

**Palaeontological Impact Assessment for the proposed
Extension for Die Wilgers Hospital, east Pretoria,
Gauteng Province.**

Desktop Study

For

Heritage Contracts and Archaeological Consulting

06 March 2019

Prof Marion Bamford

Palaeobotanist

P Bag 652, WITS 2050

Johannesburg, South Africa

Marion.bamford@wits.ac.za

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 Heritage Contracts and Archaeological Consulting, Modimolle, 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, SAHRA Case ID13136, for the proposed extension to Life Die Wilgers Hospital, located in Pretoria, Gauteng, on a part of Portion 161 of the Farm the Willows 340 JR. 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 site is on ancient sandstones of the Daspoort and Silverton Formations, Pretoria Group, Transvaal Supergroup, and rare microbially induced sedimentary structures might be preserved. These are trace fossils from microbial activity on ancient shallow water and tidal zones of the epeiric sea. They are fairly common in the Magaliesberg Formation. Since they are uncommon trace fossils there might be a very minor impact on the palaeontological heritage of South Africa so a Fossil Chance Find Protocol has been added. As far as the palaeontology is concerned the project can proceed.

Table of Contents

Expertise of Specialist.....	1
Declaration of Independence.....	1
1. Background.....	4
2. Methods and Terms of Reference	6
i. Project location and geological context.....	7
ii. Palaeontological context	8
4. Impact assessment.....	10
5. Assumptions and uncertainties.....	11
6. Recommendation.....	11
7. References.....	11
Appendix A (short CV of specialist)	14

1. Background

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 (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 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	Section 8
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 EMP, 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



Figure 1: Google Earth map of the proposed site for development with existing features shown. The site is indicated by “1374” and is the treed area to the west of the existing hospital.



Figure 2: More distant Google Earth map to show the areas to be developed “1374 and 1375” of Portion 636 of the Farm The Willows 340 JT, Die Wilgers Extension 83. Map supplied by HCAC.

