Palaeontological Impact Assessment for proposed water supply pipelines for Delmas Coal North and South Shafts and the proposed KiPower IPP Power Plant (Mpumalanga/Gauteng).

Phase 1

03 July 2013

Marion Bamford PhD
Bernard Price Institute for Palaeontological Research
School of Geosciences
University of the Witwatersrand
P Bag 3, WITS 2050
Johannesburg

Tel: +27 11 716 6690
Fax: +27 11 717 6694
Email: marion.bamford@wits.ac.za

Phase 1 - Palaeontological Impact Assessment for the proposed water supply pipelines for Delmas Coal North and South Shafts and the proposed KiPower IPP Power Plant (Mpumalanga/Gauteng).

Introduction

As requested I am providing a Palaeontological Impact Assessment on behalf of Jones & Wagener (Pty) Ltd for their client Kuyasa Mining (Pty) Ltd on behalf of KiPower (Pty) Ltd for the construction of a water supply pipeline to the proposed KiPower Independent Power Producer (IPP) Power Plant and Delmas Coal. There are two proposed options for the routes of the pipeline:

Route Option A:

- Pump raw water south from the SamQuarz silica quarry to the Power Plant and Delmas Coal;
- Pump raw water south from the Blommeland farm aquifer on the farm Brakfontein 264 IR to the Power Plant and Delmas Coal; and
- Establish a connection with a Rand Water supply pipeline, south of Devon, to transport potable water north to the Power Plant and Delmas Coal.

Route Option B:

- Pump raw water south from the SamQuarz silica quarry to the Power Plant and Delmas Coal;
- Pump raw water south from the Blommeland farm aquifer on the farm Brakfontein 264 IR to the Power Plant and Delmas Coal; and
- Establish a connection with a Rand Water supply pipeline, south of Eendracht, to transport potable water north to the Power Plant and Delmas Coal.

Phase 1 – Route options A and B:

Geology and palaeontology

The proposed routes for the pipeline (Option A and Option B), are shown in the map provided by Jones & Wagener (Figure 1). The main part of the pipeline, as well as both options, will transect two different geological formations. The southern parts originate in the region that has numerous dolerite dykes (pink area in Figure 2 here; symbol "Jd"). These dykes are part of the Drakensburg volcanic system and intruded through the underlying slightly older Ecca sediments comprising sandstones, shales and coal seams that had been deposited in a fluvial and deltaic ecosystem. The physical intrusion as well as the heat of the dykes adversely affected the coal and other fossils and effectively hardened the sediments. This destroys the fossils in the close vicinity of the dykes.

The northern part of both routes traverses rocks of the Vryheid Formation. The Vryheid Formation is in the Early Permian Ecca Group (approximately 290 to 270 million years old) with abundant coal deposits. It extends over a wide area of north eastern Karoo Basin and comprises fluvial and deltaic deposits of coarse sandstone, conglomerate and coal. The Vryheid Formation can be divided into three main layers or intervals: the lower fluvial-dominated deltaic interval, the middle fluvial interval (or coal zone) and the upper fluvial-

dominated deltaic interval (Johnson et al., 2006). The five coal seams vary greatly in thickness and distribution with one or more being absent from some local areas.

