Preliminary results of excavations at the newly investigated Coopers D deposit, Gauteng, South Africa

Lee R. Berger[a*], Darryl J. de Ruiter[a], Christine M. Steininger[a] and John Hancox[b]

Recent palaeontological and geological research at Coopers has revealed a new cave fill deposit. As presently exposed, the preserved succession consists of two geologically discrete sequences, each representing different cave boundary conditions and sedimentary processes. Fossils collected, primarily from the decalcified breccias, consist of a diverse faunal assemblage including hominin material. Based on the correlation of the fauna with the assemblages from Swartkrans and Kromdraai A, the deposit has been assigned a palaeontological age of between 1.6 and 1.9 Myr.

Introduction

Coopers is one of the lesser known of a number of cave-hosted Plio-Pleistocene sedimentary deposits in the Cradle of Humankind. The site is situated approximately 45 km northwest of Johannesburg, between Sterkfontein to the west and Kromdraai to the east. Although the site has been known since 1938,[1–3] it has received little attention, even though hominin and other faunal remains have been previously reported.[1,4–6] The site preserves at least three spatially distinct infills, with different depositional histories and fill dynamics. Excavations on the new Coopers D deposit were started in June 2001, and almost immediately the first *in situ* hominin remains were recovered. Since then an area of some 60 m^2 has been opened at surface, to a depth of between 1 and 1.5 m (Fig. 1). Along with the hominin material, an abundant and diverse faunal assemblage (>9000 elements) has been recovered, including fauna not usually common in the Witwatersrand Plio-Pleistocene cave record. Here we report preliminary results of the geology and fauna of Coopers D.

Geology

Coopers D deposits are hosted in dolomites of the Monte Cristo Formation (Malmani Subgroup, Transvaal Supergroup), that today forms a karstic landscape in which numerous soil-filled depressions have developed. The area of excavation extends along an east–west-trending, 3-m-wide by 20-m-long, de-roofed cave. Within the stratigraphic succession as presently exposed, two distinct episodes of fill may be recognized, here termed Coopers D west (26°00′46″S, 27°44′45″E) and Coopers D east deposits (26°00′47″S, 27°44′44″E) (Fig. 2).

Stratigraphic relations show the Coopers D west deposit to be the older of the two fills.

The sequence rests on a dolomitic floor that preserves flowstones of various morphologies, and represents a period of chemical sedimentation in the cave prior to the opening of the western part of the cave. Two entrances probably fed sediment to the cave at about the same time, one to the northeast and a second to the southwest. This is shown by the fact that in the southwestern deposit the sedimentary sequence begins with a spatially restricted coarse pebbly breccia, which does not occur in the more proximal northwest regions, where finely laminated sandy breccia lies directly on the basal flowstone. This stratified sequence contains an abundant micromammalian fauna, and forms the bulk of the lower unit. At places this sequence has filled the cave to the roof. In other areas, however, it is separated by a thin flowstone from a slightly coarser top unit. The entire sequence fines down dip to the west, and where it is exposed in the westernmost trench, is composed entirely of very fine sand and micromammalian remains. This sequence was deposited primarily by unconfined sheetwash that selectively remobilized micromammalian remains. The lack of any evidence of roof collapse, coupled with the presence of flowstones that bound the various units, suggests that the entire series was deposited while the cave still had a fairly competent roof.

The Coopers D east deposit is far coarser (with clasts up to 50 cm). At the eastern end of the deposit, clasts with fairly low angles dip to the west. These are overlain by numerous clasts of cave roof material (dolomite and flowstone) and macromammalian remains that downlap onto the underlying deposits. The dips on these clasts form a centripetal pattern, and formed as a cone deposit beneath a vertical to subvertical roof opening. The shape of the deposit is to a large extent controlled by the three-dimensional confines of the cave, with large, high-angle clasts abutting against the northern dolomitic cave wall. The presence of numerous roof block clasts attest to the

