

**Palaeontological Impact Assessment for the proposed
construction of the Black Mambaza Music Academy,
west of Ladysmith, KwaZulu Natal Province**

Desktop Study

For

Fuze Environmental Services

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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 Fuze Environmental Services, Durban, 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 construction of the Black Mambaza Academy of Music on Erf 17840 Ladysmith, just west of the town of Ladysmith and adjacent to the Ladysmith aerodrome. 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 Early Permian Ecca Group Vryheid Formation, sandstones, shales and mudstones. Although fossils have not been reported from this site there is a small chance that typical (but very infrequent) early *Glossopteris* flora plants could occur in the sediments just below the surface. Surface exposures are likely to be very weathered. Therefore a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required unless fossils are revealed once excavations and drilling has commenced. As far as the palaeontology is concerned a prospecting right should be granted.

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.....	6
ii. Palaeontological context	8
4. Impact assessment.....	9
5. Assumptions and uncertainties.....	10
6. Recommendation.....	10
7. References.....	11
8. Chance Find Protocol	11
Appendix A (examples of fossils)	13
Appendix B (short CV of specialist)	15

1. Background

The male choral group, Ladysmith Black Mambazo, has proposed to have a music academy constructed on the outskirts of the town of Ladysmith in KwaZulu-Natal. The site of the proposed development is 3 Ha (30000 m²) in size, hence it triggers section 38 (1) (c)(i) of the National Heritage Resources Act (NHRA), 1999 (Act No 25 of 1999), which refers to (c) any development or other activity which will change the character of a site— (i) exceeding 5 000 m² in extent.

The proposed music academy is to be situated on Erf 17840, Ladysmith, which falls within the Alfred Duma Local Municipality. The site is situated on the south-western edge of Ladysmith and borders onto the R103 road / N11 highway and is situated adjacent to the Ladysmith aerodrome.

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 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

