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GEOLOGY AND PALAEOBIOLOGY OF THE NORTHERN SPERRGEBIET, NAMIBIA

by

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History of study of the fluvio-paludal deposits of the northern Sperrgebiet, Namibia

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The palaeontological history of the northern Sperrgebiet spans over 80 years, with three main periods of activity. In the 1920's nearly 500 fossils were collected and sent to Germany for detailed study. At the same time a small collection of mammals was sent to America. The period from 1930 to 1975 saw little field activity, but some reinterpretation of previous work was undertaken, mainly on the basis of comparisons with fossils from East Africa (Cooke, 1955; Heissig, 1971; Lavocat, 1973; MacInnes, 1953; Patterson, 1965; Savage, 1965; Whitworth, 1954). Palaeontological activity increased in the mid 70's (Hamilton and Van Couvering, 1977) and since 1993 has been carried out on an annual basis (Pickford and Senut, 2000). This paper reports the main points concerning the palaeontological history of the Early Miocene deposits in the region.

Introduction

The fluvio-paludal deposits of the northern Sperrgebiet were first described by geologist Werner Beetz (1926) who collected vertebrate fossils from three localities (Elisabethfeld, Bohrloch Betrieb IV and Langental). The sediments in the Langental and neighbouring valleys were attributed by Beetz to "Posteocäne Revierablangerungen". Subsequent research was generally sporadic but a small number of detailed geological studies was undertaken (Greenman, 1970; Stocken, 1978; Corbett, 1989) but overall the deposits and their palaeontological potential remained poorly understood. In 1993 the Namibia Palaeontology Expedition started detailed prospecting and mapping and has visited the region each year .

Fossils collected by E. Kaiser and later by W. Beetz were sent to E. Stromer (Münich) who described many new species of vertebrates (Stromer, 1922, 1923, 1926) (Table 1) and who correlated the faunas to the Early Miocene. The fossil invertebrates from the Sperrgebiet were described by W. Wenz (1926) who created two new species (Table 1). Few if any of the gastropods came from the fluvio-paludal deposits, but from aeolianites which are considerably younger than the Early Miocene. Other palaeontological collections were made at Langental by F. Lang (now housed in the American Museum of Natural History, New York), where they were studied by A.T. Hopwood (1929) (Table 1). From 1929 until 1966 very little was published about these deposits. In that year L. Greenman studied the sediments in the Grillental and neighbouring valleys as part of his Masters Thesis (Greenman, 1966, 1970) and he mentioned in particular the dolomitisation of fluvial deposits. C.G. Stocken (1978) compiled an unpublished report for CDM (Pty) Ltd on the Mesozoic and Cenozoic deposits of the Sperrgebiet which provides a useful overview of what was known at that time, but which is erroneous on a number of counts. For instance, the travertine and aeolianite terrace that at present blocks off the Grillental at its downstream end was thought to have acted as a dam, upstream of which the Early Miocene Grillental clays and grits accumulated. But it is now clear that the travertine terrace and aeolianites lie unconformably on the clays and grits, and in fact most likely correlate to the 30 metre littoral marine package of subsequent workers (Corbett, 1989) which is of Pleistocene age. I. Corbett's PhD Thesis (1989) concentrated on the deflation deposits of the Sperrgebiet, but references are made to the Early Miocene deposits and fossils, in particular to fossil termite hives, bird egg shells and gastropods that occur in Grillental and Strauchpfütz.

Lavocat (1973) erected the new genus and species *Paracryptomys mackennae* on the basis of a fragmentary maxilla from Langental stored in the American Museum of Natural History. In 1975, Hamilton and Van Couvering (1977) visited the Sperrgebiet and published an overview of the faunas. The suid fossils in their collection cleared up doubts about the affinities of *Propalaeochoerus* mentioned by Stromer (1922, 1923, 1926) as a result of which Pickford (1986a) published the new species *Nguruwe namibensis* (Table 1). Since 1995, two new genera and species of ruminants, a bird and a creodont have been erected for material from Elisabethfeld (Morales *et al*., 1995, 1998, 1999, Mourer-Chauviré *et al*., 1996) collected by the Namibia Palaeontology Expedition.

The preliminary geological results of the Namibia Palaeontology Expedition were published by Pickford and Senut (2000) who mapped the fossiliferous localities, measured stratigraphic sections and carried out palaeontological collections. The most northerly Early Miocene fluvio-paludal sites occur at Fiskus and E-Bay Mine. The fossil site at Bohrloch Betrieb IV (Beetz, 1926; Stromer, 1926) is overlain by an undetermined thickness of well indurated Fiskus Sandstone, and until appropriate excavation equipment is brought in, the fossiliferous deposits will remain inaccessible. Eight fossiliferous localities were discovered in the Grillental. The neighbouring

Table 1. Taxa with types (*) from the Early Miocene and subsequent deposits of the northern Sperrgebiet