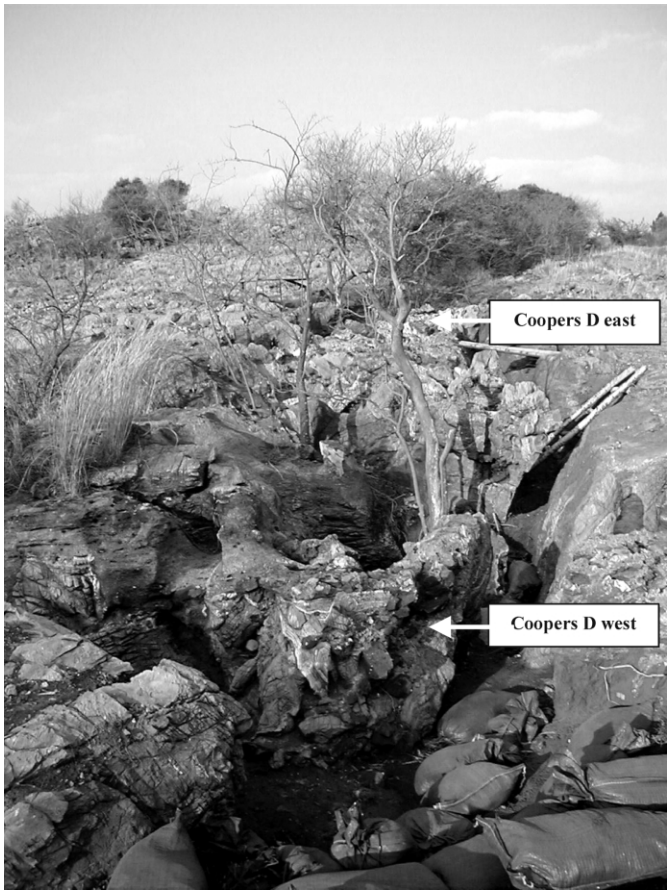

Fig. 1. Coopers D deposit, viewed from west to east.

[a]Palaeoanthropology Unit for Research and Exploration, Bernard Price Institute for Palaeontological Research, School of Geosciences, University of the Witwatersrand, Private Bag 3, WITS 2050, South Africa.

[b]School of Geosciences, University of the Witwatersrand, Private Bag 3, WITS 2050, South Africa.

[*]Author for correspondence. E-mail: bergerl@geosciences.wits.ac.za

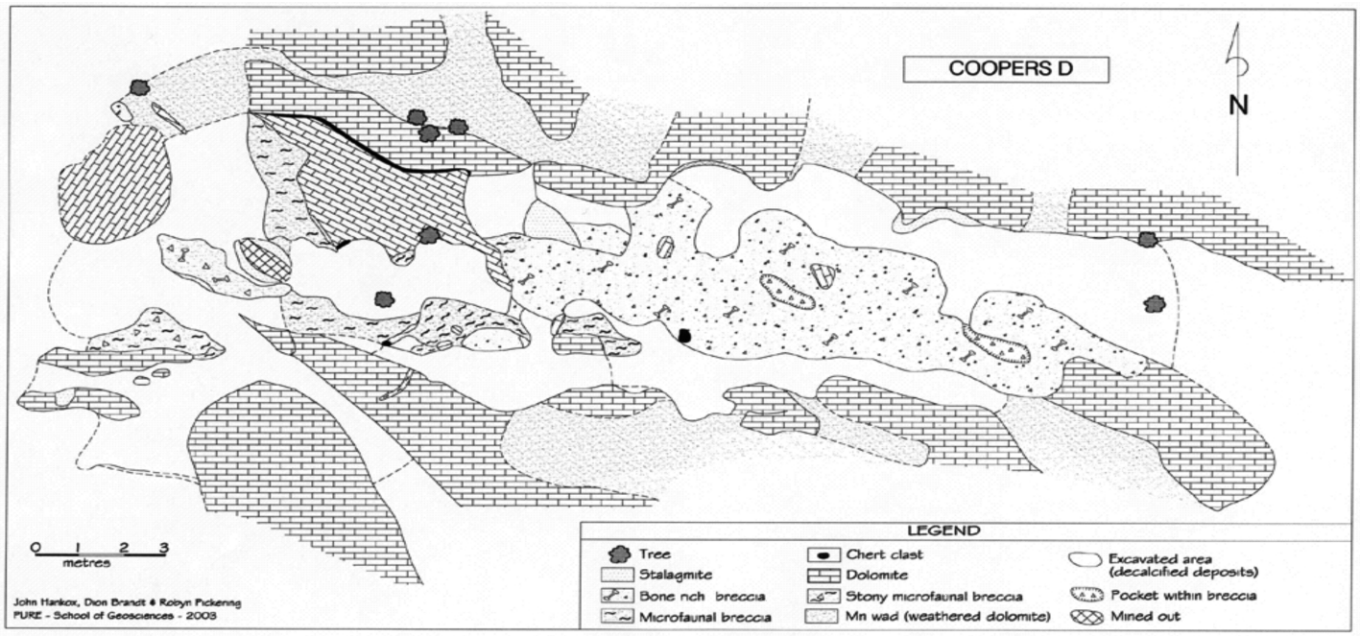

Fig. 2. Plane table surface map of Coopers D.

initial stages of deroofing of the cave, probably in response to a period of downwasting of the surface.

