Evidence for cultivated fire during the late Early Paleolithic in southeastern Spain: preliminary results from a micromammal taphonomic approach

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Site background

Cueva Negra (Black Cave), an upland rock-shelter in southern Spain has revealed a rich lithic, paleontological and paleopalynological record. The 5-m deep sedimentary deposits provide evidence of paleomagnetic reverse polarity and micromammalian biostratigraphy indicative of a late Early Pleistocene age (>0.78 Ma). Excavation in 2011 revealed a shallow lens of dark coloured sediment (the burnt layer) which shows signs of thermal alteration and contains heat-shattered chert and white calcined large mammal bone. The research discussed herein substantiates claims of cultivated fire use at this site through analysis of heat altered micromammalian bone.

Image 1.0: Location of site on Iberian Peninsula

Materials and methods

The data presented herein was collected over 3 months at the Universidad de Murcia and the MNCN, in Madrid. Visually identified colour modifications on bones were compared from 0.5m deep deposits within three 2m² units (C2a, C2d and C2g). The burnt layer extends to a depth of 30 – 60mm, recognizable as a dark grey/black layer overlying reddish sediment in unit C2d and C2a. Adjacent deposits (Unit C2g) are included as hydraulic sediment movement is indicated (Angelucci *et al*., 2013). Over 4,400 specimens were identified to element and Class (see Works cited for all reference materials). Of these, 2,291 small mammal specimens were separated for taphonomic analysis using a Leica MZ12 stereo light microscope at 0.8 x - 100x magnification. Visual evidence of taphonomic/ diagenetic change including mineral oxide staining, thermal discolouration, and digestive corrosion were recorded along predefined categories. SEM analysis was used to differentiate oxide and thermal modifications. The focus of this poster is on the patterns of thermal discolouration between samples from above, below and within the burnt layer.

Image 2.0: The 5 categories of burning (image compliments of Fernandez-Jalvo)

