Palaeontological Impact Assessment for the proposed gypsum mining operation on farm Kanakies 332 Calvinia District, Northern Cape Province

Desktop Study

For

Cabanga Environmental

30 March 2018

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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 Cabanga Environmental, Randburg, 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

Witkop Fluorspar (Pty) Ltd intends to develop a Gypsum mine on the farm Kanakies 332 and has submitted an application for a Mining Right (MR) in terms of the Minerals and Petroleum Resources Development Act, Act No. 28 of 2002 (MPRDA). The project area is situated in the Northern Cape, on the border with the Western Cape, about 45km west-south-west of the town of Loeriesfontein and 40km north-north-west of the town of Nieuwoudtville.

The possibly fossiliferous Ecca sediments are not in the mining area but occur to the north. Granites, gneisses, sands, alluvium and calcretes are not fossiliferous. There is a small chance that trace fossils and stromatolites could occur in the Knersvlakte Subgroup shales but these will not be mined. Based on the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be identified in the proposed site. Furthermore, the gypsum to be mined would have formed when a saline pan dried out, and this would have been long after the underground rocks were formed, and the gypsum would not contain fossils. No further palaeontological assessment is required. As far as the palaeontology is concerned the project may continue.

Table of Contents

1. Background

Witkop Fluorspar (Pty) Ltd intends to develop a Gypsum mine on the farm Kanakies 332 and has submitted an application for a Mining Right (MR) in terms of the Minerals and Petroleum Resources Development Act, Act No. 28 of 2002 (MPRDA).

The project area is situated in the Northern Cape, on the border with the Western Cape, about 45km west-south-west of the town of Loeriesfontein and 40km north-north-west of the town of Nieuwoudtville. It falls within the Hantam Local Municipality of the Namaqwa District Municipality. The overall Mining Right Area (MRA) is 7456.6974 of which approximately 689 ha will be earmarked for mining, whilst a further 9 ha will be affected by surface infrastructure.

The MRA is currently zoned for agricultural purposes and is utilised for grazing. The property is bisected by the Transnet Freight railway line that links Sishen Iron Ore to the Port of Saldanha. Existing infrastructure on site includes a small rail siding, power lines, sub-station, cellular (MTN) tower, farmsteads and associated infrastructures.

This application relates to the surface mining of the industrial mineral, Gypsum. Gypsum is typically used in the agricultural and construction industries (plasterboard, Portland cement, plaster etc.). The deposit consists of two layers of gypsum i.e. a powder layer and nodular crystalline (clay) layer of gypsum. The deposit will be harvested by means of simple roll-over trench mining and the depth of trenching will vary between 1.4 and 2.5m. The first step involves removing the overburden layer of between 0.2 and 0.7m, followed by the selective removal of the powder layer of approximately 0.4 m and subsequently by removal of the crystal-containing clay layer of between 0.9 and 1.3m.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Appendix A
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section ii **Error! Reference source**

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	Relevant section in report
	not found.
An identification of any areas to be avoided, including buffers	N/A
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
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
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
Any mitigation measures for inclusion in the EMPr	N/A
Any conditions for inclusion in the environmental authorisation	N/A
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
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
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A

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*).

