Recycling of trace and Rare Earth Elements in HP/LT assemblages of metabasites, Ile de Groix, France

S.TH. SCHMIDT[1], A. EL KORH[1] AND A. ULIANOV[2]

[1]Department of Mineralogy, University of Geneva, Switzerland (Susanne.Schmidt@terre.unige.ch, Afife.ElKorh@terre.unige.ch)

[2]Institute of Mineralogy and Geochemistry, University of Lausanne, Switzerland (Alexey.Ulianov@unil.ch)

Devolatilization reactions and the transfer of fluid and elements from subducted rocks into the overlying mantle wedge are considered responsible for the specific signature of arc magmatism. However, compilation of phase diagrams for subduction conditions has revealed that a large portion of the H_2O will be liberated in a stepwise and continous process at relatively shallow levels of the subduction zone.

To better understand the geochemical fingerprinting that a mobilized fluid left on the rock during the subduction process, the trace and rare-earth element distribution patterns in HP/LT metamorphic assemblages of eclogite, blueschist and greenschist facies rocks of the Ile de Groix were obtained by LA-ICPMS analysis. The results of nine metamorphic assemblages (grt-omp-gln-ep-phe-ttn-rt-ap-amp-chl) show that the mafic whole rocks retained their characteristic element patterns and that the rare-earth and trace elements were recycled within the various mineral assemblages or generations stable under changing metamorphic conditions during the subduction process.

One of the key minerals in the recycling process is epidote, which has a large stability field ranging from lower greenschist up to blueschist and eclogite facies conditions. During prograde metamorphism, ep I showing enrichement in MREE crystallized in equilibrium with LREE-rich lws (now present as pseudomorphs), HREE-rich ttn and gln. During lws breakdown and beginning of garnet growth, LREE content in ep II increases, while HREE content decreases. At higher PT conditions, ttn is replaced by rt and HREE are transferred to grt and ep. At the peak of metamorphic conditions, LREE-rich ep III crystallises in equilibrium with grt rims, slighty depleted in HREE. During the retrogression, grt becomes unstable and is altered to chl. HREE liberated from garnet alteration are mainly trapped in newly formed titanite.

Devolatilization reactions do not necessarily imply a high simultaneous trace and rare-earth element release. The trace and rare-earth element content of minerals is controlled by the stable mineral assemblage and directly related to appearance, disappearance and re-appearance of mineral phases (ep, grt, ttn, rt) during the subduction zone metamorphism.

U-Th age constraints on processes of differentiation and solidification in carbonatite - phonolite associations

A.K. SCHMITT[1]*, G. WÖRNER[2], K. COOPER[3] AND H.B. ZOU[1]

[1]Department of Earth and Space Sciences, UCLA, Los Angeles, CA 90095, USA (*correspondence: axel@oro.ess.ucla.edu) (hzou@ess.ucla.edu)

[2]Abteilung Geochemie, GZG, Universität Göttingen, Goldschmidtstr. 1, 37077 Göttingen, Germany (gwoerne@gwdg.de)

[3]Department of Geology, UC Davis, CA 95616, USA (kmcooper@geology.ucdavis.edu)

Carbonatites are frequently associated with rifting and continental intra-plate volcanism, and at least in some instances are generated by exsolution of immiscible carbonatitic melt from alkaline silicic melts. U-series disequilibria in the only example of a recent carbonatitic volcano (Oldoinyo Lengai) indicate extremely short (~10 - 100 years) time scales between carbonatitic magma generation and eruption, but little is known about the general applicability of these observations and the time scales over which unerupted carbonatitic magma may solidify in subvolcanic intrusions. Laacher See, Germany, is outstanding with regard to addressing time scales of carbonatitic magma generation and crystallization because the 12.9 ka cataclysmic eruption of volumetrically dominant phonolitic magma ejected a suite of carbonatitic xenoliths whose youthful age permits detection of $^{230}Th/^{238}U$ equilbria with ~ka temporal resolution. Zircon in Laacher See carbonatites is interstitial, implying late-stage zircon growth when the magma was largely solidified. *In situ* ion microprobe dating of zircon yielded isochron ages for individual carbonatitic and syenitic xenoliths that indicate episodic crystalliation between ~30 ka and the near-eruption ages, with a dominant peak at ~18 ka, similar to the zircon U-Th isochron age for evolved Laacher See phonolite. Preliminary whole-rock $(^{230}Th)/(^{232}Th)$ ratios of carbonatites and syenites are elevated compared to phonolites [1] at similar U/Th. This is consistent with elevated δ18O (by ~1 ‰) zircon values for evolved phonolite compared to carbonatitic xenoliths, which implies some crustal contamination of the phonolitic magma. We propose an approximately 20 ka buildup phase leading to the Laacher See eruption characterized by episodic differentiation and assimililation of crustal rocks.

[1] Bourdon *et al.* (2004) *Earth Planet. Sci. Lett.* **126**, 75-90.