Zinc isotopes as a tool to study zinc uptake by marine phytoplankton

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The availability of metals to marine phytoplankton has been suggested to control oceanic carbon uptake from the atmosphere and its sequestration to the deep sea. Metal variability across glacial/interglacial periods could have driven changes in the composition of atmospheric greenhouse gases [1]. Many transition metals, including zinc, are often extremely scarce in the euphotic zone and are coupled with deep enrichments, consistent with biological uptake at the surface and regeneration at depth. However, abiotic processes, such as scavenging, can also contribute to this depth cycling [2]. If the surface to depth cycling is associated with zinc isotopic fractionation, then isotopic studies should be able to elucidate the key contolling processes, both now and in the past.

Here we seek to evaluate zinc isotopes as a potential tool to track metal cycling in the oceans. Recently obtained depth profiles of dissolved zinc isotopes from the NE Pacific reveal anomalously light compositions in the shallow sub-surface immediately below the isotopically heavier euphotic zone. This dataset suggests shallow zinc recycling in the upper ocean, possibly caused by the release of biologically bound light zinc [3,4]. To our knowledge, the diatom *Thalassiosira oceanica* is thus far the only planktonic organism that has been shown to fractionate zinc isotopes during uptake [5]. We have cultured this organism, and a variety of other marine phytoplankton strains, in order to explore systematic and species-dependent changes in their isotopic fractionation. Thermodynamic reaction modelling of our experiments and natural systems elucidates zinc isotopes as a potentially powerful tool to reconstruct biological metal cycling in both modern and past oceans.

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Noble gas signature of Tertiary alkaline basalts and xenoliths from central Europe

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We present preliminary He and Ar isotope data for two suites of pristine alkaline basaltic rocks associated with the Eger Rift, Bohemian Massif, in order to deconvolve the noble gas signature of the sub-continental lithospheric mantle beneath central Europe. In addition, He and Ar data were collected from xenoliths enclosed in these alkaline basalts in order to compare the noble gas isotope signature of the mantle source of the xenoliths, thought to be located at shallower depths than that inferred for alkaline volcanic rocks.

Most xenolithic and phenocrystic olivines have ^{3}He/^{4}He ratios between 4.7 and 6.6R$_A$, clearly more radiogenic than MORB, and rather constant despite ^{4}He concentrations varying by nearly two orders of magnitude (0.1–8.9×10^{-8} cm^3 STP/g), although the highest ^{4}He concentration is associated with an elevated ^{3}He/^{4}He of 7.2R$_A$. The latter may suggest sampling of a convective mantle similar to MORB. Homogeneous ^{3}He/^{4}He ratios (5.5–5.7R$_A$; n=3) are found for olivines from the Doupovske hory volcanic complex, whereas clinopyroxene shows a slightly more radiogenic signature (4.1R$_A$). Collectively, He isotope data shows a remarkable homogeneity across two chemically distinct volcanic centres associated with the major Eger rift lineament, attesting to their temporally and spatially invariant lithospheric mantle source, and confirms further the observations of a homogeneous He isotope signature of the sub-continental mantle beneath central Europe [1]. ^{40}Ar/^{36}Ar ratios for the same samples are between 306 and 3690. Atmospheric Ar could be admixed by infiltration of air from basaltic melts; such a process of metasomatism of mantle xenoliths by basaltic melts has been reported from other localities of the Eger rift [2]. Further He and Ar isotope analyses of alkaline basaltic and basanitic rocks and xenoliths of distinct mantle layers from between 32 and 70 km in depth are in progress.

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