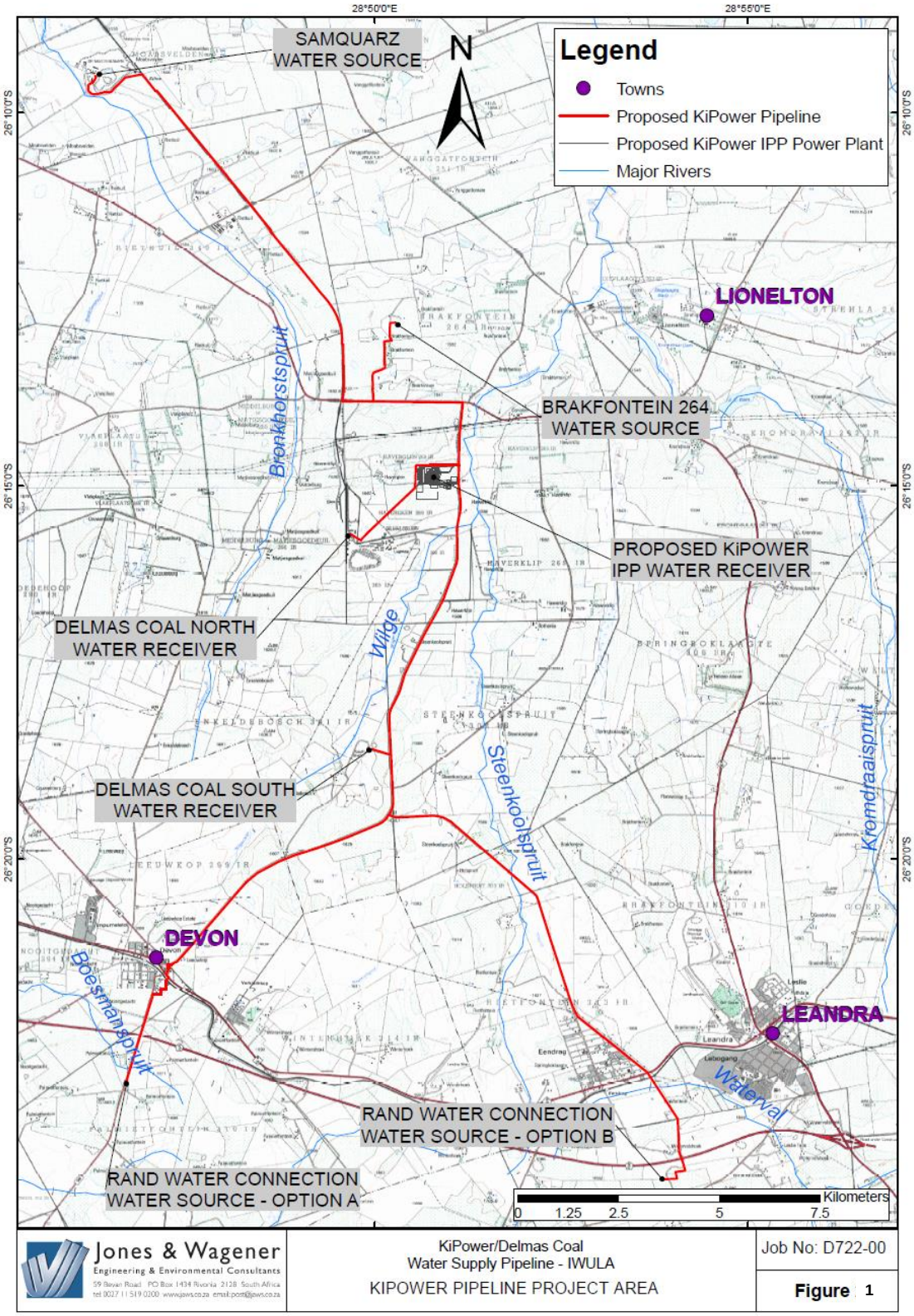


Figure 1: Topographic map 1:50 000 supplied by Jones & Wagener showing the two proposed routes for the pipeline.

Coal is formed from ancient compressed and altered plant material so coal itself is of little interest palaeobotanically, but well preserved plant material is commonly found in the

shales associated with the coal seams (within, above and below). Fossil insects can be locally common, but invertebrates and vertebrates are very rare, especially in the Early Permian strata. While fossil plants can be preserved in coarse sandstones, the preservation is usually poor. Vertebrate fossils are very rarely preserved with fossil plants.

According to the published records (Anderson and Anderson, 1985; Aitken, 1994) and unpublished records in the Bernard Price Institute for Palaeontological Research (fossil plant catalogue), no fossils have been recorded from the area south of Delmas to Leandra and Devon. The pipelines will be within a few metres of the ground surface and so will be placed well above the uppermost coal seam, no 5, which in that area lies between 25 and 170 m below the surface (Jordaan, 1986; Snyman 1998).

The underlying Malmani Group rocks are very old, about 2200 million years, and do not contain any fossils.

