Geochemical variation in granitoids induced through hot fluid transfer

ILKA C. KLEINHANNS[1*], ANE K. ENGVIK[2], FERNANDO CORFU[3] AND RONNY SCHOENBERG[1]

[1]Department of Geosciences, University of Tuebingen, Germany
[2]Geological Survey of Norway, Trondheim, Norway
[3]Department of Geosciences, University of Oslo, Norway
[*]correspondance: kleinhanns@ifg.uni-tuebingen.de

Metasomatism is an often inferred process to explain observed variation in major and trace element pattern and/or isotope geochemical signatures. This study focusses on Pan-African dry granitoids (charnokites) from Dronning Maud Land in East Antarctica that show spectacular field observations of fluid infiltration by strong bleaching of the country rock close to fluid pathways. Analysed rocks constitute pairs of pristine and altered rock samples that were taken in close spatial relation to ensure derivation of the same host rock. This approach allows not only to qualify, but also to quantify metasomatic changes.

Petrological changes are well studied and include (1) breakdown of orthopyroxene and formation of amphibole and/or biotite, (2) increased turbidity of feldspar including pore formation, sericitisation, albitisation of plagioclase, and replacement of perthite to microcline (3) few samples show ilmenite break-down and formation of titanite. These mineral reactions are well reflected in major element signatures by a decrease of the "dark" elements (MgO, MnO, TiO_2, Fe_2O_3) and of the CaO content. Surprisingly, the strongly fluid-mobile alkali elements (Na_2O, K_2O) remain relatively unaffected, presumably caused by the K-feldspar recrystallisation, which keeps them in place. Trace element ratios correspond to the alteration event as for example the Ce/Pb mostly shows lower ratios in the altered sample compared to their pristine partner. Interestingly, even the ratio of the fluid-immobile HFSE pair Zr-Hf seem to respond to this event with a decrease in the altered sample.

U-Pb age data constrain the intrusion of these granitoids to 520 Ma based on zircon whereas the fluid infiltration is framed by an U-Pb titanite age of 486 Ma. This later fluid alteration event is reflected in a reset of the Rb-Sr isotope system evident through a linear correlation in an isochrone diagram with a regression age of ca. 480Ma (R^2 0.99). The Sm-Nd isotope system is generally considered as relatively resistent towards later alteration. Sample pairs show, however, differences in their initial e(Nd) values of up to 2 e-units with no general direction of shift from pristine to altered sample.