Mass transfer in mafic gneiss during upper-amphibolite facies chloride brine infiltration

FUMIKO HIGASHINO[1*], TETSUO KAWAKAMI[1], NORIYOSHI TSUCHIYA[2], M. SATISH-KUMAR[3], MASAHIRO ISHIKAWA[4] AND GEOFFREY H. GRANTHAM[5]

[1]Department of Geology and Mineralogy, Kyoto University, Japan (*correspondence: fumitan@kueps.kyoto-u.ac.jp)
[2]Tohoku University, Japan
[3]Niigata University, Japan
[4]Yokohama National University, Japan
[5]Council for Geoscience, South Africa

In the granulite facies lower crust, chloride brines have been considered as important fluid species that can coexist with CO_2-rich fluids [1] [2]. In addition to fluid inclusions, Cl-rich biotite (Bt) and hornblende (Hbl) are the potential indicators of the presence of brines. In the central Sør Rondane Mountains, Antarctica, ca. 1 cm-thick Grt-Hbl vein discordantly cuts the gneissose structure of Grt-Opx-Hbl gneiss. With a distance from the vein center, Cl in Bt and Hbl, and K in Hbl gradually decrease and become constant at ca. 1.6 cm, and Na-richer rims of plagioclase (Pl) become thinner. REE and Sc in garnet, and Sc, V, Cr, Y, Nb, and REE in Hbl increase as a distance from the vein, whereas Zn, Rb, Sr, Ba, Pb, and U in Hbl, and Sr, Ba, and Pb in Pl gradually decrease. Overall increasing/decreasing trend of these trace elements show diffusion-like profiles, although trace element zoning within each mineral is slightly observed. Distances where trace element concentrations become constant is dependent on elements, and not on mineral species. The *P-T* conditions of vein formation is estimated to be ca. 700°C, 0.7GPa from geothermobarometry.

Variation in whole-rock composition shows a mass imbalance around the vein, suggesting the vein formation in open system [3]. Using Zr as an immobile element, the mass balance analysis [4] based on the whole-rock chemical variation with a distance from the vein revealed that Li, Cu, Rb, Ba, Pb, and U were added to the wall rock of the vein. Li, Cu, Rb, Ba, and Pb tend to be incorporated in fluids rather than melts [5-9], supporting that the Grt-Hbl vein was formed by the brine infiltration. Possible mechanisms responsible for the formation of chemical and microstructural characteristics in the wall rock are also discussed.

[1] Newton et al. (1998) [2] Harlov (2012) [3] Oliver & Bons (2000) [4] Ague (1991) [5] Keppler (1996) [6] Keppler & Wyllie (1991) [7] Borchert et al. (2009) [8] Kawamoto et al. (2014) [9] Webster et al. (1989)