

**Palaeontological Impact Assessment
for the establishment of a 600 MW power plant
and ash disposal facility
at Delmas (Mpumalanga/Gauteng).**

Phase 1

03 May 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 establishment of a 600 MW power plant and ash disposal facility at Delmas (Mpumalanga/Gauteng).

Introduction

As requested I am supplying a Phase 1 Palaeontological Impact Assessment on behalf of Jones and Wagener for their client KiPower (Pty) Ltd (a subsidiary of Kuyasa Mining, which also owns Delmas Coal and iKhwezi Colliery) which is located approximately 20km to the south-east of the town of Delmas in the Victor Khanye Municipality, within the Nkangala District Municipality of the Mpumalanga Province of South Africa.

Therefore a phase 1 desktop study is recommended and is presented in two parts: A-pipeline routes, and B – KiPower plant area.

Phase 1 – A – Pipeline Routes:

Geology and palaeontology

The proposed routes for the pipeline (Option 1 and Option 2, as shown in the map provided by Jones and Wagener “Figure 1 Rand Water Supply Routes”) transect two different geological formations. The southern parts originate in the region that has numerous dolerite dykes (pink area in Figure 1 here; symbol “Jd”). These dykes, part of the Drakensburg volcanic system, intruded the local areas during the Jurassic and “cooked” the adjacent rocks. This had the effect of hardening the rocks and destroying any fossil plant material or physically destroying the vertebrate fossils.

The northern part of both routes traverses rocks of the Vryheid Formation. This 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 Vryheid Formation is in the Ecca Group (approximately 290 to 270 million years old) with abundant coal deposits. 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. While fossil plants can be preserved in coarse sandstones, the preservation is usually poor. Vertebrate fossils are very rarely preserved with fossil plants.

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. Coal and fossil plants do occur along the northern part 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.

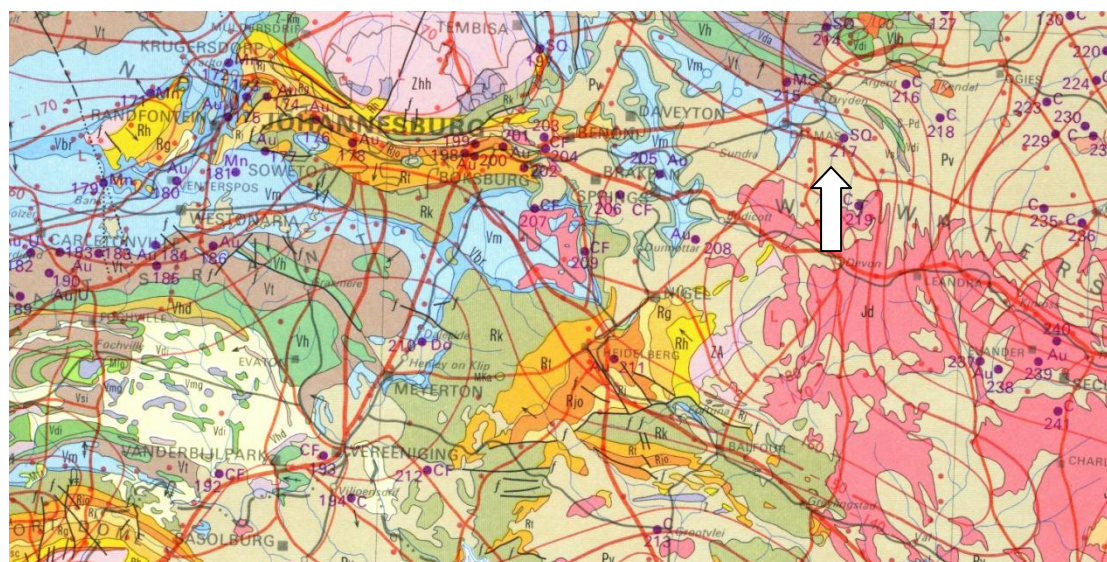


Figure 1: Geology of the Delmas area. Arrow marks the proposed development area. Abbreviations and lithology in Table 1. Map from the Geological Survey, Pretoria; 1984, 1: 1 000 000.

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

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

Phase 1 – B – KiPower Plant area

Geology and Palaeontology

Geologically the site is in the middle fluvial or coal layer of the Vryheid Formation. The excavation for coal in the ikwhezi Colliery will obviously penetrate and remove the coal layers. The ash stack and power station will be surface structures.

There are no records of fossil plants from this area. Published books, papers and reports and unpublished records housed at the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, have been consulted.

Recommendation

Fossil plants will be associated with the coal but it is unlikely that they are of great importance. From the palaeontological point of view the proposed development can proceed.

Final Recommendation

From the palaeontological point of view the proposed development can proceed. However, if fossils are excavated during construction or operation of the proposed pipelines and KiPower Plant (see Table 2 for list of plants) I strongly recommend that the fossils are rescued and donated to a recognized research or storage facility that is recognized by SAHRA (i.e. the Council for Geosciences or the Ditsong Museum in Pretoria, or preferably the Bernard Price Institute at the University of the Witwatersrand in Johannesburg where there is a professional palaeobotanist).

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.

