Heritage Impact Assessment within Lesotho Lowlands Water Development Project Phase II (LLWDP-II)

Palaeontological Impact Assessment

Prepared for:
Lesotho Lowlands Water Development Project II

Project Number:
LLW6521

June 2021

DIGBY WELLS
ENVIRONMENTAL

Your Preferred Environmental and Social Solutions Partner

Providing innovative and sustainable solutions throughout the resources sector

Digby Wells and Associates
(South Africa) (Pty) Ltd
Company Registration: 2010/008577/07

Turnberry Office Park,
Digby Wells House.
48 Grosvenor Road,
Bryanston,2191

Phone: +27 (0) 11 789 9495
Fax: +27 (0) 11 789 9495
E-mail: info@digbywells.com
Website: www.digbywells.com

Directors: J Leaver (Chairman)*,
NA Mehlomakulu*, A Mpelwane*, DJ Otto,
M Rafundisani
*Non-Executive

This document has been prepared for Digby Wells Environmental by Prof Marion Bamford.

Report Type:	Palaeontological Impact Assessment
Project Name:	Heritage Impact Assessment within Lesotho Lowlands Water Development Project Phase II (LLWDP-II)
Project Code:	LLW6521

Name	Responsibility	Signature	Date
Prof Marion Bamford	Reporting		April 2021
Johan Nel	Technical Review		April 2021
Lucy Stevens	Senior Review		April 2021

DECLARATION OF INDEPENDENCE

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Digby Wells & Associates (Pty) Ltd, 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
Qualifications:	PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience:	32 years research; 24 years PIA studies
Signature:	

EXECUTIVE SUMMARY

A palaeontological Impact Assessment was requested for the Lesotho Lowlands Water Development Project, Phase II, Package (Zones 2 and 3: Hlotse and Maputsoe). The route is potentially highly fossiliferous so a site visit was conducted by Mr Putsetso Nyabela from Lesotho.

The proposed pipeline route for this sector of the project lies on the Burgersdorp Formation (Beaufort Group) and the Molteno and Elliot Formations of the Stormberg Group (Karoo Supergroup). All the formations could potentially preserve fossil plants, vertebrate footprints and vertebrate fossils. The site visit survey showed that there are **no fossils** visible along the route. Surface soils and alluvium do not preserve fossils but there might be fossils in the rocks below the soils, therefore, a Fossil Chance Find Protocol should be added to the EMPr (Section 8 and Appendices B, C, D). Based on this information it is recommended that no further palaeontological assessment is required unless fossils are found when excavations or drilling commences.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. Background

The original designs for the LLWSS were completed in 2008 with the assistance of the European Union (EU). These designs focused on bulk infrastructure only. The first phase of the LLWSS included the Metolong Dam and Water Supply Program (MDWSP), which included Zone 4 and Zone 5. These original designs included only bulk infrastructure and aimed for a design horizon in the year 2035.

Through additional funding, the GOL has since updated these designs, which incorporate changes made in the target areas since 2008. The updates considered changes to the bulk water infrastructure including water intake, treatment plants, transmission pipelines and associated infrastructure but do not include detailed designs for distribution systems. The updated designs consider a design horizon to 2045.

Based on the updates to the designs, the LLWSS program has been grouped into six packages. Two of these packages have been prioritised for the next phase of the LLWSS:

- Project Package 4, which includes Zones 6 and 7 (which comprises the Mafeteng and Mohale's Hoek areas); and
- Project Package 2, which includes Zones 2 and 3 (which comprises Hlotse to Maputsoe and including the villages en route).

The Project comprises Zone 2 in the latter of the prioritised work packages. The World Bank will finance investments in Zones 2 and 3. These investments will include: a water intake, water treatment works, 32 km of transmission mains, two pumping stations, five reservoirs and distribution networks.

1.1. Terms of Reference

To complete a Heritage Resources Management (HRM) process focussed on a review and revision of part of completed ESIA, ESMP and RAP for the Project area in the Leribe District. The HRM process must be undertaken in compliance with the relevant sections of the Historic Monuments, Relics, Fauna and Flora Act No. 41 of 1967 (HMRFFA) and the National Heritage Resources Act No. 2 of 2012 (NHRA).

1.2. Project Objectives

The overall objective of the HRM process is to determine how Project related activities will impact upon the cultural, palaeontological and archaeological heritage of the Project area. Through an understanding of the potential impacts, feasible and appropriate recommendations to manage known and unknown heritage resources can be developed. As such, the primary deliverables to demonstrate the methodology employed in the assessment, as well as clear, transparent and workable management measures will include:

- A Heritage Scoping Report including a Gap Analysis (previously referred to as an Inception Report);
- A Stakeholder Engagement Plan (SEP); and
- An HIA Report comprising an AIA, PIA and Chance Find Procedure (CFP).

This report is the PIA and CFP for the Lesotho Lowlands Water Development Project, Phase II, Project Package 2.

Table 1-1: 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 A
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page **Error! Bookmark not defined.**
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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
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	Appendix B
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Appendix B
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.	N/A

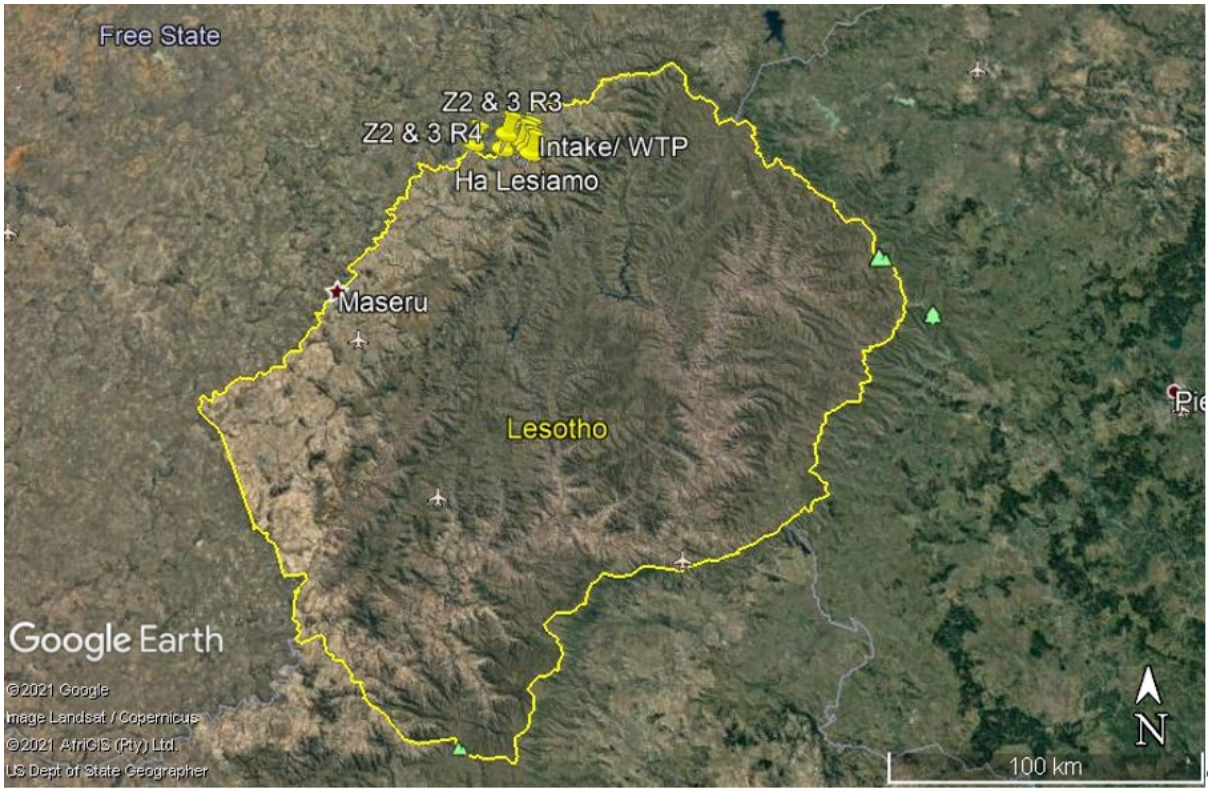


Figure 1-1: Google Earth Map of Lesotho to Show the Position of Work Package 2 and Zones 2 and 3 for the Lesotho Lowlands Water Development Project, Phase II, as Indicated by the Pins

