5.5.P09

High resolution MC-ICP-MS measurements of Fe isotopes in granitoids

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A recent survey of the iron isotope composition of terrestrial material concluded that high temperature magmatic rocks show no noticeable isotopic variations [1]. On the other hand, it was suggested in a preliminary study [2], also based on low resolution MC-ICP-MS measurements using the sample-standard bracketing technique, that hydrothermally altered granitoids could be an exception to this rule.

We thus reevaluated this question using high resolution MC-ICP-MS to measure iron isotope abundances outside molecular interferences. Both the sample-standard bracketing technique and the internal doping approach using Ni were compared. It appears that both approaches yield comparable repeatability and accuracy for $\delta^{57}Fe/^{54}Fe$ and $\delta^{56}Fe/^{54}Fe$, similar to the figures recently reported using sample-standard bracketing without Ni doping, but with the same Neptune instrument [3]. A systematic comparison of the results obtained by the two approaches can be used as a check that no matrix effect occur. On the other hand, a double correction with simultaneous bracketing and Ni doping does not appear to improve further repeatability and accuracy.

These new measurements confirm the low resolution analyses and earlier finding [2] that some granites display $\delta^{57}Fe/^{54}Fe$ higher by up to 0.5‰ than the terrestrial average. There is no apparent relationship between the relative crust-mantle proportion involved in the genesis of these granitoids and their Fe isotope signatures. Instead, it seems that granites showing the heaviest Fe isotope composition are among those that were the most affected by hydrothermal alteration. Hence, Fe isotopes appears to be a complimentary tool to other isotope tracers in granitoids research, potentially promising for fluid-rock interaction investigations.

References

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5.5.P10

Fluid distribution in the Tervu granite massif (Scandinavian shield)

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The compositions and concentrations of the different volatile species reveal information about the fluid medium acting during mineral nucleation and crystallization and also during post-crystallization alteration. Thus, an understanding of fluid-mineral relationships is of great importance for investigating magmatic and post-magmatic processes. The object of investigation is the Tervu granite massif, which is situated in the Ladoga region (in the eastern part of the Fennoscandian Shield). The Tervu granite massif is one of the post-collision granites that intruded a high–grade core of the Early Proterozoic Ladoga metamorphic complex. The Tervu massif consists mainly of two feldspar mica granites with rare veins of aplite and pegmatite. The U-Pb age of zircon of the Tervu massif is 1.86 Ga. The age of monazite from the latest veins of the Tervu massif is 1.85 Ga. Minerals of the Tervu granite massif consist of different types of fluid inclusions such as H_2O, H_2O+salt (up to 1-3 % NaCl, KCl, $CaCl_2$, $MgCl_2$), CO_2, CH_4, N_2. Original homogeneous allocation of a fluid phase is expected at the moment of crystallization of the massif. This is supported by the monotonic mineral composition of rocks of the massif, absence of significant bulks of facies and phase varieties. Fluid inclusions of the massif have more or less the same compositions, but there are also specific features of their allocation: 1) CO_2 inclusions occur only in the northern part of the massif, 2) aqueous, mineralized by salts Ca, Mg (Cl_2) occur in the northern peripheral part, 3) methane - nitrogenous inclusions occur in the northern and central areas, 4) only aqueous occur in the south-east and northern areas of the massif, 5) aqueous inclusions with NaCl and KCl mineralization occur in the central and northern parts, 6) aqueous inclusions with a low mineralization occur everywhere. Such variability of compositions of fluid implies that most likely the total contents of fluid in samples varied from the moment of crystallization because of new volatile phases, which have caused variations in composition of fluid inclusions in the most fluid-enriched rocks. Comparison of compositions of fluid of the Tervu massif with composition of fluid of metamorphic rocks demonstrates their similarity. However, the fluid inclusions enriched with salts $CaCl_2$ and $MgCl_2$ are not characteristic of the metamorphic rocks. It is possible to consider that genesis is primary magmatic for such fluid inclusions. Thus, the Tervu massif is characterised by unequal fluid compositions, and strong variations in density and salt contents in different parts of the massif. The specified features of allocation of fluid may be a consequence of disproportionation of a fluid phase inside the massif under effect of postcrystallization tectonic and thermal processes.