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Bone breccias, bone dumps, and sedimentary sequences of the western Limeworks, Makapansgat, South Africa

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Abstract

The sediments in the western side of the Makapansgat Limeworks were either precipitated as speleothems, represented in the earlier massive deposits, or were deposited as coarsening clastic sediments, mainly representing later deposits. Between the earlier deposits and the main sedimentary phase, the stratigraphic sequence was inverted twice to a considerable height by the unusual deposition of subaqueous speleothem. Bone-bearing deposits, including the Main Quarry Bone Breccia and the well-known Grey Breccia belong, in time, to the lower part of the clastic deposits called the Red Silts. Australopith fossils have been found in the Grey Breccia dumped material and, in situ, from the dolomite clast breccia on the Main Quarry entrance buttress. Whatever the problems may be in provenancing some of the material from the Limeworks dumps, there is no doubt that the three rows of blocks on the southern side of the dumps belong to the Grey Breccia, and other rows contain red sediment sufficient for them to be safely associated with the Red Silts. There is no reason why this material should not be prepared with confidence as to its stratigraphic provenance. In any case, stratigraphic evidence, presented here, shows that there is little difference in time between the deposition of the bone-bearing breccias.

Keywords: *Australopithecus*; Cave infilling; Chronology; Grey Breccia; Makapansgat; Provenancing

Introduction

A stratigraphic sequence for the Makapansgat Limeworks was presented by Wells and Cooke (1956), largely based on the premise of simple superposition of deposits over the whole cavern, and this was followed by Brain (1958) and by Partridge (1979). A partial stratigraphy, with emphasis on the bone breccias of the western side of the site, was presented by Eitzman (1958), who had visited the mining operations several times in the 1920s. Partridge (1979) introduced the member notation for the different strata considered as a site-wide sequence, on which McFadden et al. (1979) based their magnetostratigraphic chronology. This site-wide reconstructed sequence was criticized by Maguire et al. (1985), who saw the cave as having consisted of several repositories separated by a topographically elevated central section. A modified section showing how the mass of speleothem in the Entrance Quarry had led to separate infill histories was presented by Partridge (2000). Latham et al. (2003) showed that there were indeed several repositories but that these had been created by a conjoined mass of tall bosses and stalagmitic masses, which formed in a roughly arcuate configuration around the perimeter of the original cavern; it was dubbed the ''Speleothem Arc.'' As the roof of the cavern eroded, roof-fall and surface-slope wash came to accumulate in the different repositories at different times and in different ways. These huge

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masses of speleothem were removed by the lime workers for gold processing in the first half of the twentieth century, and now only traces of the Speleothem Arc remain.

The question of the age of the Makapansgat australopiths and associated fauna has included two issues that are the focus of this paper. The first is provenance. Although a given block of dump bone breccia may not be traced back to its original position, there is no doubt that many of the dump rows can be reliably assigned to a given extant stratum, as was the intention of those who originally sorted the dumps; this needs to be reasserted. Moreover much of the faunal material can be, and has been, assigned in the literature to strata Members 2, 3, and 4 of the western side of the site, and we discuss the likely age relationship between these three members and how that impinges on the chronology of the australopith remains.

Table 1 is presented to show how the older member system compares with the newer stratigraphic succession; the youngest stratum is at the top. In this paper, we have followed the nomenclature for parts of the site introduced by Maguire et al. (1980), together with, necessarily, a few others for the western side of the cavern. The strata of the subsequence up to Member 3 are in stratigraphic order, including the subaqueous layers. Members 4 and 5 of the central section are diachronic and probably overlap with Members 2 and 3 to some extent. Although some stratigraphic correlations are known with strata in the eastern side, they are not included here as, with the exception of Horse Mandible Cave, they have contributed essentially no faunal remains to the dumps.