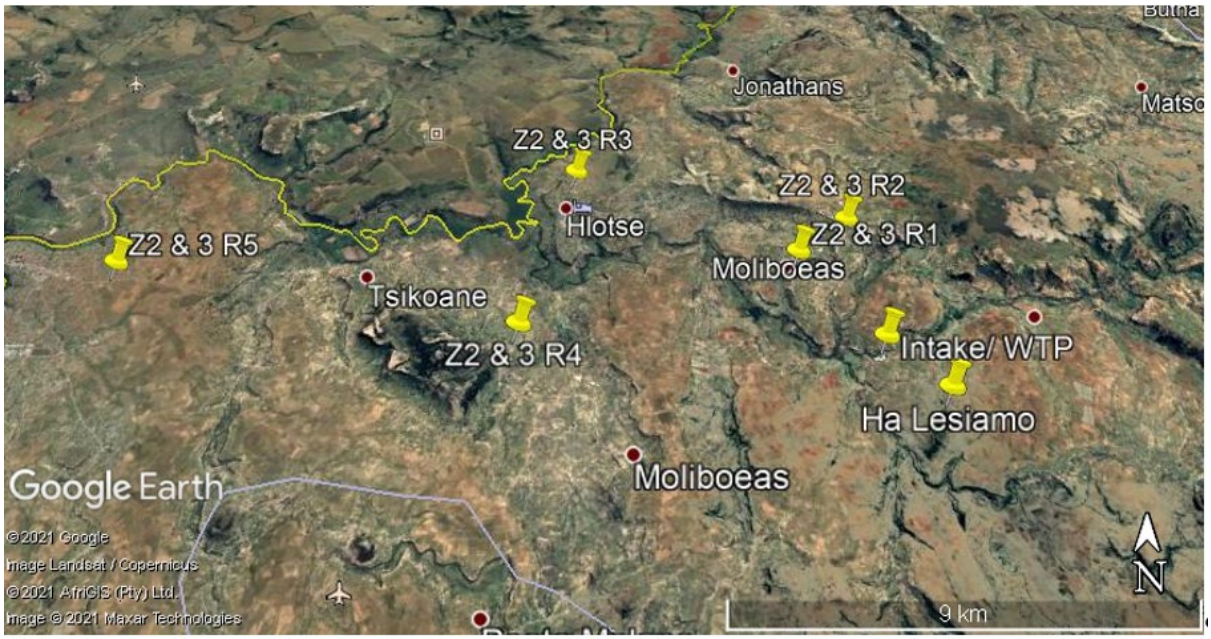


Figure 1-2: Higher Resolution Google Earth Map to show the Zone Sites as Referred to in the Site Visit Observations Below

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:

- 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;
- 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);
- 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
- 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

3.1. Project Location and Geological Context

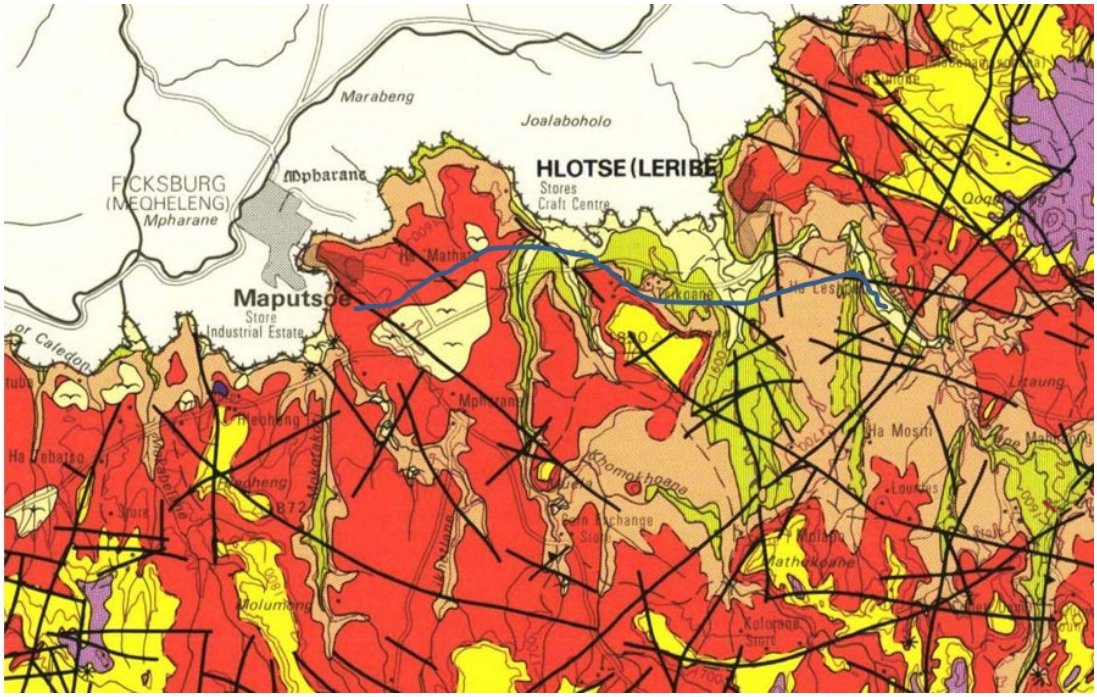


Figure 3-1: Geological Map of the Area Around the town Hlotse and Maputsoe on Northwest Lesotho. The Location of the Proposed Project is Indicated within the Blue line. Map Enlarged from the Lesotho Geological Map 1:250 000

Abbreviations of the Rock Types are explained below in Figure 5.

