

## Lithium isotope fractionation in pegmatites — Function of bond length

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Large ranges in Li isotope compositions of pegmatites have recently been reported and  $\delta^7\text{Li}$  variations variously ascribed to melt–exsolving fluid fractionation [1], source variations [2], the  $^7\text{Li}$  affinity to occupy stronger (i.e. shorter) Li–O bonds [3] or extensive crystal–melt fractionation [4].

Petalite, spodumene, amblygonite, lepidolite, tourmaline, beryl, muscovite and secondary lithiophosphate and cookeite from two pegmatites with similar mineral assemblages but distinct ages (Nová Ves, Czech Republic, ~335 Ma; Tanco, Canada, ~2640 Ma), show large range in Li (770–154, 000 ppm) and  $\delta^7\text{Li}$  (from -2 to +32‰). The Nová Ves pegmatite has  $\delta^7\text{Li}$  comparable with crustal rocks from wider area [5, 6] while the Tanco pegmatite has uniformly high  $\delta^7\text{Li}$  >9‰, indicative of distinct sources (melting of upper continental crust vs.  $^7\text{Li}$ -rich brines) for the two localities.  $\delta^7\text{Li}$  tends to increase with decreasing coordination number of Li in the crystal lattice (see also [3, 4]). More notably, tight negative  $\delta^7\text{Li}$  correlation with the Li–O bond length is observed with nearly identical slopes for both localities, perhaps suggestive of general rule driving the Li isotope fractionation at moderate temperatures (500–250°C), overall confirming experimental results [3]. These observations are further tied by broadly similar order of crystallizing mineral phases but the crystallization sequence does not result in uni-directional evolution of  $\delta^7\text{Li}$ . Thus, the Li–O bond length appears to be the key factor in fractionating Li isotopes, irrespective of genetic context (parental melt, sub-solidus or hydrothermal origin). Also, pegmatite zones crystallized from Na–Li-rich melts during the final phase of solidification are the most important carriers of Li, implying (i) behavior of the whole system as a near-infinite Li reservoir and (ii) high Li mobility in Na–Li–F-rich melts and hydrothermal fluids that impedes development of Li isotope heterogeneity.

[1] Maloney *et al.* (2008) *Eur J Min* **20**, 905–916. [2] Shabaga *et al.* (2010) *Min Mag* **74**, 241–255. [3] Wunder *et al.* (2011) *Eur J Min* **23**, doi, 10.1127/0935-1221/2011/0022-2095. [4] Teng *et al.* (2006) *Am Min* **91**, 1488–1498. [5] Janoušek *et al.* (2009) *GCA* **73**, A586. [6] Magna *et al.* (2010) *Chem Geol* **274**, 94–107.

## Water contents of incipient partial melts in equilibrium with peridotite at upper mantle conditions

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Beneath mid ocean ridges the onset of adiabatic melting in the mantle is thought to first occur through the formation of small degree melts likely rich in H<sub>2</sub>O. Small degree melts produced from a mantle with a relatively low bulk H<sub>2</sub>O content still have the potential to strip trace elements from larger regions of the mantle compared to dry melting processes. Also, the presence of such melts may be responsible for the low viscosity of the asthenospheric mantle and for the regular metasomatism of the lithospheric mantle. Therefore, the compositions of incipient melts in particular the H<sub>2</sub>O content and H<sub>2</sub>O partitioning between the melts and peridotite minerals are very important and need to be constrained.

The aim of this study is to determine the chemical composition and H<sub>2</sub>O content of small degree partial melts that form by melting a hydrous peridotite at pressures and temperatures compatible to the upper mantle and to determine the H<sub>2</sub>O mineral–melt partitioning.

Sandwich experiments have been performed at 6 GPa and 1400°C, the adiabatic temperature at this depth. In our experiments, an initial guess melt composition containing H<sub>2</sub>O is sandwiched between layers of peridotite and equilibrated at high P and T. Changes in the melt composition during the equilibration result in a new melt composition, which is then used as a starting material in a second experiment. After several iterations a melt composition is found saturated in the same peridotite assemblage as found under anhydrous conditions at the same P and T. The water content of each experiment has to be assessed through mass balance. We then measure the mineral/melt partition coefficients. Our results have implications in terms of melt production in the Earth's upper mantle and observed anomalies in the propagation of seismic waves.