# Rare earth element abundances of human bone assemblages originated from a Merovingian necropolis

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Trace element chemistry of bones is rapidly altered post-mortem. Therefore, trace elements and particularly rare earth elements (REE) of bones are used to reconstruct diverse aspects in the field of archaeology. However, analysis of soils surrounding the burial are rarely presented, although it is well known that soil characteristics heavily affect bone weathering. Special decomposition patterns of trace elements and rare earth element abundances of bones have been studied under well-drained, slightly acid and clay-enriched burial conditions. We selected small samples from the cranium and pelvic of 14 individuals originated from a Merovingian necropolis (6$^{th}$ century) in South Germany. Additionally, soil samples were taken in the range of cranium, pelvic and outside (reference) from the individual grave. Bones were digested with $HNO_3$, whereas soils were extracted with aqua regia. chemistry: Soils surrounding the burial were enriched in nitrogen, pedogenetic Mn and Fe oxides in comparison to reference soils. The REE abundance in soils was significantly greater than that in fossil bones. We found a high variation of REE signature in bones. However, no correlation was found between sex and age of individuals and their specific REE signature. Finally, element abundances of bones collected from Merovingian necropolis were compared to other archaeological sites exhibiting different burial environments (loess deposits, wet conditions). The REE distribution and abundance from different burial environments differed considerable. This finding highlighted the importance of considering the burial environment in the context of interpretation of element replacement during bone weathering.

# Influence of nacre precipitation on the chemical composition of prismatic shell layers in *Mytilus edulis*

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Marine biogenic carbonates e.g. corals, foraminifera and bivalve shells are widely used for proxy studies to reconstruct environmental parameters like temperature, salinity, pH etc. Within the context of predicted major changes in the marine ecosystems (warming, acidification) detailed insight in the chemical composition of calcerous hard parts of marine organisms is needed to evaluate their potential future performance. Despite decades of research on biomineralization, comprehensive knowledge about processes linking environmental parameters, physiology and chemical composition of the biominerals is still lacking.

In particular the shells of the common blue mussel *Mytilus edulis* have been thoroughly investigated with respect to shell structure, biological control on shell formation and environmental reconstruction using elemental (Mg/Ca) or isotopic proxies ($\delta^{18}$O, $\delta^{44/40}$Ca). So far, no clear relation between e.g. Mg/Ca in the prismatic outer shell layer and temperature has been found.

We obtained elemental mappings (Mg, Na, Sr, S and Ca) on shell sections of a Mytilus edulis specimen using electron microprobe. No evidence of an influence of the growth rate on trace element concentrations was found when comparing slow and fast grown sections of the shell. Comparing the outer (prismatic) and inner (nacreous) shell layers, we observed a strong anti-correlation of Mg and Na concentrations. Areas within the outer shell with the highest Mg and lowest Na contents are attached to destinct nacre layers being enriched in Na but strongly depleted in Mg. Our interpretation is that the chemical composition of the prismatic and simultaneously grown nacre layers influence each other i.e. the processes controlling nacre formation also contribute to those forming the prisms in the outer shell. The latter appears to generate a kind of feedback dominating the Mg and Na composition in the outer shell. This is interpreted as a physiologically based effect overprinting first order temperature influences on the Mg/Ca ratio of prismatic shell layers.

Our observations indicate a potential source for the failure of earlier approaches to establish Mg/Ca as a temperature proxy using *Mytilus edulis*.