Fauna

Although the deposit can be subdivided into two sequences at the present level of resolution, there seem to be no major faunal differences between the two. The fauna from Coopers D is surprisingly diverse (Table 1) given the small excavation area, corresponding closely to the faunas from Swartkrans and Kromdraai A. It differs from these sites in that it preserves numerous examples of what are generally considered rare taxa at other Witwatersrand sites. In particular, Coopers D shows an abundance of suids and canids, with both represented by many specimens. The abundance of these taxa might be the result of the accumulating agent, and further research is currently under way to clarify this situation.

Several hominin fossils have been recovered from the decalcified areas of the excavation. Cranio-dental material consists of three isolated teeth, an edentulous mandible fragment derived from a juvenile individual, as well as numerous cranial fragments. Postcranial remains include a damaged lumbar vertebra and several potential hominin phalanges. Two of the three isolated teeth are deciduous molars, while the remaining tooth is an unworn left maxillary second molar. It is possible that the deciduous teeth may be associated with the juvenile mandible. The cranio-dental remains are morphologically consistent with the hominin fossil samples from Swartkrans[7] and Drimolen[8] and are here attributed to *Paranthropus robustus.*

Cercopithecids at Coopers D are represented by *Papio hamadryas robinsoni* and *Theropithecus oswaldi. P. h. robinsoni* has been recorded previously from Coopers[9,10] and is represented by several isolated premolars and molars, as well as a mandible fragment with moderately worn dentition. *Theropithecus oswaldi* is represented by numerous isolated teeth and a well-preserved mandible fragment. A partial facial fragment of a large primate may also be representative of this species, as well as several remarkably robust and thick cranial fragments.

Felids are notably diverse in the Coopers D assemblage. *Panthera pardus* is represented by cranio-dental and postcranial remains. *Panthera leo* may be represented by postcranial fossils, though this tentative identification will require future confirmation with cranio-dental remains. *Felis caracal* is present in the form of an isolated left mandibular carnassial, and *Felis lybica* is recognized by a mandible fragment and an isolated mandibular canine. *Dinofelis* sp. is present based on both maxillary dentition and mandibular remains. One of the most intriguing fossils recovered from Coopers D is a very small felid mandible displaying the distinctive enlargement of the anterior mandibular symphysis that characterizes the Machairodontinae.[11] Despite the small size of this specimen, it compares favourably with *Megantereon gracile* from Sterkfontein Member 4 (ref. 12) and Kromdraai A.[13]

Several hyaenid cranio-dental fossils are found at Coopers D that are indistinguishable from modern *Crocuta crocuta, Parahyaena brunnea* and *Proteles cristatus.* A single, isolated premolar representing *Chasmaporthetes* sp. has also been recorded. Hyaenid postcranial remains are also abundant, though attribution beyond the family level is not yet possible.

Canid fossils recovered from Coopers D indicate the presence of two species of *Canis.* The smaller, represented by abundant cranio-dental and postcranial remains, is consistent with the modern black-backed jackal, *Canis mesomelas.* The larger canid is also represented by numerous cranio-dental and postcranial remains, and although it is similar in size to the African wild dog, *Lycaon pictus,* it is morphologically distinct from *Lycaon,* and clearly allied with the genus *Canis.*

The Viverridae are abundant in the assemblage, with well-preserved remains of at least three taxa recovered, *Herpestes ichneumon, Suricata* sp. and *Cynictis penicillata.* The Mustelidae are rare in Coopers D, known only from a single mandible fragment of the African weasel *Poecilogale.*

Equid specimens are extremely rare in the Coopers D assemblage, but clearly represented by a large and small morph. The smaller morph is indistinguishable from modern *Equus burchelli.* The large morph exceeds the size range of living zebra, and is morphologically consistent with the extinct giant Cape horse, *Equus capensis.*

Remains of suids are remarkably common in Coopers D, with more than 300 numbered specimens, both cranio-dental and

Table 1. Faunal material recovered from Coopers D.