Table 2:

Plant group/common name	Genus and species	Early to Middle Permian	Upper Permian
Lycopods (clubmosses)	<i>Haplostigma permianica</i>	+	
	<i>Leptophloem santae-helenae</i>	+	
	<i>Azaniadendron fertile</i>	+	
	<i>Cyclodendron leslii</i>	+	
Sphenopsids (horsetails)	<i>Sphenophyllum hammanskraalensis</i>	+	
	<i>Sphenophyllum mesoccaense</i>	+	
	<i>Sphenophyllum speciosum</i>	+	+
	<i>Annularia hammanskraalensis</i>	+	
	<i>Raniganjia kilburnensis</i>	+	+
	<i>Raniganjia rayneri</i>	+	
	<i>Raniganjia lanceolate</i>	+	
	<i>Phyllothea australis</i>		+
	<i>Phyllothea lawleyensis</i>	+	+
	<i>Phyllothea westensis</i>		+
	<i>Schizoneura gondwanansis</i>		+
Ferns	<i>Asterotheca hammanskraalensis</i>	+	
	<i>Asterotheca leeuwkuilensis</i>	+	
	<i>Sphenopteris lobifolia</i>	+	+
	<i>Liknometalon enigmata</i>	+	
Glossopteridales	Numerous leaves – morphotypes, not species	+++++	+++
- Female fructifications	<i>Arberia hlobanensis</i>	++	
-	<i>Arberia madagascariensis</i>	+	
-	<i>Bifaria intermittens</i>	+	
-	<i>Dictyopteridium natalensis</i>	+	
-	<i>Dictyopteridium flabellatum</i>	+	
-	<i>Elatra leslii</i>	+	
-	<i>Estcourtia bergvillensis</i>		+
-	<i>Estcourtia conspicua</i>	+	
-	<i>Estcourtia vandijkii</i>		+
-	<i>Gladiopomum acadarensis</i>	+	

-	<i>Gonophylloides strictum</i>	+	
-	<i>Gonophylloides waltonii</i>	+	
-	<i>Lidgettonia africana</i>	+	+
-	<i>Lidgettonia elegans</i>	+	+
-	<i>Lidgettonia inhluzanensis</i>		+
-	<i>Lidgettonia lidgettonioides</i>	+	+
-	<i>Lidgettonia mooiriverensis</i>		+
-	<i>Ottokaria buriadica</i>	+	
-	<i>Ottokaria hammanskraalensis</i>	+	
-	<i>Ottokaria transvaalensis</i>	+	+
-	<i>Plumsteadia gibbosa</i>	+	+
-	<i>Plumsteadia natalensis</i>		+
-	<i>Plumsteadia lerouxii</i>	+	
-	<i>Rigbya arberioides</i>	+	+
-	<i>Scutum leslii</i>	+	
-	<i>Vereenia leeukuilensis</i>	+	
- -male fructifications	<i>Eretmonia spp.</i>	+	
Ginkgoales	<i>Sphenobaiera eccaensis</i>	+	
	<i>Metreophyllum lerouxii</i>	+	
	<i>Ginkgophyllum kidstonii</i>	+	
	<i>Ginkgophyllum spatulifolia</i>	+	
	<i>Flabellofolium leeukuilensis</i>	+	
Conifers	<i>Noeggerathiopsis hislopai</i>	+	
	<i>Noeggerathiopsis spathulata</i>		+
	<i>Walkomiella transvaalensis</i>	+	
	<i>Podozamites hlobanensis</i>	+	
	<i>Pagiophyllum vandijkii</i>		+
	<i>Benlightfootia mooiensis</i>		+
	<i>Cyparissidium sp.</i>	+	
Incertae sedis	<i>Taeniopteris gemmina</i>	+	
	<i>Taeniopteris estcourtiana</i>		+
	<i>Botrychiopsis valida</i>	+	
	<i>Various seeds</i>	+	

Table 2: List of Early to middle Permian and Upper Permian plants from the Karoo Basin, South Africa. The proposed site for development lies in the Vryheid Formation (Early Permian). Compiled from Plumstead, 1969; Anderson and Anderson, 1985; Adendorff, 2004; Adendorff et al., 2003; Prevec et al., 2008, Taylor et al., 2009. (+ = present; +++++ = abundant/dominant)

References

Adendorff, R., 2004. A Revision of the Ovulate Fructifications of *Glossopteris* from the Permian of South Africa. Unpublished PhD thesis, University of the Witwatersrand, Johannesburg. 362 pp + 100 plates.

Adendorff, R., Bamford, M.K., McLoughlin, S., 2003. *Liknopetalon*: a review of a rare Gondwanan Permian pteridophyte. *Review of Palaeobotany and Palynology*. 126, 83-101.

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum of South African megaflores, 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.

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.

Prevec, R., McLoughlin, S., Bamford, M.K., 2008. Novel double wing morphology revealed in a South African ovuliferous glossopterid fructification. *Review of Palaeobotany and Palynology* 150, 22-36.

Taylor, T.N., Taylor, E.L., Krings, M., 2009. Palaeobotany. The biology and evolution of fossil plants. Academic Press, Burlington MA, USA. 1230pp.

Marion Bamford
03 May 2013