Permian (Ecca) flora

Fossil plants, however, have been collected from collieries in the Ermelo, Witbank, and Rietspruit areas in the Vryheid Formation and these include a wide variety of *Glossopteris* leaves and roots (extinct seed fern), sphenophytes (horsetails), lycophytes (clubmosses), ferns, ginkgophytes and Cordaitales (extinct early conifer). It is possible that these plants would be found close to or within the coal seams so they are illustrated in the Appendix.

Recommendation

From the Palaeontological perspective there is no difference between the two routes proposed for the pipelines. Fossils are extremely unlikely to occur along the southern part of the routes because of the dominance of dolerite dykes. Coal and fossil plants do occur along the northern part close to the proposed KiPower IPP Power Plant but as the area has already been extensively disturbed by agriculture, quarrying and road developments, it is very unlikely that good fossil plants or invertebrates would be found on the surface or at the relatively shallow depth required for the pipelines.

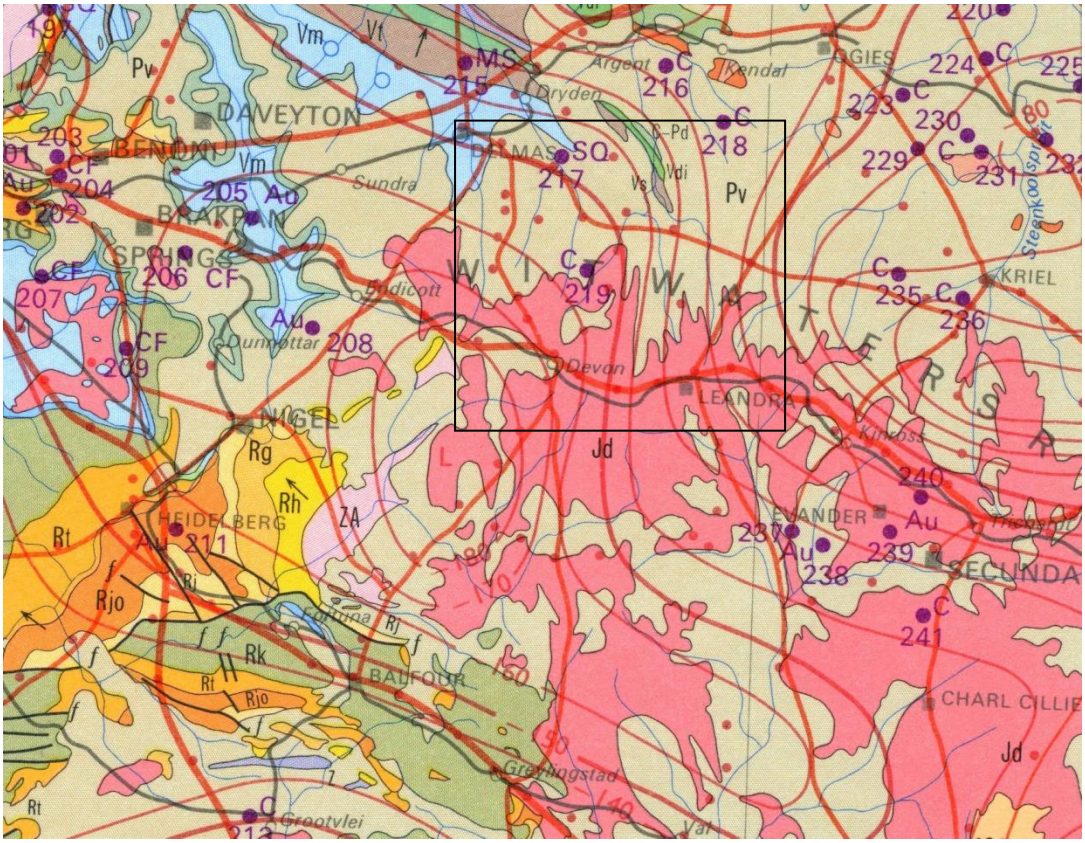


Figure 2: Geology of the Delmas area. The square marks the area enclosing the proposed pipelines. Abbreviations and lithology in Table 1 below.
Map from the Geological Survey, Pretoria; 1984, 1: 1 000 000.