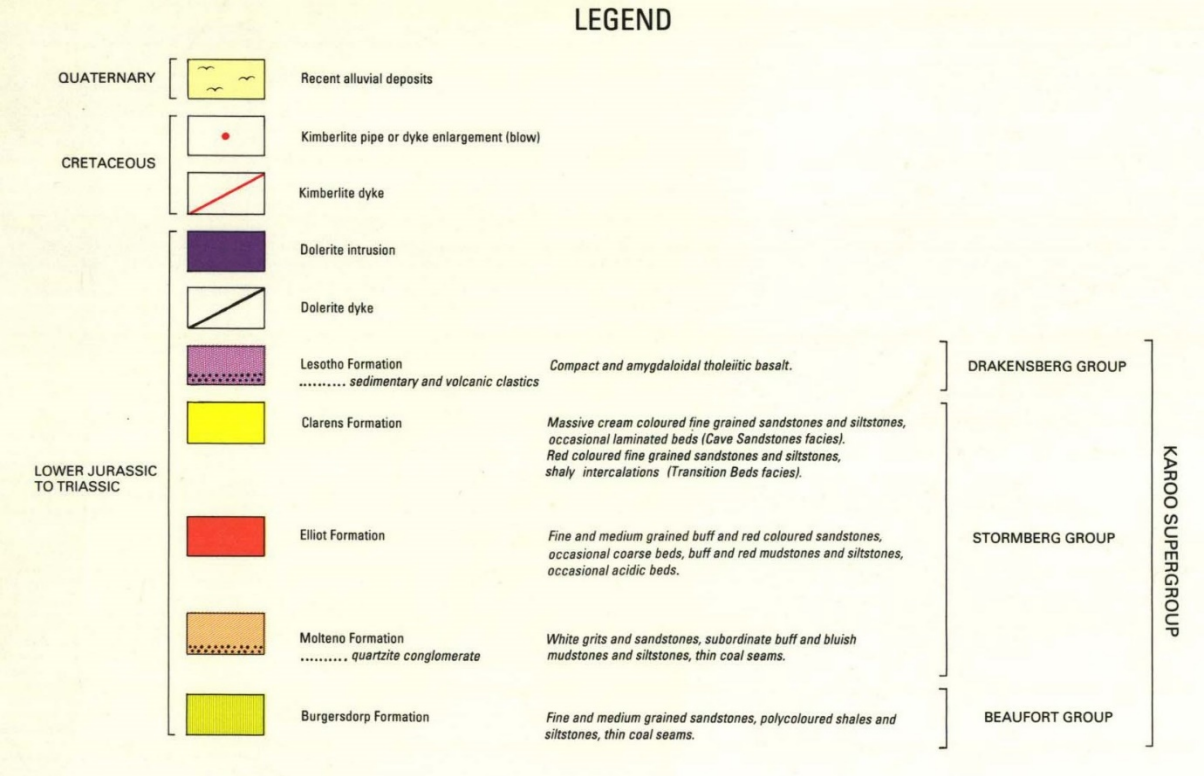


Figure 3-2: Explanation of symbols for the geological map and approximate ages. SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project

The high central part of Lesotho is composed of the basalts and lavas (purple in the geological map) that form the capping rocks, the Drakensberg Formation, of the Karoo Supergroup. They form the largest area of the country but as they are volcanic in origin and do not preserve fossils in the basalt but may preserve fossils in very weathered sections, they will not be considered further. Furthermore, the project does not intercept the basalts.

The perimeter of the country is composed of the underlying Karoo Supergroup rocks, with the Burgersdorp Formation (upper Beaufort Group) forming the basal rocks. Overlying these strata are the three formations that comprise the Stormberg Group, namely the lower Molteno Formation, the middle Elliot Formation and the upper Elliot Formation (Figure 3-1 and Figure 3-2).

The rivers draining the highlands have cut down through these sediments and in some areas much younger sands and alluvium have filled the depressions.

These rocks range in age from the Middle Triassic to the early Jurassic (Table 3-1) and represent braided stream deposits to desert and aeolian sands, and finally topped and preserved by the massive outpourings of basalt (the Drakensberg Formation. This was the time of the vertebrates, mammals and dinosaurs with diverse vegetation and so the potential for fossils is good.

Table 3-1: Ages and Palaeoenvironments of the Lesotho rocks (Bamford, 2004; Catuneanu et sl., 1998; Smith et al., 2020).

Group	Formation	Age	Environment
	Quaternary	Last ca 2.5 Ma	Mesic to dry
Drakensberg		180 Ma	Volcanic eruptions
Storm-berg	Clarens	191-187 Ma	Desert environment, wind-blown dunes, shallow playa lakes in wetter areas
	Elliot	219-191 Ma	Meandering streams and transition to semi desert and desert
	Molteno	242-219 Ma*	Braided streams on a vast braid plain; few filled in abandoned channel tracts, and some ponds
Beaufort	Burgersdorp	247-242 Ma	Mixed-load meandering rivers and floodplains

Palaeosensitivity colours taken from the Free State Palaeotechnical Report, Groenewald et al. (2014) with red = very high, orange = high, green = moderate, blue = insignificant. Ma = million years. *No dates so estimated

3.2. Palaeontological Context

There is no equivalent SAHRIS map for Lesotho, so the palaeontological sensitivity has been extrapolated from the geology and vertebrate biozones of the South African Karoo Supergroup. From the geological map (Figure 3-1) and Table 3-1, it can be deduced that the whole route is potentially fossiliferous so a site visit was completed and is reported here. In summary, it is expected to find vertebrates and plants in the Burgersdorp Formation, footprints and plants in the Molteno Formation, and vertebrates and footprints in the Elliot and Clarens Formations. See Appendix C for faunal and floral lists and illustrations of fossils.

3.3. Site Visit Observations

Putsetso Nyabela, an archaeologist and field assistant to palaeontologists at the Field Regional Museum in Maseru, Lesotho, carried out the site visit at the end of March 2021. His observations and GPS points for the photographs are given in Table 3-2 and Figure 3-3 to Figure 3-9 below. Mr Nyabela is accredited for all the site photographs.

Table 3-2: Site Visit Observations

Zone 2	GPS coordinates	Observations	Figure
(Zone 1) Ha Lesiamo	S 28°55.608 E 28°07.756 1676m	It was not listed; however, a water tank is going to be constructed at Ha lesiamo. Soils and vegetation, no fossils of any kind. Burgersdorp and Clarens Fms	5a, b

Zone 2	GPS coordinates	Observations	Figure
Intake & WTP Ha Setene	S 28°54.810 E028°07.049 1517m	The unploughed open field is where the WTP is going to be constructed. Soils and vegetation seen but no fossils. Burgersdorp and Quaternary Fms	6a, b, c,
Z2 & 3R1 Khanyane Moliboeas	S28°53.417 E028°05.990 1743 m	No fossils were seen along the flat land where the pipes will be; there might be footprints in the kopjie strata but not visible. Molteno Fm	7a, b, c,
Z2& 3R2 Khokhotsaneng	S28°52.837 E028°06.819 1782m	No fossils seen on the flat ground (soil and rocks) where the pipes will be; kopjie not surveyed as not on the route. Burgersdorp and Molteno Fms	8a, b, c
Z2 & 3R3 Ha Tlaitlai	S28°51.779 E028°02.562 1669m	Photos show that place is used as sport field. No fossils seen in the rocks. Molteno and Elliot Fms	9, b, c
Z2 & 3R4 Matukeng, Tsikoane	S28°54.653 E028°01.791 1669m	The tank will be constructed on the graveyard. However, the place was surveyed from the big bolder to second strata Molteno Fm	10a, b, c
Z2 & 3R5 Ha 'Mathata	S28°53.580 E027°55.614 1628m	All the photos show that part of the area is used as a football pitch. No fossils. Elliot Fm	11a, b, c

Figure 3-3: Site Photos for the Water Tank (Zone 1)

Figure 3-4: Site Photos for Intake and WTP - Hla Setane

Figure 3-5: Site Photos of Zones 2 & 3 - R1 - Khanyane

Figure 3-6: Site Photos for Zone 2 & 3 - R2 - Kokhotsaneng

Figure 3-7: Site Photos for Zones 2 & 3 - R3 - Ha Thaitlai

Figure 3-8: Site Photos for Zone 2 & 3 - R4 - Makhuteng-Tsikoane

Figure 3-9: Site Photos for Zones 2 & 3 - R5 - Ha Mathata

4. Impact Assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4-1 and Table 4-2.

Table 4-1: 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.

PART A: DEFINITION AND CRITERIA		
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 4-2: Impact Assessment

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	Soils and alluvium do not preserve fossils; rocky strata of the Karoo Supergroup might preserve plants, bones or footprints; no records from this region but it is possible that fossils occur in the region. The survey showed that there are no fossils. The impact would be low.
	L	
	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 plants, vertebrates or footprints from the Karoo SG in the rocks, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**

PART B: ASSESSMENT		
	M	**-**
	L	It is likely that fossils occur in the rocks BUT the site survey showed that there are no fossils in the soils along the route. It is not known if there fossils subsurface or if they will be disturbed by the foundations. 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. The geological structures suggest that the rocks are the correct type and age to contain fossils. However, the site survey did not reveal any surface fossils along the route. Since there is a small chance that fossils may occur in the rocks below the soils and alluvium, 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 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 sands of the Quaternary period would not preserve fossils. The site survey showed that there are NO FOSSILS along the pipeline route, BUT it is not known what lies in the rocks below the surface.