Order	Family	Tribe	Genus and species
Primates	Hominidae		*Paranthropus robustus*
	Cercopithecidae		*Papio hamadryas robinsoni*
			Theropithecus oswaldi
Carnivora	Felidae		*Panthera pardus*
			cf. *Panthera leo*
			Felis caracal
			Felis lybica
			Dinofelis sp.
			Megantereon cultridens
	Hyaenidae		*Crocuta crocuta*
			Parahyaena brunnea
			Chasmaporthetes sp.
			Proteles cristatus
	Canidae		*Canis mesomelas*
			Canis sp. (not *mesomelas*)
	Viverridae		*Herpestes ichneumon*
			Suricata sp.
			Cynictis penicillata
	Mustelidae		*Poecilogale* sp.
Hyracoidea	Procaviidae		*Procavia antiqua*
			Procavia transvaalensis
Perissodactyla	Equidae		*Equus burchelli*
			Equus capensis
Artiodactyla	Suidae		*Metridiochoerus andrewsi*
	Giraffidae		*Sivatherium maurusium*
	Bovidae	Neotragini	Neotragini sp. indet.
			Raphicerus sp.
		Alcelaphini	*Megalotragus* sp.
			Connochaetes sp.
			Medium-sized alcelaphines
			Damaliscus cf. *dorcas*
		Antilopini	*Antidorcas marsupialis*
			Antidorcas recki
		Hippotragini	*Hippotragus* sp.
		Reduncini	*Redunca* cf. *fulvorufula*
		Tragelaphini	*Taurotragus oryx*
			Tragelaphus cf. *strepsiceros*
			Tragelaphus cf. *scriptus/pricei*
		Bovini	*Simatherium kohllarseni*
		Peleini	*Pelea* sp.
Rodentia	Hystricidae		*Hystrix africaeaustralis*
	Pedetidae		*Pedetes* sp.
Lagomorpha	Leporidae		*Lepus* sp.

postcranial, having been recovered. The morphology of the teeth is consistent with *Metridiochoerus andrewsi*, with nothing to suggest more than one suid taxon is present.

Giraffids are rare in Coopers D, with only three teeth positively identified. Two of the teeth are juvenile, and are most likely derived from the same individual, while the remainder is a permanent mandibular molar. The specimens compare favourably with *Sivatherium maurusium* from the grey breccia of Makapansgat, and are here assigned to this taxon. The presence of *Sivatherium* at Coopers is the second well-documented occurrence of this taxon in a Witwatersrand Plio-Pleistocene deposit.[14] Although the morphology of the Coopers specimens is consistent with *Sivatherium maurusium* in many features, the permanent molar differs in that it lacks the pronounced metastyle seen in Makapansgat specimens.

As is common in the fossil-bearing caves of the Witwatersrand area, bovids numerically dominate the assemblage. Cranio-dental remains are numerous, though the vast majority are isolated teeth. Postcranial remains of bovids are particularly common, represented by virtually all skeletal elements. Alcelaphines dominate the assemblage, followed by antilopines. Fossils of the extinct taxon *Antidorcas recki* are not common in the fossil caves of the Witwatersrand, although they are well represented in the Coopers D assemblage, alongside the modern springbok *Antidorcas marsupialis*. Tragelaphines are well represented in terms of species present, although each species is known only from isolated dental remains. The Bovini are known from three isolated teeth that are morphologically consistent with *Simatherium kohllarseni*. They are relatively narrower than teeth of the modern Cape buffalo, *Syncerus caffer*, a feature noted by Vrba[15] as diagnostic of *Simatherium*. All other bovid tribes are sparsely represented by isolated dental remains.

Several small mammal taxa also recorded in the assemblage, including porcupine *Hystrix africaeaustralis*, springhare *Pedetes* sp. as well as a lagomorph, probably *Lepus*. Hyracoids known from both cranio-dental and postcranial remains, are represented by two extinct taxa, *Procavia antiqua* and *Procavia transvaalensis*.

Coopers has added to the growing list of *P. robustus* sites known in South Africa. These sites (Coopers, Swartkrans, Kromdraai, Drimolen and Gondolin) present diverse faunal and geological dimensions. The fauna from Coopers D, in comparison with other australopithecine sites in the Cradle of Humankind area, suggests that this site spans a probable palaeontological age of between 1.6 and 1.9 Myr. This serves to provide an even more continuous record of hominin evolution in the late Pliocene and early Pleistocene of southern Africa.[16]

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