# Palaeontological Impact Assessment for the proposed Rugron Prospecting Permit Application, NNE of Hotazel, Northern Cape Province

**Desktop Study**

**For**

**Heritage Contracts and Archaeological Consulting**

**01 December 2018**

**Prof Marion Bamford**
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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 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 for the Prospecting Rights Application by Rugron Exploration Co (Pty) Ltd in the Magisterial District of Kuruman on seven farms: Rugby No 43-IM, Olney No 44-IM, Rhokana No 61-IM, Nevin No 45-IM, Pastow No 50-IM, Magonat No 507-AM and Holmby No 49-IM.

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 development of a sand mining area.

The proposed site lies on the Kalahari Sands that do not preserve fossils except around pans. Below the sands are the non-fossiliferous Asbestos Hills Subgroup iron formation (the target of the operation) and potentially fossiliferous stromatolites of the Campbell Rand Subgroup. Although there is only an extremely small chance that microscopic green and blue-green algae could be preserved in the stromatolites 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 and a prospecting right can be granted.

# Table of Contents

# 1. Background

Rugron Exploration Co (Pty) Ltd intends to apply for a prospecting right and related infrastructural activities on the farms Rugby No. 43, Padstock No. 50, Rhokana No. 61, Magonat No. 507, Olney No. 44, Neven No. 45 and Holmby No. 49, which falls in the Motshaweng Local Municipality, Kgalagadi District Municipality, Kuruman Magisterial District, Northern Cape Province.

The farms Rugby No. 43, Padstock No. 50, Rhokana No. 61, Magonat No. 507, Olney No. 44, Neven No. 45 and Holmby No. 49 are situated approximately 53 km North-North- East of Hotazel, Northern Cape Province. The towns of Padstow, Goedbegin and Rugby, Moed and Magonata fall within the proposed prospecting area. The commodity of interest is Iron Ore. The primary activity will be sampling and borehole cores.

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 prospecting rights application.

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<br>**Error! Reference source not found.** 6 |
| 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 | Section 8 |
| 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 prospecting rights area for Rugron Exploration Co (Pty) Ltd, in the Kuruman Magisterial District with the sections shown by the red outline. Map supplied by HCAC.