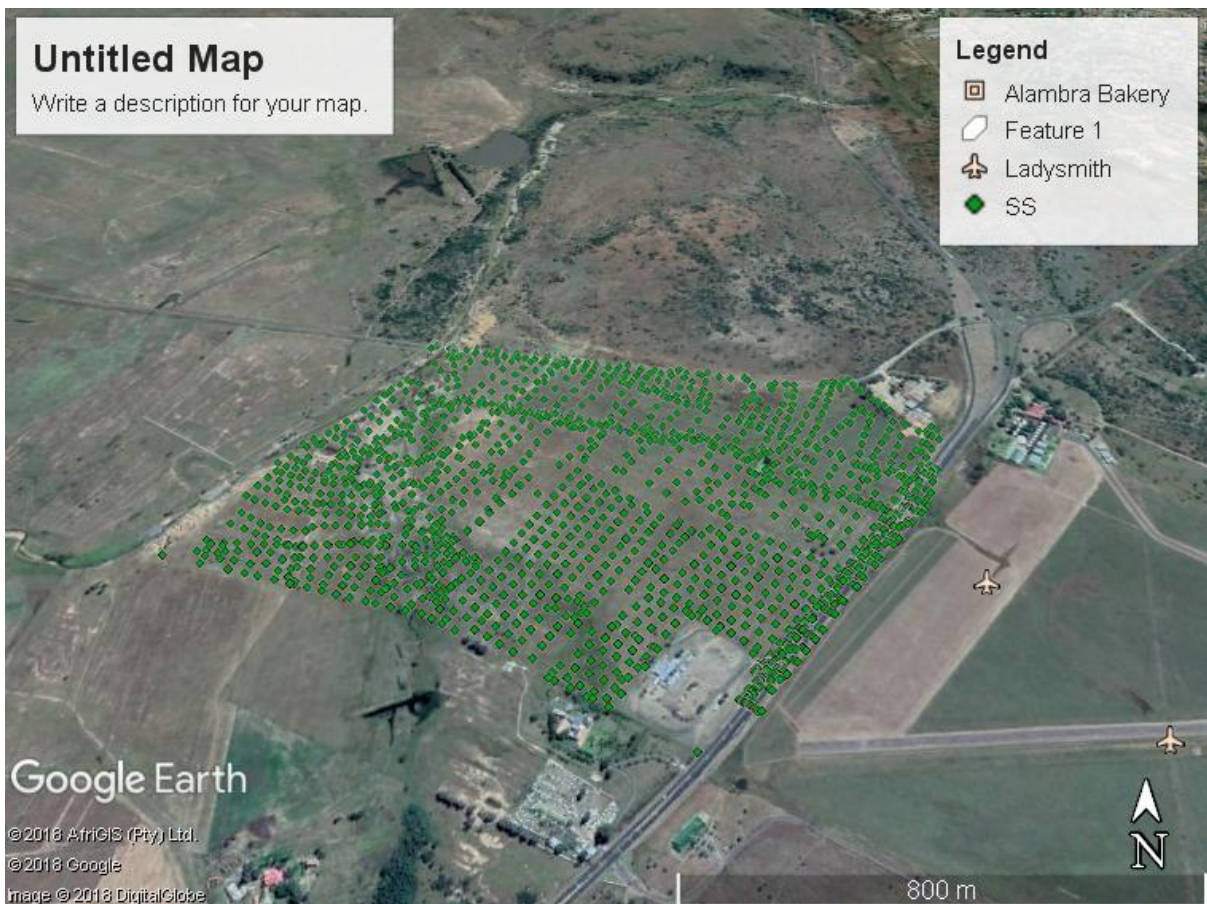


Figure 1: Google Earth map of the proposed area for the Black Mambaza Music Academy southwest of Ladysmith. Map supplied by Fuze Environmental Services.

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

The site lies in the eastern sector of the Karoo Basin and there is a complex pattern of Ecca Group deposits outcropping in the area, more to the east, overlying younger Beaufort Group layers to the west and with younger intrusive Jurassic-aged dolerite dykes commonly occurring.

The basalmost Ecca layer is the Pietermaritzburg Formation comprising shales that were deposited in a moderate to deep water environment. Above this Formation is the Vryheid Formation that is composed of interbedded sandstones, shales and underlying coal beds that were deposited in a fluvio-deltaic environment. Next are the Volksrust Formation (and Estcourt Formation in older literature) comprising dark shales with intercalated fine-grained sandstones that were deposited in deep to shallow marine environments. The basal Beaufort Group is represented in KwaZulu Natal by the Normandien Formation that was deposited by meandering streams and channels in a wide semi-arid floodplain. It is composed of interbedded sandstones and mudstones. This formation can be correlated with the Adelaide subgroup.

Intruding through all these sediments are dolerite dykes that formed during the Jurassic Drakensberg basaltic eruptions.

