Experimental garnet and hornblende trace element partitioning on andesitic magmas in the deep arc crust

O. MÜNTENER[1], P. ULMER[2] AND R. ALONSO-PEREZ[2]

[1]Institute of Mineralogy and Geochemistry, University of Lausanne, Switzerland (othmar.muntener@unil.ch)
[2]Institute for Mineralogy and Petrology, ETH Zürich, Switzerland (peter.ulmer@erdw.ethz.ch)

We report trace element partitioning data derived from high-pressure H_2O-undersaturated equilibrium crystallization experiments. As a starting material a synthetic andesitic composition at pressures (0.8-1.2 GPa), temperatures (850-1000°C), and H_2O wt% content (4-6 wt %) relevant for arc crust formation was used. As fractionation products, garnet pyroxenites and garnet hornblendites crystallize at high-pressure (1.2 GPa) and high-temperature (900-1000°C). Garnet gabbros (plg + grt + cpx + opx + oxides) and hornblende gabbros (plg + amph + oxides) formed at 900°C, at 4 to 6 wt % H_2O and at 1.2 to 0.8 GPa respectively. At high pressure and low temperature (800°C) garnet and amphibole are stable together with plagioclase forming garnet-bearing amphibole gabbros. Mineral/melt partition coefficients (K_D) for garnet, amphibole and plagioclase for Li, Sr, Sc, Y, B, REE (La, Ce, Nd, Sm, Eu, Gd, Dy, Lu) and High Field Strength Elements (Hf, Zr, Nb and Ta) have been determined by ionprobe. We show that low temperature experimental data display generally higher K'ds. Trace element models using the experimental K_D's demonstrate that fractionation of garnet and amphibole exert an important control on some geochemical ratios, (e.g. Sr/Y and Nb/Ta) on derivative liquids. Our model shows that high Sr/Y (>200) generally indicative of slab derived melts can be produced by <10% of garnet fractionation at the base of a growing island arc. Therefore, high Sr/Y ratios alone do not unequivocally identify "slab-melts". Fractionation of low Mg# amphibole produces Nb-poor liquids relative to Ta and might explain the subchondritic Nb/Ta ratio of continental crust. Thus, amphibole-rich cumulates at the base of the arc crust will constitute an additional scenario to explain sub-chondritic Nb/Ta ratio in differentiated island-arc magmas. Thus, a garnet and amphibole-bearing cumulate, emplaced in "the lower continental crust" will have superchondritic Nb/Ta ratios and is an underestimated reservoir in mass balances of bulk continental crust. Garnet and hornblende-bearing cumulates from the Kohistan island arc are consistent with this hypothesis.

Evaporative mixing origin for groundwater evolution in arid climate carbonates aquifer

A.A. MURAD

Department of Geology, UAE University, P.O.Box:17551, Al-Ain, United Arab Emirates (ahmed.murad@uaeu.ac.ae)

Late Paleozoic to Early Mesozoic carbonate rocks (limestone and dolomite) constitute vital groundwater reservoirs in the United Arab Emirates (UAE) along the northwest of the Gulf of Oman and southeast of the Arabian Gulf. This region is characterized by arid climate conditions and low annual rainfall with an average of 155 mm. Extensive exploitation of groundwater during the last decade has called for accurate evaluation of the recharge water source and origin in the region. A combination of hydrogen and oxygen stable isotopic analyses of groundwater collected from the study area, are used to establish such information. The results indicate a relatively small range of variations in $\delta^{18}O$ and δD, with $\delta^{18}O$ values being from -3.94 to -3.47‰ and δD from -13.54 to -9.78‰. The deuterium excess ranges from 16.2 to 20.98‰.

The plot of δD verses $\delta^{18}O$ produces a regression correlation expressed by the equation: $\delta D=3.2\delta^{18}O +0.6$. The slope of 3.2 reflects deviation from local meteoric water line (LMWL). This pattern can be related to selective evaporatic alteration of the moisture source during transportation to the region. The scatter of groundwater samples around and close to the Mediterranean meteoric water line (MMWL) suggests that the Mediterranean Sea is the main source of precipitation in the region. The distinct high deuterium excess observed in groundwater of the studied area may be ascribed to the evaporative transport of a Mediterranean Sea moisture source.