

Li isotope fractionation during slab dehydration? Implications from studies of subduction-related eclogites and associated garnet mica schists T. Zack, P. Tomascak, R.L. Rudnick and W.F. McDonough; Department of Geology, University of Maryland, College Park, MD 20742, USA (tzack@geol.umd.edu).

Introduction: Lithium isotopes have great promise for tracking subducted components in mantle sources owing to the large isotopic offset between low T altered crustal material and relatively monotonous mantle rocks. Additionally, Li is taken up by mantle minerals, in contrast to LIL elements and B, which are effectively recycled back into the crust via the slab component in island arc magmas.

We address the question of isotopic fractionation of Li during devolatilization in subducting slabs by studying eclogites and associated garnet mica schists from Trescolmen, Central Alps, Switzerland [1, 2]. These rocks experienced peak metamorphic conditions at ca. 650°C and 2.0 GPa, corresponding to maximum devolatilization temperatures prior to onset of melting.

Metamorphic history: Eclogite protoliths from Trescolmen have major, HREE and HFS element similarities with MORB [1]. Phengite-bearing eclogites still preserve compositional features consistent with low-T ocean-floor alteration [2]. This package of basalts and pelitic sediments was subjected to eclogite-facies conditions during Alpine orogeny, during which they lost 2-4% fluid.

Small-scale fluid infiltration from the surrounding garnet mica schist into the eclogites occurred during early stages of uplift at eclogite-facies conditions. The amount of fluid was large enough to equilibrate Cs-Rb-Ba contents between eclogite-facies amphibole from different samples, but too small to erase an early low-T pattern preserved in phengites [2]. Evidence for fluid flow at high pressure is also visible from widespread veins consisting of qz+phengite±kyanite±omphacite±rutile.

Amphibolite-facies overprinting was minor at Trescolmen. Eclogite bodies often only have a small rind of amphibolite, while interiors are pristine. Garnet mica schists are more strongly overprinted, as indicated by the formation of biotite, but celadonite-rich phengites are still abundant.

Li data: We are investigating the systematics of Li in eclogites, garnet mica schists and high pressure veins. The methods include laser ablation-ICP-MS for Li concentration of minerals, solution ICP-MS for Li whole rock concentration and solution MC-ICP-MS for Li isotopes of mineral separates and whole rocks.

Phengite is the dominant host for Li in garnet mica schist (26-75 ppm Li) and phengite-rich veins, while omphacite is the most important phase for Li in eclogites (16-64 ppm Li), even in phengite-rich samples (0.7-4.2 ppm Li in phengite). The large difference in Li

concentration in phengites from eclogites and mica schists is taken as evidence that fluid infiltration from mica schists into the eclogites was not large enough to homogenize Li in both assemblages. Thus, Li in the eclogites should be largely retained from a stage before fluid infiltration.

Lithium isotopes have been measured from two phengite separates of one phengite-rich vein ($\delta^7\text{Li}$ of +0.6‰ and +0.9‰), one phengite separate from garnet mica schist (+1.2‰) and one eclogite whole rock sample (+0.6‰), with an uncertainty of $\pm 1\%$ (2σ). By measuring pristine eclogite and biotite-free phengite separates we can exclude any effect from amphibolite-facies overprinting. Since Li was not largely redistributed during high pressure fluid infiltration, these low values of $\delta^7\text{Li}$ record an earlier process.

The likely protoliths of Trescolmen eclogites and mica schists, low-T altered MORB and clay-rich sediments, all have significantly heavier Li isotopes (from +2.5‰ up to +12‰). We are therefore left with the possibility of significant Li isotope fractionation by fluid loss during subduction.

The similar $\delta^7\text{Li}$ compositions of the analysed eclogite and mica schist samples might be coincidental if their protoliths had similar compositions. However, since assemblages from Trescolmen come from a range of sources, we expect to see a larger range in $\delta^7\text{Li}$ with the collection of more data.

What happens to Li in dehydrating slabs? Further evidence for Li isotope fractionation by devolatilization is found in unusually heavy Li isotopic compositions of fluids from the downgoing crust at Conical Seamount, Mariana forearc ($\delta^7\text{Li}$ of +17‰) [3]. Isotopically heavy fluid is not entirely lost in the forearc, given that lavas in certain circumstances (e.g., Panama, Central America) have $\delta^7\text{Li} > \text{MORB}$ [4,5]. We envision a scenario where Li in source rocks ($\delta^7\text{Li} \geq \text{MORB}$) is fractionated during early stages of subduction, leaving a residual, low $\delta^7\text{Li}$ component in eclogites. This is consistent with relatively low $\delta^7\text{Li}$ values in adakites from Panama [4].

References: [1] Zack T. et al. (2001) *CMP*, in press, [2] Zack et al. (2001) *Chem. Geol.*, submitted, [3] Benton L.D. et al. (1999) *Eos* 80, S349, [4] Tomascak P.B. et al. (2000) *Geology* 28, 507-510, [5] Chan et al. (2001) *Chem. Geol.*, in press.