

Palaeontological Impact Assessment for the Proposed Dagsoom Twyfelaar Coal Mining Project near Ermelo, Mpumalanga Province

Site Visit (Phase 2) Report

For

Digby Wells

10 March 2020

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford

Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf

Experience: 31 years research; 23 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Digby Wells, Johannesburg, 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 proposed development of an underground coal mine, the Twyfelaar Coal Mine, near Ermelo in the Mpumalanga Province by Dagsoom Coal Mining (Pty) Ltd. In order 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 site visit Palaeontological Impact Assessment (PIA) was completed for the proposed development. The site visit was carried out on 27th and 28th February by Rick Tolchard.

The proposed site lies on the shales, mudstones, sandstones and coals of the Vryheid Formation (Ecca Group, Karoo Supergroup) and could potentially contain fossil plants of the Glossopteris flora in the partings between coal seams. During the site visit and detailed survey no fossils were found in the soils or in the exposures of shales and sandstones. Fossils may occur underground so a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological site visit is required unless the geologist or responsible person on site finds fossils when the excavations and mining begin.

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1. Background

Dagsoom Coal Mining (Pty) Ltd (hereinafter Dagsoom) propose to develop an underground coal mine, the Twyfelaar Coal Mine, near Ermelo in the Mpumalanga Province (Figure 1). Dagsoom intends to apply for a Mining Right in terms of the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). This will require Environmental Authorisation (EA) and an Integrated Water Use Licence (IWUL) Application in compliance with the South African national environmental legislative framework.

The Project will consist of three underground sections accessed by boxcuts that will later be developed into mine adits. Dagsoom intend to concentrate the associated surface infrastructure around these three access areas, avoiding the wetlands present in the area and taking cognisance of additional environmental sensitivities.

A Palaeontological Impact Assessment was requested for the Twyfelaar Coal Mine project. 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 site visit and survey Palaeontological Impact Assessment (PIA) was completed for the proposed development. Mr Rick Tolchard visited the farms in question on 27-28 February 2020, and his findings are 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
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page i
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1 and 2
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 4
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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section
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 EMP, 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.	N/A

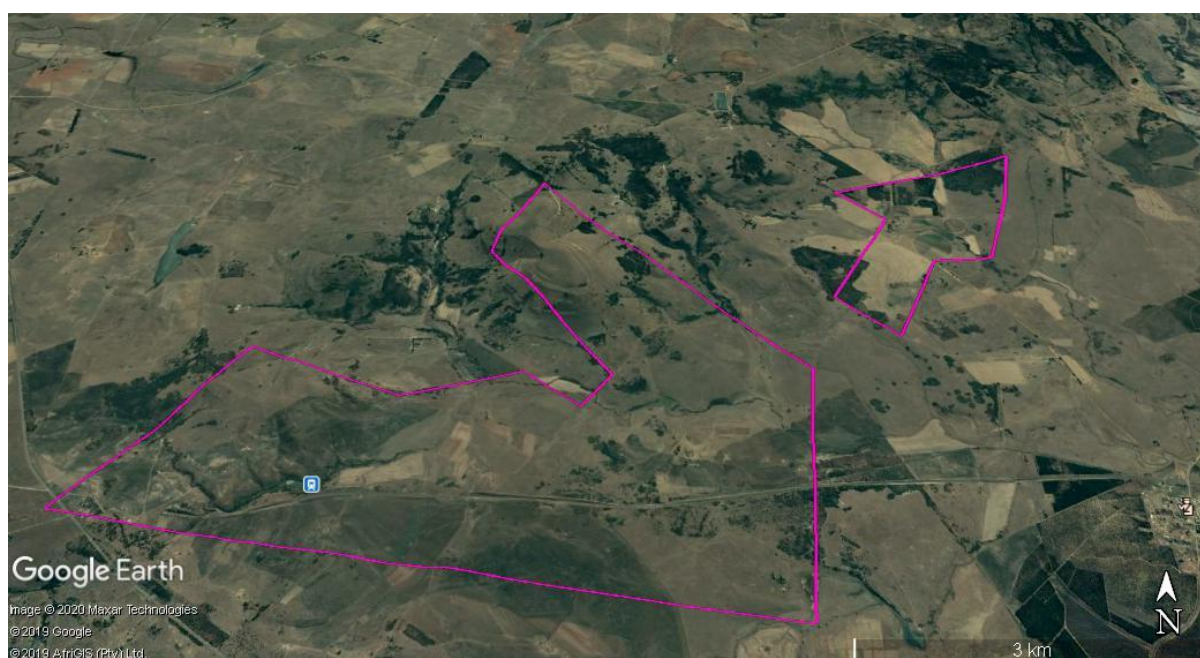


Figure 1: Google Earth map of the proposed area to be mined for the Twyfelaar Coal Mine project by Dagsoom Coal (Pty) Ltd., southeast of Ermelo.

