Lithium-boron isotope fractionation during degassing of rhyolitic magma

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It has been considered that some volatile trace elements partition into a gas phase and leave the host magma during degassing events. For example, lithium and boron are light elements, which show strong affinity to fluid phase. Then, it is certainly possible to partition these elements into degassing fluid bubbles under pressure. Furthermore, during such element redistribution via diffusion transport, isotopes of lithium and boron may fractionate.

We have analyzed experimentally degassed natural rhyolitic obsidian, which was pre-saturated in H_2O at 210 MPa, 800 °C giving approximately 6 wt%. These samples were isothermally decompressed at the rate of 1000 and 27.8 kPa/s. The final pressure before quench was approximately 70 MPa. Here, a rhyolitic composition was chosen for their ability to retain bubbles within the melt matrix. A maximum element exchange is expected between gas phase and melt, while element diffusivities are slower in rhyolite than basalt. The result shows that significant lithium and boron depletion in the host lava can take place within 12 min of isothermal decompression at 800 °C. The duration of bubble growth was 20 sec and 12 min depending on the decompression rate.

The fast and slow decompression resulted in heterogeneous lithium and boron abundance in the charge. The areas further away from bubbles have lithium and boron abundance indistinguishable from the starting glass, and the areas close to bubbles show 43 and 18 % depletion of lithium and boron, respectively, while H_2O depletion is 50%. When significant abundance depletions were observed in the glass, in close vicinities, ^{7}Li is enriched by as much as 20.2 ± 1.5 permil, and ^{11}B is enriched by 8.8 ± 2.6 permil. The association of abundance depletion and heavy isotope enrichment strongly indicates isotope fractionation governed by diffusion transport.

Loparite composition in stratified Lovozero alkaline intrusion

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Lovozero massif, the largest of the Globe layered peralkaline intrusion, comprises super-large rare-metal (Nb, Ta, REE) deposit. The main ore mineral is loparite (Na, Ce, $Ca)_2$ $(Ti, Nb)_2O_6$ which was mined during many years. Compositional evolution of loparite has been investigated through a 2.35 km section of the Lovozero massif using LA-ICP-MS Institut für Geowissenschaften, University Frankfurt and CAMECA SX50 British Museum of Natural History (London) (Kogarko *et al*. 2002). The composition of cumulus loparite changed systematically upward through the intrusion with an increase in Na, Sr, Nb, Th, Nb/Ta, U/Th and decrease in REE, Zr, V, Zn, Ba and Ti. Our investigation indicates that the formation of loparite ore was the result of several factors including the chemical evolution of high alkaline magmatic system and mechanical accumulation of loparite at the base of convecting unit.

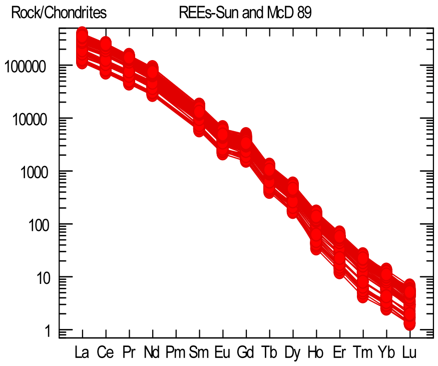

Figure 1: Range of REE contents in loparites.