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Detection of diagenetic processes in bones: the case of Arkoudospilia cave, N. Greece

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Diagenesis of bone material over geological time is a highly complex phenomenon involving the physical, chemical, histological and mechanical alterations that occur at different time scales from the time of death to present and depend on the local geochemical conditions. The significance of diagenesis and the information that can provide its decoding, led to its study by a variety of physicochemical techniques. Despite serious research efforts, a detailed scenario of bone diagenesis remains elusive.
The δ18O of the carbonate material of hydroxyapatite of the bones is though to be a good indicator of the δ18O of the local water precipitation and therefore can be used for palaeoclimatic reconstraction, while δ13C is used for definition of palaeodiet habits. The study of isotopic composition requires the detection of the diagenetic degree, because both δ18O and δ13C can be contaminated by these processes.
Stable carbon and oxygen isotope values (δ13C, δ18O) were obtained for structural carbonate in the hydroxy-apatite of bear bones from Arkoudospilia Cave, Pella, N. Greece. The age range of the fossil layers is from 32ka BP to a maximum of 38ka BP (radiocarbon dating). The findings belong to Ursus ingressus, an extinct cave bear. The difficulty in studying an extinct species lies to the fact that it cannot be easily correlated with a present one, so it is impossible to determine the diagenesis by the analytical deviation. However, in order to include the environmental and climatic differences of the past and modern bear habitats, the isotopic composition of the water should be also included in the study.
Cave bears are considered to be endemic in Europe. The shortage of data in literature concerning cave bears isotopic analyses in combination with the burden of the difficulties in spotting and sampling such rare materials makes difficult to compare the results of a study. The diet and the physiology of this species are not well known. However the morphology of teeth, skull and mandible indicate a basically herbivorous regime and the metabolism of this species is usually considered similar to this of the American black bear (Ursus americanus) or of the brown bear (Ursus arctos).
Structural carbonate is considered to be less resistant than phosphate to post – depositional alteration because P-O chemical bonds in apatite are stronger than the C-O bonds, however phosphate is susceptible to microbial activity. For the needs of the present study isotopic composition of fossil bones where correlated with the isotopic composition of modern bears that live in the area of the findings. Moreover both fossil and modern bones were examined with X-ray diffraction for minelalogical alterations. The comparison of the isotopic composition and mineralogical characteristics of fossil and modern bones indicated possible diagenetic effects that may lead to exclude specific samples from palaeoclimatic archives.