Behavior of nitrogen and its isotopes during high-pressure fluid-driven metasomatic processes: A case study from the Tian Shan, China

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The nitrogen (N) isotope system has a great potential as geochemical tracer for crustal and volatile recycling due to the large isotopic differences in the various terrestrial reservoirs, and nitrogen is a sensitive tracer of sediment-derived fluids and metasomatic processes [1].

In this study, we investigate the behavior of N and N isotopes in a major fluid conduit – wall rock system within the high-pressure mélange of the Tian Shan, western China. A massive blueschist is cross-cut by a garnet-omphacite-carbonate-quartz vein, which is surrounded by an eclogitic reaction halo [2]. A profile from the unaltered blueschist via a blueschist alteration zone (BAZ) and the eclogitic selvage towards the vein shows a continuous decrease in N concentrations. The concomitant decrease in Cs, Rb, K and Ba contents provides evidence that N is incorporated as NH_4^+ into white mica and liberated during fluid-rock interaction. $\delta^{15}N$ values of blueschists and the BAZ are overlapping (~2‰), but increase in the eclogitic selvage (+2.6±0.2‰) and the vein (+4.8‰).

Three alternative explanations for the N systematics are discussed. Devolatilization leads to a decrease in N contents and an increase in $\delta^{15}N$ in the residual rock, i.e. the eclogitic selvage, but for a good fit with the observed data pure batch devolatilization and isotopic fractionation factors slightly lower than those published have to be assumed. Second, the elevated $\delta^{15}N$ signature in vein and eclogitic selvage may be externally derived. This explanation is supported by positive correlations of $\delta^{15}N$ with Ca, Sr and Pb, the latter elements being enriched by an infiltrating fluid [2]. Finally, N may have been leached together with Cs, Rb, K and Ba from the selvage near the vein involving diffusion. One can speculate that the diffusion caused a preferential removal of the light ^{14}N isotope causing an elevated $\delta^{15}N$ in the selvage, whereas the $\delta^{15}N$ signal in the vein is dominated by an external source.

[1] Bebout (1997) *EPSL* **151**, 77-90. [2] Beinlich *et al*. (in review) *GCA*.

High-resolution analysis of trace elements in encrusting coralline red algae by laser ablation ICP-MS

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Coralline red algae are ideal extratropical marine climate recorders owing to their common occurrence not only in the tropics but also in mid- to high latitude oceans. Coralline red algae archive past climate information along fixed annual growth increments in a high Mg-calcite skeleton. Live-collected specimens have yielded radiometrically-determined ages of up to 850 years and recent calibration experiments have demonstrated the value of a number of coralline algal species as paleothermometers. Annually to seasonally resolved stable oxygen isotope and Mg/Ca records have provided up to century-scale climate reconstructions.

Here we present high-resolution Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) elemental ratios (Mg/Ca, Sr/Ca, Ba/Ca, U/Ca, Pb/Ca) from the encrusting coralline red algal genus *Clathromorphum*. Specimens were live-collected from the North Atlantic and North Pacific Oceans and elemental ratios were measured in sub-monthly resolution to provide century-scale proxy records. Duplicate transects were analyzed in multiple specimens in order to assess the robustness of the proxy data. The reproducibility is excellent and LA-ICP-MS results were validated by comparison to electron microprobe measured elemental ratios and bulk sample ICP-OES data. In particular, algal Mg/Ca ratios show a high degree of correlation with local seawater temperatures on different timescales, providing further evidence for the temperature dependency of algal Mg/Ca variations and their use as a valuable paleothermometer. Hence, this study demonstrates the feasibility of extracting high-resolution geochemical signals from coralline red algae using LA-ICP-MS. This technique allows rapid sampling of the algal surface with unprecedented resolution and provides a valuable tool for future analysis of algal-derived environmental records.