The two sections of the Project area are shown by the purple outline. Map supplied by Digby Wells.

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 (as reported herein, and collect or rescue fossils if required);
 3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*as indicated in section 4 below*); and
 4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a just a representative sample collected and housed in a recognised repository.

3. Geology and Palaeontology

i. Project location and geological context

The farms Twyfelaar 289 IT and Klipfontein 283 IT lie about 15 km southeast of Ermelo, in the northern part of the Ermelo Coal Field (formerly the Eastern Transvaal Coal Field). This is the northern part of the Karoo Basin and has deep deposits of the Vryheid Formation (Ecca Group, Karoo Supergroup), and contains the major coal deposits that are mined by a number of companies for local consumption in power stations and for export.

In this coalfield, the seams are identified by the letters A-E from the top downwards. In some cores the seams are divided into upper and lower parts (U or L) or with an 'X'. From a core taken from east of Ermelo, the closest to Twyfelaar, the five coal seams are present and all except the lowest one, E, have been divided into upper and lower seams, making nine seams in total (Snyman, 1998, fig. 17). The uppermost seam, A, is covered by about 8m of soil, and there are no overlying sandstones, mudstones or shales (ibid). According to Snyman (1998), the A seam is generally of poor quality, and the lower seams vary in thickness and types, from dull coal to bright coal to torbanite.

To the east is a large outcrop of leucocratic biotite granite from the Pongola granite group. This is of volcanic origin and will not be impacted upon by the Twyfelaar Coal mine.

Figure 2 presents the regional geology within which the Project is located. The Project area is shown in the yellow rectangle. Table 2 includes an explanation of the abbreviations of the rock types. In this table, SG refers to Supergroup, Fm refers to Formation and Ma refers to million years. Geological features impacted by the Project are highlighted through grey shading.

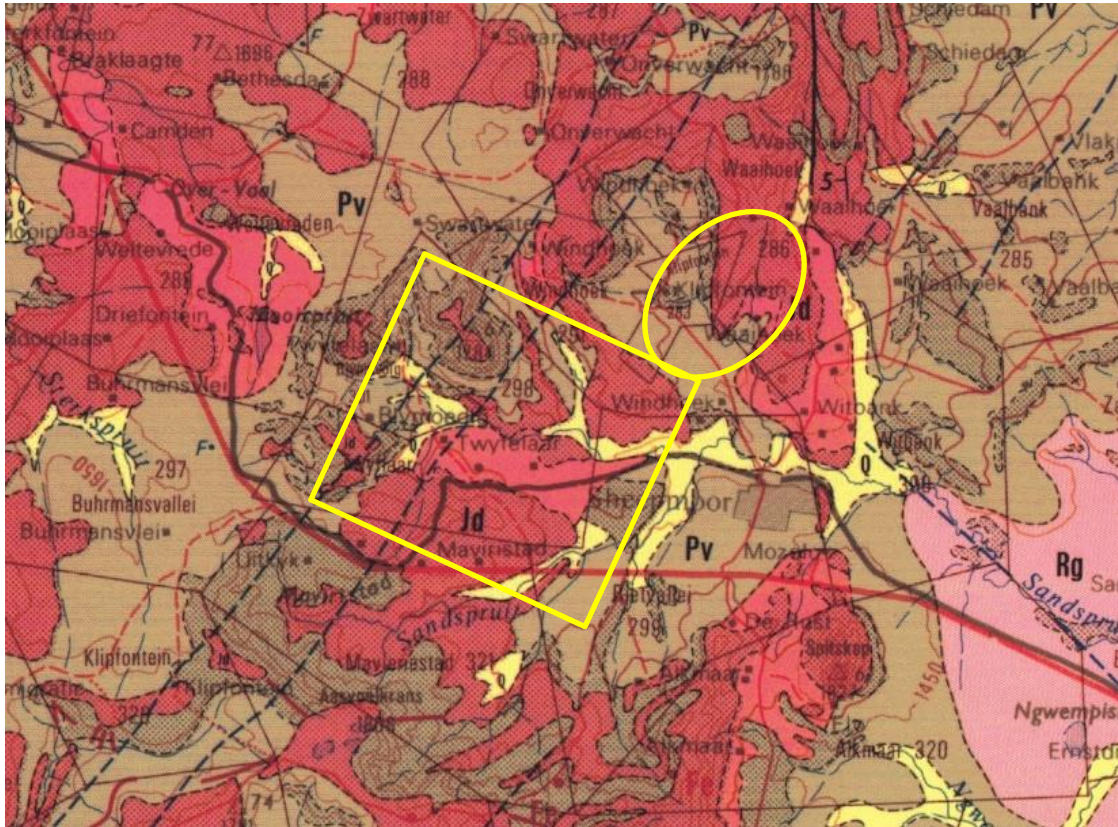


Figure 2: Geological map of the area around the Farm Twyfelaar 298 IT for the Dagsoom Coal Mining (Pty) mining rights application. The location of the proposed project is indicated within the two outlines.

