Revised $\delta^{18}O$ phosphate-water fractionation equation from fish raised in controlled environment

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Since the work of Longinelli and Nuti [1], refined by Kolodny *et al*. [2], fish tooth apatite $\delta^{18}O$ has been used to infer temperatures of ancient oceans [eg.3]. This proxy presents many advantages for paleotemperature reconstruction, as biogenic apatite is particularly resistant to diagenetic alteration and as fish are throught to precipitate their apatite in equilibrium with seawater [4]. However, because existing fractionation equations have been established from fish recovered from natural environments, they present very large uncertainties due to large data scattering. The uncertainties are mainly due to seasonal variations of both temperature and $\delta^{18}O$ of the water from which the analysed fish have been recovered, associated with a short formation time of fish teeth (less than a season). As different fish species have been used, and because of the large dispersion of fish tooth $\delta^{18}O$ data, the existence of limited vital fractionation effects during apatite mineralisation cannot be excluded.

We present new $\delta^{18}O$ data for two different fish species, seabream and dogfish, raised in aquariums at constant temperatures (16, 18, 20, 22, 24, 26 and 28°C) and water $\delta^{18}O$. The data show no difference in apatite $\delta^{18}O$ of the two fish species, demonstrating the absence of vital effects. A revised phosphate-water fractionation equation with low uncertainties is presented.

[1] Longinelli and Nuti (1973a) *Earth Planet. Sci. Lett.* **19**, 337-340. [2] Kolodny *et al.* (1983) *Earth Planet. Sci. Lett.* **64**, 398-404. [3] Pucéat *et al.* (2007) *Geology* **35** (2) 107-110. [4] Vennemann *et al.* (2001) *Geochim. Cosmochim. Acta* **65** (10) 1583-1599.

Highly siderophile elements in the Earth's mantle: Message from the Archean komatiite zoo

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Studies of the absolute and relative abundances of the highly siderophile elements (HSE) in Archean komatiites provide valuable information regarding the origin and early evolution of Earth. Mantle sources of some Archean komatiites (e.g., the 3.5 Ga Schapenburg, S. Africa) were characterized by near-flat LREE patterns, radiogenic initial $^{143}Nd/^{144}Nd$ and $^{187}Os/^{188}Os$, and low absolute and fractionated relative HSE abundances, as compared to Primitive Upper Mantle (PUM) estimates. These characteristics likely reflect either hydrous melting of a mantle wedge in an Archean subduction zone, or re-melting of a majorite-enriched mantle domain formed during solidification of a terrestrial magma ocean. In contrast, sources of most komatiites (e.g., 2.9 Ga Volotsk, Fennoscandia, 2.7 Ga Abitibi, Canada, and 2.7 Ga Belingwe, S. Africa) were characterized by strong LREE-depletions and high $\varepsilon^{143}Nd(T)$, identical time-integrated chondritic Re/Os and Pt/Os, and absolute and relative HSE abundances similar to those in the PUM. These komatiites were likely formed via dry melting in deep mantle plumes at temperatures up to 2000°C. One mechanism to account for the HSE budgets of the sources of these komatiites is late accretion, whereby planetesimals with average HSE compositions similar to those in E-chondrites were added to the mantle and homogenized after cessation of core formation and a putative initial mantle stratification event that removed part of highly incompatible lithophile elements from the bulk convecting mantle. Such a combination of processes is required to account for the decoupling of Sm-Nd and Re-Os isotope systematics of these komatiite sources. Other komatiite sources (e.g., 2.8 Ga Kostomuksha, Fennoscandia) show strong LREE-depletions and high $\varepsilon^{143}Nd(T)$, absolute and relative HSE abundances similar to those in the PUM, yet exhibit time-integrated suprachondritic Re/Os and Pt/Os. These komatiites may have been derived via dry, high-T melting in a starting mantle plume. The coupled $^{186,187}Os$ enrichment in these komatiites was either the result of core-mantle interaction, requiring early onset of inner core crystallization, or the presence of some sort of recycled material in the source. Additional species of the Archean komatiite zoo may yet be discovered.