# Palaeontological Impact Assessment for the proposed mining of salt on Farm Konga 250, northwest of Upington, Northern Cape

**Desktop Study**

**For**

**ASHA Consulting**

**02 October 2021**

**Prof Marion Bamford**
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# Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 32 years research; 24 years PIA studies

# Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by ASHA Consulting, Muizenberg, 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

## Executive Summary

A palaeontological Impact Assessment was requested for the proposed mining of salt at Konga Pan on Farm Konga 250 northwest of Upington, Northern Cape Province. 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.

The proposed mining area lies on the Quaternary Kalahari Group aeolian sands, alluvium and calcrete and a small portion of surface limestone. There is a very small chance that fossils may occur in palaeo-pans or palaeo-springs but this is not common in this region. The northern part of the pan is already highly disturbed from current mining operations, but the area under consideration is completely undisturbed. No fossils were seen on the surface by the specialist when he did a walk through for the heritage impact assessment. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once the surveyor and/or the environmental officer have checked the sites for the planned facilities, the fossils should be photographed, their position recorded, then removed and stored. Photographs sent to the palaeontologist will enable him/her to assess the scientific importance of the fossils and act accordingly. As far as the palaeontology is concerned, the project should be authorised.

# Table of Contents

# 1. Background

The owner of the property is proposing to mine salt from Konga Pan on Farm Konga 250, northwest of Upington (Figures 1, 2). A gravel access road will be constructed along an existing firebreak to provide access. The area is covered in red Kalahari sands, is semi-arid, partly vegetated and, in the northern part of the pan, has been disturbed by an existing salt mining operation.

A Palaeontological Impact Assessment was requested for the proposed project. In order to comply with the regulations of 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 and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2017)

| | **A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:** | **Relevant section in report** |
|---|---|---|
| ai | Details of the specialist who prepared the report | Appendix C |
| aii | The expertise of that person to compile a specialist report including a curriculum vitae | Appendix C |
| b | A declaration that the person is independent in a form as may be specified by the competent authority | Page 1 |
| c | An indication of the scope of, and the purpose for which, the report was prepared | Section 1 |
| ci | An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report | Yes |
| cii | A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change | Section 5 |
| d | The date and season of the site investigation and the relevance of the season to the outcome of the assessment | N/A |
| e | A description of the methodology adopted in preparing the report or carrying out the specialised process | Section 2 |
| f | The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure | Section 4 |
| g | An identification of any areas to be avoided, including buffers | N/A |
| h | 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 |
| i | A description of any assumptions made and any uncertainties or gaps in knowledge; | Section 5 |

| | | |
|---|---|---|
| j | 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 |
| k | Any mitigation measures for inclusion in the EMPr | Section 8 |
| l | Any conditions for inclusion in the environmental authorisation | N/A |
| m | Any monitoring requirements for inclusion in the EMPr or environmental authorisation | Section 8 |
| ni | A reasoned opinion as to whether the proposed activity or portions thereof should be authorised | N/A |
| nii | 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 |
| o | A description of any consultation process that was undertaken during the course of carrying out the study | N/A |
| p | A summary and copies if any comments that were received during any consultation process | N/A |
| q | Any other information requested by the competent authority. | Section 8 |


Figure 1: Google Earth Map of the area around Konga Pan to show the site relative to other pans.


Figure 2: Google Earth map of the proposed salt mine (small red circles) in Konga Pan and associated access road (red line) on Farm Konga 250, Northern Cape Province. Map supplied by ASHA.

# 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 but a walk through was done by the archaeologist*);
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 is beyond the north-western margin of the Karoo Supergroup and occurs on deep Kalahari Group sands that lie unconformably on much older basement rocks.

Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common. Some areas of surface limestone also occur. Linear dunes are indicated on the geological map and some have been stabilised by vegetation.

