Palaeontological Impact Assessment for the proposed development on Clayville Ext 59, between Pretoria and Johannesburg, Gauteng Province

Desktop Study

For

Texture Environmental Consultants

24 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 Texture Environmental Consultants, 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 CaseID: 13386) for the proposed construction of a warehouse on the Adcock Ingram Site at Clayville X59 for industrial purposes. The HIA report shows that the site is highly disturbed. 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 cherts, dolomites and limestones of the Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup, and stromatolites may be present. Stromatolites are trace fossils of ancient algal colonies and only extremely rarely are the algae preserved. Since they are common trace fossils there will be no significant impact on the palaeontological heritage of South Africa. Nonetheless a Fossil Chance Find Protocol has been added in the case that well-preserved stromatolites are discovered they should be reported. As far as the palaeontology is concerned no site visit is required and the project may proceed.

Table of Contents

1. Background

A Palaeontological Impact Assessment was requested by SAHRA Interim Report (SAHRA CaseID: 13386) for the proposed construction of a warehouse on the Adcock Ingram property at Clayville Extension 59, in Clayville between Pretoria and Johannesburg, Gauteng Province. The proposed development entails the building of a warehouse on the study area, after which the site will be used for industrial purposes. According the Heritage Impact Assessment (Van Vollenhoven, A. May 2018. Letter For HIA Exemption Request: Adcock Ingram Site At Clayville X 59) the entire site is disturbed and consists of grassland and pioneer plants such as weeds, wattle remnants and evidence of previous storm water management constructions.

The area is indicated as very highly sensitive on the SAHRIS palaeosensitivity map. 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 and is presented here.

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 B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
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 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

Figure 1: Google Earth map of the Adcock Ingram property on Clayville Ext 59. Map supplied by Texture Environmental Consultants.

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

To the north and east of the ancient Johannesburg dome, an Archean granitoid intrusion, are outcrops of the Transvaal Supergroup, and Clayville lies in the dolomites and limestones of the Transvaal Supergroup that are more than 2700 million years old. 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). In the lower part of the Chuniespoort is the Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. Clayville Ext 59 lies in the cherts of the Malmani Subgroup.

To the west of Clayville is a long almost north-south trending exposure of the Black Reef Formation that is slightly older than the Malmani Subgroup. To the east, also almost in a north-south orientation, are two of the Pretoria Group Formations, namely the Timeball Hill Formation (shales and siltstones) and the Hekpoort Formation (volcanic: andesite and some agglomerate). Interspersed in the region are small outcrops of the considerably younger Karoo Supergroup that represent remnants of the inland Karoo "sea" from 300 to 290 million years ago. The oldest of these are the Dwyka Group tillites and shales, and the overlying Ecca Group sandstones, siltstones ad shales.

Although the Dwyka and Ecca Group sediments are potentially fossiliferous the project will not impact on these rocks, so they will not be considered any further.