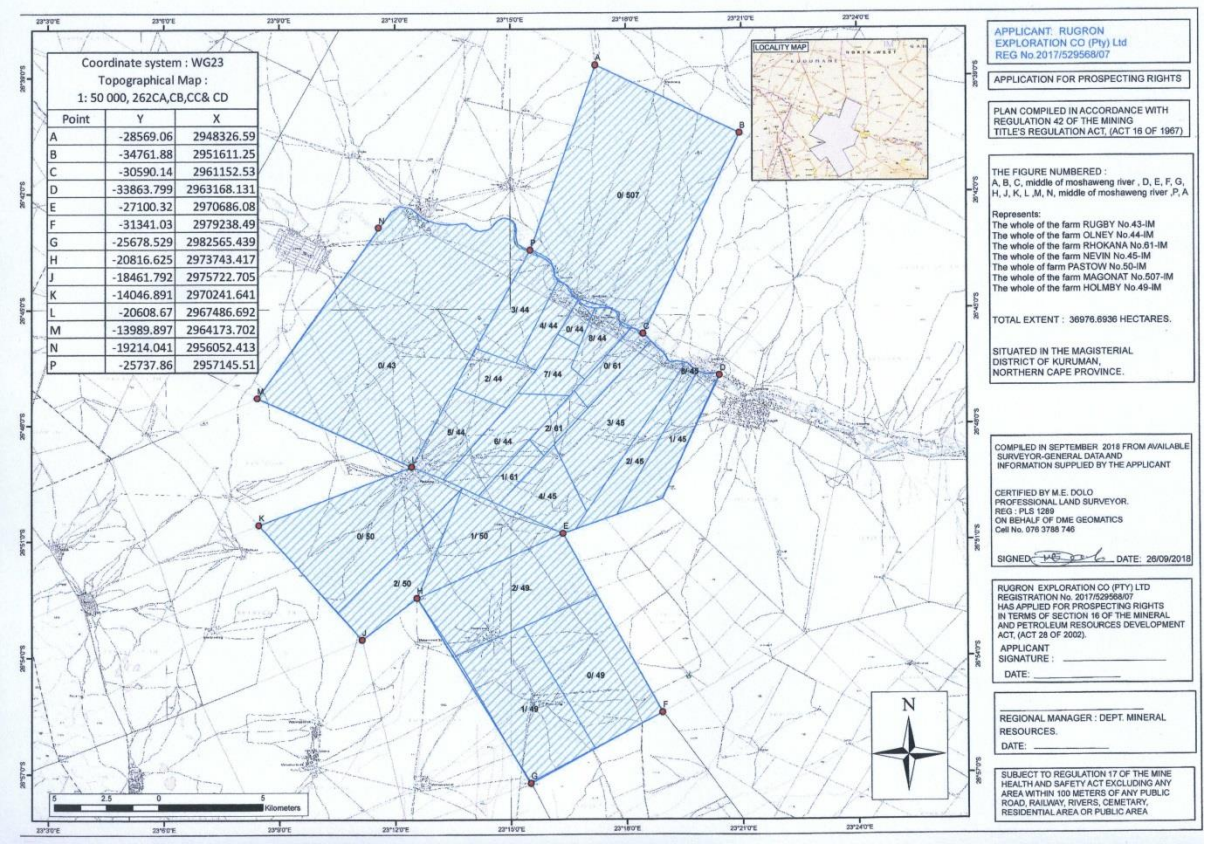


Figure 2: detailed site map for the Rugron Exploration Co (Pty) Ltd prospecting right application.

# 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

Most of the area is covered by relatively young alluvial sands and calcrete of the Kalahari Group. Underlying the sands are the rocks of the Transvaal Supergroup that is subdivided into two groups, the basal Ghaap Group and upper Postmasburg Group. At the base is the Vryburg Formation which is made up of quartzite and dolomite. Next is the Ghaap Group and it is subdivided into three subgroups: the basal Schmidtsdrift Subgroup has two formations: the Boomplaas and Clearwater Formations. The Campbell Rand Subgroup has eight formations: the Monteville, Reivilo, Fairfield, Klipfonteinheuwel, Papkuil, Kogelbeen, Gamohaan and Tsineng Formations. There are three formations in the Asbestos Hills Subgroup, the Kliphuis, Kuruman and Danielskuil Formations, and all three are iron formations. The uppermost group, the Postmasburg Group, is not represented in this area. Dolomites and limestones are the dominant rocks in the Campbell Rand Subgroup.

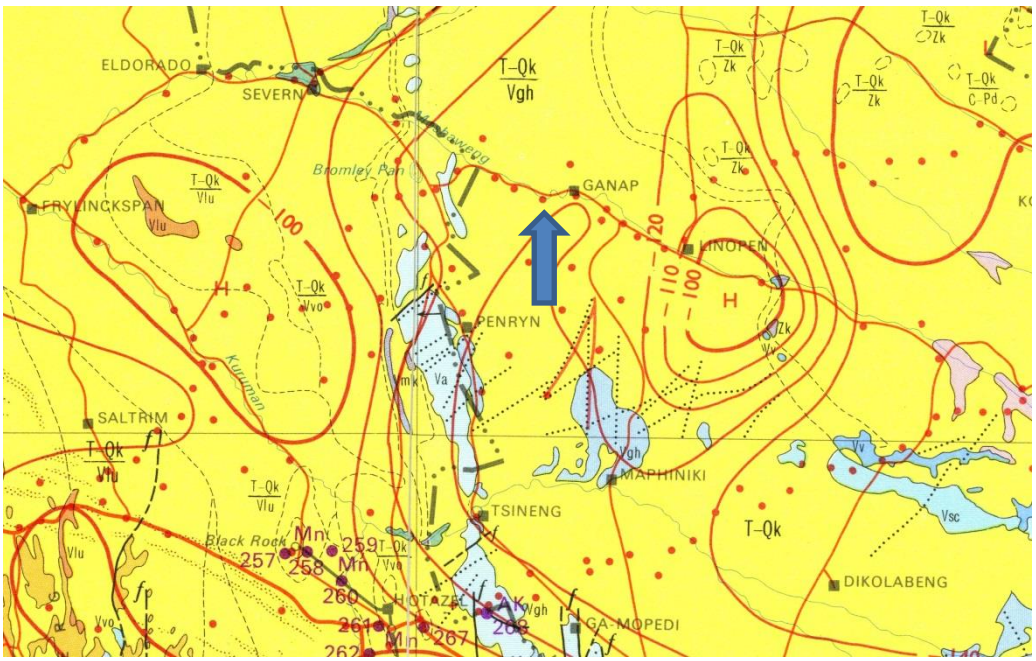


Figure 3: Geological map of the area around the Rugron prospecting right area application. The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

