STUDY OF FLUID-ROCK INTERACTIONS IN MAFIC GRANULITE XENOLITHS FROM THE BAKONY-BALATON HIGHLAND VOLCANIC FIELD, HUNGARY

NÉMETH, B. [1,2]*, TÖRÖK, K.[1,2] & SZABÓ, Cs.[2]
[1] Eötvös Loránd Geophysical Institute, Columbus u. 17-23, Budapest, Hungary
[2] Lithosphere Research Group, Department of Petrology and Geochemistry, Eötvös Loránd University, Pázmány Péter sétány 1/C, H-1117 Budapest, Hungary
* E-mail: bianca.nemeth@gmail.com, nemeth@elgi.hu

The Pannonian Basin is famous of its Plio-Pleistocene alkaline basalt hosted xenoliths derived from different depths of the lithosphere. We studied fluid-rock interactions in mafic, lower-crustal garnet granulite xenoliths from the Bakony-Balaton Highland Volcanic Field (BBHVF) by petrography, microthermometry, electron microprobe analyses, Raman and IR spectroscopy on silicate melt inclusions to find out the composition and origin of the migrating melts and fluids to assess their interaction with the granulitic lower crust.

The studied xenoliths have granoblastic texture and the main rock forming minerals are plagioclase, clinopyroxene, garnet ± orthopyroxene. The most common accessories are sphene and ilmenite. Some xenoliths contain hydrous minerals like amphibole and rarely biotite. This is the oldest mineral assemblage which could be detected. Texturally younger minerals occur in some samples originating from different reactions, like melting and subsequent crystallisation due to fluid-rock interaction.

Geothermobarometry shows that the equilibrium temperature of mafic garnet granulites was between 800 and 950°C, and the equilibrium pressure was 10–13 kbar. Two generations of silicate melt inclusions (SMI) were observed in the samples. There are primary silicate melt inclusions, in the original granulite facies rock forming minerals (plagioclase, clinopyroxene and sphene) and some of the minerals which were formed later on during fluid-rock interactions (e.g., Ilm, Cpx and Opx, new Amp and Pl) also trapped SMI during their growth.

The SMI contain glass phase ± bubble. Microthermometry was made on the bubbles of the SMI where low temperature phase changes were visible. Melting temperatures of the bubble content ranged from -56.6 to -57.6 It suggests that the bubbles contain CO_2-dominated liquid. The homogenisation temperatures (+29.9°C) show low-density liquid in the bubbles in the clinopyroxene hosted SMI. Raman spectroscopy shows other gas and liquid components associated with the CO_2 (81–100 mol%), such as N_2 (up to 7 mol%) and H_2O (up to 12 mol%). Raman spectroscopy was made on those inclusions where microthermometry was not possible due to the small size or dark appearance of the bubble. The detected components of these bubbles change between the following values: CO_2: 70.8–100 mol%; CO: up to 26.7 mol%; N_2: up to 4.4 mol%. The bubbles of plagioclase and clinopyroxene hosted SMI contain up to 6 mol% and 12 mol% H_2O, respectively. In SMI hosted by sphene, the bubbles do not contain H_2O.

We measured the composition of the glass phase in SMI by electron microprobe and compared them with experimental data to find out the origin of the melts. The composition of the glass of SMI trapped in clinopyroxene and plagioclase show similarities to the rhyolitic-dacitic glass derived by melting of biotite-quartz-plagioclase mineral assemblage or of metagraywacke but also might derived by melting of mafic granulites. The composition of the glass phase of SMI trapped in ilmenite is close to composition of a glass phase which derived by melting of alkaline basalt in the presence of additional CO_2-H_2O fluid. The glass phase of granulitic sphene hosted SMI has the same compositions as the ilmenite hosted ones. The glass of SMI trapped in later sphene has dacitic to rhyolitic composition similarly to those derived by melting of quartz-amphibolite or mafic granulite.

These results suggest that the SMI originated from partial melting of different lower crustal rocks of mafic and metasedimentary origin with an occasional presence of C-O-H-N fluids. According to the two different generations of host minerals and primary melt inclusions trapped by theses minerals, we can establish at least two events when melt percolated the lower crust and interacted with the lower crustal granulite rocks causing mineral reactions.

The research was supported by OTKA to K. Török, project number: NN79943 and for the REG_KM_INFRA_09 Gábor Baross Programme.