6. Recommendation

Based on experience, the lack of any previously recorded fossils from the area, and the observations from the site visit, it is possible that fossils may be preserved in the rocks below the soils. It is not known how deep the excavations and or drilling will be, therefore, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The potential fossils are listed and illustrated in Appendix B (separate file). A summary of the paleontological record for Lesotho is provided in Appendix C.

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.

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.

Smith, R.M.H., Rubidge, B.S., Day, M.O., Botha, J., 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123, 131-140. doi:10.25131/sajg.123.0009.

(More references in Appendix C).

8. Chance Find Protocol

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

1 The following procedure is only required if fossils are seen on the surface and when drilling/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, 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 Appendix C). 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 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.

DIGBY WELLS
ENVIRONMENTAL

Appendix A: Short CV of Speicalist

Curriculum vitae (short) - Marion Bamford PhD

January 2021

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

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.

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

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

Supervision of Higher Degrees

All at Wits University

Degree	Graduated / Completed	Current
Honours	11	2
Masters	10	5
PhD	11	4
Postdoctoral fellows	10	4

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.

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

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

Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 29; Google scholar h index = 36;

Conferences: numerous presentations at local and international conferences.

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)

Appendix B: Lists and Figure of Fossils

List and photographs of fossils that could be found in the strata in support of Section 8 (Fossil Chance Find Protocol).

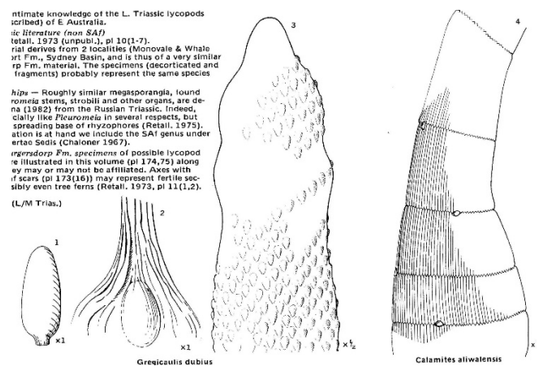
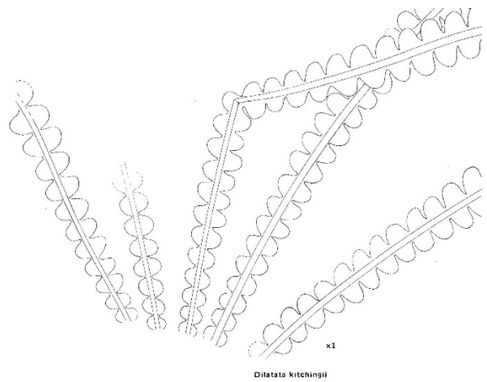
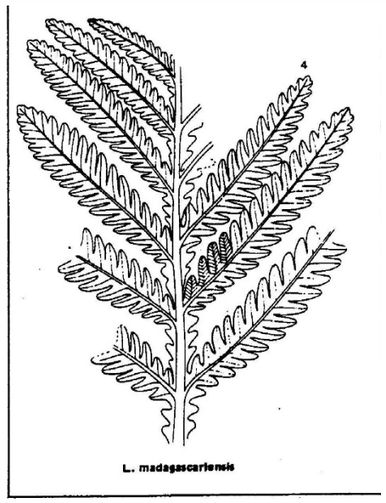
Lists and illustrations of fossils Burgersdorp Fm; Stormberg Group

Anderson and Anderson, 1985; Bamford, 2004; Smith et al., 2020; MacRae, 1999 (photographs).

Period	Group/subG/Formation	Plant group	Genera	Animal Group	Genera
Triassic	Beaufort; Burgersdorp	Lycophyta	*Gregicaulis*	Pisces	*Phycoceratodus, Saurichthys, Lissodus* *Polyacrodus, Clethrolepidina*
	Cynognathus AZ	Sphenophyta	*Calamites*	Amphibians	*Kestrosaurus, Trematosuchus, Parotosuchus, Bathignathus, +7*
		Filicophyta	*Asterotheca* *Cladophlebis*	Parareptilia	*Palacrodon, Theledectes, Thelerpeton, Thelephon, Myocephalus*
		Incertae sedis	*Bergesia*	Eureptilia	*Garjania, Erythrosuchus, Eohyosaurus, Howesia, Mesosuchus, Euparkeria*
		Peltaspermales	*Lepidopteris* *Dicroidium*	Anomodontia	*Kannemeyeria, Kombuisia, Ufudocyclops, Shansiodon*
		Ginkgoales	*Ginkgoites* *Sphenobaiera*	Therocephalia	*Microgomphodon, Bauria, Melinodon, Sesamodon, Watsoniella*
		Cycadales	*Pseudoctenis* *Nilsonia*	Cynodontia	*Cynognathus, Langbergia, Trirachodon, Lumkuia, Bolotridon, Diademadon, Cricodon*
		Coniferales	*Sewardistrobus*		
Upper Triassic	Stormberg; Molteno	Bryophyta	Marchantium Muscites	Pisces	*Ceratodon*
		Sphenophyta	Phyllotheca, Neocalamites Schizoneura, Equisetites	Cynodontia	*Cynognathus, Diademodon*
		Filicophyta	Todites, Asterotheca Cladophlebis,Dictyophyllum		
		Peltaspermales	Dicroidium, Lepidopteris Yabiella, Taenopteris Dejerseya		
		Cycadales	Pseudoctenis, Nilssonopteris		
		Ginkgoales	Ginkgoites, Baiera		
		Coniferophyta	Rissikia, Heidiphyllum		
				LOWER ELLIOT	SCALENODONTOIDES AZ
Upper Triassic – Lower Jurassic	Stormberg; Elliot	Sphenophyta	*Equisetites*	Pisces	*Ceratodus*
		Bennettitaleans	*Otozamites*	Amphibia	*Chigutisaurid indet.*
		Coniferophyta	*Sphenolepidium* *Pinus??*	Eureptilia	*Rauisuchia indet., Blikanasaurus, Melanorosaurus, Ecnemasaurus. Plateosaurus, Theropod indet, Sefapanosaurus, Meroktenos*

Period	Group/subG/Formation	Plant group	Genera	Animal Group	Genera
			Agathoxylon		
		Incertae sedis	*Phoenicopsis*	Anomadontia	*Pentasaurus*
				Cynodontia	*Scalenodontoides, Elliotherium, Trithelodon,*
				UPPER ELLIOT & CLARENS	MASSOSPONDYLUS AZ
Lower Jurassic	Stormberg: Clarens	Sphenophyta	*Equisetum*	Pisces	*Ceratodus, Endemichthys, Semionotus, Daedalichthys*
		Coniferophyta	*Podocarpoxylon*	Amphibia	*Chigutisaurud indet.*
				Eureptilia	*Protosuchus, Lesothosaurus, Aardonyx, Megapnosaurus, Eocursor, Massospondylus, Australochelys, Ignavusausrus, Dracovenator, Pegomastax, Antetonitrus, Litargosuchus, Pulanesaura, Ledumahadi. Arcusaurus, Orthosuchus, Sphenosuchus, Abrictosaurus, Clevosaurus, Heterodontosaurus, Lychorhinus, Ngwevu, Notochampsa*
				Cynodontia	*Elliotherium, Trithelodon, Tritylodon, Diarthrognathus, Pachygenelus, Tritylodontoides*
				Mammaliformes	*Megazostrodon, Erythrotherium*

Photographs and Diagrams of selected fossil plants and animals

<table>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Burgersdorp Fm: Gregicaulis</td><td>Burgersdorp Fm: Dilatata</td><td>Burgersdorp Fm: Lepidopteris</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Molteno Fm: Dicroidium sp.</td><td>Molteno Fm: Sphenobaiera sp.</td><td>Molteno Fm: Bennettitalean leaf</td></tr>
</table>

Burgersdorp Formation (Cynognathus AZ) and Stormberg Fauna (Scalenodontoides – Lower Elliot and Massospondylus – Upper Elliot) Below