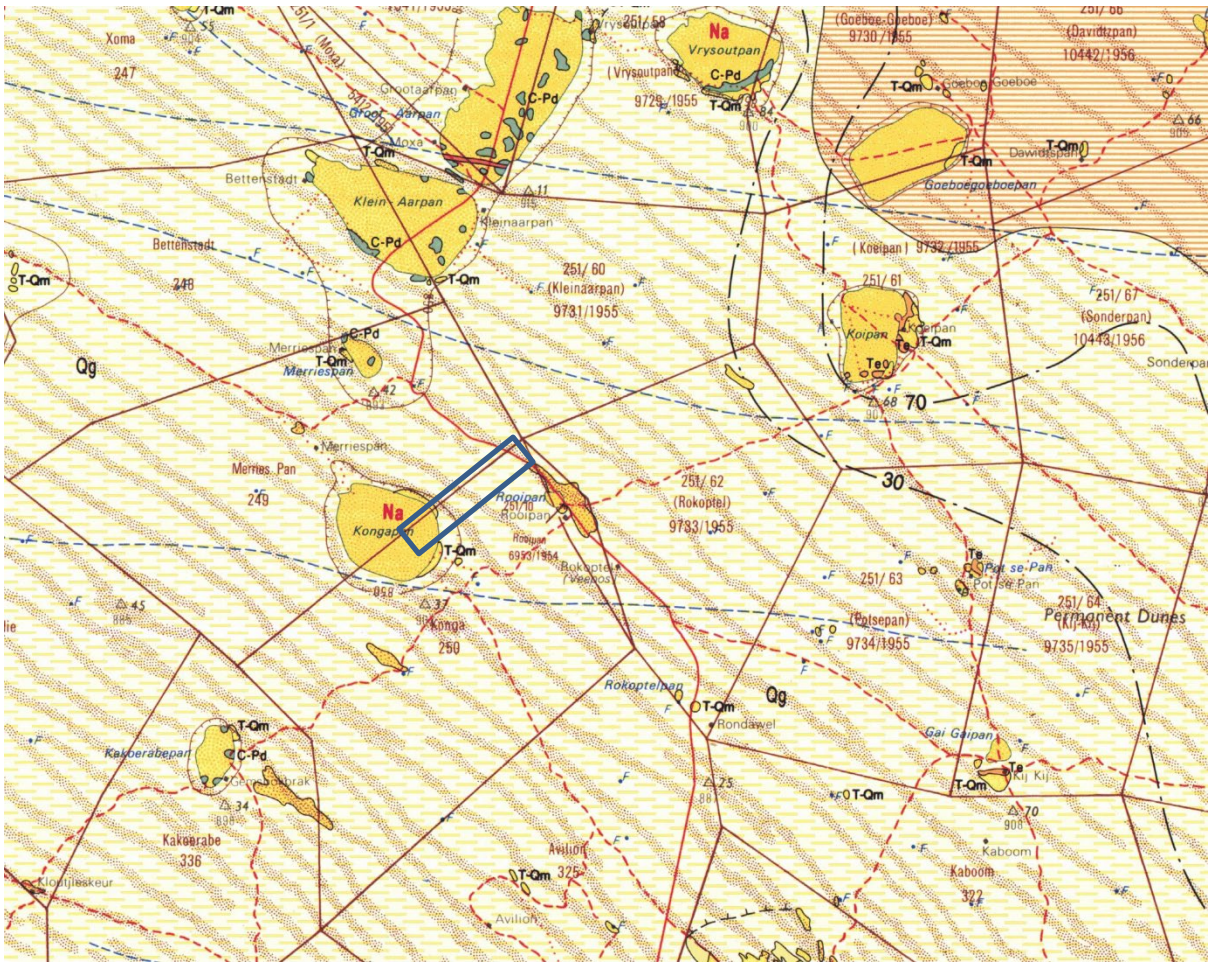


Figure 3: Geological map of the area around Konga Pan on Farm Konga 250. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 2720 Noeniepunt.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; Matmon et al., 2015; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| Qs | Kalahari Group | Alluvial and aeolian sands | Last ca few 100 years |
| Qg | Gordonia Fm, Kalahari Group | Red aeolian sands; dotted = white aeolian sands | Ca 1.0 – 1.2 Ma |
| T-Qm | Kalahari Group | Calcrete, diatomaceous in places | Ca 1.0 – 1.2 Ma |
| C-Pd | Dwyka Group, Karoo SG | Tillites, diamictites, mudstones, shales | Late Permian – Early Carboniferous, ca 300 Ma |

New cosmogenic burial ages (Matmon et al., 2015) obtained from a 55 m section of Kalahari Group sediments, indicate that, at least in the southern Kalahari, the majority of deposition occurred rapidly at 1.0–1.2 Ma and that all earlier sediments here were eroded during previous sedimentary cycles. Collectively, the stratigraphy, sedimentology, and cosmogenic nuclide data indicate:
1) the existence of a stable, shallow and low-energy water body over the southern Kalahari for at least 450 ka prior to 1–1.2 Ma;
2) rapid sediment accumulation that filled up the basin at 1–1.2 Ma; and
3) the establishment of the Kalahari sand cover shortly thereafter.
This timeframe is far younger than expected from the conventional estimates for the Kalahari Group sediments (Haddon and McCarthy, 2005).

## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 6. The site of the Konga Pan is predominantly on alluvium and on aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995), and finally deposited in this region during the Quaternary. Since they are windblown, the sands are not in primary context, nor do they preserve any fossils because they are aerobic ad organic matter is recycled.

Fossils can only be preserved if there are spring or palaeo-pan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. No such fossils have been recorded from this site. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, and salt weathering and aeolian deflation occur. These conditions apply to this environmental setting. There are numerous pans in the region but fossils are not common. This region is indicated as only moderately sensitive in the SAHRIS palaeosensitivity map but the pan itself is shown as unknown (Figure 4). This means there are no records of fossils, only a chance that they could occur there.

The walk-through by Dr Jayson Orton on 01 October 2021 confirmed that there were no fossils in the project footprint (Appendix A, Figures 5-7).

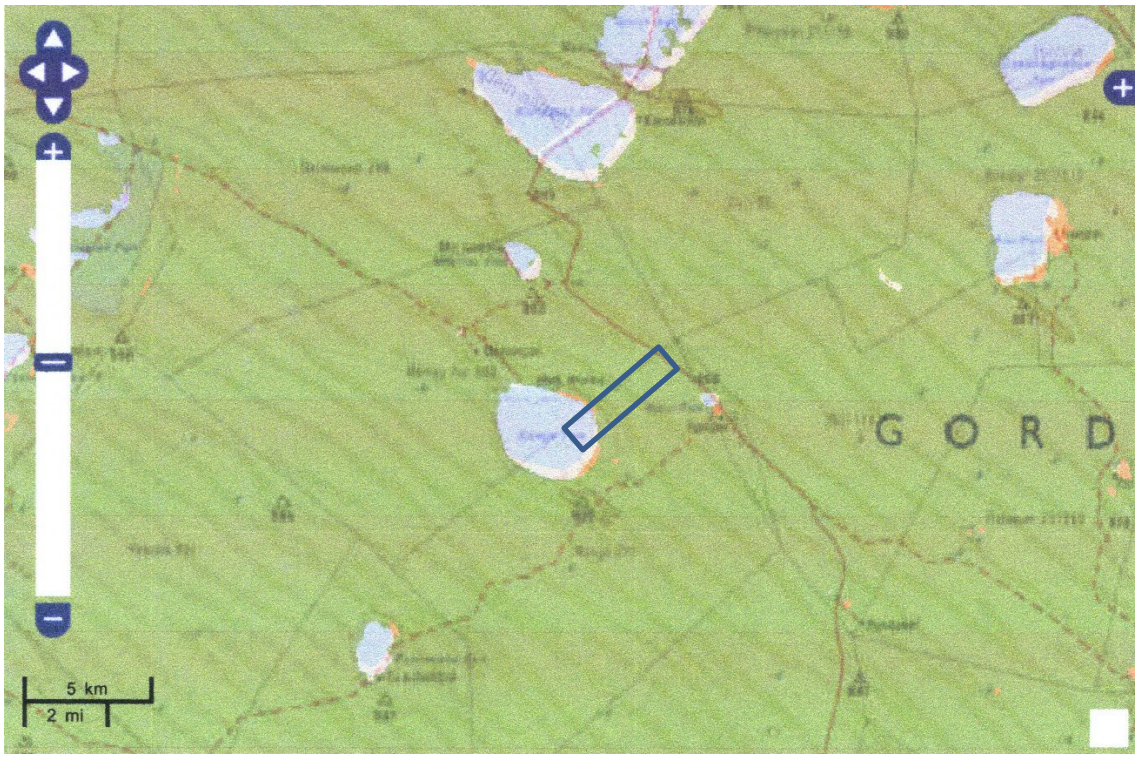


Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed mining project on Farm Konga 250, adjacent to Konga Pan shown within the blue rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Plio-Pleistocene fossils have been recovered from palaeo-pans much farther east of this region, for example near Kuruman at Kathu Pan (Walker et al., 2017,) but there are no records of fossils in this region.