Map enlarged from the Geological Survey 1: 250 000 map 2630 Mbabane.

Table 2: Explanation of symbols for the geological map and approximate ages

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, scree, ferricrete	Neogene, ca 25 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm	Grit, sandstone, shale, coal	Lower Permian, Middle Ecca
Rg	Pongola Group	Leucocratic biotite granite	Ca 2 900 Ma

(Johnson et al., 2006; Gold et al., 2006).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is in the Vryheid Formation.

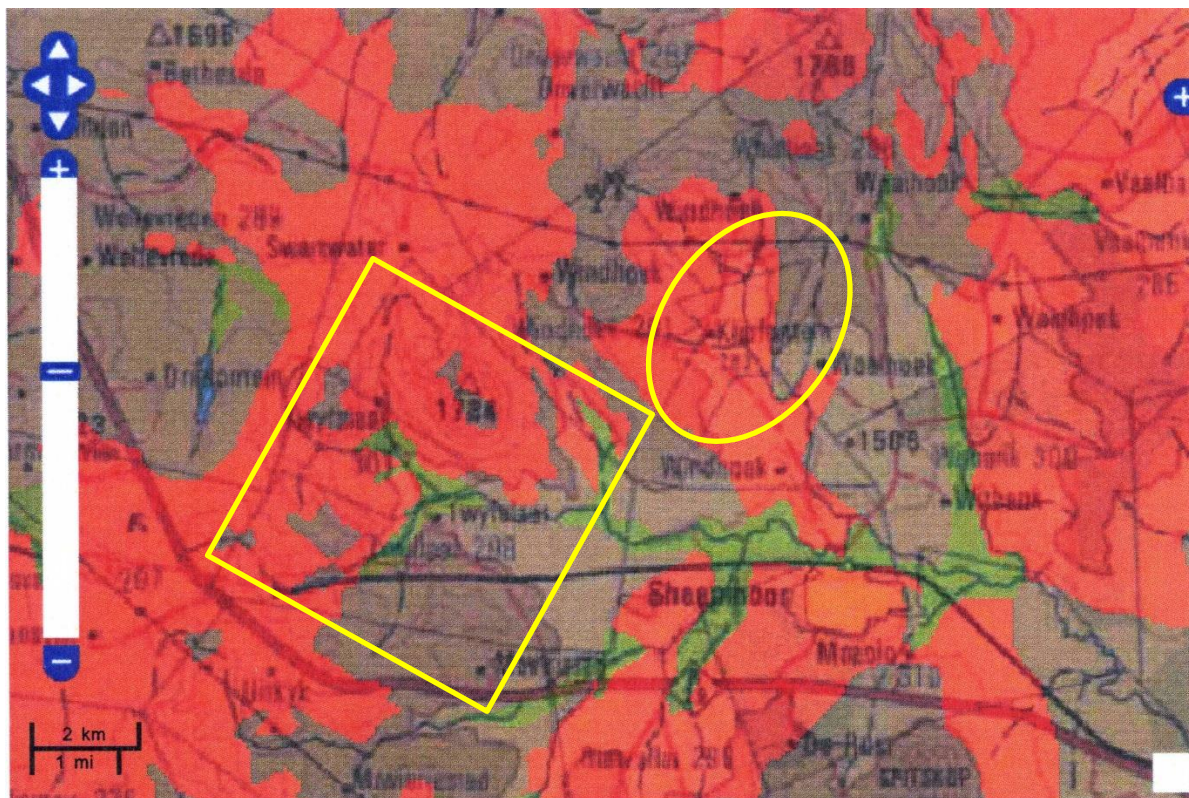


Figure 3: SAHRIS palaeosensitivity map for the Farm Twyfelaar 298 IT for the proposed coal mine shown within the yellow rectangle and oval.

Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

iii. Site visit observations

From the SAHRIS map above the area is indicated as very highly sensitive (red) so a site visit was undertaken on 27-28 February 2020. Table 3 presents a summary of in-field observations which are illustrated in Figure 4 to Figure 7 below. All photographs were taken by Rick Tolchard during the site inspection.