	
Cynognathus skull	*Diademadon* skull
	
Kannemeyeria skull	*Euparkeria* skull

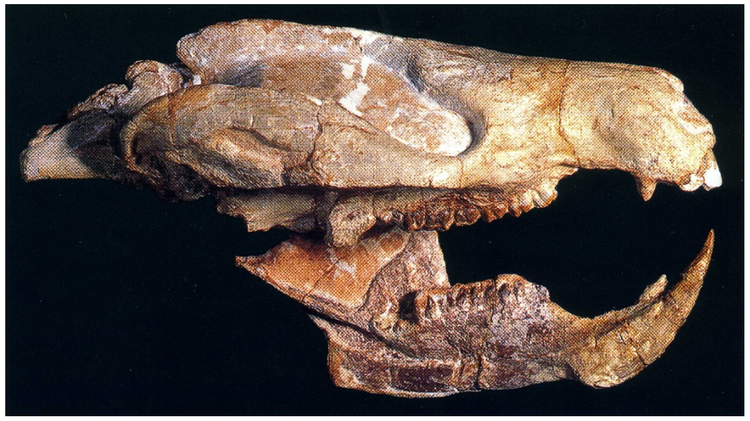
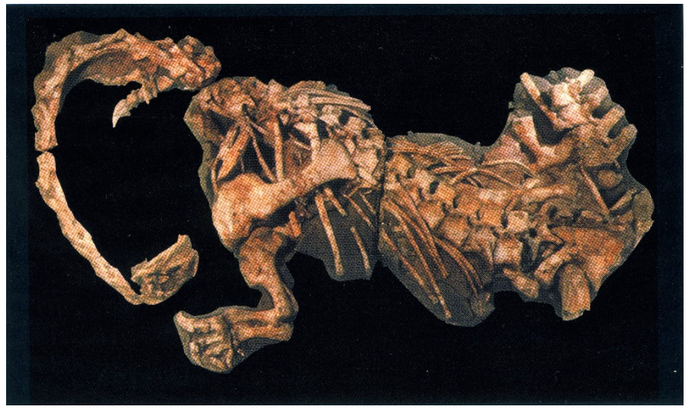
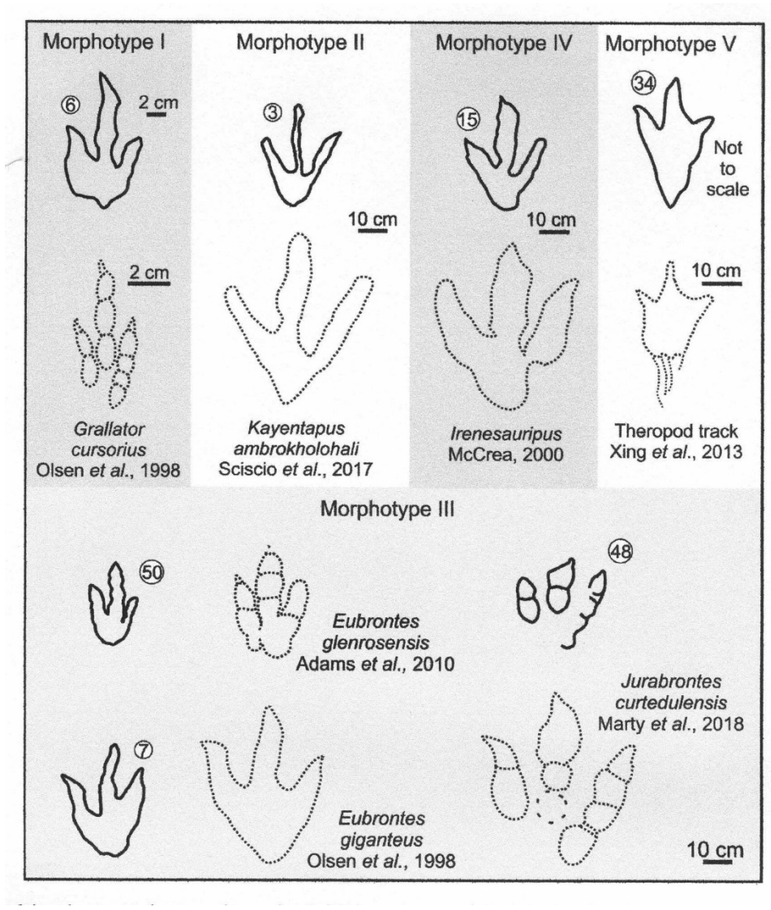
Stormberg Group Fauna	
	
Erythrosuchus skull	Massospondylus skull
	
Tritylodon skull	Massospondylus skeleton

Figure showing the different types of fossil footprints (ignites). Taken from Abrahams et al. 2020; fig 7.



DIGBY WELLS
ENVIRONMENTAL

Appendix C: Summary of Lesotho Fossil Record

Lesotho Palaeontology Database – MKB 01April2021

Age	Locality	Fossils	References
Clarens Fm, lowermost	The Tsikoane ichnosite (28°54'4.90"S, 27° 59'41.67"E) is located in the Hlotse district, northern Lesotho, directly above the Tsikoane Anglican Church, in the lower-most Clarens Formation (Zone B/4 of Ellenberger 1970; Figure 1(a)).	3 types of tridactyl tracks: Kayentapus-like and Eubrontes-like features in addition to previously recognised Grallator-like features. Extent: 250m	Abrahams et al., 2021 ? Ellenberger 1972 and synonymised by Olson & Galtier 1984
Upper Elliot	Roma Valley, at Lephoto Dam, Maseru district. The Lephoto dam site (29°26′49.03″S 27°44′18.57″E) <1.5 km ENE of the National University of Lesotho in the Roma Valley,	Two tridactyl ichnite morphologies Grallator-like, from small and medium-size theropod dinosaurs. Trisauropodiscus, rare, tracks of small birds and is known with certainty in Lesotho - heterodontosaurid ornithischian dinosaur.	Abrahams et al., 2016.
	Qala		2ndary in Abrahams+2021
	Morija		ditto
Elliot Fm	A, Upper Elliot Formation (Hettangian–Sinemurian), Likhoele, Lesotho	*A, Fabrosaurus australis* - nomen dubium *Lesothosaurus diagnosticus* - rediagnosed *Stormbergia dangershoeki* gen. et. sp. nov. – 3 partial skeletons And is significantly larger than previously described Elliot Formation ornithischians	Butler 2005
Upper part of Lower Elliot	Moyeni tracksite, southwest Lesotho, and tracks NW of town of Quthing (Moyeni) 30°23'42"S; 27°41'34"E	Tracks of the 3.5m long temnospondyl *Episcopopus ventrosus*	Marsicano et al., 2014. Ellenberger P, 1974
Lower Elliot Fm	Thaba 'Nyama SA 30°36'45.56"S 27°20'45.59"E	*Melanorosaurus readi*	McPhee et al., 2016
Lower Clarens Fm	Leribe, just north of the town, northern Lesotho 28° 49' 54.02" S, 28° 5' 44.80" E	*Kalosauropus* tracks - a bipedal massospondylid,	Mukkadam et al., 2021 Ellenberger F. 1959; Ellenberger P. 1979; Ellenberger et al. 1970).
		The floral diversity in the Clarens Formation is also notable and includes sphenophytes, conifers as well as petrified wood (e.g. *Agathoxylon* sp. – Ellenberger 1970; Petrified gymnosperm wood with well-developed growth rings is especially prevalent in the lower and upper zones of the Clarens Formation (Ellenberger 1970), and locally has been preserved in growing position at the contact with the conformably overlying Drakensberg Group (Meijs 1960).	Info in Mukkadam + 2021
Clarens Fm		Dadoxylon sp.	Meijs, 1960