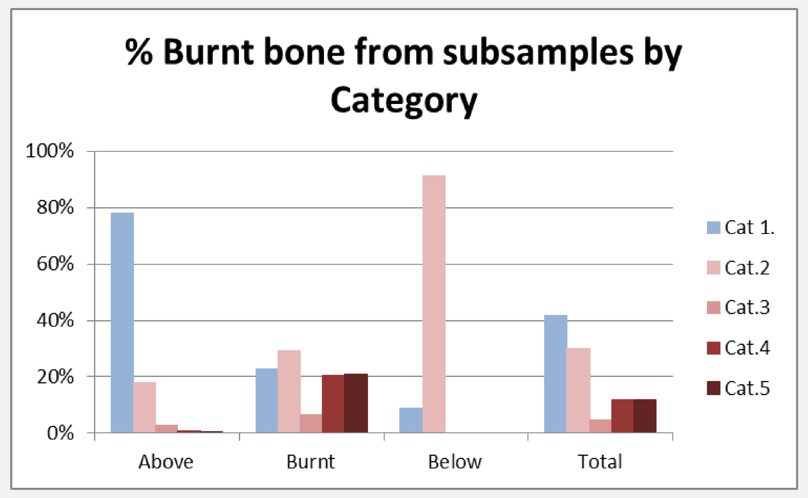
Results

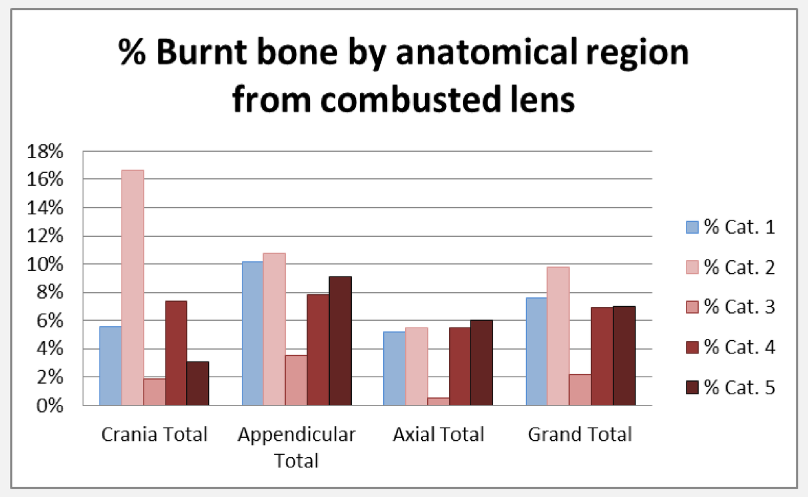
Assuming an anthropic origin for the thermal alteration of the burnt layer, our hypothesis states that small mammal bone deposited within the burnt layer will show a higher proportion of thermal alteration, as well as a higher intensity of colour modification, than bone deposited above or below the burnt layer. Carbonation or calcination of bone results from exposure to temperatures >600ºC, generally exceeding natural fire levels (Lyman, 2009). Of the 2,291 bones examined, 582 (25%) revealed evidence of thermal alteration as discolouration of the bone surface. The majority of these specimens (>70%) fall into Category 1 (light coloured isolated spots) and Category 2 (dark gradient discolouration). The remaining 30% exhibited either carbonation (Category 3) or calcination to grey-white (Category 4) or pure white (Category 5) colour. These specimens were also found to be much more fragile than those in Cat. 1 and 2, with more cracking and less root etching.

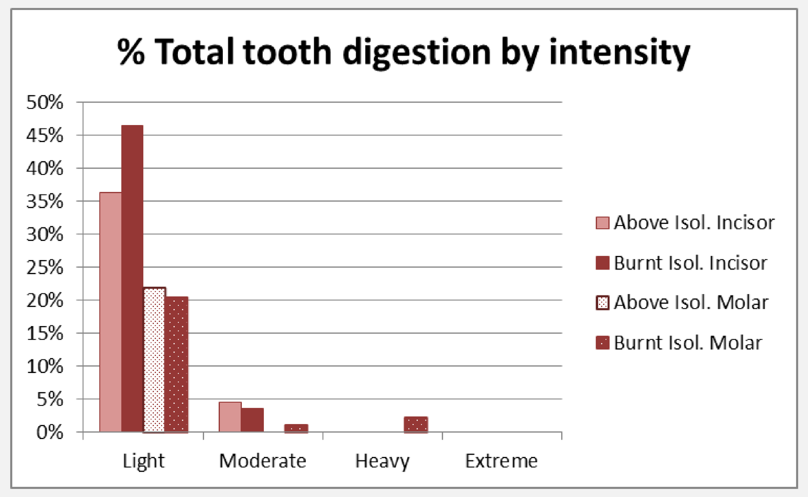
Above the burnt layer the majority of specimens are either Cat. 1 (NISP = 173) or Cat. 2 (NISP = 40). **Only 4.1% (NISP = 9) of the material from these deposits is designated Cat. 3 or higher.** The sample recovered from below the burnt layer is too small to discuss in detail (NISP = 141; MNI = 5), however, the burnt specimens show a clear dominance of Cat. 2 discolouration. **From within the burnt layer, the distribution is bimodal with Cat. 3-5 accounting for 48.1% (NISP = 163)** of the burnt specimens or 94.8% of the total burnt specimens from these categories. Despite our small sample sizes, a clear pattern in the distribution of intensity of thermal alteration throughout the deposits is seen.