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

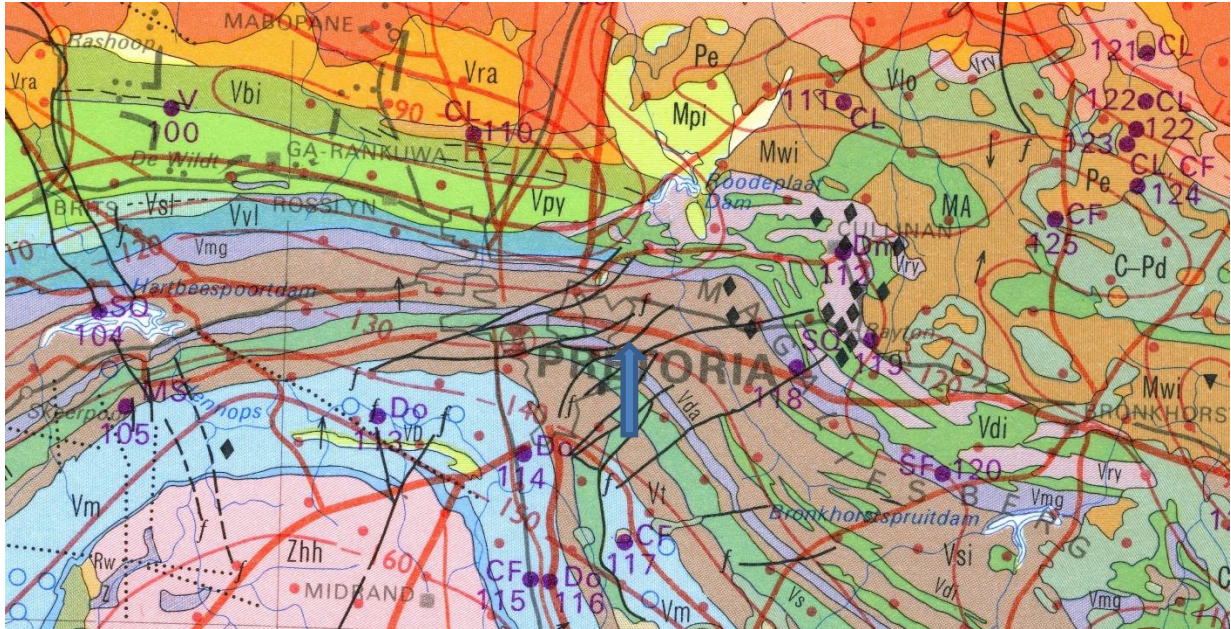


Figure 3: Geological map of the area around Pretoria . The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Anhaeusser, 2006; Cawthorn et al., 2006; Erikssen et al., 2006; Johnson et al., 2006; McCarthy, 2006; Robb et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Vvi	Villa Nora Gabbro	Gabbro, anorthosite	>2050 Ma
Vpy	Pyramid Gabbro, Rustenburg Layered Suite, bushveld Complex	gabbro	>2050 Ma
Vsl	Schilpadnest Subsuite, Rustenburg Layered Suite, Bushveld Complex	Norite, pyroxenite, anorthosite	>2050 Ma
Vvl	Vlakfontein Subsuite, Rustenburg Layered Suite, Bushveld Complex	Bronzitie, harzburgite, norite	>2050 Ma
Vmg	Magaliesberg Fm, Pretoria Group, Transvaal SG	Sandstone with mudrock lenses and interbeds	Ca 2100 Ma
Vsi	Silverton Fm, Pretoria Group, Transvaal SG	Shale, basalt, tuff	Ca 2222 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Vda	Daspoort Fm, Pretoria Group, Transvaal SG	Sandstone, mudrock	Ca 2222 Ma
Vdw	Dwaalheuwel Fm, Pretoria Group, Transvaal SG	Quartzite, siltstone, conglomerate	>2222 Ma
Vm	Malmani Subgroup, Chuniespoort Group	Dolomite, limestone	2642 – 2500Ma
Rw	Witwatersrand SG	Quartzite, shale	Ca 3100 – 2700 Ma
Z-Rm	Muldersdrift Complex	serpentinite	>3200 Ma
Zhh	Halfway House Granite, Johannesburg Dome	Granite, gneiss, migmatite, granodiorite	Archaean, 3340 – 3113 Ma

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Erikssen et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

The Dasport, Silverton and Magaliesberg Formations form a sequence as part of the Pretoria Group, Transvaal Supergroup, and represent rocks that are over 2060 million years old. Comprising sandstone and mudrock, the Daspoort Formation has been interpreted as representing distal fan, fluvial braid-plain, braid-delta facies with a transgressive epeiric sea to the east. In the Silverton Formation there are relatively deep water facies, transgressive epeiric sea facies and evidence of volcanic activity mainly in the east in the form of tuffs. The overlying Magaliesberg Formation represents a regressive sandy shoreline with braid-delta and high energy tidal flats (Erikssen et al., 2006).

Other rocks in the region are western exposures of the Rustenburg Layered Suite of the Bushveld Complex. These are igneous rocks that have been highly metamorphosed with a complex history that is still debated (Cawthorn et al., 2006). They will not be considered further

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the Silverton Formation and Daspoort Formation. Stromatolites have been recorded from the Malmani Subgroup but only Mat Related Structures (MRS) or Microbially Induced Sedimentary Structures (MISS) are common in the Magaliesberg Formation and rare in the Daspoort Formation, both of the Pretoria Group (Eriksson et al., 2012). Stromatolites are the trace fossils of algal colonies that grew in the warm shallow seas of the continent more than 2500 million years ago (Figure 5). As the algae photosynthesised in the low oxygen atmosphere they deposited layer upon layer of calcium carbonate, calcium sulphate, magnesium sulphate and other compounds. The stromatolite structures have been classified by researchers but very seldom have the algal cells been preserved in the structures.

Furthermore, they are microscopic in size and one requires thin sections and microscopes to be able to see the unicellular organisms.

Mat Related Features are trace fossils of microbial activity, such as rollups, spirals, ripple patterns, biofilms, that were present in the shallow tidal zones (Figure 6). As for stromatolites, the bacteria and algae that originally formed the biofilms, are not preserved.