Year	Taxon in order of naming	Author
1922	*Diamantohyus* africanus**	Stromer
	Protypotheroides beetzi**	Stromer
	Neosciuromys africanus**	Stromer
	Diamantomys luederitzi**	Stromer
	Pomonomys dubius**	Stromer
1923	*Metapterodon* kaiseri**	Stromer
	Propalaeoryx austroafricanus**	Stromer
	Prohyrax tertiarius**	Stromer
	*Myohyrax doederleini**	Stromer
	Austrolagomys inexpectatus**	Stromer
	Parapedetes namaquensis**	Stromer
	Bathyergoides neotertiarius**	Stromer
	Phiomyoides humilis**	Stromer
	*Testudo namaquensis**	Stromer
	*Xenopus stromeri**	Ahl (in Stromer)
1926	*Dorcasia kaiseri**	Wenz
	*Dorcasia antiqua**	Wenz
1929	*Myohyrax osborni**	Hopwood
	Phthynilla fracta**	Hopwood
	Apodecter stromeri**	Hopwood
	*Austrolagomys simpsoni**	Hopwood
1973	*Paracryptomys* mackennae**	Lavocat
1986	*Nguruwe namibensis**	Pickford
1995	*Namibiomeryx* senuti**	Morales, Soria and Pickford
1996	*Struthio coppensi**	Mourer-Chauviré, Senut, Pickford and Mein
1998	*Metapterodon stromeri**	Morales, Pickford and Soria
1999	*Sperrgebietomeryx* wardi**	Morales, Soria and Pickford

Elisabethfeld deposits are extensive and richly fossiliferous. Further south many fossils were recovered from Langental and a few from Glastal and Strauchpfütz. Chalcedon Tafelberg yielded many freshwater gastropods and plants.

In general terms the Early Miocene fluvio-paludal deposits of the Sperrgebiet, with the exception of Chalcedon Tafelberg which is a crater infilling, accumulated in valleys draining into the Atlantic that were cut during the Oligocene low sea stand. With the rise of sea level in the Early Miocene, these valleys became clogged with sediment, some with clays and others with sands and gravels. In places, such as Langental, there is evidence of pedogenesis, with the production of mottled textures and colours, as well as carbonate nodules, suggesting a semi-arid, but well vegetated environment. At Grillental 6, fluvio-paludal deposits are rich in frogs and other aquatic animals and plants (small fish, ostracods and charophytes). In other localities, such as Strauchpfütz, there are extensive carbonate horizons, at least some of which accumulated in swamps or pans, with abundant littoral vegetation and freshwater gastropods. However, here also there is much evidence of pedogenesis with many horizons containing carbonate nodules, some of which coalesce to produce calcrete sheets.

Palaeontological samples from the Sperrgebiet

Stromer (1922, 1923, 1926) had a collection of 273 fossils from three localities (Elisabethfeld, Bohrloch Betrieb IV, Langental). 23 fossils from "South of Luderitz" housed in the American Museum of Natural History, were described by Hopwood (1929). Judging from the preservation characters of the fossils they all came from Langental. Cooke (1955) mentioned a ruminant mandible collected at "Bogenfels" (most probably Langental) and presented by Schroeder to the South African Museum. Greenman (1970) presented 23 fossils that he collected at Grillental (most likely Grillental 6) to the same institution, and a collection of 456 fossils made by Hamilton and Van Couvering (1977) is also in the South African Museum. The latter collection contains fossils from four localities in the Sperrgebiet, including Fiskus. In 1978, Corvinus presented the same museum with 35 fossils from the northern Sperrgebiet, including Grillental and in 1983, Schneider sent a brachypothere metapodial that he had collected at Glastal to the same institution. Thus prior to the surveys of the Namibia Palaeontology Expedition, some 812 vertebrate fossils had been collected from the northern Sperrgebiet. At least 28 species of invertebrates and vertebrates are represented in these collections (Pickford and Senut, 2000).

The Namibia Palaeontology Expedition has collected at various fluvio-paludal sites in the northern half of the Sperrgebiet from 1994 to 2006. Langental and Elisabethfeld have proved to be the richest localities, and over the years, over 2000 catalogue entries have been made for Langental and 1000 for Elisabethfeld, many of which contain several fossils on account of close associations, such as in scats, for example, while Grillental (over 600 entries) and Fiskus (145 entries) were less rich. Not unexpectedly there are many new records in the expanded collections, partly because the NPE wet screened at various localities and discovered many small to tiny species that had hitherto escaped notice, but also because excavations were undertaken in selected localities

which yielded material that would normally have been destroyed by moisture and wind if naturally eroded.

Other sites from which fossils were collected by the NPE include Chalcedon Tafelberg (molluscs and plant remains only), Glastal (gastropods, rodents and tortoises), Strauchpfütz (molluscs only). Finally, Kaukausib, a Plio-Pleistocene site which yielded vertebrate bones and teeth and several fossiliferous deposits in aeolianites in the region, such as Kalkrücken and *Trigonephrus* site (Pickford and Senut, 2000) were prospected, but these are not treated in this monograph.