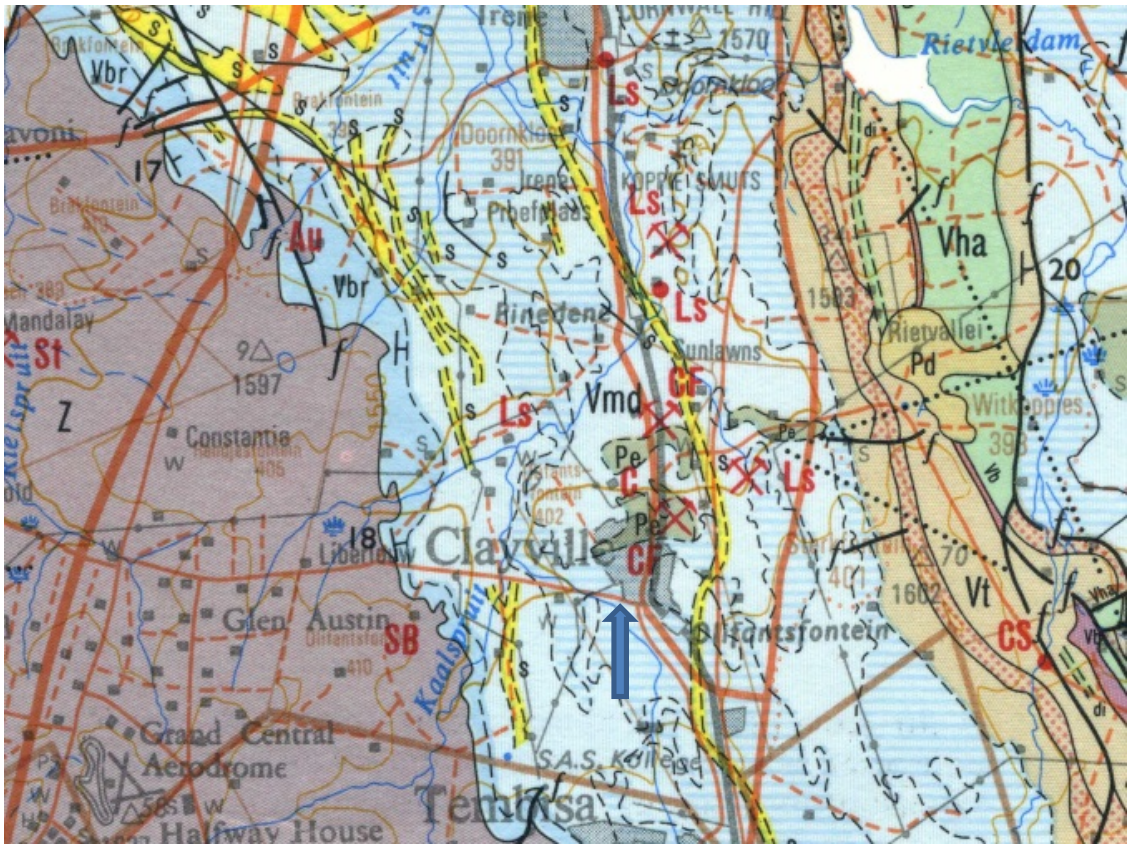

Figure 2: Geological map of the area around Clayville Ext 59. The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 geological map 2528 Pretoria, 1978.

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

Symbol	Group/Formation	Lithology	Approximate Age
Pe	Ecca Group, Karoo SG		Early Permian
Pd	Dwyka Group, Karoo SG		Late Carboniferous to early Permian
Vha	Helpoort Fm, Pretoria Group, Transvaal SG		2222 Ma
Vt	Timeball Hill Fm, Pretoria Group, Transvaal SG		>2222 Ma
Vm	Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dolomite, chert, limestone	2642 – 2500Ma
Vbr	Black Reef Formation	Quartzite, conglomerate, shale	>2642 Ma
Zhh	Halfway House Granite, Johannesburg Dome	Granite, gneiss, migmatite, granodiorite	Archaean, 3340 – 3113 Ma

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is in the Malmani Subgroup that is composed of dolomite, chert, limestone and stromatolites. Stromatolites are the trace fossils of unicellular and filamentous algal or cyanobacterial colonies that grew in the warm shallow seas of the continent more than 2500 million years ago. As the algae photosynthesised in the low oxygen atmosphere they deposited layer upon layer of calcium carbonate, calcium sulphate, magnesium sulphate and other compounds, forming domes or sheets of dolomite. 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.

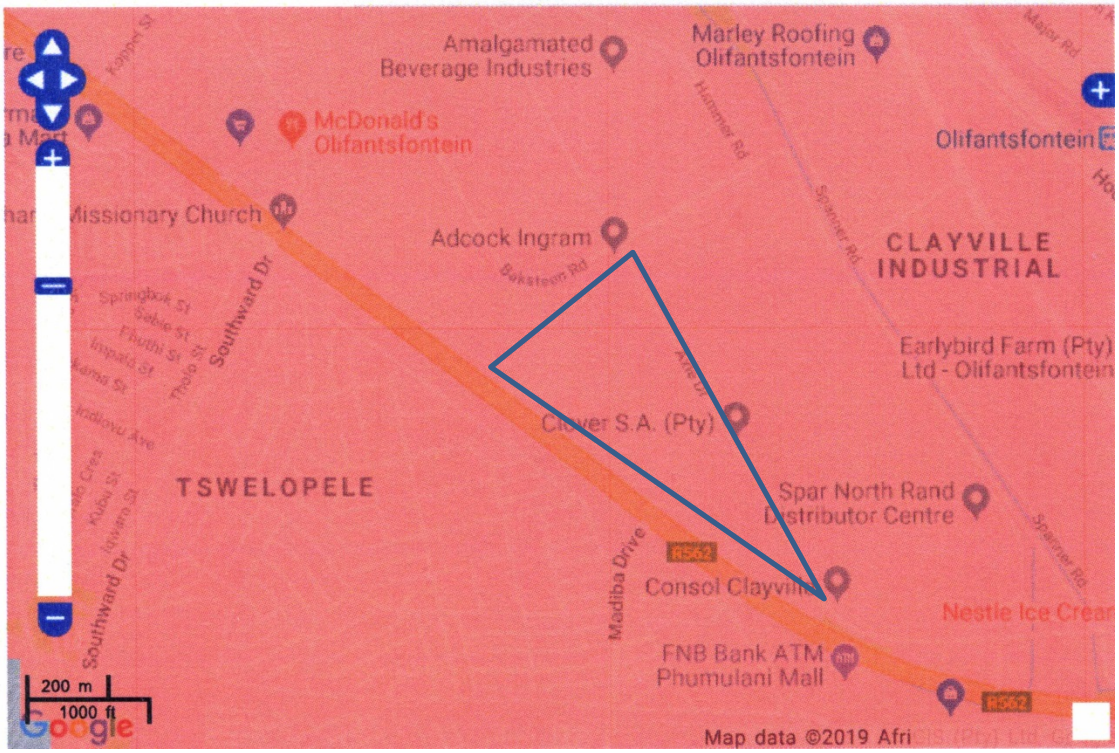

Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed development on Remainder of Portion 107 (a Portion of Portion 73) of the Farm Olifantsfontein 410-JR, City of Ekurhuleni. Project area is within the blue rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