Table 3: GPS Points and Site Observations from the Palaeontological Survey

Point No.	GPS coordinates	Observations	Figure
Stop 1:	S26°42.805' E30°13.743' 1145m	General view of the topography and secondary grasslands from previous agricultural activities. There are low rolling hills and deep soils.	4; 5A, B

Point No.	GPS coordinates	Observations	Figure
Stop 2:	S26°42.821' E30°14.322' 1531m	Sandstone boulders with no fossils, D: close-up of the rock	5C, D
Stop 3:	S26°42.673' E30°14.544' 1505m	An exposure of sandstone amongst the grassland vegetation.	6A
Stop 4:	S26°42.301' E30°14.434' 1476m	Well vegetated but a gully showing sand; some rocky exposures.	6B, C
Stop 5:	S26°41.762' E30°14.451' 1533m	Some rocks exposed but no fossils	6D
Stop 6:	S26°41.808' E30°14.521' 1520m	General view of the area showing the same secondary grasslands as seen throughout, B: incision by a stream through the soil.	7A, B
Stop 7:	S26°41.903° E30°14.620° 1493m	Pathway to stream cutting down to some resistant shales, but no fossils exposed. D: – close-up of the rocks but no fossils preserved in them.	7B, C
Stop 8:	S26°42.007' E30°14.637' 1483m	Dense grassland and no exposures	No photo