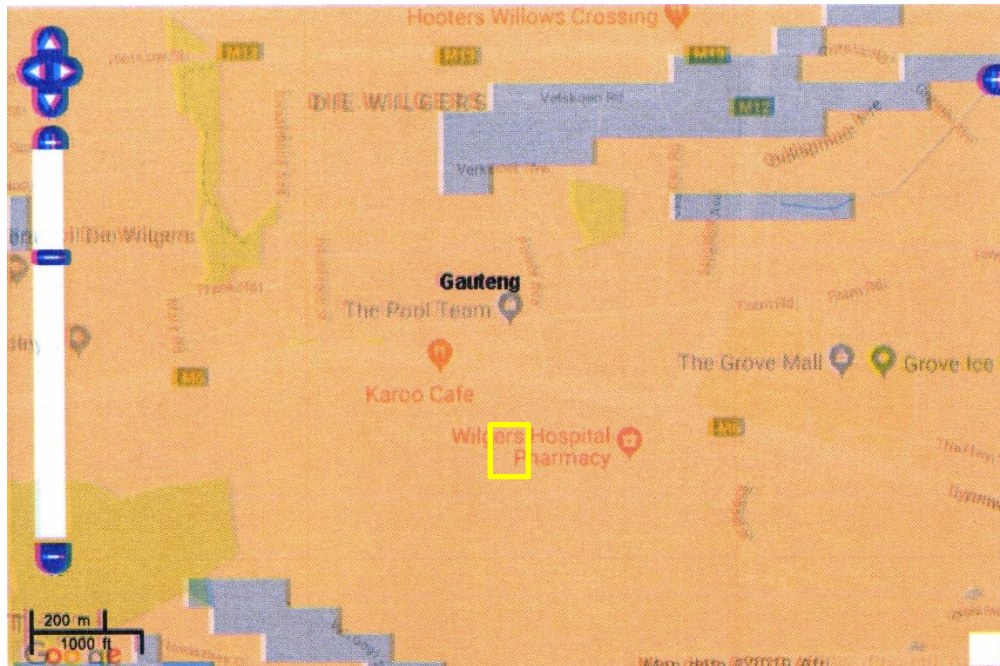


Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed development on Part of Portion 161 of the Farm The Willows 340 JR, Pretoria east. Project area is within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The project area is shown as highly sensitive based on the reports of Mat Related Structures described from a site in the Daspoort Formation about 50 km east of Pretoria central (Erikssen et al., 2012; their Fig 6) and reproduced here as Figure 5. These structures are rare and are trace fossils of microorganisms. The age of the rocks predates the origin of body fossils

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	Although trace fossils have been reported from the Daspoort Subgroup they are only trace fossils.
	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 trace fossils in dolomite and sandstones, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any trace fossils would be found in the surface soils; Microbially Related Structures might be visible and in the sandstones.

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 mostly much too old to contain fossils. Furthermore, no body fossils had evolved by this time. There is only an extremely small chance that trace fossils from the Silverton and Daspoort Formations, Pretoria Group, Transvaal Supergroup may occur on the site. In general microbial trace fossils are not given much significance. 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 might contain Microbially Induced Structures or stromatolites which are trace fossils. The overlying modern soils 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 soils. No fossils are preserved in the igneous rocks but there is a very small chance that trace fossils might be found in the hard sandstones as these have been reported from the Daspoort Formation Subgroup. If trace fossils are found by the developer once excavations have commenced, then a geologist should be called to assess the traces and if they are of scientific interest then a SAHRA permit must be obtained and a representative sample collected. As far as the palaeontology is concerned the project can proceed.

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.

Anhaeusser, C.R., 2006. Ultramafic and Mafic Intrusions and the Kaapvaal Craton. 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 95-134.

Cawthorn, R.G., Eales, H.V., Walraven, F., Uken, R., Watkeys, M.K., 2006. The Bushveld Complex. 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 261-281.

Eriksson, P.G., Altermann, W., Hartzler, F.J., 2006. The Transvaal Supergroup and its precursors. 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 237-260.

Eriksson, P.G., Bartman, R., Catuneanu, O., Mazumder, R., Lenhardt, N., 2012. A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterozoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa; the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. *Sedimentary Geology* 263, 67-75

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.

MacRae, C.S., 1999. Life Etched in Stone. Fossils of South Africa. Geological Society of South Africa, Johannesburg. 305pp.

