

## **Taphonomy of vertebrate fossil assemblages from swampy circum-lake**

### **environments: An example from the late Eocene of Zambrana (Iberian Peninsula)**

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### **ABSTRACT**

Biostratigraphic and bone-diagenesis parameters are used to evaluate the effects of abiotic and biotic processes on the final composition of two late Eocene vertebrate assemblages preserved in a swampy circum-lake environment from the Zambrana site (Basque-Cantabrian Region, northern Iberian Peninsula). No significant transport or bone sorting by fluvial action is observed, and complete and fragmentary bones in the assemblages (Z4 and Z6 beds) show the same biostratigraphic features. The attritional bone accumulation in both excavated beds was caused mostly by biotic factors related to routine ecological deaths of population members, probably with some input from predators on the most vulnerable ungulate individuals (autochthonous), although a weak input of small remains by superficial water currents from nearby areas (parautochthonous) cannot be rejected. The vegetation and wet conditions of the swampy environment, together with possible predator and scavenger activity, could have caused the disarticulation and dispersion of some vertebrate remains, mainly those of ungulates. The bones were buried relatively quickly in the phreatic zone under reducing conditions and suffered considerable crushing and fragmentation because of lithostratigraphic compaction. Mineralogic similarities between sedimentary fillings in the fossils and the host sediment, as well as the homogeneous rare earth element (REE) trends of the fossils, are indicative of a uniform and unique diagenetic history and the absence of reworked elements. The fossil bone mineral is well-crystallized francolite (carbonate fluorapatite). The REE enrichment of bones and their calcite and pyrite crusts and fillings were formed during early diagenetic phases. The black coloration of the bones may be explained by their high hydrocarbon (n-alkane components) contents.