Figure 4: Stop 1 - general view of the farm from the road

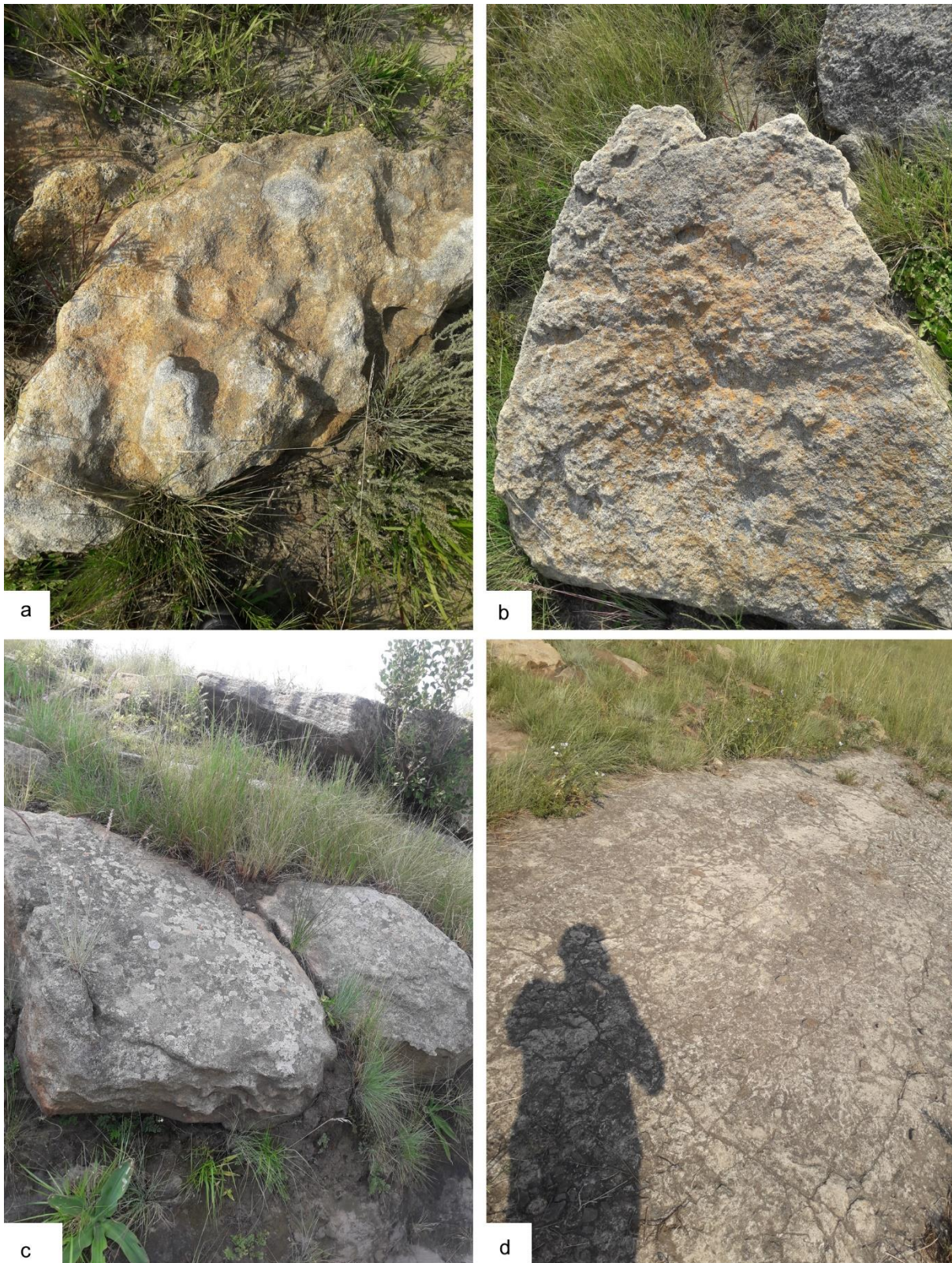


Figure 5: A: Stop 1 – close-up of the coarse-grained sandstone with nodular surface, B: coarse-grained sandstone with rough surface. C: Stop 2 – sandstone boulders with no fossils, D: close-up of the rock.

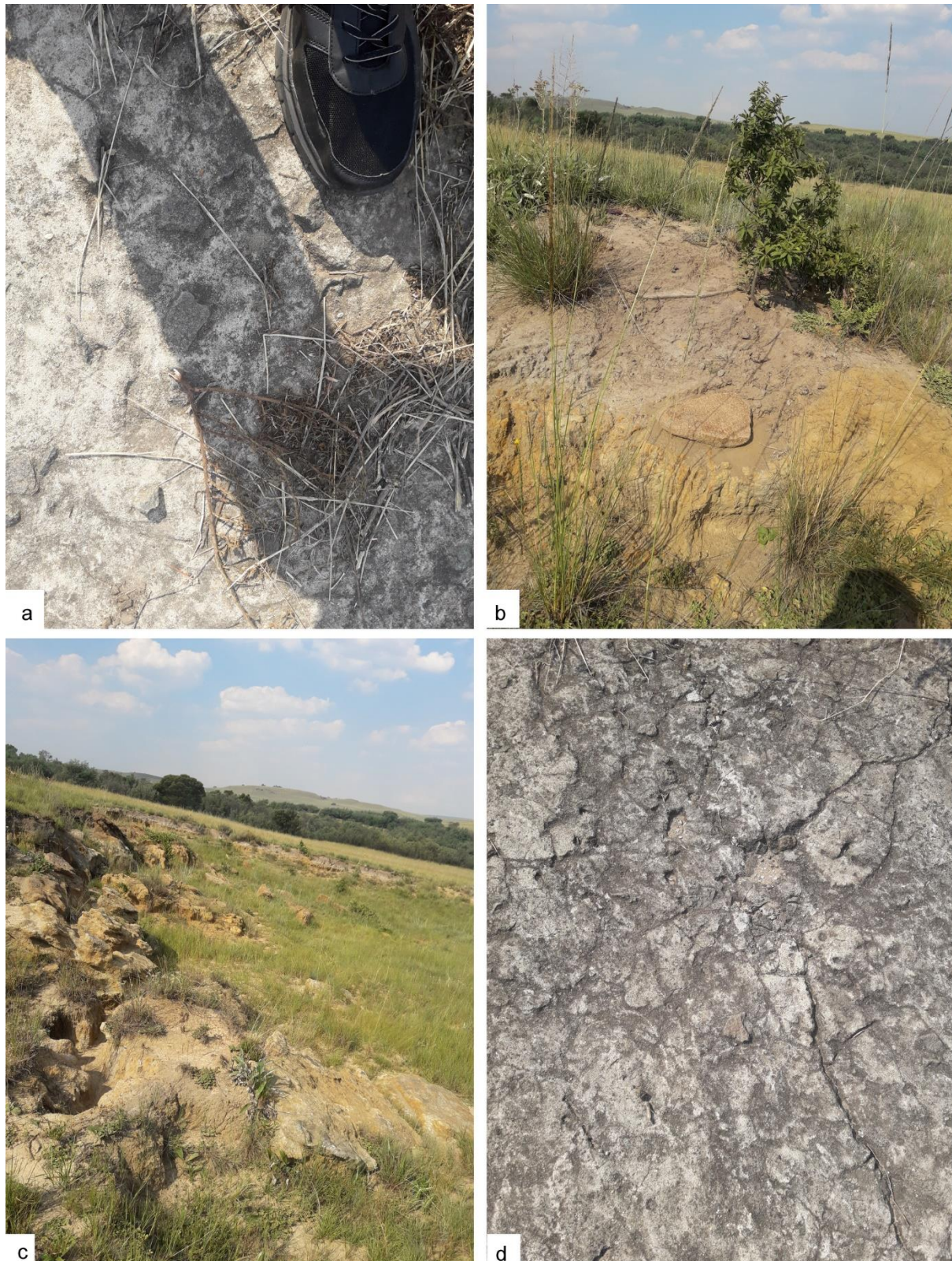


Figure 6: A: Stop 3 – an exposure of sandstone. B: Stop 4 – gully showing sand, C: – rocks and view. D: Stop 5 – a rare exposure of rocks.