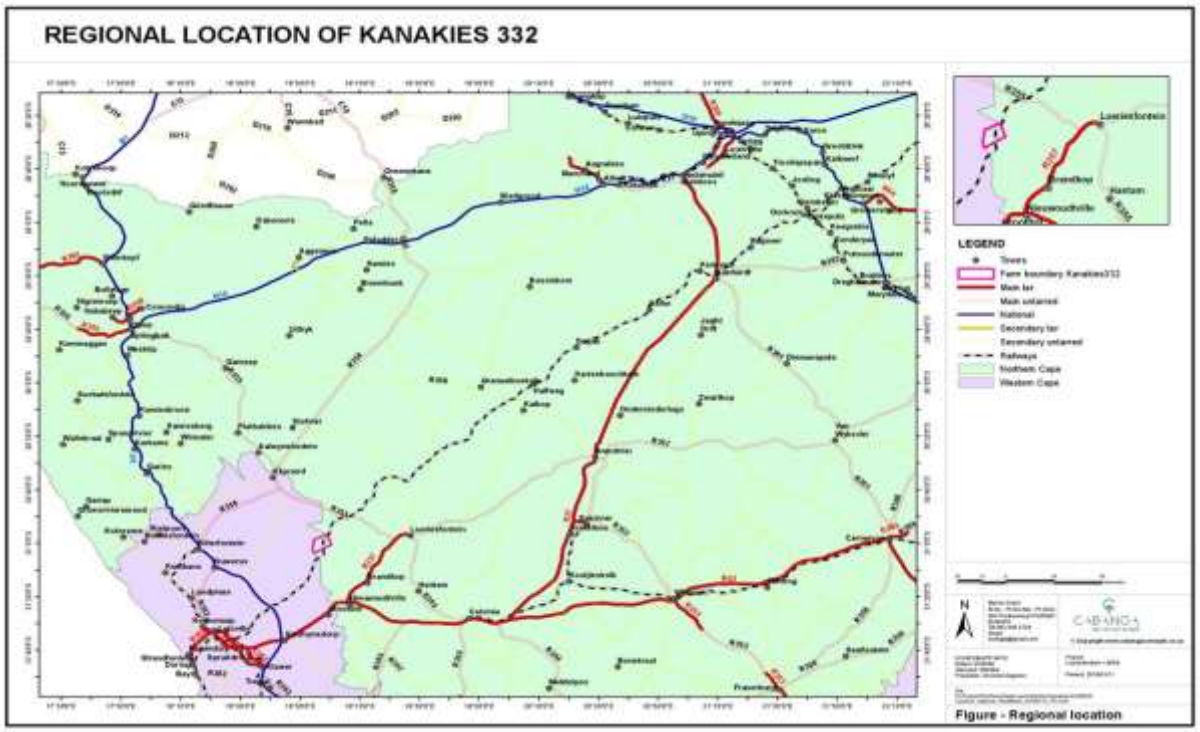
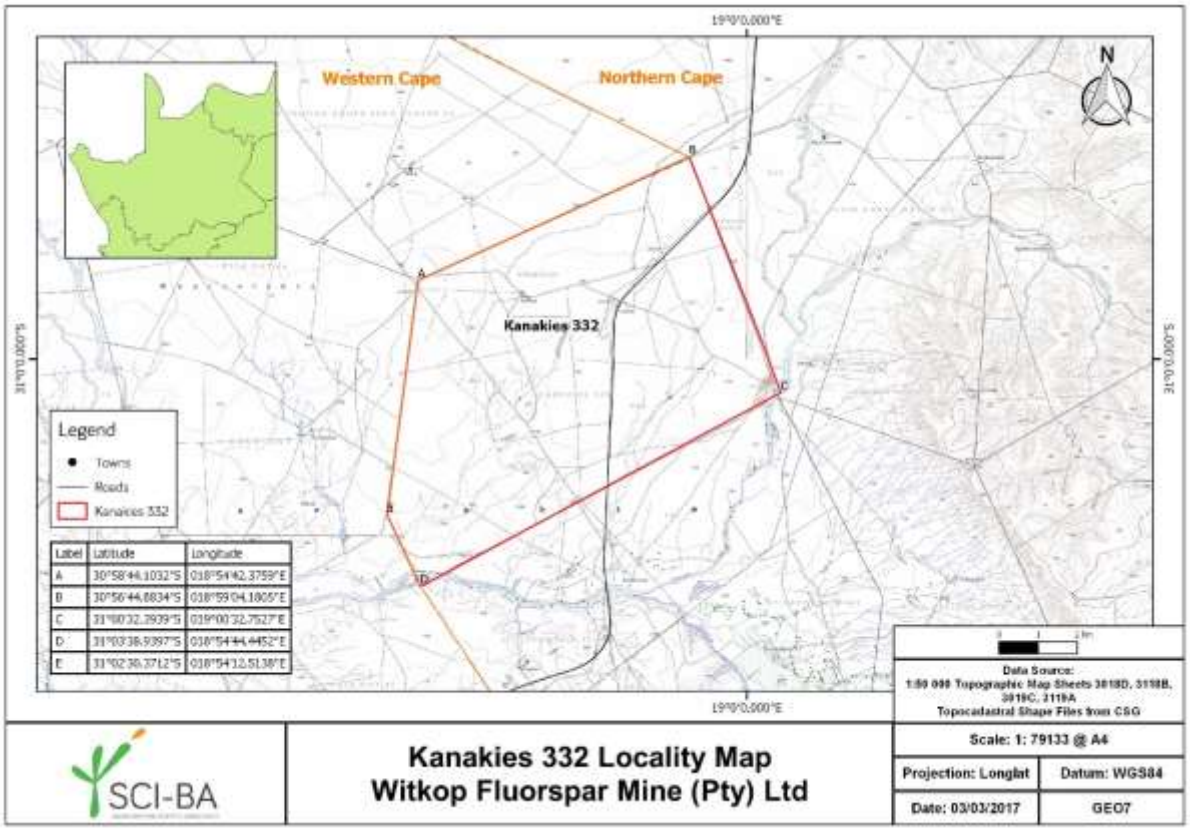


