New insights into the geochemical behaviour of W by high precision isotope dilution measurements

STEPHAN KÖNIG[1,2], CARSTEN MÜNKER[1,2] AND STEPHAN SCHUTH[1,2]

[1]Universiät Bonn, Germany (wayangkulit@web.de)
[2]Universität Münster, Germany

The geochemical behaviour of W during silicate Earth differentiation is only poorly constrained, largely due to its low abundance that makes high precision measurements difficult. Previous results (e.g., [1]) indicate a lower W/Th of the mantle (ca. 0.19) compared to the Earth's crust, (ca. 0.26), suggesting that W appears to be more incompatible than Th. New data for MORB [2], however, demonstrate that W/Th is not significantly fractionated during dry peridotite melting, rather suggesting a fractionation of the two elements during crust formation by subduction related processes.

In order to assess the geochemical behaviour of W closer, we determined concentrations of W together with those of other high field strength elements by isotope dilution, using a mixed ^{183}W-^{180}Ta-^{94}Zr-^{180}Hf-^{176}Lu tracer and multiple collector inductively coupled plasma mass spectrometry (MC-ICPMS). In contrast to concentrations of other HFSE, which typically can be reproduced to within ±1%, W concentrations obtained for replicates display a larger scatter, ranging up to a few percent. The external reproducibility obtained for W concentrations (typically 3-4% 2σ) appears to depend on petrological properties, suggesting an influence of sample heterogeneity effects. For the BHVO-2 standard, significant variations in both Ta and W concentrations can be observed between multiple analyses. However, whereas measured W concentrations display large variations (200 – 350 ppb), Ta/W ratios (4.96-5.16) still yield an external reproducibility of ±4% (2σ). Altogether, our results confirm a similar compatibility of Th-W and Ta that is also reported for variably depleted MORBs [2], where measured Ta/W ratios only range from 4 – 6.

First Ta-W abundances determined in basaltic glasses and whole rock powders from various island arc settings display Ta/W ratios of 0.6 – 1.7, significantly lower than the values reported for MORB. These systematic differences indicate a higher mobility of W relative to Ta in subduction related processes, which possibly causes the selective W enrichment in the continental crust.

References

[1] Newsom H.E. *et al*. (1996), *Geochim Cosmochim Acta* **60**, 115-1169.
[2] Münker *et al*. *Geochim Cosmochim Acta Supplement* (this volume)

Trace element partitioning in subducted slabs: Constraints from garnet inclusions and thermodynamic modelling

MATTHIAS KONRAD-SCHMOLKE[1], THOMAS ZACK[2] AND PATRICK J. O'BRIEN[1]

[1]Universität Potsdam, Karl-Liebknecht-Strasse 24-25 14476 Golm (mkonrad@geo.uni-potsdam.de)
[2]Universität Heidelberg, INF 236 69120 Heidelberg, (tzack@min.uni-heidelberg.de)

Due to limited insight into mineralogical processes during subduction, interpretation of trace element amounts and patterns in exposed rocks is far from straightforward and heavily debated. Better quantitative constraints on prograde metamorphic reactions during subduction can be derived from thermodynamic forward modelling, utilising Gibbs energy minimisation with consideration of element fractionation.

In this contribution we combine results from thermodynamic modelling with detailed major and trace element determinations in HP and UHP garnets and their inclusion phases. The aim is to correlate trace element partitioning between solid phases and liberated fluids with modelled phase relations and devolatilisation events during deep subduction.

Our results show that water liberation is strongly dependent on the P-T path and often pulse-like due to mineral reactions in the subducted slab. In samples from lawsonite eclogites, for example, lawsonite inclusions as well as host garnet exhibit systematic variabilities from core to rim, such that garnet rims and lawsonite inclusions therein are depleted in HREE, while lawsonite in garnet cores exhibits a flat REE pattern. This observation is consistent with our models that predict lawsonite to be stable throughout garnet growth and water liberation to be continuous along the considered P-T path. In contrast, complexely zoned UHP garnets from Verpenesset (Norway) show compositionally distinct growth zones and a characteristic MREE spike. Water liberation in these samples is predicted to be highly discontinuous and triggered by the breakdown of epidote and amphibole, which are relatively enriched in MREE corresponding to the observation of the MREE spike in garnet.