# 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** | Sands do not preserve fossils; features such as palaeo-pans or palaeo-springs might preserve fossils. So far there are no records from the Kalakari Group of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very negligible -. |
| | **L+** | - |
| | **M+** | - |
| | **H+** | - |
| **DURATION** | **L** | - |
| | **M** | - |
| | **H** | Where manifest, the impact will be permanent. |
| **SPATIAL SCALE** | **L** | Since the only possible fossils within the area would be fossil plants or bones trapped in the palaeo-pan, 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 surrounds the site, or in the salt that will be mined. No fossils were seen but they might be buried, therefore, a Fossil Chance Find Protocol should be added to the eventual mining plan. |

Based on the nature of the project, surface activities may impact upon fossil heritage if preserved in the development footprint. The geological structures suggest that the sediments are the right age to trap fossils in the Quaternary pan. However, the material to be obtained is salt from the evaporation of salty water and this does not preserve fossils. Since there is an extremely small chance that fossils from the margin of the pan 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 aeolian sands, sandstones, calcrete and surface limestone are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. Only the palaeo-pans or palaeo-springs could entrap fossils, but no fossils were seen on the walk-through, therefore it is extremely unlikely that they occur in the mine and infrastructure footprint.

# 6. Recommendation

Based on the walk-through surface observations and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils occur in the aeolian sands, calcretes or surface limestone of the Quaternary. There is a very small chance that fossils may occur in palaeo-pans BUT no fossils were seen. Nonetheless, a Fossil Chance Find Protocol should be added to the mining plan or EMPr (see section 8). If fossils are found once the mining commences, they should be photographed, position recorded, removed and stored. Photographs sent to the palaeontologist will enable him/her to assess the scientific importance of the fossils and act accordingly.

# 7. References

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1–69.

Haddon, I., McCarthy, T., 2005. The Mesozoic–Cenozoic interior sag basins of Central Africa: the Late-Cretaceous–Cenozoic Kalahari and Okavango basins. Journal of African Earth Sciences 43, 316–333.

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.

Matmon, A., Hidy, A.J., Vainer, S., Crouvi, O., Fink, D., 2015. New chronology for the southern Kalahari Group sediments with implications for sediment-cycle dynamics and early hominin occupation. Quaternary Research 84, 118–132. http://dx.doi.org/10.1016/j.yqres.2015.04.009.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa.

Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 585-604.

Porat, N., Chazan, m., Grün, R., Aubert, M., Eisenmann, V., Kolska Horwitz, L., 2010. New radiometric ages for the Fauresmith industry from Kathu Pan, southern Africa: Implications for the Earlier to Middle Stone Age transition, Journal of Archaeological Science 37, 269–283.

Walker, S.J.H., Lukich, V., Chazan, M., 2014. Kathu Townlands: A High Density Earlier Stone Age Locality in the Interior of South Africa. PLoS ONE 9(7): e103436. doi:10.1371/journal.pone.0103436

# 8. Chance Find Protocol

**Programme for Palaeontology – to commence once the mining operations start**

1. The following procedure is only required if fossils are seen on the surface when surveyed and when mining commences.
2. If any fossiliferous material (plants, insects, bone) is seen it should be 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 Figures 8-10). 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 scientifically important fossil material as assessed from the submitted photographs, then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the site and excavate (having obtained a SAHRA permit).
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.
7. Annual reports must be submitted to SAHRA as required by the relevant permits.
8. If no good fossil material is recovered then the site inspection by the palaeontologist will not be necessary.
9. If no fossils are found during the survey then no further palaeontological impact assessment is required.

## Appendix A – Site photographs taken by Dr Jayson Orton on 01 October 2021– No fossils seen

Figure 5: Looking south along the eastern side of the pan from on top of the pan dune.

Figure 6: Looking along pan dune on southern edge of pan.