Age determinations

Stromer (1922, 1923, 1926) proposed an Early Miocene age for the faunas from the northern Sperrgebiet, a suggestion that has stood the test of time, no-one having suggested a different scenario. His reasoning was based on a comparison of the Sperrgebiet faunas with those from Karungu (Kenya) (Andrews, 1914) and Moghara (Fourtau, 1920) and Wadi Faregh (Stromer, 1916) (Egypt) which were at that time considered to be Early Miocene. Given the paucity of knowledge available at the time when compared with what is known now, Stromer's estimate was quite prescient (Hopwood, 1929). In fact there was very little in common between the Sperrgebiet faunas on the one hand, and those from Kenya and Egypt on the other. Indeed, the only taxa known by Stromer (1926) to be common to the Sperrgebiet and Karungu were the tortoise *Testudo*, and the hypsodont macroscelidid *Myohyrax oswaldi* and there were no taxa shared with the Egyptian faunas.

Subsequent research at these and other sites has vindicated Stromer's correlations. For instance, faunal lists for Karungu and other East African Early Miocene sites such as Songhor, Koru, Napak, and Rusinga, now contain several taxa shared with the Sperrgebiet, including *Diamantohyus africanus*, *Diamantomys luederitzi*, *Bathyergoides neotertiarius*, *Austrolagomys* and so on (Pickford, 1986b; Mein and Pickford, 2003). Even Wadi Moghara in Egypt has yielded *Diamantohyus africanus*. Furthermore, new discoveries in the Sperrgebiet by the NPE comprise *Eozygodon morotoensis*, a species found at Meswa Bridge (Kenya), Moroto (Uganda) and Wadi Moghara (Egypt) (Pickford, 2003), *Protenrec* a common insectivore in Early Miocene deposits of Kenya and Uganda, *Protarsomys* and several other taxa unknown to Stromer (Pickford, 1986b).

Palaeoecology

Stromer (1926) considered that the fauna that he and his colleagues described from the northern Sperrgebiet, indicated a steppic or savanna environment at the time of deposition. The presence of hypsodont rodents, lagomorphs, and the macroscelidids *Myohyrax* and *Protypotheroides* (at the time thought to be hyracoids), along with two kinds of ruminants, two species of suids and a diversity of other mammals, indicated to Stomer that he was not dealing with a forest-adapted fauna. This semi-arid region contained permanent water bodies, attested by the xenopodid frogs and freshwater molluscs. Thus, from the beginning of palaeontological studies in the Sperrgebiet, it was recognised that it was not as arid during the Early Miocene as it is today.

This theme was incorporated into the regional palaeoclimatic model of Ward and Corbett (1990) who concluded that there was a Miocene humid phase in the history of the Namib Desert, separating a so-called proto-Namib phase of pre-Miocene age, from a Namib Phase of Late Miocene to Recent age. It was shown by Pickford and Senut (2000) however, that the Early Miocene deposits of the Sperrgebiet pre-dated the onset of hyper-arid conditions in the Namib, the onset of desertification occurring at the base of the Middle Miocene rather than the Eocene or Oligocene. Dune sands in the Oligocene Buntfeldschuh cliffs are not related to regional desertification as previously thought, but probably represent a coastal dune system of local climatic significance only. Thus, the Namib Desert as we know it today dates only from the base of the Middle Miocene, some 16-17 Ma, with some fluctuations between semi-arid, arid and hyper-arid conditions occurring from time to time, especially during the Pleistocene.

Nevertheless, during the Early Miocene the region was appreciably drier and more open than tropical Africa was, as revealed by the dominance of mammalian lineages adapted for life in such conditions (exhibiting hypsodonty and cementodonty for example) and the relative paucity of lineages adapted to frugivory and folivory (brachyodonty, bunodonty) as was realised by Stromer (1926). An important implication of the precocious onset of aridity in the southern parts of the continent, is that plants and animals have had considerably longer to adapt to such conditions than they have elsewhere on the continent. Thus the southern faunas and floras have a strong element of autochthonous evolution in them. Subsequently, with the aridification of tropical Africa in the Late Miocene and Plio-Pleistocene, many of these lineages spread northwards to occupy niches opening up there before local lineages could adapt to them. Thus the extant East African faunal province is home to many lineages of vertebrates that originated in southern Africa.

Conclusions

The Northern Sperrgebiet, Namibia, has been an important source of palaeontological data for more than 80 years. Recent work in the region reveals that it will continue to yield fossils and other information useful for palaeoclimatology, palaeoenvironmental studies, palaeoecology and biochronology. The Na-

mibia Palaeontology Expedition, which studied the area from 1993 to 2006, employed field techniques that had not previously been used in the area, and discovered several new invertebrates and vertebrates, and improved the fossil record of many hitherto poorly known taxa. Comparisons of the new collections with material from other parts of Africa, notably Kenya, Uganda and Egypt, have led to the revision of the systematic position and nomenclature of several species of mammals, and have improved the data base for biochronological age estimates of the various deposits.

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