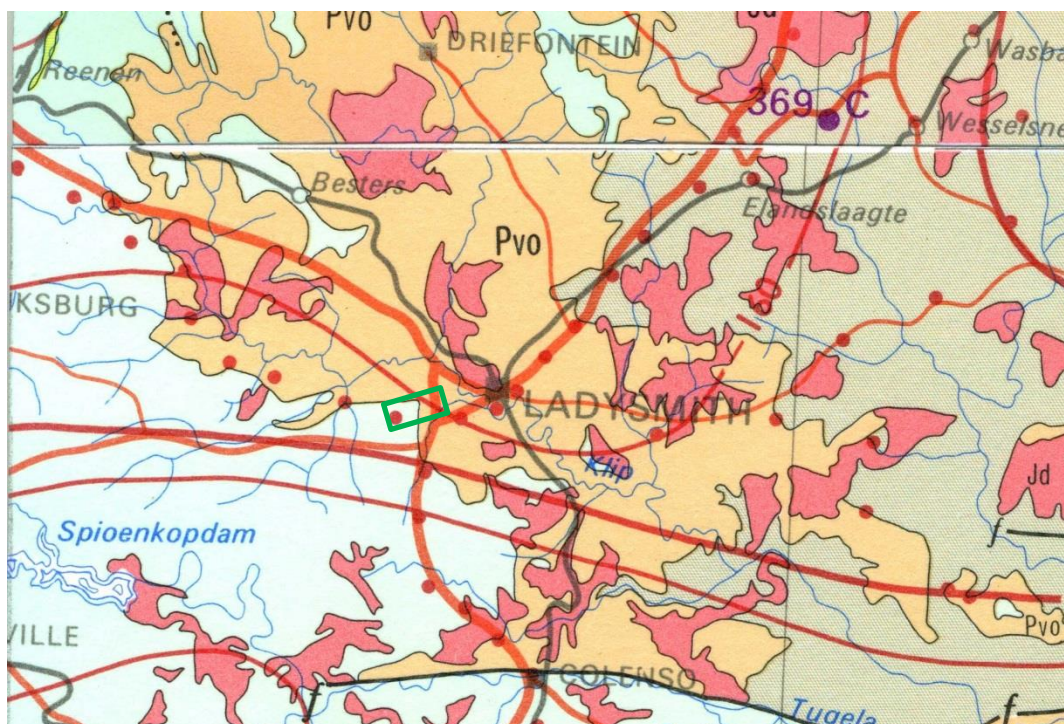


Figure 2: Geological map of the area around Ladysmith with the proposed site for the Black Mambaza Music Academy shown within the green rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984. Note – more recent maps show a more complex pattern of strata.

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Johnson et al., 2006; Rubidge, 2005). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pa	Adelaide subgroup Normandien Fm	Mudstones, shales	Upper Permian, Lower Beaufort
Pvo	Volksrust Fm	Deep water siltstone	Middle Permian, Upper Ecca 266 – 255 Ma
Pv	Vryheid Fm	Shales, sandstone, coal	Lower Permian, Middle Ecca <269 - 266 Ma 268 Ma
Pp	Pietermaritzburg Fm	Deep water shale	Lower Permian, Lower Ecca 287 - 269 Ma
C-Pd	Dwyka Group	Tillites	Carboniferous – Permian >290 Ma

ii. Palaeontological context

Shales, and shale lenses between coal seams, of the Vryheid Formation are likely to preserve leaf impressions of the *Glossopteris* flora (lycopods, sphenophytes, ferns, cordaitaleans, ginkgophytes and early conifers), but none has yet been reported from this area.

The Pietermaritzburg and Volksrust Formations were deposited under deep water so are unlikely to contain any fossils, except rarely trace fossils. Jurassic dolerite dykes do not preserve fossils as the heat and intrusive action tends to destroy any fossils in the host rock.

The *Glossopteris* flora fossils are of interest to palaeobotanists but in general they are widely scattered and difficult to locate. This flora is well known but there is always a very small chance that some new taxa may be discovered. To date no fossils have been reported from the Ladysmith area although there are numerous sites farther to the west, such as Harrismith, and to the south such as Estcourt, Colenso, and Loskop (Anderson and Anderson, 1985; Plumstead, 1969; Prevec et al., 2009). Fossil vertebrates of this age are extremely rare and there are no known occurrences of vertebrate fossils associated with coals in southern Africa (Rubidge, 2005). Insect wings can occur with the leaves but they are extremely rare and difficult to find.