Figure 1a: Map from Cabanga of the proposed mining area at Kanakies 332, Northern Cape Province. Fig 1b (below) showing details of the farm border.


19°0'0.000"E
Western Cape
Northern Cape
N
Kanakies 332
31°0'0.000"S
Legend
Towns
Roads
Kanakies 332
Label | Latitude | Longitude
A | 30°58'44.1032"S | 018°54'42.3759"E
B | 30°56'44.8834"S | 018°59'04.1805"E
C | 31°00'32.2939"S | 019°00'32.7527"E
D | 31°03'38.9397"S | 018°54'44.4452"E
E | 31°02'39.3712"S | 018°54'12.5138"E
Data Source:
1:50 000 Topographic Map Sheets 3018D, 3118B, 3019C, 3119A
Topocadastral Shape Files from CSG
SCI-BA
Kanakies 332 Locality Map
Witkop Fluorspar Mine (Pty) Ltd
Scale: 1: 79133 @ A4
Projection: Longlat
Datum: WGS84
Date: 03/03/2017
GEO7

3. Geology and Palaeontology

i. Project location and geological context

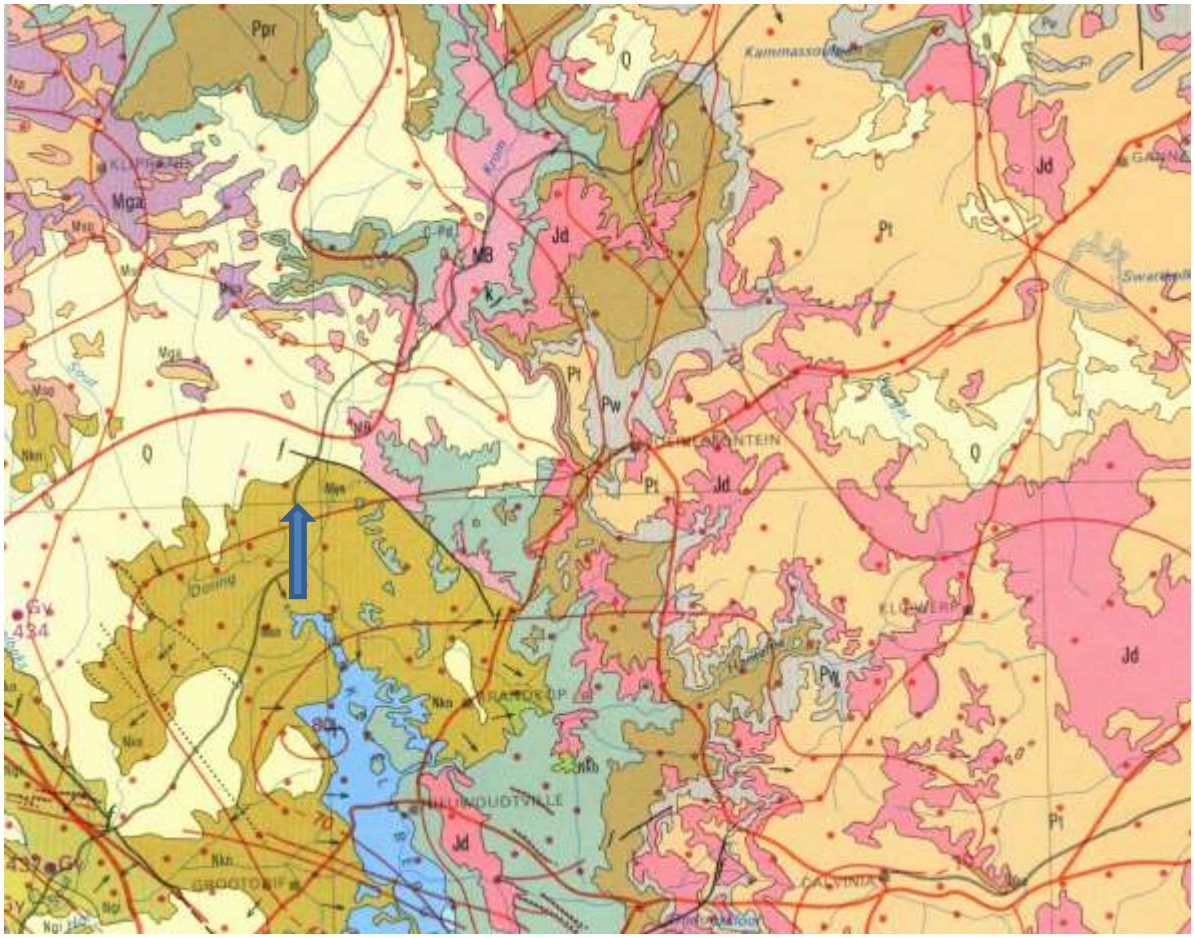


Figure 2: Geological map of the area around Loeriesfontein, Nieuwoudtville and Kliprand.. The proposed site for the gypsum mine is indicated by the blue arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Gresse et al., 2006; Cornell et al., 2006; Erikssen et al., 2006. Johnson et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary sand; Gordonia Fm	Sands, alluvium, calcrete	Last 2.5 Ma
Jd	Jurassic dykes	dolerite	182-183 Ma
Pt	Tierberg Fm, Ecca Group, mid Permian	shale	269-265 Ma