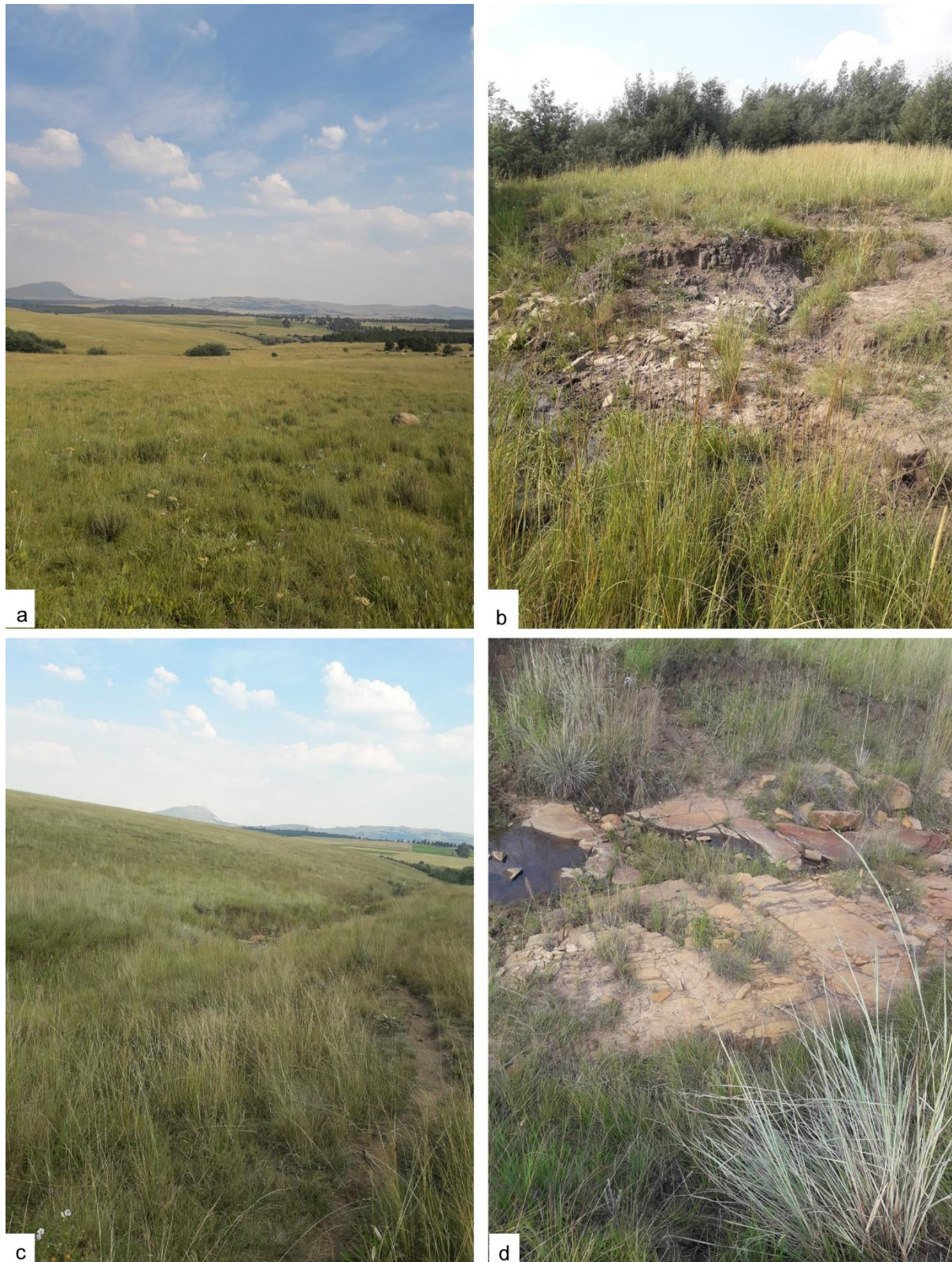


Figure 7: A: Stop 6 – general view of the area, B: incision by a stream through the soil. C: Stop 7 – pathway to stream cutting down to some resistant shales, but no fossils exposed. D: – close-up of the rocks but no fossils preserved in them.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4: Table 5 presents the results of the impact assessment.

