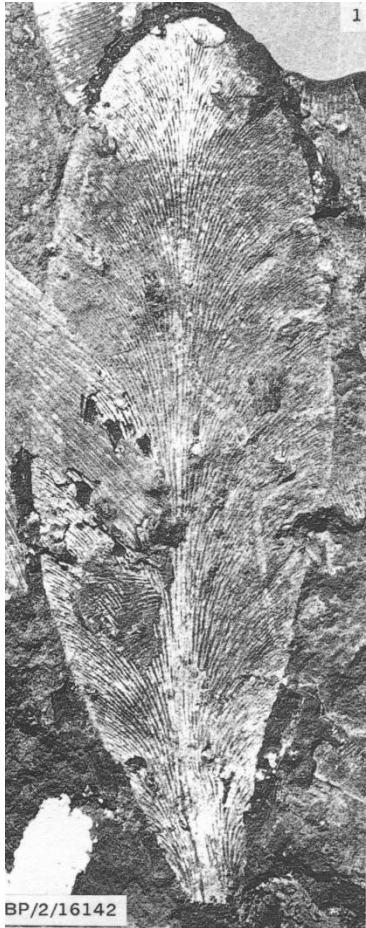


Figure 4: examples of stromatolites from the Transvaal Supergroup (Figure from Eriksson et al., 2006)



Noeggerathiopsis and  
Glossopteris leaves

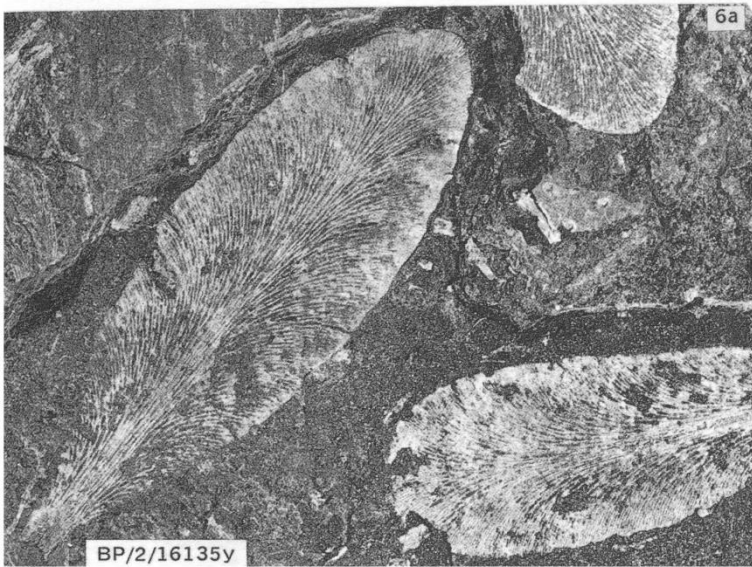


Figure 5: examples of glossopteris flora leaves from the Vryheid Formation

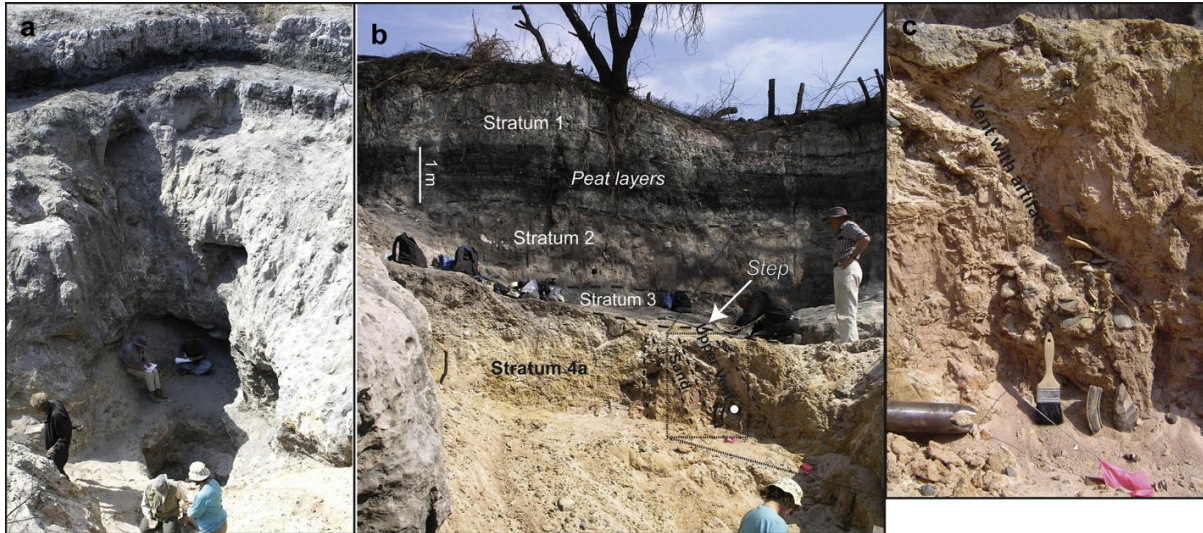


Figure 6: example of a palaeo-pan in Kalahari sands at Kathu, northern Cape. Figure from Porat et al., 2010.

## Appendix B – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD June 2019

#### i) Personal details

Surname : **Bamford**  
 First names : **Marion Kathleen**  
 Present employment : Professor; Director of the Evolutionary Studies Institute.  
 Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-  
 Telephone : +27 11 717 6690  
 Fax : +27 11 717 6694  
 Cell : 082 555 6937  
 E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ; [marionbamford12@gmail.com](mailto:marionbamford12@gmail.com)

#### ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:  
 1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.  
 1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.  
 1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.  
 1986-1989: PhD in Palaeobotany. Graduated in June 1990.

### iii) Professional qualifications

*Wood Anatomy Training (overseas as nothing was available in South Africa):*

1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps

1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer

1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

### iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa

Royal Society of Southern Africa - Fellow: 2006 onwards

Academy of Sciences of South Africa - Member: Oct 2014 onwards

International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+

Botanical Society of South Africa

South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016

SASQUA (South African Society for Quaternary Research) – 1997+

PAGES - 2008 –onwards: South African representative

ROCEEH / WAVE – 2008+

INQUA – PALCOMM – 2011+onwards

### vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	6	1
Masters	8	1
PhD	10	3
Postdoctoral fellows	9	3

### viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year

Biology III – Palaeobotany APES3029 – average 25 students per year

Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;

Micropalaeontology – average 2-8 students per year.

### ix) Editing and reviewing

Editor: *Palaeontologia africana*: 2003 to 2013; 2014 – Assistant editor

Guest Editor: *Quaternary International*: 2005 volume

Member of Board of Review: *Review of Palaeobotany and Palynology*: 2010 –

*Cretaceous Research*: 2014 -

Review of manuscripts for ISI-listed journals: 25 local and international journals



## **x) Palaeontological Impact Assessments**

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO

## **xi) Research Output**

Publications by M K Bamford up to June 2019 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 26; Google scholar h index = 30;

Conferences: numerous presentations at local and international conferences.

## **xii) NRF Rating**

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)

NRF Rating: B-3 (2005-2009)

NRF Rating: C-2 (1999-2004)