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Soil micromorphology of Gibraltar Caves coprolites

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Abstract
[extract] Introduction Several coprolites (fossil faeces) were collected from the Middle Palaeolithic levels in Gorham's and Vanguard Caves during the 1995-1998 excavations (Finlayson and Finlayson 2000; Stringer et al. 2000).

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R.I. Macphail and P. Goldberg

Introduction

Several coprolites (fossil faeces) were collected from the Middle Palaeolithic levels in Gorham's and Vanguard Caves during the 1995–1998 excavations (Finlayson and Finlayson 2000; Stringer et al. 2000). Coprolites from Gorham's Cave were recorded from at least three localities (Table 19.i). Of particular interest in Vanguard Cave was a fragment of coprolite (sample 371), one of several recovered from on top of a hearth in the Upper Area near the top of the sequence (Fig. 19.1a) (Macphail and Goldberg 2000; Goldberg and Macphail 2000). Here, the hearth is an in situ layer of reddened sand, capped by a well preserved thin ash layer (see Fig. 16.6). The principal question revolves around whether this was human or animal coprolite. We opted to use micromorphology to evaluate this issue since it permits observation of the mineral and organic composition, and fabric of the material. Furthermore, we have reference material of both human and animal coprolites and modern excreta from zoos, including herbivores and carnivores (Courtney et al. 1998). Specifically, we compared them to ancient dog coprolites and wolf excreta, and reference modern excreta from several big cats, such as lion, leopard, and tiger. We also looked at a number of likely hyena coprolites from the adjacent Gorham's Cave (samples 179 and 183), employing reference material (Kolska Horwitz and Goldberg 1989; Larkin et al. 2000; Lewis 1997). We also attempted pollen preparations on all of the Gibraltar samples, but, unfortunately, all proved to be technically non-feasible (G. M. Cruze, Open University, pers. comm.)

Methods

From Vanguard Cave, three slices were taken of the same coprolite fragment (sample 371), which measured 1 x 1 cm. These pieces and the coprolites from Gorham's Cave were imbedded in methyl methacrylate from which small petrographic thin sections were made (Goldberg and Macphail 2006). The thin sections were examined with the petrographic microscope using plane-polarized (PPL) and cross-polarized (XPL) light, as well as with blue episcopic illumination (400 nm excitation filter, 510 nm dichroic mirror, 525 nm barrier filter) for ultra violet light observation (UVL). Studies have shown that coprolites formed of 'apatite' are non-birefringent, but are autofluorescent under UVL and Blue Light (Courtney et al. 1989; Larkin et al. 2000; cf. Stoops 1996; 2003).

Results and inferences

Vanguard Cave - coprolite sample 371 (Figs. 19.1-19.4)

This coprolite is a pale to dirty/cloudy grey colour (PPL), and generally non-birefringent under XPL apart from fine sand-size quartz inclusions and coarse (nm size) pieces of bone, the latter being evidence of ingested material. On the other hand, the coprolite is highly autofluorescent under UVL and Blue Light. The coprolite also exhibits narrow, tubular voids that are likely pseudomorphs of fur. Some parts of the coprolite are porous with loose inclusions of very thin excreta of mesofauna.

The inclusion of sand grains, bone and curved voids (possibly the remains of animal hair), in cement that is autofluorescent under UVL and Blue Light, is typical of coprolites and excreta of carnivores. The darkish colours (PPL) and inclusion of coarse bone fragments are typical of Canidae, as noted in Early Iron Age to Saxon British, American palaeoindian and Jomon Japanese dog coprolites (Courtney et al. 1989; Matsui et al. 1996; Goldberg and Macphail 2006; Macphail 2000). The presence of loose excremental inclusions indicates that the coprolite was exposed to a period of biological weathering - like the underlying ash - before being buried by the overlying wind blown sands at Vanguard Cave (Goldberg and Macphail 2000; Macphail and Goldberg 2000). It can be noted, in contrast, that ancient human coprolites, although reflecting dietary variations, more commonly contain vegetal fragments, only very small pieces of bone, and have a cement that is often a pale yellowish colour (Courtney et al. 1989, pl. VI; Macphail et al. 1991, fig. 19.3).