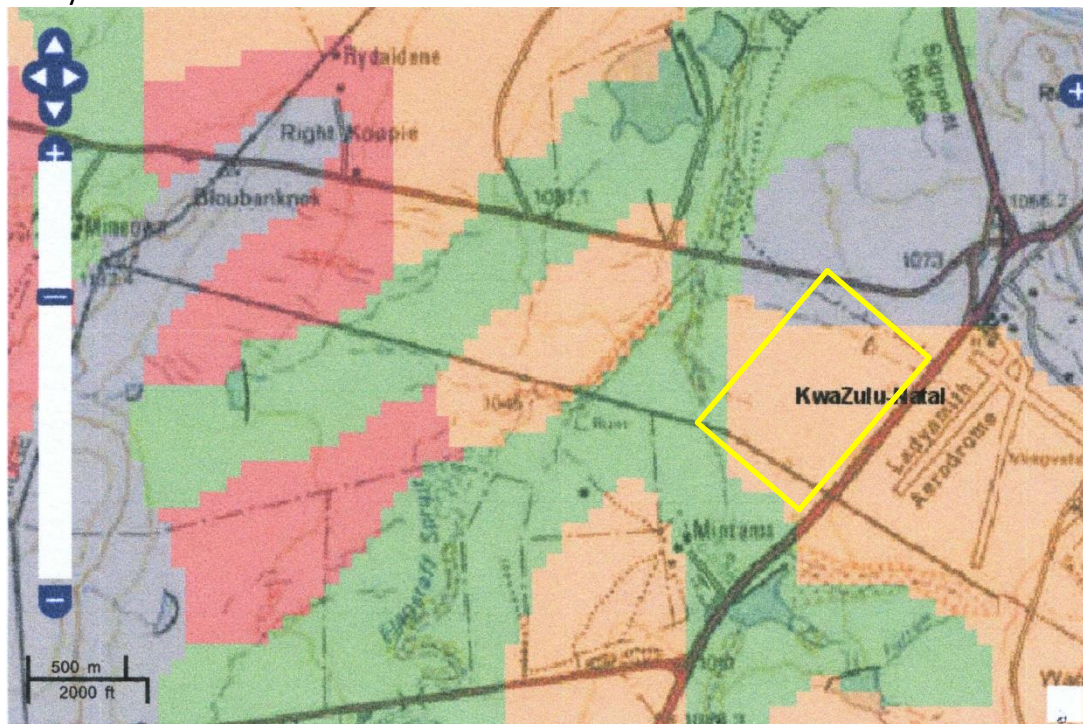


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed Black Mamabaza Music Academy on Erf 17840 Ladysmith shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The area has been disturbed from previous urban and agricultural activities so any surface fossils are likely to be very weathered (naturally) or destroyed by previous activities. Along the ephemeral streams there could be downcutting into underlying sediments that contain fossil plants. There is, however, a very small chance that fossil plants could be found where new excavations are made for the building foundations, clean water and sewage pipes, electricity supply lines and access roads.

From the SAHRIS map above the area is indicated as highly sensitive (orange; Figure 3) so a desktop assessment is being reported upon here. No fossils have been reported from the

Ladysmith area but there is a small chance that fossil plant fragments could occur in the building area. Fossils are not likely to be seen on the land surface because of extensive weathering and previous agricultural or urban activities.

4. Impact assessment

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

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 a small chance that fossil plants occur in the Vryheid Fm sandstones and shales but any surface occurrences would have been disturbed by previous agricultural and urban activities. The impact would be very unlikely.
	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 sandstones and shales, the spatial scale will be localised within the site boundary.

PART B: ASSESSMENT		
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is unlikely that any fossils would be found in the surface sediments but there may be plant fragments in the underlying shales or mudstones. No surface fossils are likely to be found. Therefore a fossil 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. Underlying rocks of the Vryheid Group, namely the mudstones or shales, might preserve fossil plants but this will be evident once excavations commence. Although no fossils have been recorded from near Ladysmith there is a small chance that fossils from the Permian Vryheid Formation may be disturbed so 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 very 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 do contain fossil plant, insect, invertebrate and vertebrate material. The deep water shales of the Pietermaritzburg and Volksrust Formations (Permian) would not preserve fossils, nor would the dolerite dykes.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is unlikely that any fossils would be preserved on the surface. There is a very small chance that fossil plant fragments may occur in the Vryheid Formation shales and sandstones so a Chance Find Protocol should be added to the EMPr: if fossils are found once excavations for foundations, pipes and services 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 megaflores, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Barbolini, N., Bamford, M.K., Rubidge, B., 2016. Radiometric dating demonstrates that Permian spore-pollen zones of Australia and South Africa are diachronous. *Gondwana Research* 37, 241-251.

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.

Prevec, R, Labandeira, C.C., Neveling, J., Gastaldo, R.A., Looy, C., Bamford, M., 2009. Portrait of a Gondwanan ecosystem: A new Late Permian locality from KwaZulu-Natal, South Africa. *Review of Palaeobotany and Palynology* 156, 454-493.