Age	Locality	Fossils	References
Lower Elliott Fm (Triassic not Jurassic as said previously	Thabana Morena, west SW Lesotho Exact locality not known	*Melanorosaurus thabanensis* , known as the Maphutseng dinosaur'	de Fabrègues & Allain, 2016 Ellenberger et al., 1964; Ellenberger, 1970; Ellenberger & Ellenberger, 1956; Ellenberger & Ginsburg, 1966; Gauffre, 1993b
Lower Elliot Formation (Upper Triassic)	Maphutseng, Lesotho Stratigraphy questioned	*Kholumolumo ellenbergerorum*, gen. et sp. nov., a new early sauropodomorph; bipedal 9m long Thotobolo ea 'Ma-Beata,' meaning 'Beata's mother's trash heap').	De Fabregues & Allain, 2019
		represents sedimentary facies typical of the top of the Molteno Formation. It is mainly composed of gray to yellowish-green sandy clays and soft gritty sandstone that contains abundant plant fossils, with the foliage species *Dicroidium odontopteroides* dominating the assemblage. Laterally, the bone bed grades into red sandstone typical of the LEF (Ellenberger and Ellenberger, 1956a). In their subsequent publications (Ellenberger and Ginsburg, 1966; Ellenberger et al., 1970), the same authors changed their interpretation and referred the bone bed of Maphutseng to the top of the Molteno Formation. In 1970, Paul Ellenberger established a subdivision for the Molteno, Elliot, and Clarens formations in Lesotho and revised the stratigraphic position of the Maphutseng bone bed, which he placed in Zone A/4 ('Molteno supérieur b du Lesotho'). Zone A/4 is now considered to form part of the LEF	In de Fabregues & Allain 2019
Upper Elliott Fm	Ha Nohana, southern Lesotho	Two morphoypes of ichnites (footprints).	Rampersadh et al., 2018
Upper Elliot Fm	Matobo West Lesotho	*Eubrontes* or *Kayentapus* 1.8 km west of the National University of Lesotho main entrance in the Roma Valley (Maseru District, Lesotho; Fig 1). It lies on an informal road between the villages of Ha Mokhosi and Ha Matobo. Although the megatheropod trackways were discovered by the authors, the site is immediately adjacent to the Matobo trackway site that was briefly documented by Ambrose [22].	Sciscio et al., 2017 Close to Ambrose 2003 site
uppermost Lower Elliot Formation	Alwinskop, near Quthing, southwestern Lesotho.	Giant brachyopoid temnospondyl 1970, B. Battail, P. Ellenberger and L. Ginsburg discovered a skull fragment of a "grand Stégocéphale" from the uppermost part of the lower "Red Beds"	Steyer & Damiani, 2005 Dutuit and Ginsburg, 1982
Lower Elliot	Damplaats 55, close to Ladybrand, Free State Likhoele, western Lesotho	Rauisuchian Likhoele, Mafeteng, Lesotho, tentatively lower Elliot Formation (Norian-Rhaetian), or potentially base of upper Elliot Formation (upper Elliot fauna have been collected from the same locality, Crompton, 1964)	Tolchard et al., 2019

Age	Locality	Fossils	References
Upper part of lower Elliot Fm	Moyeni track site	(see also Marsicano et al., 2014) Trackways of *Anomoepus* and *Grallator*	Wilson et al., 2009

Abrahams et al. (2021?) page 8 Historical tracks: verbatim - Tridactyl tracks with morphologies similar to the Tsikoane ichnites are known from other ichnosites in the Clarens Formation of Lesotho such as Qalo and Morija (Dieterlen 1885; Dornan 1908; Ellenberger and Ellenberger 1958; Ellenberger et al. 1970; Ellenberger 1970, 1972). Although a detailed description of the Tsikoane ichnosite was not supplied, the Tsikoane tracks have been briefly mentioned in three of the publications by the Ellenberger brothers:

(1) Ellenberger and Ellenberger (1958) mentioned and attributed the Tsikoane tracks, together with those at Qalo and Morija, to bipedal saurischians, maybe theropods;

(2) Ellenberger et al. (1970, (their Figure 2(r)) provided one trackway outline from Tsikoane and attributed it to '? Plateosauridé'; and

(3) Ellenberger (1970) likened the Tsikoane tracks to those at Morija and assigned them to the ichnotaxa Kainotrisauropus morijiensis. It is unclear if the Ellenbergers located the fallen block described by Dornan (1908). It is likely that the Tsikoane tracks ascribed to Kainotrisauropus morijiensis are the abundant morphotype III tracks preserved beneath overhangs. The average track ratios and total digit divarications (TL/TW = 1.44, Dp/TS = 0.55, Dp/TL = 0.38 and II^IV = 47°) from the illustration in Ellenberger et al. (1970, their Figure 2(r)) are comparable to the average Morphotype III dimensions (Table 5.2). Furthermore, the Ellenberger et al. (1970) tracks are shown to preserve digital pad impressions and claw marks, which are common features in Morphotype III tracks. As mentioned earlier, in a revision of the southern African vertebrate tracks, Olsen and Galton (1984) synonymised Kainotrisauropus morijiensis with Grallator.

Figure 7 sketch of track morphotypes.

Thus far, Massospondylus and Melanorosaurus are the only genera known from both South Africa and Lesotho (Galton & Upchurch, 2004). Another basal sauropodomorph (i.e., `the Maphutseng dinosaur'), discovered by a team led by Paul and François Ellenberger in the 1950s, is known from Lesotho (Ellenberger & Ellenberger, 1956; Ellenberger & Ginsburg, 1966). The material, under review, was preliminarily published in 1993 (Gauffre, 1993b) and fully described in a PhD thesis (Gauffre, 1996), but has unfortunately never been published further. Melanorosaurus is considered by some authors as the only basal sauropodomorph genus found both in Triassic and Jurassic deposits from Southern Africa (Gauffre, 1993a; Galton & Upchurch, 2004). Melanorosaurus readi (Haughton, 1924) is known from Late Triassic-aged (Norian) deposits in the Eastern Cape and Free State Provinces, South Africa (Galton, Van Heerden & Yates, 2005). Melanorosaurus thabanensis was described based on an isolated right femur, as ``the only Early Jurassic Melanorosauridae'' (Gauffre, 1993a:653). Recently, it has transpired that six other bones `associated' with the femur, and assigned the same specimen number, were discovered in the collections of the Muséum National d'Histoire Naturelle (MNHN), Paris. This material was originally collected in 1959 by a team led by François Ellenberger in the area of Thabana Morena, Lesotho (Costedoat, 1962; Ellenberger et al., 1964; Ellenberger, 1970).

DIGBY WELLS
ENVIRONMENTAL

Appendix D: Reference List for Lesotho Fossil Record

DIGBY WELLS
ENVIRONMENTAL

Publication List for Lesotho Palaeontology – MKB 30Mar2021

NB list in alphabetical then date order to track changes in ideas.

Abrahams M, Bordy EM, Sciscio L, Knoll F. 2017. Scampering, trotting, walking tridactyl bipedal dinosaurs in southern Africa: ichnological account of a Lower Jurassic palaeosurface (upper Elliot Formation, Roma Valley) in Lesotho. Historical Biology 29(7), 958–975. doi:10.1080/08912963.2016.1267164.

Abrahams, M., Bordy, E.M., Knoll, F., 2020. Hidden for one hundred years: a diverse theropod ichnoassemblage and cross-sectional tracks from the historic Early Jurassic Tsikoane ichnosite (Clarens Formation, northern Lesotho, southern Africa). Historical Biology, DOI: 10.1080/08912963.2020.1810681.

Abrahams M, Sciscio L, Reid M, Haupt T, Bordy EM. 2020. Large tridactyl dinosaur tracks from the Early Jurassic of southern Gondwana – uppermost Elliot Formation, Upper Moyeni, Lesotho. Ann Soc Geol Pol. 89. doi:10.14241/asgp.2020.07.