Table 4: 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 5: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	H	-
	M	-
	L	The Vryheid Fm could preserve fossil plants of the <i>Glossopteris</i> flora but none was observed. The impact would be very unlikely. The site visit confirmed this.
	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 shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	It is possible that fossil plants may occur underground associated with the coal seams so a Fossil Chance find Protocol should be added to the EMPr., however they are rare and sporadic.
	L	-

Based on the nature of the project and the site survey, surface activities will not impact on the fossil heritage. The geological structures suggest that the rocks between the coal seams may contain plant fossils. However, for safety reasons a palaeontologist cannot monitor underground activities. If the geologist or responsible person on site finds fossils then they should be removed and stored above ground until a palaeontologist can assess their scientific importance. A Fossil Chance Find Protocol has been added to this report with photographs of potential fossils to assist the geologist. Taking account of the defined criteria, the potential impact to fossil heritage resources is 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 plants and insects but only in the shales between coal seams, not in the coal itself. As observed during the site survey, the overlying soils and rocks do not preserve fossils.

6. Recommendation

Based on experience and the observations from the site visit, no fossils occur in the soils or exposed rocks. There is a small chance that fossils may occur in the shales between the coal seams of the early Permian Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

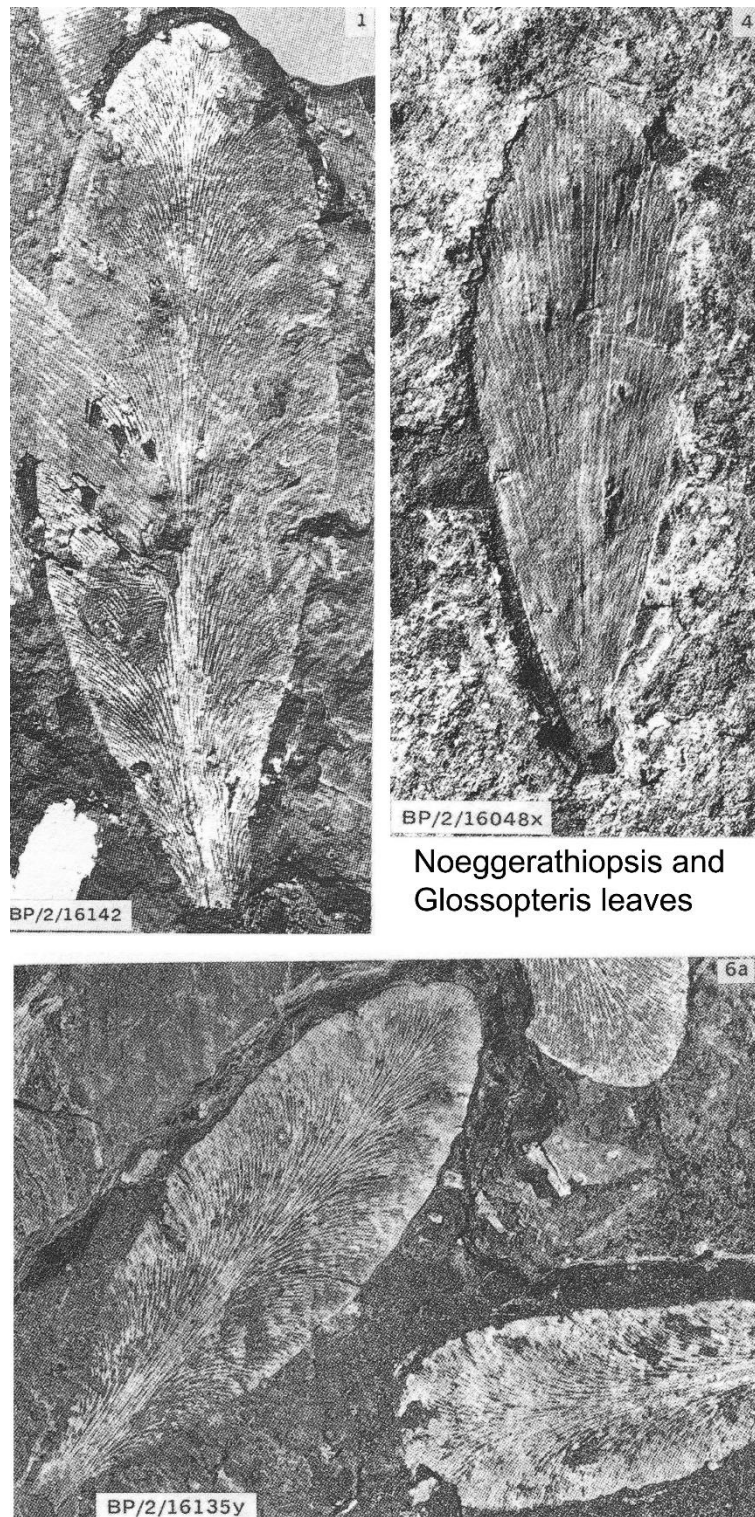
- Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrumus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.
- Gold, D.J.C., 2006. The Pongola Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 135-148.
- 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.
- Snyman, C.P., 1998. Coal. In: Wilson, M.G.C., and Anhaeusser, C.P., (Eds) The Mineral Resources of South Africa: Handbook, Council for Geosciences 16, 136-205.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling / mining activities begin.