Pw	Whitehill Fm, Ecca Group, lower Permian	Carbonaceous shale	283-275 Ma
Ppr	Prince Albert Fm, lower Permian	Shale	290-283 Ma

Symbol	Group/Formation	Lithology	Approximate Age
C-Pd	Dwyka Group	Tillite, sandstone, mudstone, shale	300-290 Ma
Sn	Nardouw Subgroup,	Quartzite, sandstone, shale, tillite	Silurian-Devonian
Nkn	Knersvlakte Subgroup, Vanrhynsdorp Group,	Shale, siltstone, sandstone, limestone	550-530 Ma
MB	Unnamed granites and gneiss	Gneiss, granite	
Mga	Garies subgroup, Okiep Group, now Koperberg Suite	Biotite gneiss	>1200 Ma

The rocks in this region are part of a global orogenic period and were formed when the supercontinent Gondwana was constructed during the Neoproterozoic (Gresse et al., 2006). In South Africa the Gariep Belt (north) and Saldania Belt (south) are generally composed of low-grade metamorphosed volcanic-sedimentary successions, intruded by syn- to post-orogenic granitoids, with associated foreland and molasse deposits known as the Nama and Vanrhynsdorp Groups (ibid).

In the Vanrhynsdorp Basin there are three subgroups overlying the basal Flaminkberg Formation, the lower Kwanous Subgroup, the Knersvlakte Subgroup and upper Brandkop Subgroup. The formations within these groups comprise alternating layers of conglomerate, grit, sandstone, siltstone, shale, mudstone and limestone and represent a southeastward-prograding fan delta system (Gresse et al., 2006).

