The elemental budget of W during mantle melting and crust formation

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Tungsten behaves as a highly incompatible trace element during mantle melting, similar to Ba, Th, or U. Previously reported W-Th-U data for oceanic basalts appear to indicate a similar compatibility of these elements during mantle melting [1], with the most recent study [2] proposing that W is similarly incompatible than U but more compatible than Ba and Th. Independent of the specific approach, the W concentration of the bulk silicate Earth has been estimated to ca. 15 ppb using the near constant W/U or W/Th in mafic rocks [1,2]. This estimate is also the basis for the Hf-W age for the formation of the Earth's core that is inferred from the ^{182}W abundance and the Hf/W ratio of the silicate Earth.

In order to closer assess the behaviour of W relative to Ba-Th-U and other HFSE during mantle melting, we analysed a suite of well characterized mafic rocks from a variety of tectonic settings for their W-Nb-Ta-Zr-Hf compositions, employing isotope dilution and MC-ICPMS. Our results for MORBs indicate that W is slightly more incompatible than Th, U, Ba, and Ta with Th being the next incompatible element to W. Notably, Ta/W ratios in the analysed MORBs (4 to 10) are throughout higher than the proposed primitive mantle value (ca. 2.5, [3]). Our new estimate for W/Th in the depleted upper mantle (0.18±0.3, 2σ), however, agrees with the previously proposed value of [1]. High precision W data for a variety of mafic arc lavas from different settings ([4] and unpublished data) indicate that W is more mobile than U-Th and Nb-Ta, respectively. Ratios of Ta/W in arc lavas are therefore consistently lower relative to MORB (as low as 0.2). Likewise, W/Th in many arc lavas tend to be more elevated (up to 1), particularly in arc systems where significant amounts of pelagic sediment are being subducted.

Altogether, our data suggest that W is selectively enriched relative to U and Th in the sources of arc magmas and possibly in the continental crust. As a consequence, the present day W/Th of the Earth's upper mantle might be different from that of the bulk silicate Earth, imposing larger uncertainties on the Hf-W age for core segregation on Earth.

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Incorporation of 'hydrothermal' elements in foraminiferal calcite: Results from culturing experiments

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The trace race element chemistry of foraminiferal tests reflect the environment in which they grew. Thus geochemical data can be used as paleo-proxies constraining environmental conditions in ancient seas [e.g.: 1]. Seawater chemistry may be influenced by local sources such as hydrothermal activity. However, for elements considered diagnostic for hydrothermalism, reliable experimental data is rare [e.g. 2].

To provide a solid basis for a more complete understanding of trace element partitioning between foraminiferal calcite and seawater, we carried out culture experiments under controlled laboratory conditions. This is the main objective of our study.

For our experiment we grew freshly collected benthic foraminifera (*Ammonia tepida*) in seawater, containing a cocktail of Mn, Co, Ni and Cu, at defined trace element levels.

Measurements of the culture solutions were carried out regularly by HR-ICP-MS whereas the calcite of newly grown chambers of the cultured foraminifera was detected by a non-destructive technique - µSy-XRF [3]. To confirm the data LA-ICP-MS measurements have been performed. To distinguish between old and new chambers the calcein labeling technique [4] was applied.

First results demonstrate that especially Ni and Cu could be determined with high precission and accuracy using µSy-XRF measurements. We determined trace element/Ca ratios and D_{Ni} as well as D_{Cu} using LA ICP-MS.

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