Table 1: Geology of the proposed development area. Refer to map in Figure 2.

Symbol	Formation/Group	Lithology	Age
Jd		Dolerite dykes	Jurassic
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Carboniferous- Early Permian
Vm	Malmani	Dolomite, chert	Vaalian > 2200 Ma
Pv	Vryheid	Sandstone, shale, coal	Middle Ecca; middle Permian

Final Recommendation

From the palaeontological point of view the proposed construction of the pipelines development can proceed. The selection of Route A or Route B would have to be determined by other factors.

However, if fossils are excavated during construction or operation of the proposed pipelines, I strongly recommend that the fossils are rescued and donated to a recognized research or storage facility that is acknowledged by the South African Heritage Resources Agency (SAHRA). Such facilities are the Council for Geosciences or the Ditsong Museum in Pretoria,

or preferably the Bernard Price Institute (BPI) at the University of the Witwatersrand in Johannesburg where there is a professional palaeobotanist. From 1st July 2013 the BPI is known as the Evolutionary Studies Institute and is one of the six 21st Century Institutes recently established by the University.

If it is discovered that unusual fossils occur in the affected area (this can be determined by sending photographs of fossils to a professional palaeobotanist) then a Phase 2 – site visit and rescue project - will be necessary.

References

Aitken, G.A., 1994. Permian palynomorphs from the Number 5 Coal seam, Ecca Group, Witbank/Highveld Coalfields, South Africa. Palaeontologia africana 31, 97-109.

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.

Cadle, A.B., Cairncross, B., Christie, A.D.M., Roberts, D.L., 1993. The Karoo basin of South Africa: the type basin for the coal bearing deposits of southern Africa. International Journal of Coal Geology 23, 117-157.

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.

Jordaan, J., 1986. Highveld coalfield. In: Anhaeusser, C.R., and Maske, S. (Eds). Mineral Deposits of Southern Africa. Vols I and II, Geological Society of South Africa, Johannesburg, pp. 1985-1994.

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.

Appendix 1
Photographs of fossil plants from Ecca rocks and coal deposits.

As part of the Environmental Management Program (EMPr) I recommend that the personne involved in construction look out for fossil plants whilst excavating, then collect any fossils found and deliver them to a research institute.

Figure A1 – top left and bottom: *Glossopteris* leaves. These are the most abundant plant fossils from this time and are easily recognized by the shape and venation. There is a midrib and smaller veins travelling from the midrib to the margin. The leaves range in size from a few cm long to over 60 cm long but more commonly are around 10-20 cm long.
Top right – leaf of the cordaitalean, *Noeggerathiopsis*. The leaves are similar in shape to *Glossopteris* but there is no midrib and the veins travel from the base to the top margin.

Figure A2 – Lycophytes (common name: club mosses). Most commonly the stem of these plants are preserved and one can see the leaf scars on the stem, of various shapes, either circular, round or diamond-shaped. The leaves are long and narrow. The stems are 1-10cm in diameter.

Figure A3 – Ferns and horsetails. The fossil ferns look like modern ferns. *Asterotheca*, top left, has rounded pinnae (leaflets). Sphenopytes are commonly known as horsetail ferns and they have stems much like bamboo with longitudinal striations, horizontal bands from which roots or whorls of leaves are attached. The leaves can be wide, long and narrow, or very short like the only surviving genus, *Equisetum*. The stems are 0.5 to 6 cm in diameter.

