VISUALIZING FLUID-MEDIATED ROCK TRANSFORMATIONS USING MICRO-CT AND MICRO-XRF: THE BÄROFEN METAGABBRO

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The aim of this study is to provide textural and petrographic constraints on the gabbro-eclogite transition from the locality Bärofen in the Koralpe (Styria, Austria) using micro-CT and micro-XRF in comparison with backscatter electron image petrography. Petrographic investigations showed that the primary Permian magmatic assemblage plagioclase + clinopyroxene$_1$ + orthopyroxene reacted during eo-Alpine high-P metamorphism in micro-domains to form clinopyroxene$_2$, garnet, kyanite, hornblende and occasionally corundum. Fluid influx lead to the progression of reactions involving plagioclase and orthopyroxene. The investigations were performed on a hand specimen showing in-situ eclogitization with a length of 13 cm, width of 3 cm and thickness of 1 cm.

Micro-computed tomography (micro-CT) investigations were performed using a XtremeCT 2 (Scanco Medical AG, Brüttisellen, Switzerland). The scans were performed using 900 projections with 4608 samples, resulting in a 30.3 µm isotropic resolution. The tube settings were 68 kV voltage, 1470 µA current and an integration time of 900 ms per projection. In the first step 5 representative rock volumes where defined. Therefore a mask for the rock surface had to be created by segmenting the volume of interest (VOI) using a Gauss threshold algorithm. Afterwards the filter settings for the different materials had to be defined. Based on their density the following minerals could be identified: plagioclase, clinopyroxene (omphacite), orthopyroxene/garnet and pyrite. The resulting threshold widows using the -1000-1000 scaling were: 248-329 for omphacite, 330-431 for plagioclase, 432-609 for orthopyroxene/garnet and 610-1000 for pyrite. Unfortunately due to a similar density it was not always possible to distinguish between magmatic clinopyroxene (augite) and omphacite as well as garnet and orthopyroxene. Nonetheless the mineralogical transformation from gabbro to eclogite is clearly visible and modal amounts of plagioclase and orthopyroxene decrease whereas garnet and omphacite strongly increase.

Micro-XRF element mapping was performed with Bruker Tornado M4 Micro-XRF with a Rh target X-ray tube powered at 50 kV and 600 µA. The beam was focused with polycapillary optics to a spot size between ~15 and ~100 µm, with smaller spot sizes at high X-ray photon energies, and secondary x-ray energies were collected with EDS silicon drift detector at 20 mbar vacuum chamber atmosphere. The map has a size of 1178 mm x 25.5 mm (1573 x 340 Pixel) and a resolution of 75 µm/Pixel. Netto-Measuring time was ca. 15 hrs, which equal 120 ms per Pixel. False colour element maps are normalized representations of cps intensities of characteristic Kα or Lα-lines energies. The phase maps are quantitative results of a semi-automatic numerical discrimination method, which is based on clustering of bins of Na, Mg, Al, Si, K, Ca, Ti, and Fe cps-histogram. In contrast to micro-CT this method leads to a more detailed mineralogical discrimination such as between magmatic clinopyroxene and omphacite as well as garnet and orthopyroxene