



## Li as a Barometer for Bimineralic Kimberlitic Eclogites

**M. Hanrahan**, G. Brey, A. Woodland

Institut für Geowissenschaften, Universität Frankfurt Germany,  
m.hanrahan@em.uni-frankfurt.de

High PT eclogitic xenoliths, megacrysts and inclusions in diamond (DIs) occur in kimberlites and other volcanic rocks. Eclogites reside through the depth profile of the continental lithosphere, asthenosphere and transition zone of the mantle and are a major source of information about the physical and chemical properties and processes of the upper mantle.

With such a ubiquitous range in PT and setting, it has long been a goal to formulate an accurate barometer for this rock type in order to gain a better understanding of mantle and kimberlite processes. The vast majority of kimberlitic eclogites are bimineralic consisting of Cr poor garnets and omphacitic clinopyroxenes (cpx) and no suitable barometer exists for such rocks (Schmickler et al. 2004; Jacob 2004). Currently equilibration temperatures for eclogitic xenoliths from kimberlites are calculated using an assumed pressure of 50kbar, however, as eclogite resides throughout a significant cross section of the inner earth, this assumption is highly incorrect. Correspondingly, not only is a precise geobarometer lacking, but much of the published temperature data that has been calculated for eclogites is expected to be misleading or potentially erroneous due to this incorrect assumption (Jacob 2004).

Seitz et al. (2003) suggested that the partitioning of Li between garnet and clinopyroxene is pressure dependent and may serve as a barometer for eclogites. This suggestion was based on the analysis of natural rocks (eclogitic kimberlitic xenoliths and inclusions in diamond), the fact that Li is a faithful follower of Mg into octahedral sites and that only garnets with a majoritic component have  $Mg^{VI}$ .

We can assume a coupled substitution with P and carried out high pressure experiments in CMAS +  $Li_3PO_4$  from 6 - 13 GPa, 1100 - 1500°. The run products from over

25 reversal experiments were analyzed by EPMA and SIMS. These experiments in synthetic systems show an irrefutable pressure dependence on Li partitioning between garnet and cpx in eclogitic assemblages, with very little corresponding temperature dependence. The experiments were carried out using starting materials with varying Li contents to check for compliance with Henry's law. Experiments will now be performed in natural systems to aid in the calibration of a Li barometer for kimberlitic eclogites.

Following this the barometer will be applied to kimberlitic eclogitic xenoliths from worldwide localities. Problems in the application may arise from a presumed rapid diffusion of Li in certain minerals. Initial Li profiles (using SIMS) on pristine natural samples from Roberts Victor (SA), Finch (SA) and the Lake Ellen Kimberlite (USA) were performed. These profiles show Li enriched rims, with Li plateaus in the cores. This suggests that kimberlite ascent is sufficiently rapid to preserve original equilibrated mantle Li signatures.

Jacob, DE, 2004. Nature and Origin of eclogite xenoliths from kimberlites. *Lithos* 77, 295-316.

Schmickler B, Jacob DE, Foley SF (2004) Eclogite xenoliths from the Kuruman kimberlites, South Africa: geochemical fingerprinting of deep subduction and cumulate processes. *Lithos* 75: 173– 207

Seitz, H.-M., Brey, G.P., Stachel T. and Harris, JW, (2003), *Chemical Geology*, 201, 307-318.