McCarthy, T.S., 2006. The Witwatersrand 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 155-186.

Noffke, N., Erikssen, K.A., Hazen, R.M., Simpson, E.L. 2006. A new window into Early Archean life: Microbial mats in Earth's oldest siliciclastic tidal deposits (3.2 Ga Moodies Group, South Africa). *Geology* 34, 253–256.

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.

Robb, L.J., Brandl, G., Anhaeusser, C.R., Poujol, M., 2006. Archaean Granitoid Intrusions. 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 57-94.

8. Fossil Chance Find Protocol

Monitoring procedure to commence once excavations commence:

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (stromatolites, microbial structures) should put aside in a suitably protected place. This way the construction 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 5, 6). 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. As required and to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project, the palaeontologist should visit the site to inspect the selected material and check the samples where feasible. The frequency of inspections should be determined by the finding of interesting material. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
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 geologist/palaeontologist are not necessary.
8. If no fossils are found and the excavations have finished then no further monitoring is required.



Figure 5: examples of stromatolites a- in the field in side view; b – surface view in the field; c – side view in section. (Photographs from MacRae, 1999).

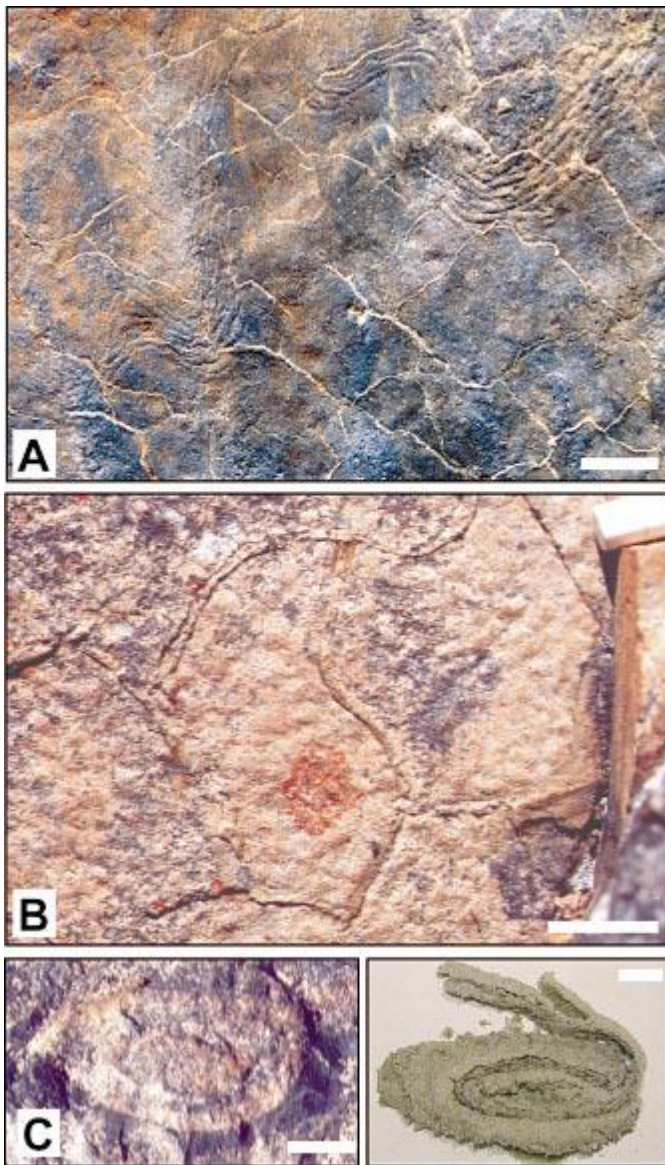


Figure 6: Microbially Induced Structures, from Nofke et al., (2006). A- wrinkle structure; b – desiccation cracks; c - rollup structures.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 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 ; 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 – 1984 to present

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 onwards – 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
- Amandelbult 2018 for SRK
- 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
- SARA0 2018 for Digby Wells
- Ventersburg B 2018 for NGT
- Hanglip Service Station 2018 for HCAC
-

xi) Research Output

Publications by M K Bamford up to January 2019 peer-reviewed journals or scholarly books: over 125 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 27; Google scholar h index = 29;

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)