There is a large exposure, more or less running north-south of Cape Supergroup rocks, of the Nardouw Subgroup. To the north of the site are sediments of the Karoo Supergroup, of the Dwyka and Ecca Groups. Tillites and diamictites of the Dwyka Group represent receding glaciers, meltwaters and deep marine settings. From the Ecca are shales and carbonaceous shales deposited in a marine environment (Prince Albert Formation), foreland basin environment (Whitehill Formation, and in a deepwater environment (Tierberg Formation) (Johnson et al., 2006). Dolerite dykes during the Jurassic have intruded through the sediments and much of the region has a covering of Quaternary sands, alluvium and calcretes.

The proposed gypsum mine is on the Knersvlatke Subgroup but mining will be of the surficial deposits only. These are most likely associated with much more recent events than the Knersvlatke sediments. Gypsum forms in arid regions where the evaporation in saline pans causes the mineral to deposit (Cairncross, 2004).

ii. Palaeontological context

Trace fossils, *Phycodes pedum, Planolites* and *Oldhamia*, as well as stromatolites, have been recorded from the Knersvlakte subgroup (Germs, 1995; Gresse et al., 2006; Almond and Pether, 2009). The fossils have been found near the towns of Vanrhynsdorp and

Bitterfontein, but not in the Kanakies area. Examples of these trace fossils are shown in Figure 3

The Ecca sediments near Douglas and in southern Namibia have preserved some fossils. McLachlan and Anderson (1973) reported fish and shells from the lower Dwyka, and fossil wood and *Mesosaurus* from Namibia. Fossil wood and plants of the *Glossopteris* flora were recovered from near Douglas (Vaal River, near Kimberley; McLachlan and Anderson, 1973) and from Brandhoek, southwest of Calvinia (Anderson and McLachlan, 1976).

Quaternary alluvial sands do not preserve fossils because of their friable and transported nature. Almond and Pether (2009) do not record fossils from this region.

Figure 3: SAHRIS palaeosensitivity map of the region around Kanakies farm. The site in the grey area (yellow arrow). Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

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

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

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	There is no chance of any fossils being found here
	L+	-
	M+	
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	The spatial scale is extremely small.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	
	L	There is no chance of finding fossils in the surrounding rocks or in the sandy overburden or in the gypsum.

Based on the nature of the project, only the alluvial sands will be removed and the ground would be penetrated to a maximum depth of 2.5m to access the gypsum deposits. Since there is no chance of finding fossils in the gypsum or loose surface sands there would be no impact on the fossil heritage. There is no chance of finding fossils so a phase 2 or site visit is NOT recommended. Taking account of the defined criteria, the potential impact to fossil heritage resources is zero.

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 shales, sandstones, diamictites, tillites, gneisses, schists, granites and sands are typical for the country and do not contain any microfossils, fossil plant, insect, invertebrate and vertebrate material.

6. Recommendation

The possibly fossiliferous Ecca sediments are not in the mining area but occur to the north. Granites, gneisses, sands, alluvium and calcretes are not fossiliferous. There is a small chance that trace fossils and stromatolites could occur in the Knersvlakte Subgroup shales but these will not be mined. Based on the lack of any previously recorded fossils from the area, it is extremely unlikely any fossils would be identified in the proposed site. Furthermore, the gypsum to be mined would have formed when a saline pan dried out, and this would have been long after the underground rocks were formed. The gypsum would not contain fossils. No further palaeontological assessment is required. As far as the palaeontology is concerned the project may continue.

