Geochemical evolution of lavas of the Rabaul caldera – Fractionation of Fe isotopes and HFSE ratios during fractional crystallisation

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The Rabaul area, Papua New Guinea, is among the few examples worldwide, where the magmatic evolution of a single, still active system can be examined *in situ*. Our work focusses on the geochemical evolution of the Rabaul caldera system, and on differences between the two major volcanic cycles found at Rabaul.

Crystal fractionation of olivine, pyroxene and plagioclase is the most important process controlling the long-term magmatic evolution. The abscence of systematic variations in Sr-Nd-Hf isotope compositions with MgO or SiO_2 suggests that the volcanic system has been in steady state or even behaved as closed system, indicating that isotopically different materials such as crustal rocks or older basement have not been assimilated to a significant extent. Within the analytical error of ±0.4 б-units, most Fe isotope compositions of inner caldera lavas (б ^{56}Fe from 0.01 to 0.14 ‰) overlap with the mafic outer caldera samples and compositions of terrestrial basalts. Only some felsic samples show slightly lower values indicating possible fractionation of magnetite [2]. Trace element compositions of Rabaul lavas indicate that slab derived fluids control the subarc enrichment of the mantle wedge. Coupled Hf-Nd isotope compositions (εHf from +13.9 to +15.4 and εNd from +6.4 to +8.1) reveal the presence of the Indian-Australian mantle domain beneath Rabaul. High-precision HFSE data obtained by isotope dilution reveal subchondritic Nb/Ta ratios (15.5 to 18) and near chondritic Zr/Hf (40-44). Ratios of Nb/Ta tend to decrease with increasing degree of differentiation, consistent with amphibole fractionation. Likewise, a distinct increase of Zr/Hf ratios from the basaltic lavas (40) to the dacitic lavas (43-44) can be explained by fractionation of clinopyroxene or amphibole. Increasing W/Th (0.27-0.42) and decreasing Ta/W (0.73-0.49) ratios with increasing degree of differentiation indicate a higher incompatibility of W relative to Th and Ta. The overall low Ta/w and high W/Th in Rabaul lavas support previous models [3] arguing for a high mobility of W in fluid-dominated subduction systems.

[1] Shahar, A.; Young, E. and Manning, C.E. (2008): *Earth and Planetary Science Letters* **268**, 330-338. [2] König, S.; Münker, C.; Schuth, S. & Dieter Garbe-Schoenberg (2008): *Earth and Planetary Science Letters* **274** 82- 92.

Measurement of isotopes and chemistry in tunnel inflow for study of water flow in fractured rock

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We present the introductive study of the starting project of water composition monitoring in the underground springs in the tunnel through a granite massif in up to 150m depth, in Bedrichov site, northern Bohemia, Czech Republic. The work continues the recent geological and multidisciplinary research at Czech Geological Survey [1][3]. The site is specific with combination of two different excavation method in the single tunnel and quite small total inflow concentrated to main faults and few fractures.

The inflow data are available with 5 years history. Within the 8 selected inflows of different depth and different flowrate, pH and conductivity is periodically measured and samples of 2H and 18O isotopes collected in 14 days intervals from beginning of 2010, together with single sampling of tritium and standard full chemical analyses. The isotope analyses are measured in connection with GNIP and GNIR data from Uhlirska exparimental basin nearby [2].

The evaluation from first year of sampling shows small but visible tranfer of year cycle of stable isotopes to the underground. We present several hypotheses based on lumped parameters model, which are still preliminary, but we expect the potential of combining more method together with sampled depth-dependence of water geochemical parameters.

[1] Klomínský *et al* (2010), *RAWRA report*. [2] Žák *et al* (2009) *Int. J. Earth Sci*. **98**, 949-967. [3] Vogel *et al* (2010) *Vadose Zone J*. **9**, 1–8.