

Interactive comment on “Sediment sequence and site formation processes at the Arbrede Cave, NE Iberian Peninsula, and implications on human occupation and climate change during the Last Glacial” by M. Kehl et al.

M. Kehl et al.

kehlm@uni-koeln.de

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Thank you very much for the interesting points you raised concerning the origin of trace elements and possible implications for occupation of the cave by humans. The origin of copper, zink and phosphorus in the upper part of the Arbrede sequence probably relates to both, anthropogenic and zoogenic sources. However, the human input appears to dominate: Near the rise in P and trace element levels at -3.90 m depth, the sequence is rich in bone fragments of *Equus caballus* and *Cervus elaphus* (Estevez 1987), probably brought into the cave by humans. Fragments of carnivores such

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as *Vulpes vulpes* are rare. *Oryctolagus cuniculus* is quite common, but it is unclear whether rabbit was consumed by humans, brought into the cave by carnivores or perished in burrows. Pieces of carnivore coprolites were also detected in thin sections CA5, CA6 and CA7, but these cannot be specifically related to defecation by either humans or other carnivores.

In level I (Late Mousterian), zoogenic inputs probably dominated. These mainly consisted of bat guano, clearly visible in thin sections. Evidence for carnivore coprolites and bone fragments are very scarce, which may partly result from bone dissolution in the decalcified sediment. The bone assemblage shows the presence of *Ursus spelaeus* (Estevez et al. 1987), whereas bones of human prey such as *Equus caballus* or *Cervus elaphus* is very rare. Copper and barium concentrations are at maximum but Zn concentrations are lower than in level H (Archaic Aurignacian). In combination with reduced Cu and, less clearly, Ba concentrations in level H, there is a clear difference in trace element signatures in these two levels, which may indicate a change in dominance of human or animal occupation. However, lateral and vertical migration of trace elements as well as their preferential absorption, e.g. of Cu on organic matter of the humic sediment of level H, have to be taken into account, before an increased presence of humans at the beginning of the Upper Palaeolithic could be deduced from trace element signatures.

Evidence for defecation by humans and a distinction between anthropogenic and zoogenic inputs may be gained from fecal biomarker analyses. Future investigations should test if steroids and bile acids marking the presence of human feces are preserved in sediments of Arbrede down to more than 40 ky ago.

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