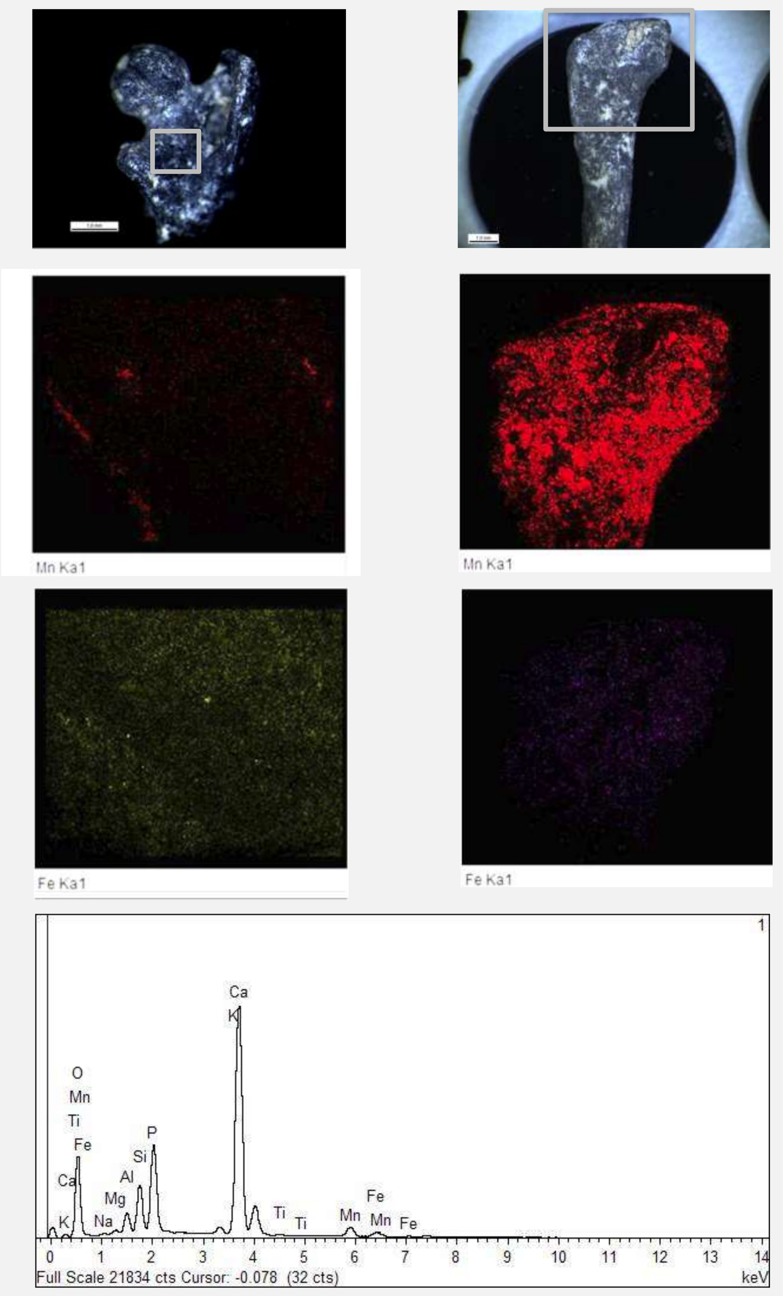
The even distribution of each category of burning across anatomical regions suggests that these modifications result from *in situ* exposure to high temperatures. Evidence for exposure to high temperatures among cranial elements suggests humans were not accumulators of the assemblage (Dewar & Jerardino, 2007). The intensity of digestive destruction can indicate what predator is responsible for biotic accumulations of small mammal bones (Andrews, 1990). The dominance of light digestive destruction (slight reduction of enamel and rounding of salient edges in both incisors and molars) suggests the small mammal assemblage from Cueva Negra was accumulated by a Category 1 or 2 predator – most likely a barn owl or eagle owl. However, a high rate of fragmentation throughout the sample does not fit this pattern, and suggests more complex post-depositional taphonomic modification.

Both burnt and unburnt specimens throughout the deposit show evidence of mineral oxide staining. To differentiate between this and thermal alteration, type specimens were examined using SEM and surface element analysis (EDS). While no clear visual distinction was seen (suggesting the mineral deposits extend below the cortical surface), isolated pockets of Manganese (Mn) and Iron (Fe) deposit are recognizable on oxide stained bone surfaces. EDS on type specimens from all five categories of burning excluded these minerals as the agents behind the discolouration, supporting our visual identification of thermal alteration.









Conclusions

The small mammal collection from Cueva Negra reveals clear evidence of anthropic burning events deep within the cave deposits. The occurrence of carbonated and calcine bone indicates temperatures exceeding those commonly reached by natural fires and the aggregation of 94.8% of the recovered calcined bone within a thin stratigraphic level suggests these events were isolated both spatially and temporally. The anatomic pattern of thermal damage, as well as light digestion of dental elements, suggests the assemblage was accumulated by birds of prey, and that the specimens were unintentionally damaged by human-cultivated fire. This research reinforces similar interpretations based on faunal, lithic, and micromorphological evidence and presents a novel methodology for identifying early pyro - technological capabilities in the archaeological record.

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