Ambrose, D. 2003. A note on fossil trackways at Roma. Lesotho Miscellaneous Documents No. 4, House 9 Publications Roma, 2003 iv+ 14pp.

Barrett, P.M., Butler, R.J., Yates, A.M., Baron, M.G. & Choiniere, J.N. 2016. New specimens of the basal ornithischian dinosaur Lesothosaurus diagnosticus Galton, 1978 from the Early Jurassic of South Africa. Palaeontologia africana 50, 48-65. (from Fouriesburg in the Free State)

Bordy EM, Abrahams M, Sciscio L. 2017. The Subeng vertebrate tracks: stratigraphy, sedimentology and a digital archive of a historic Upper Triassic palaeosurface (lower Elliot Formation), Leribe, Lesotho (southern Africa). Boll Soc Paleontol Ital. 56(2):181–198

Bordy EM, Abrahams M, Sharman GR, Viglietti PA, Benson RBJ, McPhee BW, Barret PM, Sciscio L, Condon D, Mundil R, et al. 2020. A chronostratigraphic framework for the upper Stormberg Group: implications for the Triassic-Jurassic boundary in southern Africa. Earth-Science Reviews 203, 103-120. doi:10.1016/j.earscirev.2020.103120.

Bordy EM, Eriksson P. 2015. Lithostratigraphy of the Elliot Formation (Karoo Supergroup), South Africa. South African Journal of Geology 118(3), 311–316. doi:10.2113/gssajg.118.3.311.

Bordy EM, Hancox PJ, Rubidge BS. 2004a. Fluvial style variations in the Late Triassic – Early Jurassic Elliot Formation, main Karoo Basin, South Africa. Journal of African Earth Sciences 38, 383–400.

Bordy EM, Hancox PJ, Rubidge BS. 2004b. Basin development during the deposition of the Elliot Formation (Late Triassic - Early Jurassic), Karoo Supergroup, South Africa. South African Journal of Geology 107, 395–410. doi:10.2113/107.3.397

Bordy EM, Head HV. 2018. Lithostratigraphy of the Clarens Formation (Stormberg Group, Karoo, Supergroup), South Africa. South African Journal of Geology 121(1), 119–130. doi:10.25131/sajg.121.0009.

Bordy EM, Sztanó O, Rampersadh A, Almond J, Choiniere JN. 2019. Vertebrate scratch traces from the middle Triassic Burgersdorp Formation of the main Karoo Basin, South Africa: sedimentological and ichnological assessment. Journal of African Earth Sciences 160, 103594. doi:10.1016/j.jafrearsci.2019.103594.

Bordy, E.M., Sciscio, L., Abdala, F., McPhee, B.W., and Choiniere, J.N. 2017. First Lower Jurassic vertebrate burrow from southern Africa (upper Elliot Formation, Karoo Basin, South Africa). Palaeogeography, Palaeoclimatology, Palaeoecology 468: 362–372.

Bordy, E.M., Van Gen, J., Tucker, R., and McPhee, B.W. 2015. Maphutseng fossil heritage: Stratigraphic context of the dinosaur trackways and bone bed in the Upper Triassic–Lower Jurassic Elliot Formation (Karoo Supergroup, Lesotho). In: H. Saber, A. Lagnaoui, and A. Belahmira (eds.),

First International Congress on Continental Ichnology [ICCI-2015],

Proceeding Abstracts, 67. Chouaïb Doukkali University, El Jadida

Bristowe A, Raath M. 2004. A juvenile ceolphysoid skull from the Early Jurassic of Zimbabwe and the synonymy of Coelophysis and Syntarsus. Palaeontologia africana 40, 31–41.

Butler, R.J. 2005. The “fabrosaurid” ornithischian dinosaurs of the upper Elliot Formation (Lower Jurassic) of South Africa and Lesotho. Zoological Journal of the Linnean Society 145: 175–218

Crompton, 1964. A preliminary description of a new mammal from the Upper Triassic of South Africa. Proceedings of the Zoological Society of London 142, 441–452.

Ellenberger, P. 1955. Note préliminaire sur les pistes et restes osseux de

vertébrés du Basutoland (Afrique du Sud). Comptes Rendus de

l’Académie des Sciences 240:889–891.

Ellenberger, F., and P. Ellenberger. 1956a. Le gisement de dinosauriens de Maphutseng. Compte Rendu Sommaire de la Société Géologique de France 8:99–101.

Ellenberger, F., and P. Ellenberger. 1956b. Quelques précisions sur la série du Stormberg au Basutoland (Afrique du Sud). Comptes Rendus de l’Académie des Sciences 242:799–801.

Ellenberger F, Ellenberger P. 1958. Principaux types de pistes de Vertébrés dans les couches du Stormberg au Basutoland (Afrique du Sud) (Note préliminaire). [Main types of vertebrate footprints in the Stormberg beds of Basutoland (South Africa). (Preliminary note)]. Compte rendu somm des séances de la Soc Géol Fr. p. 65–67.

Ellenberger, F., and P. Ellenberger. 1960. Sur une nouvelle dalle à pistes de vertébrés découverte au Basutoland (Afrique du Sud). Compte Rendu Sommaire de la Société Géologique de France 9:236–237.

Ellenberger F, Ellenberger P, Fabre J, Mendrez C (1963) Deux nouvelles dalles a` pistes de verte´bre´s fossiles de´couvertes au Basutoland (Afrique du Sud). C R Somm Se´ance Soc Ge´ol France 1963: 315–317.

Ellenberger, F., P. Ellenberger, J. Fabre, L. Ginsburg, and C. Mendrez. 1964. The Stormberg Series of Basutoland (South Africa); pp. 320– 330 in R. K. Sundaram (ed.), International Geological Congress:

Proceedings of the 22nd International Geological Congress, New Delhi, December 14–22, 1964. R.K. Sundaram, Calcutta.

Ellenberger, F. and Ginsburg, L. 1966. Le gisement de dinosauriens de Maphutseng (Basutoland, Afrique du sud) et l'origine des sauropodes. Comptes Rendus de l'Académie des Sciences, Paris 262: 444–447.

Ellenberger, F., Ellenberger, P., and Ginsburg, L. 1969. The appearance and evolution of dinosaurs in the Trias and Lias: a comparison between South African Upper Karroo and Western Europe based on vertebrate footprints. In: A.J. Amos (ed.), Gondwana Stratigraphy: IUGS Symposium Paris, 333–354. UNESCO, Buenos Aires.

Ellenberger F, Ellenberger P, Ginsburg L. 1970. Les Dinosaures du Trias et du Lias en France et en Afrique du Sud, d'après les pistes qu'ils ont laissèes. [The Triassic and Lias dinosaurs in France and South Africa, according to the tracks they left]. Bull Geol Soc Fr. 7(1):151–159.

doi:10.2113/gssgfbull.S7-XII. 1.151.

Ellenberger P 1970. Les niveaux paleontologiques de premiere appartition des mammiferes primordiaux en Afrique du Sud et leur ichnologie: establissement de zones stratigraphiques detaillees dans le Sotrmberg du Lesotho (Afrique du Sud)(Trias superieur a Jurassique) [The fossil-bearing strata associated with the earliest appearance of mammals in South Africa and their ichnology: establishment of detailed stratigraphic zones in the Stormberg of Lesotho (South Africa)(Upper Triassic to Jurassic)]. In: Haughton SH, editors. Second Gondwanaland Symposium on Gondwana Stratigraphy and Palaeontology: proceedings and papers; Council for Scientific & Industrial Research, Pretoria; p. 343–370.

Ellenberger, P. 1970. Establissement de Zones Stratigraphiques Détaillées dans le Stromberg du Lesotho (Afrique du Sud) (Trias Supérieur à Jurassique). In: S.H. Haughton (ed.), Proceedings and Papers of the Second Gondwanaland Symposium, 343–370. Council for Scientific and Industrial Research, Pretoria.