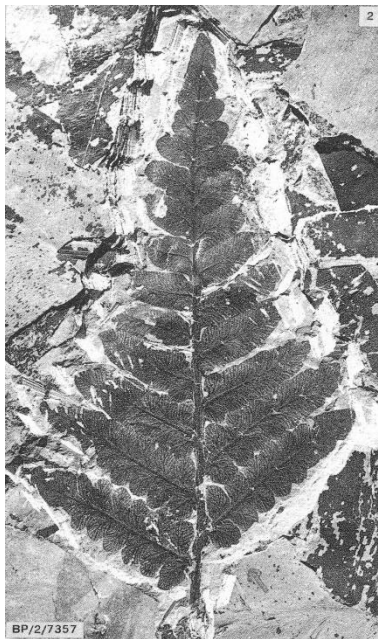
1. The following procedure is only required if fossils are seen on the surface and when excavations/mining commence.
2. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) should be put aside in a suitably protected place. This way the mining 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 1.5). 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/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 no site inspections by the palaeontologist will not be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A: Examples of fossils from the Vryheid Formation



Noeggerathiopsis and
Glossopteris leaves

Figure 8: Glossopteris and Noeggerathiopsis leaves.



Fern: *Asterotheca* sp.

Sphenophytes: whorls of leaves on a striated stem

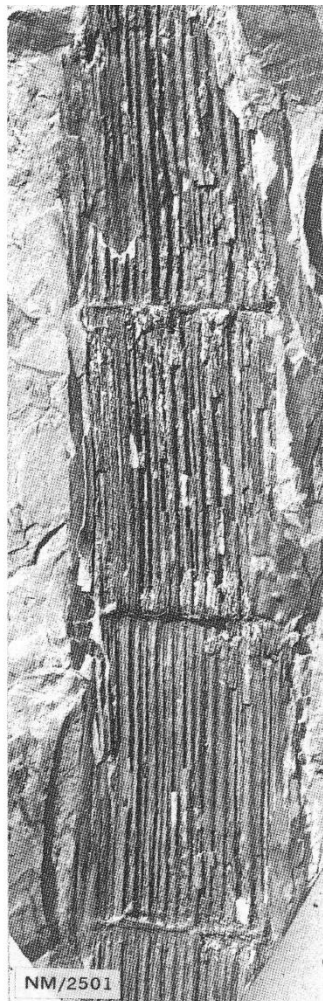


Figure 9: Examples of other fossil plants that could occur in the Vryheid Formation.

Appendix B: Details of specialists

Curriculum vitae (short) - Marion Bamford PhD

January 2020

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	7	0
Masters	10	4
PhD	12	5
Postdoctoral fellows	10	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 –
 Journal of African Earth Sciences: 2020 –

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

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 140 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 27; Google scholar h index = 32;

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)

Mr Frederick Tolchard

Brief Curriculum Vitae – February 2020

Academic training

BA Archaeology – University of the Witwatersrand, graduated 2015

BSc (Honours) Palaeontology – University of the Witwatersrand, 2017 with distinction

MSc Palaeontology – University of the Witwatersrand, 2018 – 2019.

Field Experience

Honours Fieldtrip – Karoo biostratigraphy – April 2017

Research fieldwork – Elliot Formation with Prof Choiniere – April 2018, November 2018; April 2019

PIA fieldwork projects

2018 May – Williston area – SARAO project, Digby Wells

2018 September – Lichtenburg PVs – CTS Heritage

2018 November – Nomalanga farming – Digby Wells

2019 January – Thubelisha coal – Digby Wells

2019 March – Matla coal – Digby Wells

2019 March – Musina-Machado SEZ – Digby Wells

2019 June – Temo coal – Digby Wells

2019 September – Makapanstad Agripark – Plantago

2020 January – Hendrina, Kwazamakuhle – Kudzala

2020 February – Hartebeestpoort Dam - Prescali