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

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| Q | Quaternary | Alluvium, sand, calcrete, sands | Neogene, ca 25 Ma to present |
| T-Qk/ C-Pd | Kalahari sands overlying Dwyka Group | Alluivium, sands, calcrete overlying tillites, | Neogene over Upper Carboniferous |

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| | | diamictites, sandstone, mudstone, shale | |
| Vgh | Ghaap Group (includes 3 subgroups: Asbestos Hills, Campbell Rand and Schmidtsdrif) | Dolomite, limestone, chert | 2642 – ca 2425 Ma |
| Va | Asbestos Hills Subgroup, Ghaap Group, Transvaal SG | Iron formation, jaspilite | 2500 – ca 2425 Ma |
| Vsc | Schmidtsdrif Subgroup, Ghaap Group, Transvaal SG | Dolomite, shale | 2642 – 2620 Ma |
| Vv | Vryburg Fm, Transvaal SG | Quartzite, dolomite and shale | >2642 Ma |

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for prospecting is overlain by Kalahari sands. These are Aeolian or alluvial in origin and do not preserve fossils except where there are pans that might have stabilised sediments, for example calcrete formed by the frequent wetting and drying around an ephemeral pan, or evaporation around a permanent pan.

The target rocks for the prospecting project are the iron formations of the Asbestos Hills Subgroup, the exact lateral and vertical extent is unknown, hence the need for drilling of cores. Likewise the full extent of the Cambell Rand Subgroup dolomites and limestones is unknown and these may be impacted upon by the drilling. Dwyka Group tillites are known to occur below the sands nearer the Orange River, to the northwest of the site.

Banded iron was formed by the activity of microscopic photosynthetic algae that released oxygen into the atmosphere. The oxygen was rapidly absorbed by the iron in the earth and oxidised, so banded iron is evidence of life on the earth but is not a fossil per se. Similarly the dolomites are evidence of early life where microscopic algae, also photosynthesising, laid down layer upon layer of inorganic material such as calcium carbonate, calcium sulphate, magnesium carbonate and magnesium sulphate. Occasionally the algal domes, the stromatolites, are evident in the rocks and these are of limited interest to palaeontologists as they very rarely preserve the algal cells. The sedimentation of the Campbell Rand Subgroup has been attributed to extensional tectonics in three successive rift phases (Clendenin et al, 1988; Erikssen et al., 2006).

The site is indicated as moderately sensitive (green) on the palaeosensitivity map (Figure 4) because there is a chance that stromatolites might occur below the Kalahari sands. Stromatolites, however, are trace fossils and only very rarely preserve the colonies of microscopic green and blue-green algae that formed them.