Marion Bamford
03 July 2013

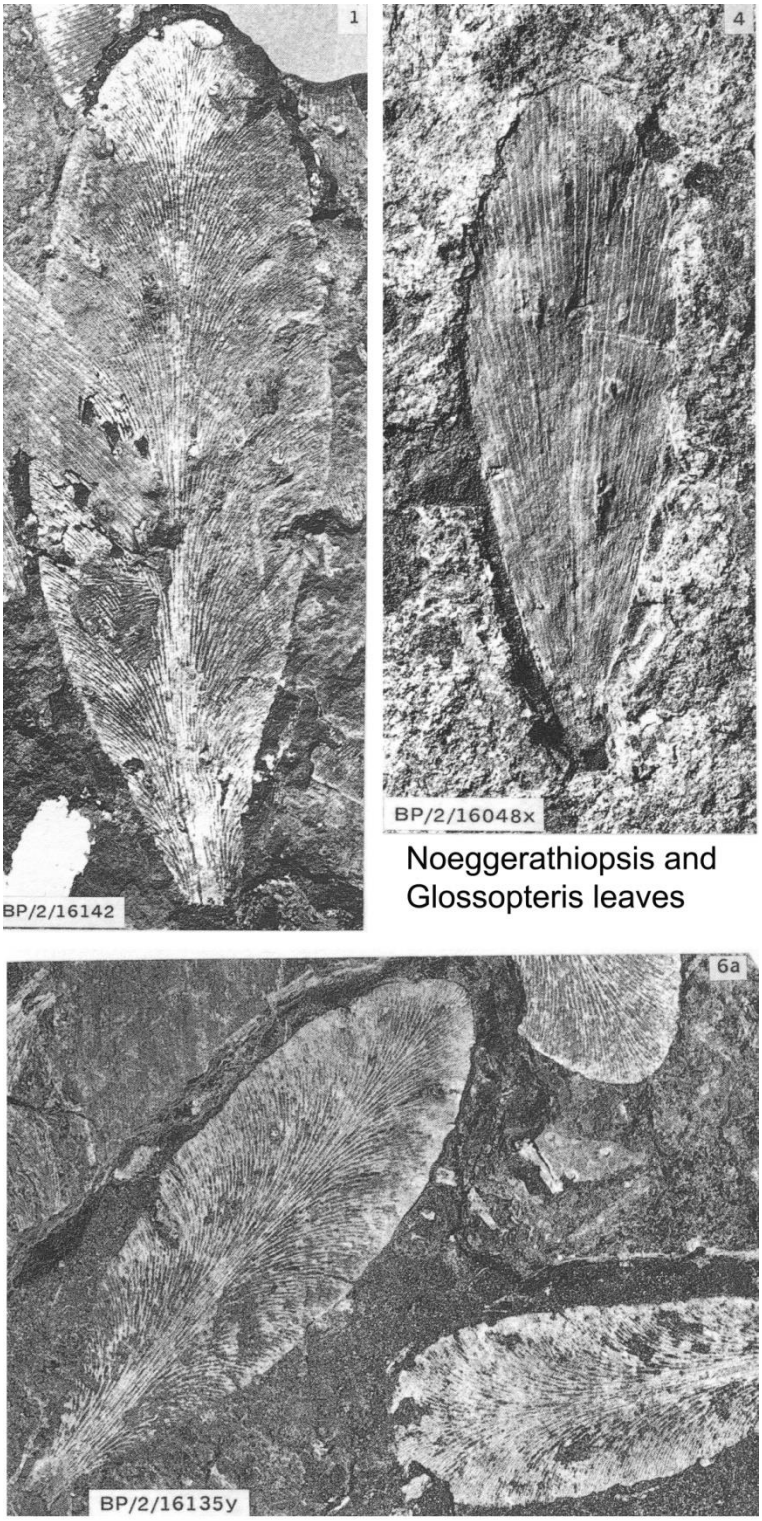
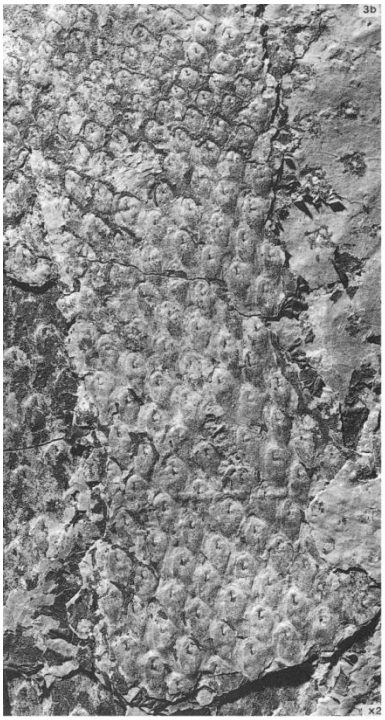
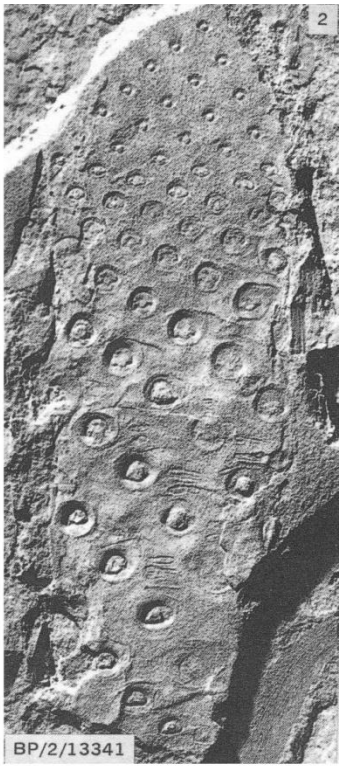
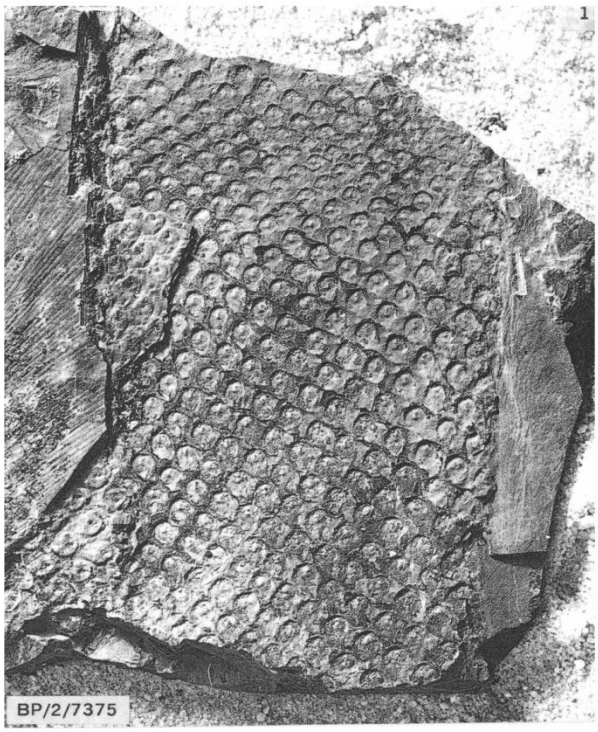