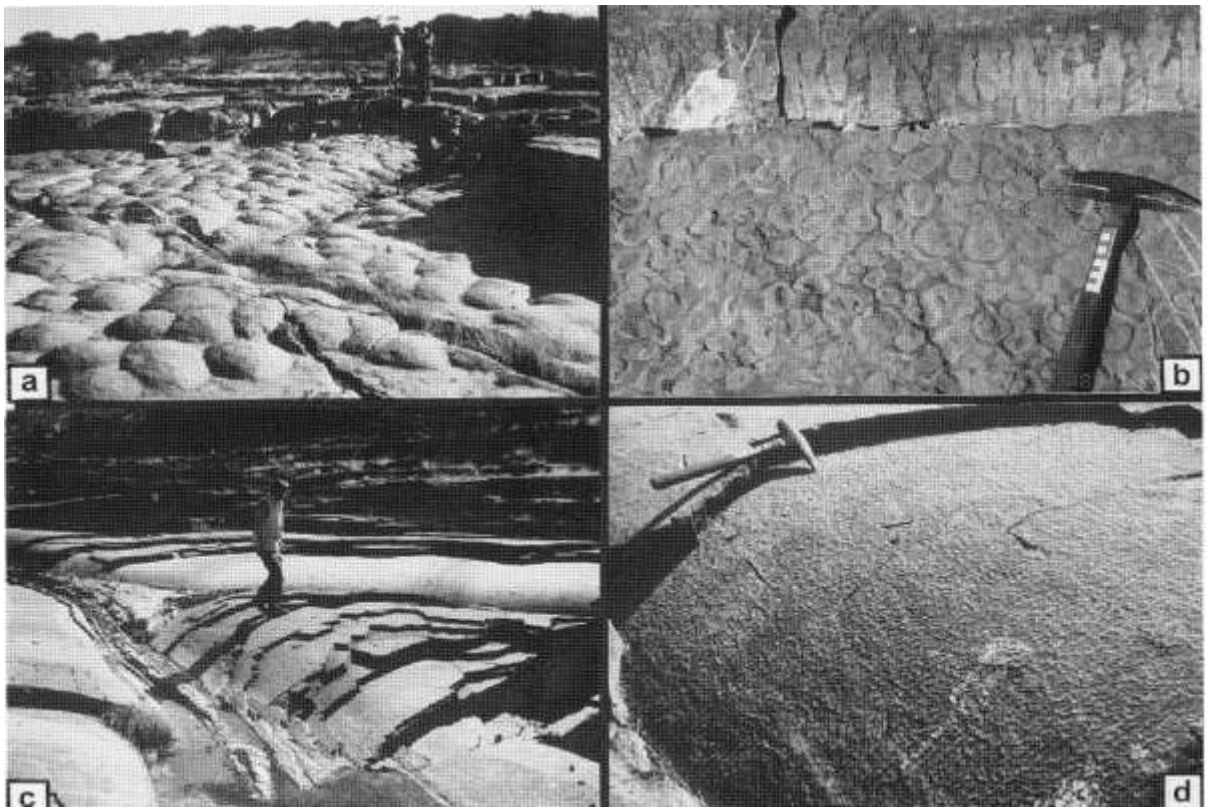


Figure 5: examples of stromatolites (from Erikssen et al. 2006).

7. References

Almond, J., Pether, J. 2009. Palaeontological Heritage of the Northern Cape. SAHRA Palaeotechnical Report. 143 pp.

Anderson, A.M., McLachlan, I.R., 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the great Karoo Basin, South Africa. Palaeontologia africana 19, 31-42.

Cairncross, B. 2004. Field Guide to Rocks and Minerals of Southern Africa. Struik Publishers, Cape Town, 292 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.

Germs, G.J.B. 1995. The Neoproterozoic of southwestern Africa, with emphasis on platform stratigraphy and palaeontology. Precambrian Research 73: 137-151.

Gresse, P.G., von Veh, M.W., Frimmel, H.E., 2006. Namibian (Neoproterozoic) to Early Cambrian Successions. 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 295-420.

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McLachlan, I.R., Anderson, A.M., 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15(2), 37-64.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. 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 585-604.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 2018

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
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E-mail	:	marion.bamford@wits.ac.za ; 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	5	2
Masters	6	3
PhD	9	3
Postdoctoral fellows	5	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

xi) Research Output

Publications by M K Bamford up to January 2018 peer-reviewed journals or scholarly books: over 110 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 22; Google scholar h index = 24;
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)