Gorham's Cave - coprolite samples 157, 179 and 183 (Figs. 19.5-19.8)

Of the three coprolite examples studied from Gorham's Cave, samples 157 and 179 are pale grey to grey under PPL, non-birefringent (XPL), but highly autofluorescent under UVL and Blue Light. Sample 183 differs by featuring highly birefringent, invasive micrite (Figs. 19.7 and 19.8). All coprolites contain silt and fine sand, and fragments or traces of ingested bone. The coprolites are also characterized by areas of vesicular porosity (e.g. Fig. 19.6) and curved, tubular voids, perhaps indicating animal hair.

The optical properties of these coprolites, the inclusion of silt and sand, and marked areas of vesicular porosity and curved tubular voids are all indications of these coprolites being from hyenas (Kolska Horwitz and Goldberg 1989; Larkin et al. 2000).

Discussion and conclusions

The micromorphological study of more than 150 thin sections from Gorham's and Vanguard Cave has shown that fragments of coprolites of carnivores are almost ubiquitous, alongside guano (Goldberg and Macphail 2000; Macphail and Goldberg 2000). This study shows that when larger pieces are preserved it is possible to distinguish forms from different carnivores through thin section micromorphology. This demonstrates, along with faunal remains analysis, that the cave was occupied by different kinds of carnivores, in addition to humans and large numbers of birds. Consequently, we cannot ignore the effects of biogenic sediments and associated biological reworking of cave deposits at these sites.

When the Vanguard Cave coprolite (sample 371) is compared with reference material from humans, dog, wolf, hyenas and big cats, the most likely origin is from a Canidae (Dog/Fox), because of its optical properties, internal structure and inclusions. The coprolite, like the in situ hearth ash, appears to have been exposed to short-lived biological weathering, before burial by blown sands.

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References

20 The lithic artefact assemblages of Vanguard Cave

R.N.E. Barton

Introduction
The lithic assemblages reported here mainly come from deposits in the Upper and Middle Areas of the cave. Except for a small number of finds from the very top of the sedimentary sequence the occupation layers in this cave are exclusively Middle Palaeolithic. The methodology used to describe the Vanguard Cave lithic assemblages is the same as that presented in Chapter 12.

Upper Area A
A small number of blades and blade fragments were recovered in 1995 during the cleaning of a section in the upper part of the cave. The artefacts were thinly scattered within sands and silts near the top of the sequence. A single undiagnostic bladelet located approximately 40 cm below the upper baseline in Area A (Fig. 13.3) represents the lowermost record of an Upper Palaeolithic technology within the sediment series. It confirms that Vanguard was largely infilled by the time Upper Palaeolithic populations were present in the area, permitting only limited access to the cave.

Upper Area B midden and hearth
A midden deposit containing marine mussel shells and Middle Palaeolithic artefacts was discovered at approximately 5.4 m above the main site datum in Area B (Figs. 13.2 and 13.10). The midden consisted of pinkish-grey ash deposits underlain in places by rubificd sands. On the surface of the ashy deposits was a scatter of almost exclusively quartzite artefacts. The finds were distributed over a total area of approximately 1 m² but with a notable concentration evident in 1 m² in the eastern and western halves of squares Z4 and A4 (Figs. 20.1 and 20.2). The scatter coincided with the thickest deposit of ash and an area of reddened sands that defined a roughly sub-circular hearth imprint of about 1.4 × 1.0 m (Fig. 20.1). Before excavation the presence of the central hearth location was obscured by lobs of the ashy sediments which covered much of the area and extended to the southern wall of the cave. Within these sediments were recovered large quantities of mussel shells of the species Mytilus galloprovincialis (Barton 2000; Fernández-Jalvo and Andrews 2000). Fragments of charcoal were also found at the base of the hearth which could be identified to warm Mediterranean genera (Pistacia sp., Juniperus, Tetracium articulatum) (Gale and Carruthers 2000, 207; Barton 2000, 215; also see Chapter 15).

The lithic assemblage from the Upper Area midden contains plain flakes (32) and other debitage characteristic of a discoidal core technology (Table 20.3; Fig. 20.3). Although only one of the cores can be described as a typical discoidal form (C-type), it is clear from the similarity in raw material that the other two examples probably derive from the same cobble of quartzite. A notable feature in this concentration is the relatively large number of chips recovered.