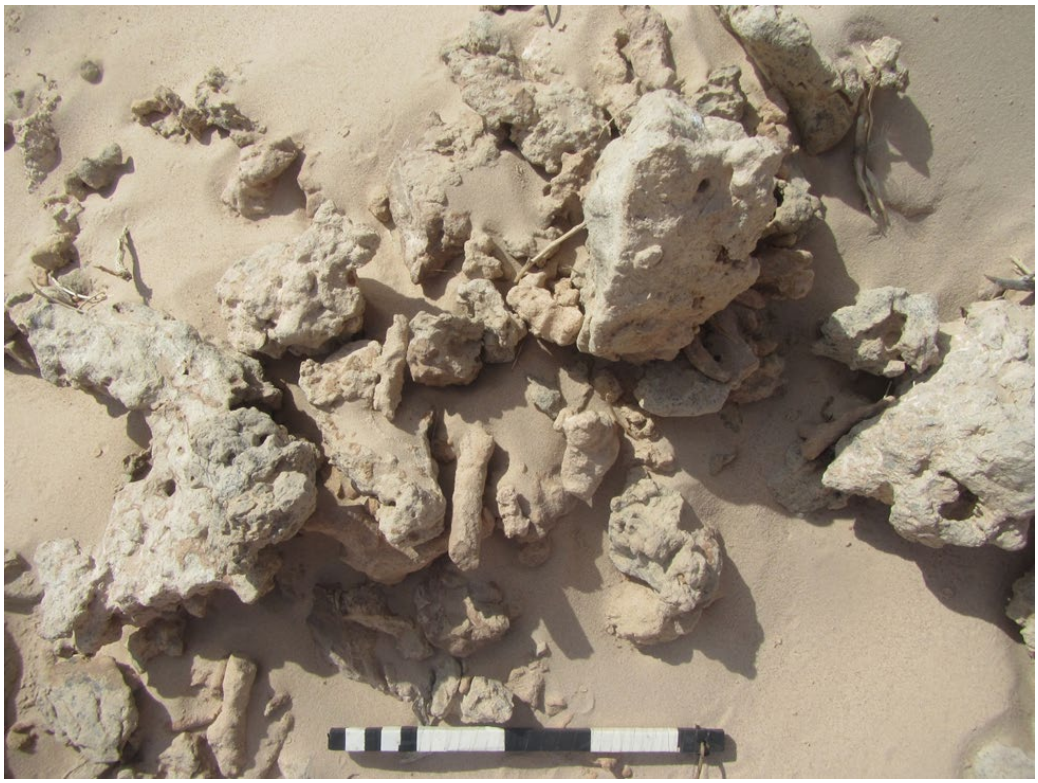

Figure 7: Close-up of the loosely consolidated material from Figure 6 that is recent diatomaceous limestone with hollow tubes and borings (Lonely Formation, upper Kalahari Group).

## Appendix B – Examples of a palaeo-pan and fossils

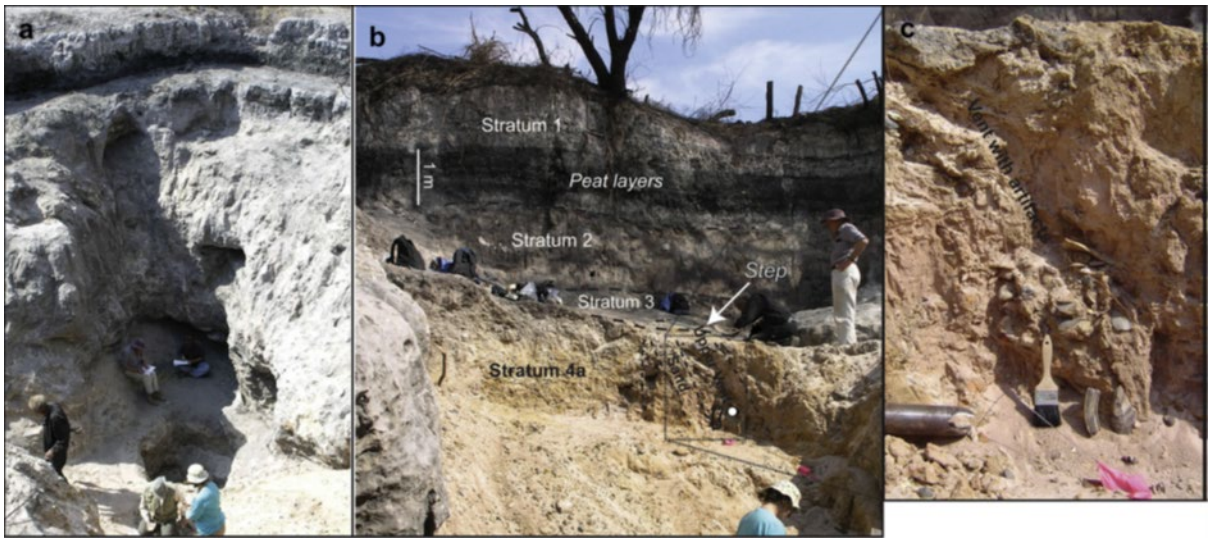


Figure 8: Example of a palaeo-pan deposit, Kathu Pan, near Kuruman and Kathu. From Porat et al., (2010).

Figure 9: Examples of bone fragments from Quaternary sediments and could be found associated with pans.

Figure 10: Examples of silicified wood from Pleistocene sediments.

## Appendix C – Details of specialist

# Curriculum vitae (short) - Marion Bamford PhD
# July 2021

### 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 | 11 | 0 |
| Masters | 10 | 4 |
| PhD | 11 | 4 |
| Postdoctoral fellows | 10 | 5 |

**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 10-15 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 –

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
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro

## xi) Research Output

Publications by M K Bamford up to July 2021 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 80
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)