According to the geological map (Fig 2) the site lies on the cherts (blue horizontal lines) of the Malmani Group, rather than on the dolomites. Chert is very fine-grained silica or cryptocrystalline quartz and is formed by the precipitation of silica in the deep sea (Marshak, 2005). While it is generally accepted that microbes are sometimes preserved in stromatolites, although the biogenicity of stromatolites has been questioned (Fedochuk et al., 2016), the reports of microbes in cherts has been disputed (Marshak, 2005, p 412).

From the SAHRIS map above (Figure 3) the area is indicated as very high sensitivity (red) and so at least requires a desktop study. The suspected fossils, however, are the trace fossils stromatolites. Palaeontologists show very little interest in stromatolites but some geologists are interested in them because they indicate the transition from a reducing environment (oxygen-poor) to an oxidizing environment (oxygen-rich), the so called Great Oxygen Event (Eroglu et al., 2017). No fossils have been reported in the project area.

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 stromatolites have been reported from the Malmani Subgroup they are only trace fossils. Their palaeontological importance/interest is questionable.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-

PART B: ASSESSMENT		
	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 limestone, 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; if dolomites are present stromatolites might be visible. The site is on cherts and these do not contain stromatolites.

Based on the nature of the project, surface activities are most unlikely to impact upon the fossil heritage because the area has already been disturbed by urban activities. 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 such as stromatolites from the Malmani Subgroup, Chuniespoort 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. If however stromatolites are found they should be reported.

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 stromatolites which are trace fossils. The overlying modern soils would not preserve fossils. The excavations for the warehouse foundations and utilities such as water, sewage and power, might reveal stromatolites below the land surface.

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 such as stromatolites might be found in the dolomites rather than the cherts as these have been reported from the Malmani Subgroup in other localities. Although the palaeontological significance of stromatolites is low their occurrence should be reported if found in the foundation excavations and photographs sent to a palaeontologist to assess their importance and collect a sample if deemed necessary. As far as the palaeontology is

concerned the project can proceed and no site visit is required unless fossils are found during excavations.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus 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.

Beukes, N.J., Lowe, D.R., 1989. Environmental control on diverse stromatolite morphologies in the 3000 Myr Pongola Supergroup, South Africa Sedimentology 36, 383-397.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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.

Eroglu, S., van Zuilen, M.A., Taubald, H., Drost, K., Will, M., Swanner, E.D., Beukes, N.J., Schoenberg, R., 2017. Depth-dependent δ13C trends in platform and slope settings of the Campbell Rand-Malmani carbonate platform and possible implications for Early Earth oxygenation. Precambrian Research 302, 122-139.

Fedorchuk, N.D., Dornbos, S.Q., Corsetti, F.A., Isbell, J.L., Petryshyn, V.A., Bowles, J.A., Wilmeth, D.T., 2016. Early non-marine life: Evaluating the biogenicity of Meso-proterozoic fluvial-lacustrine stromatolites. Precambrian Research 275, 105-118.

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.

Marshak, S., 2005. Earth. Portrait of a Plant. 2nd Edition. W.W. Norton & C0., New York. 748 pp.

8. Monitoring Programme for Palaeontology

To commence once the excavations for foundations have commenced: (Fossil chance Find Protocol)

1. The following procedure is only required if and when excavations begin. The surface activities would not impact on the fossil heritage as the dolomite and stromatolites could be below ground.
2. When excavations commence the dolomites, limestones and cherts must be given a cursory inspection by the engineer, geologist or designated person before being added to the waste rock dump. Any fossiliferous material should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossils in the dolomites (for example see Figure 4). This information should be built into the EMPr.
4. Digital photographs of the suspected fossils can be sent to a qualified palaeontologist or geologist sub-contracted for this project to get an opinion on their scientific value.
5. Stromatolites that are considered to be of good quality or scientific interest by the professional 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 property a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
6. If no good fossil material is recovered then no site inspections by the palaeontologist would be required.

Appendix A – Examples of stromatolites

Figure 4: view of stromatolites from the surface, from the Malani Group, Lichtenburg area.

Appendix B - 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
- SARAO 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)