The P-T-t evolution of migmatites in the Ötztal-Complex

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Within the Ötztal-Complex, migmatites are the last geological relicts of the pre-Variscan metamorphic evolution, which led to the occurrence of partial anatexis in different areas of the complex. In the cause of this project three migmatites of the western and central part of the complex were investigated. The Nauderer Gaisloch near the Reschen-Pass, the Verpeil migmatite and the Winnebach migmatite.

The Winnebach migmatite shows clods of paragneis (paleosome) embedded in the new formed neosome which represents the partial melt. The mineral assemblage is plagioclase (1, 2) + potash feldspar + garnet (1, 2) + pinites + biotite + kyanite (1, 2) + zircon + apatite + muscovite + chloritoid + quartz. While the pre-Variscan (caledonian) event, textures indicate that the water saturated granite solidus which led to the formation of partial melt including muscovite, K-feldspar and quartz for the reaction: mus + kfs + qtz + vapor = melt, was overstepped. The P-T conditions for this event were calculated with a pseudosection with the program PERPLEX (Connolly 2005, written comm.) and yielded about 670–750 °C and pressures <0.45 GPa. Cordierite, which is only present as pinite relicts most likely formed along the reaction biotite + sillimanite = cordierite + K-feldspar + melt. During the Variscan event garnet1 + kyanite1 + plagioclase1 + biotite1 formed at amphibolite-facies conditions, which led to the retrograde transformation of cordierite into garnet1 and biotite. Calculated P-T conditions for this assemblage resulted in temperatures around 530–540 °C and pressures of ca. 0.6 GPa. These temperatures are lower, most likely due to later re-equilibration during the Eo-Alpine event. During the Eo-Alpine metamorphic event garnet2 (calcium-rich) + plagioclase2 (sodium-rich) + kyanite2 + biotite2 + chloritoid formed at high pressure conditions of about 485 °C and 0.9 GPa but only in small microdomains. Geochronological investigations on monazites from the leucosome yields an age of 439 ± 14 Ma for the partial anatexis, which are considerably lower than previously reported ages for the partial anatexis.

The Verpeil migmatite is a small stromatic migmatite body in the Kaunertal in the western part of the Ötztal complex. Contrary to the Winnebach migmatite, only little amount of melt was present during the partial anatexis. The neosome (quartz, K-feldspar, plagioclase, garnet) is

surrounded by thin biotite layers (melanosome). The mineral assemblage was determined by microscopy, SEM and micro-RAMAN spectroscopy and is: K-feldspar + plagioclase + garnet + biotite + muscovite + cordierite + andalusite + kyanite + clinozoisite + zircon + apatite + rutile + quartz. Cordierite seems to be the last pre-Variscan relect. The pre-Variscan P-T conditions were reconstructed by using a pseudosection and resulted in P-T conditions of about 650–750 °C and <0.5 GPa. The dominat Variscan event yielded P-T conditions of 600 °C and 0.6 GPa. Because of its position within the Ötztal complex it is obvious that this migmatite as well as the migmatite of the Nauderer Gaisloch which is more western only show a low-grade greenschist-facies Eo-Alpine metamorphic overprint. The geochronological data from monazites from leucosome samples give ages of 436 ± 12 Ma and 437 ± 19 Ma for the anatectic event, which are in excellent agreement with the ages from the Winnebach migmatite.

The westernmost migmatite is near the Reschen Pass at the Nauderer Gaisloch and shows a very similar metamorphic evolution as the Verpeil migmatite. The mineral assemblage is garnet + quartz + biotite + plagioclase + muscovite + kyanite (1, 2). In contrast to Verpeil, no relict cordierite is present anymore. Kyanite1, which occurs as large grains, was formed prograde during the Variscan event, which also led to the transformation of cordierite into biotite + kyanite2 where kyanite2 occurs as small needles. The P-T conditions of the Variscan event yielded 550 °C and 0.6 GPa. Petrographic data indicate that the partial anatexis seems to be pre-Variscan but geochronological investigations of monazites are currently in progress.