Ellenberger P. 1972. Contribution à la classification des Pistes de Vertébrés du Trias : Les types du Stormberg d 'Afrique du Sud (I)[Contribution to the classification of Triassic vertebrate trackways: types found in the Stormberg Series of South Africa(I)]. Paleovertebrata. Memoire Extraordinaire. 1972 (Montpellier): p.152.

Ellenberger P (1974) Contribution a` la classification des pistes de verte`bres du Trias: les types du Stormberg d'A´ frique du Sud (II partie): le Stormberg Superieur-I. Le biome de la zone B/1 ou niveau de Moyeni: ses biocenoses). Palaeovertebrata Me´moire Extraordinaire: 1–202

Gauffre, F.-X. 1993a. Biochronostratigraphy of the Lower Elliot Formation (Southern Africa) and preliminary results on the Maphutseng dinosaur (Saurischia: Prosauropoda) from the same formation of Lesotho. New Mexico Museum of Natural History & Science Bulletin 3: 147–149.

Gauffre, F.-X. 1993b. The most recent Melanorosauridae (Saurischia, Prosauropoda), Lower Jurassic of Lesotho, with remarks on the prosauropod phylogeny. Neues Jahrbuch für Geologie und Paläontologie 11: 648–654.

Gauffre, F.-X. 1996. Phylogénie des dinosaures prosauropodes et étude d'un nouveau prosauropode du Trias supérieur d'Afrique australe. Ph.D. dissertation, Muséum National d'Histoire Naturelle, Paris, France, 156 pp.

Knoll F. 2002a. Nearly complete skull of Lesothosaurus (Dinosauria: ornithischia) from the Upper Elliot Formation (Lower Jurassic: Hettangian) of Lesotho. Journal of Vertebrate Palaeontology 22(2), 238–243. doi:10.1671/0272-4634(2002)022 [0238:NCSOLD]2.0.CO;2.

Knoll F. 2002b. New skull of Lesothosaurus (Dinosauria: ornithischia) from the Upper Elliot Formation (Lower Jurassic) of southern Africa. Geobios. 35 (5):595–603. doi:10.1016/S0016-6995(02)00072-4.

Knoll, F. 2004. Review of the tetrapod fauna of the "Lower Stormberg Group" of the main Karoo Basin (southern Africa) : implication for the age of the Lower Elliot Formation. Bulletin de la Societe Geologique de France 175: 73–83.

Knoll F. 2005. The tetrapod of the Upper Elliot and Clarens formations in the main Karoo Basin (South Africa and Lesotho). Bulletin Société Géologique Francais 1(1), 81–91. doi:10.2113/176.1.81.

Knoll F. 2010. A primitive sauropodomorph from the upper Elliot Formation of Lesotho. Geological Magagazine 147(6), 814–829. doi:10.1017/S001675681000018X.

Knoll F, Battail B. 2001. New ornithischian remains from the Upper Elliot Formation (Lower Jurassic) of Lesotho and stratigraphical distribution of southern African fabrosaurids. Geobios. 34(4), 415–421. doi:10.1016/S0016- 6995(01)80005-X.

Krupandan, E. 2019. Unravelling the biology of the Southern African Sauropodomorph dinosaurs, Plateosauravus and the 'Maphutseng dinosaur'. Doctoral dissertation, University of Cape Town, Cape Town, 228 pp.

McPhee, B.W., Yates, A.M., Choiniere, J.N., and Abdala, F. 2014. The complete anatomy and phylogenetic relationships of Antetonitrus ingenipes (Sauropodiformes, Dinosauria): implications for the origins of Sauropoda. Zoological Journal of the Linnean Society 171: 151–205.

McPhee BW, Bonnan MF, Yates AM, Neveling J, Choiniere JN. 2015a. A new basal sauropod from the pre-Toarcian Jurassic of South Africa: evidence of niche-partitioning at the sauropodomorph-sauropod boundary? Scientific Reports 5 (1):13224. doi:10.1038/srep13224.

McPhee, B.W., Choiniere, J.N., Yates, A.M., and Viglietti, P.A. 2015b. A second species of Eucnemesaurus Van Hoepen, 1920 (Dinosauria, Sauropodomorpha): new information on the diversity and evolution of the sauropodomorph fauna of South Africa's lower Elliot Formation

(latest Triassic). Journal of Vertebrate Paleontology 35: e980504

McPhee, B.W. and Choiniere, J.N. 2016. A hyper-robust sauropodomorph dinosaur ilium from the Upper Triassic–Lower Jurassic Elliot Formation of South Africa: Implications for the functional diversity of basal Sauropodomorpha. Journal of African Earth Sciences 123: 177–184.

McPhee BW, Bordy EM, Sciscio L, Choiniere JN. 2017. The sauropodomorph (Dinosauria) biostratigraphy of the Elliot Formation of southern Africa: tracking the evolution of Sauropodomorpha across the Triassic-Jurassic boundary. Acta Paleontologica Polonica 62, 441–465.

Meijs L. 1960. Notes on the occurrence of petrified wood in Basutoland. Basutoland Note Rec. 2:20–26.

Olsen PE, Galton PM (1984) A review of the reptile and amphibian assemblages from the Stormberg of southern Africa, with special emphasis on the footprints and the age of the Stormberg. Paleontol Africana 25: 87–110.

Peyre de Fabrègues, C., and R. Allain. 2016. New material and revision of Melanorosaurus thabanensis, a basal sauropodomorph from the Upper Triassic of Lesotho. PeerJ 4:e1639.

Peyre de Fabrègues, C., R. Allain, and V. Barriel. 2015. Root causes of phylogenetic incongruence observed within basal sauropodomorph interrelationships. Zoological Journal of the Linnean Society

175:569–586.

Peyre de Fabrègues, C., Allain, R., 2019. Kholumolumo ellenbergerorum, gen. et sp. nov., a new early sauropodomorph from the lower Elliot Formation (Upper Triassic) of Maphutseng, Lesotho, Journal of Vertebrate Paleontology, 39:6, e1732996,

DOI: 10.1080/02724634.2019.1732996

Sciscio L, Bordy EM, Abrahams M, Knoll F, McPhee BW. 2017a. The first megatheropod tracks from the Lower Jurassic upper Elliot Formation, Karoo Basin, Lesotho. Plos one. 12(10):e0185941.

doi:10.1371/journal.pone.0185941.

Sciscio L, Bordy EM, Reid M, Abrahams M. 2016. Sedimentology and ichnology of the Mafube dinosaur track site (Lower Jurassic, eastern Free State, South Africa): a report on footprint preservation and palaeoenvironment. PeerJ 4: e2285. doi:10.7717/peerj.2285. Sciscio, L. & Bordy, E. M., 2016. Palaeoclimatic conditions in the Late Triassic-Early Jurassic of southern Africa: a geochemical assessment of the Elliot Formation. Journal of African Earth Sciences, 119: 102–119.

Sciscio L, Knoll F, Bordy EM, de Kock M, Redelstoff R. 2017b. Digital reconstruction of the mandible of an adult Lesothosaurus diagnosticus with insight into the tooth replacement process and diet. PeerJ. 5:e3054. doi:10.7717/ peerj.3054.

Smith RM, Kitching J. 1997. Sedimentology and vertebrate taphonomy of the Tritylodon Acme Zone: a reworked palaeosol in the Lower Jurassic Elliot Formation, Karoo Supergroup, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology. 131(1 1-2): 29–50 doi:10.1016/S0031- 0182(96)00143-5.

Smith RMH, Marsicano CA, Wilson JA. 2009. Sedimentology and Paleoecology of a diverse Early Jurassic Tetrapod tracksite in Lesotho, southern Africa. Palaios. 24(10):672–684. doi:10.2110/palo.2008.p08-115r.