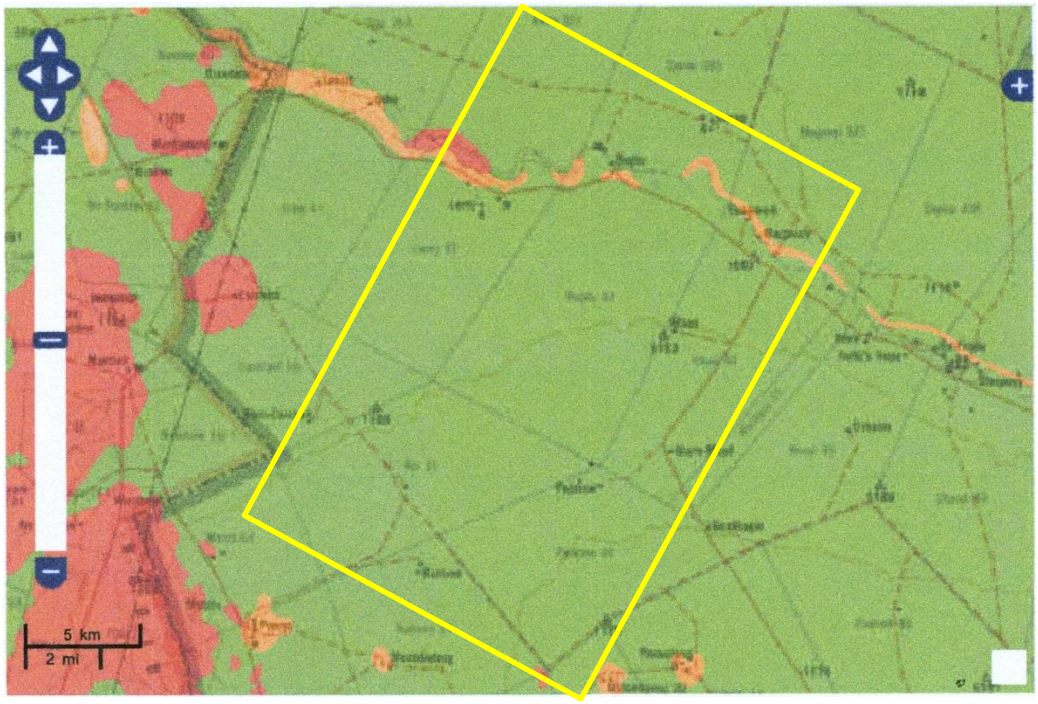


Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed prospecting rights application by Rugron Exploration, shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

# 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** | Loose sands do not preserve fossils; iron formation does not preserve fossils; dolomites of the Cambell Rand Subgroup might have stromatolites.. 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 microscopic algae in some stromatolites, the spatial scale will be localised within the site boundary. |
| | **M** | - |
| | **H** | - |
| **PROBABILITY** | **H** | **-** |
| | **M** | **-** |
| | **L** | It is extremely unlikely that any fossils would be found in the loose sand that will be cored through or in the stromatolites. Nonetheless a fossil chance find protocol should be added to the eventual EMPr. |

Based on the nature of the project, surface activities would not impact upon the fossil heritage in the prospecting footprint. The geological structures suggest that the rocks are either much too old to contain body fossils or are trace fossils (stromatolites) that only very rarely contain microscopic algae. Since there is an extremely small chance that microscopic fossils from the Campbell Rand Subgroup may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

# 5. Assumptions and uncertainties

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

trace fossils and only very rarely preserve the microscopic green and blue-green algae that formed them. It would require numerous thin sections of the cores and the relevant expertise to recognise them.

# 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the loose sands of the Quaternary. There is an extremely small chance that fossil algae may occur in the stromatolites of the Campbell Rand dolomites. Nonetheless a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once drilling 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: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Clendenin, C.W., Charlesworth, C.G., Maske, S., 1988. An Early Proterozoic three-stage rift system, Kaapvaal Craton, South Africa. Tectonophysics 145, 73-78.

Erikssen, 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.

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.

Van der Westhuizen, W.A., de Bruiyn, H., Meintjes, P.G., 2006. The Ventersdorp 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 187-208.

# 8. Chance Find Protocol

**Monitoring Programme for Palaeontology – to commence once the drilling and sampling begin.**

1. The following procedure is only required if fossils are seen on the surface and when excavations/drilling/mining commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (stromatolites, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the drilling 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. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary. 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 stromatolites from South Africa.