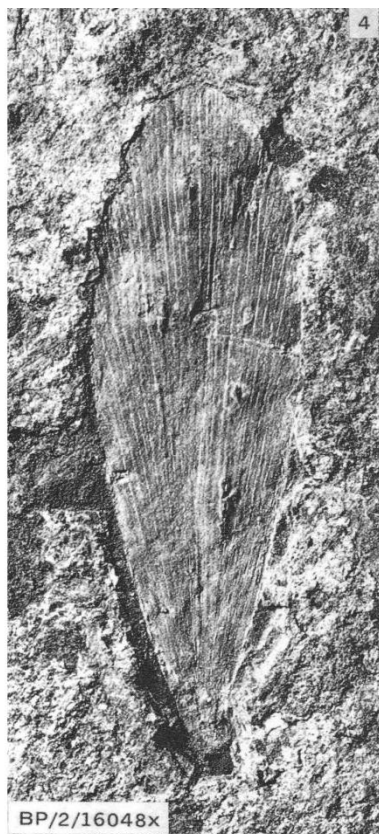
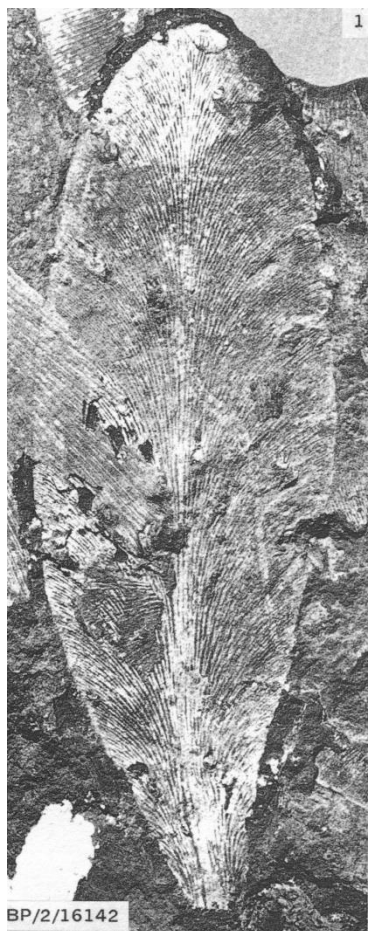
Rubidge, B.S., 2005. 27th Du Toit Memorial Lecture: re-uniting lost continents — fossil reptiles from the ancient Karoo and their wanderlust. *South African Journal of Geology* 108: 135-172.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations for foundations, water and sewage pipes, electricity supply poles or roads begin.

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 (plants, insects, wood, bone, coal) should be put aside in a suitably protected place. This way the building 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/engineers 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. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of Vryheid Formation (Ecca) fossils



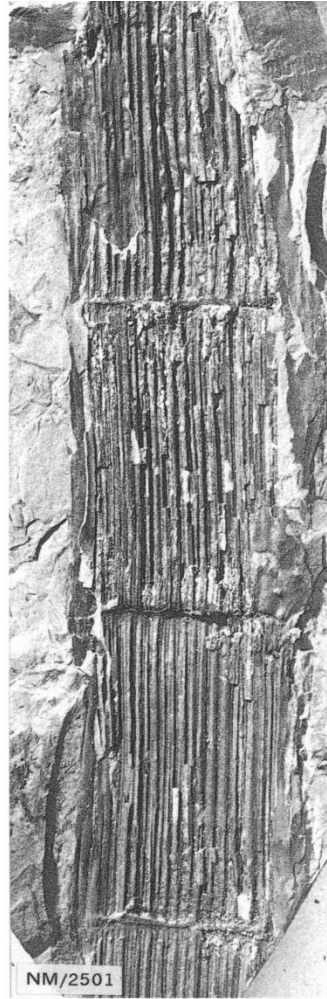
Noeggerathiopsis and
Glossopteris leaves



Figure 4: Fossil plants from the Ecca Group.



Fern: *Asterotheca* sp.



Sphenophytes: whorls of leaves on a striated stem



Figure 5: More examples of fossil plants from the Ecca Group.

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-
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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 – 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
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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)