Latham et al. (1999, 2003) showed that the Western Repository (Figs. 2 and 3) was formed largely in isolation from other repositories of the site. The Western Repository starts with the surface deposits of the Original Ancient Entrance (OAE), continues to the entrance buttress of the Main Quarry, and extends to the inner end of the Classic Section. The Grey Breccia itself actually extends underneath a stepped roof southwest of the Main Quarry to a position near the north side of the Collapsed Cone. (The Collapsed Cone is the informal name given to an unconsolidated pile of clastic sediments at the back of the Limeworks that resulted from undermining. It has created a hole at the surface about 15 m in diameter.)

The inference of Maguire et al. (1980) that the Grey Breccia originally represented the results of denning animals was supported by Latham et al. (2003), who suggested that the point of access for these animals was over massive stalagmitic bosses and under the stepped roof. The animals presumably gained access from the surface down newly deposited sediments when the rear of the cavern was only partly filled. The latter workers also presented evidence to suggest that the Grey Breccia and the white bone breccia (so not far studied) at the back of the cavern are contemporaneous. Another bone breccia, next to the upper support columns in the Main Quarry (Main Quarry Bone Breccia; MQBB), consists of a dense but more limited region of bone fragments. This calcite-cemented breccia occurs partway through the M2 Red Silts (Table 1). These three bone breccias account for the main concentrations of in situ macrofaunal bone in the Limeworks, though there are scatters of bone throughout the Red Silts and in Member 4. Lumps of pink dolomite-clast breccia containing bone fragments were retrieved from the Entrance Quarry during the early visits to the Limeworks (Tobias, 1997a) and are currently assigned to Member 4. A fine, though incomplete, cranium (MLD 37/38) of *Australopithecus africanus* was found in situ on the entrance buttress to the Main Quarry in 1958–1959 by James Kitching in a light-pink, dolomite-clast breccia that is also currently assigned to M4 (Table 1).

Further stratigraphic studies of the western side of the site show that the sediments of the Western Repository were transported from the direction of the Original Ancient Entrance (Latham et al., 2003). Preliminary magnetostratigraphy suggests that they were irregularly codeposited with flowstones just before 4 Ma and that Member 3 was deposited at the end of the Gauss normal, ca. 3 Ma (Herries, 2003). Further sampling, which is required to substantiate the overall magnetochronology, is ongoing. The research reported here aims to further our understanding of the mode of deposition in the western Limeworks, particularly of the Red Silts, and the place of the Grey and Main Quarry bone breccias within the sequence. The original solutional part of the formation of the cavern is not presented here but was discussed at length by Latham et al. (2003).

Provenancing the Limeworks dumps

The recovery of australopith specimens and other faunal remains at Makapansgat Limeworks (Fig. 1) from the debris left by lime miners began in 1947 with the discovery by James Kitching of part of an occipital bone, MLD 1 (Dart, 1955; Tobias, 1997b). From 1947 onwards, Raymond Dart put Alun Hughes to the task of clearing the huge dumps that were heaped up and largely overgrown on the slope below the entrance to the Main Quarry (Tobias, personal notes). Subsequently, Alun Hughes, James Kitching, Phillip Tobias, Brian Maguire, and others sorted the bone-breccia blocks into rows characterized by color and texture in order to match them with distinctive strata in the cave. The macrofaunal material originated almost entirely from the western side of the site, from the Entrance Quarry to the side of the Collapsed Cone. With locally recruited help, Hughes went back and forth clearing the dumps, and the material was moved down to a specially cleared and leveled area, on which at about that time the storehouse was erected. The blocks were then sorted by color and texture into rows and piles within the area, around which a fence was subsequently erected. Also at this time, some of the University of the Witwatersrand Medical School honors or masters students spent some time trying to correlate the different colored breccias in the camp with breccia that was still in situ. Each year, the students in the April vacation built up piles of smaller lumps (the ‘‘fine piles’’) in another breccia camp alongside the coarse blocks of breccias. The students sorted these fines, looking for anything they could identify. In 1947, Hughes and B. Maguire, under the aegis of the newly created Bernard Price Institute for Palaeontology, also extensively assisted in sorting the lime dumps. The sorting into