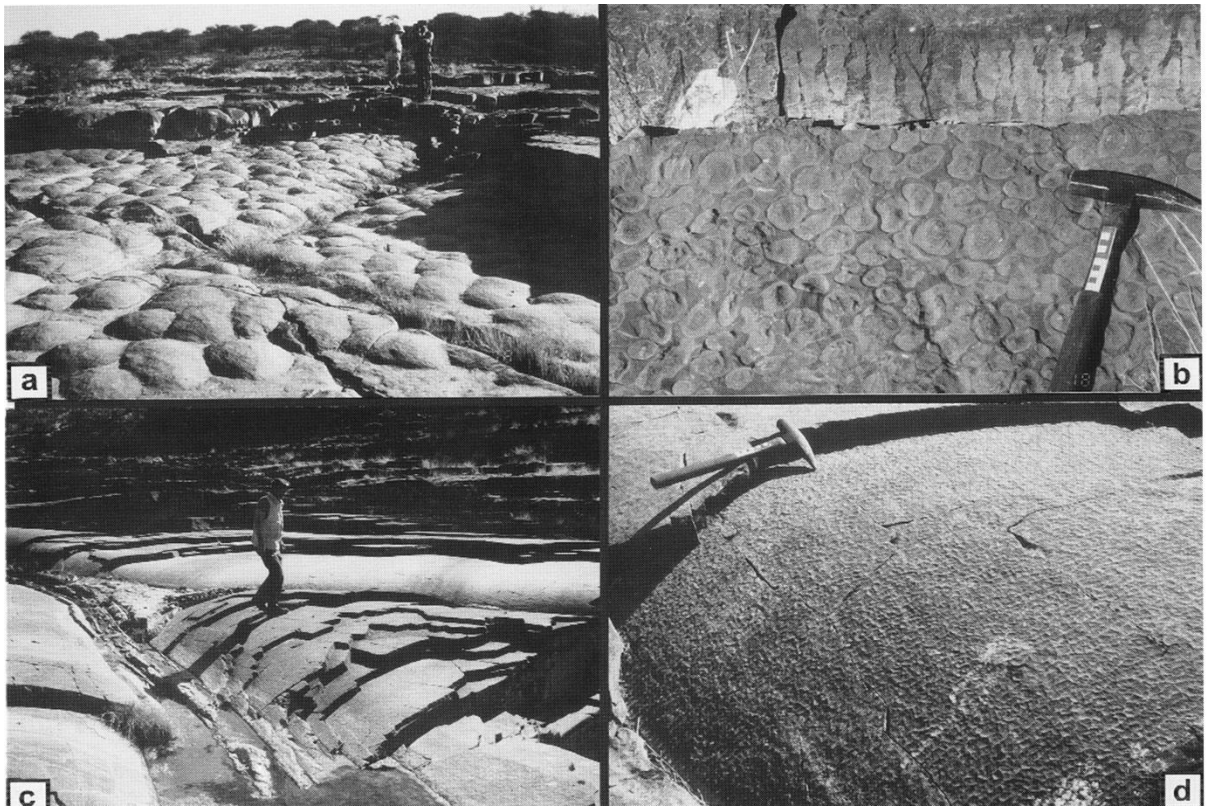


Figure 5: large scale stromatolites (from Erikssen et al., 2006)

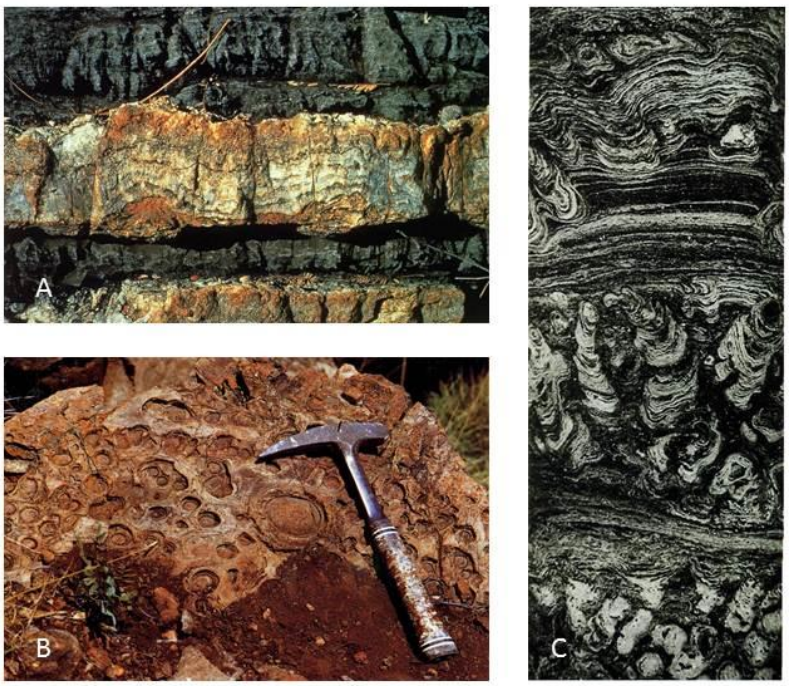


Figure 6: A = cross section of a stromatolites, note the layering. B = surface of a stromatolite bed. C = magnified view of stromatolite layers.

Appendix B – Details of specialist

# Curriculum vitae (short) - Marion Bamford PhD
# October 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 |
| 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
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

**vii) Supervision of Higher Degrees**

All at Wits University

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

**viii) Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 2-8 students per year.

**ix) Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Cretaceous Research: 2014 -

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

# x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources

- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
-

## xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 28;
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)