1
BP/2/16142
4
BP/2/16048x
Noeggerathiopsis and
Glossopteris leaves
6a
BP/2/16135y

Figure A1





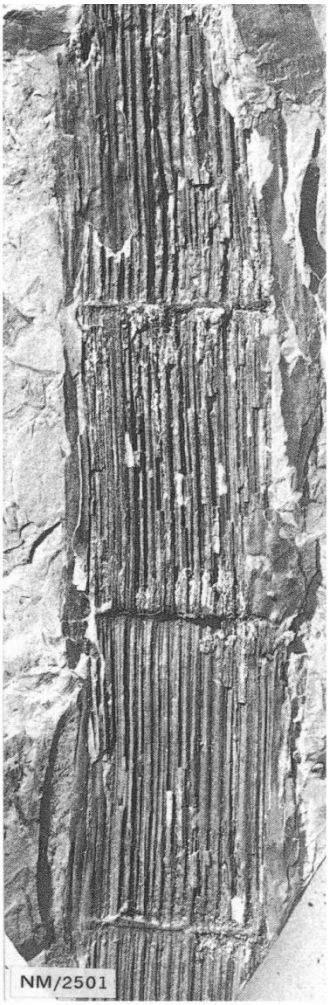


Lycopods - leaf scars on the stem

Cyclodendron lesleyii

Figure A2

Fern: Asterotheca sp.



Sphenophytes: whorls of leaves on a striated stem

Figure A3