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REE uptake in a hypermineralized fossil whale rostrum: impact of bone histology on postmortem alteration

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Rare Earth Elements (REE) have been widely used as a proxy for the study of palaeoenvironments, and taphonomy, as well as for tracing the origin of fossil remains. However, because of (i) the REE intra-bone fractionation during diagenesis, and (ii) the possible variation of the diagenetic fluid chemistry through time, REE signatures are difficult to interpret unambiguously [1]. This geochemical study (Laser Ablation ICPMS in situ analyses) focuses on the extremely thick (85 mm) and compact rostrum bones of the Mio-Pliocene beaked whale *Globicetus hiberus*, trawled from deep-sea deposits off Spain [2,3]. The studied specimen offers a unique opportunity to investigate the question of the REE uptake, regarding (i) the effect of bone histology, and (ii) the long-term (at least several myr) alteration processes this whale bone has undergone in a well-constrained environment.

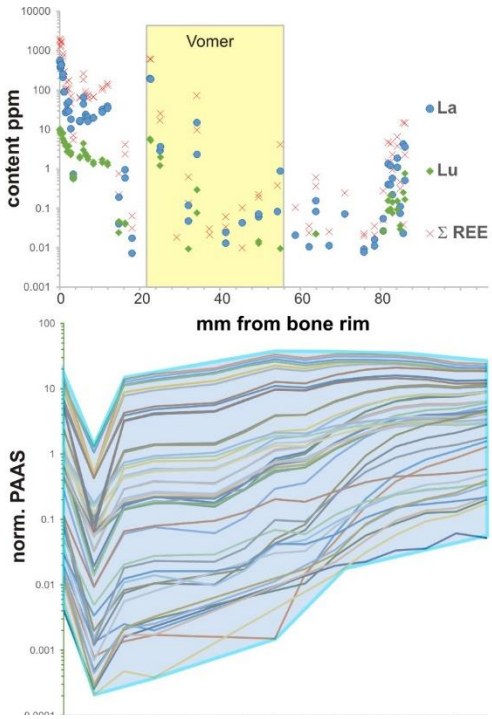

Figure 1: Distribution of the REE contents along the bone profile, and REE patterns (normalized to the Post-Archean Australian shales, PAAS [7])

The fossil rostrum has been preserved at ~1500 m depth on the border of the continental platform [4]. It is partly comprised within phosphorites [4], under a thin - condensed - layer of sediments [3]. The formation of phosphorites at the interface between the bottom water and sediments typically suggests a suboxic environment, near the redox boundary [5]. For these specific conditions, one can see that the highest REE contents (up to 2000 ppm) are observed at the outer bone rim (Figure 1) and decrease towards the inner bone, as commonly observed for fossil bones [6]. Most of the REE patterns are enriched in heavy REE ($0.02 < (La/Yb)_N < 0.6$), with a negative anomaly in Ce ($0.01 < Ce/Ce^* < 0.33$). Towards the central part of the bone, the behavior of the REE is characterized by an overall decrease of the $(La/Yb)_N$ ratio and increase of the $(La/Sm)_N$ ratio. These trends reflect the "normal" intra-bone REE fractionation [1].

Such a behavior is seemingly disrupted in zones of higher porosity: (i) in the vicinity of the largest vascular canals (in the vomer bone tissue, Figure 1), and (ii) at the boundaries of the vomer bone tissue. On the contrary, other parts of the inner bone display very low REE contents. This is likely due the extremely high compactness of this whale fossil bone.

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