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Thermobarometry of contact metamorphosed pelitic rocks at the southern rim of the Permian Brixen Granodiorite: testing pseudosections versus petrographic evidence

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Contact metamorphosed pelitic mineral assemblages vary systematically with P and T and, therefore provide valuable quantitative information about the tectonothermal evolution of metamorphic belts such as the Eastern Alps. Since the Variscan Southalpine basement with its large Permian intrusive complexes (Brixen-, Iffinger- and Kreuzberg pluton) lacks the Eo-Alpine overprint, it provides a perfect opportunity to study Permian contact metamorphism.

The contact aureole of this investigation is located at the southern rim of the Brixen Granodiorite near the village Franzensfeste/Fortezza (South-Tyrol, Italy) where the pluton intruded into the Variscan quartzphyllite basement (Brixen Quartzphyllite). The thermally unmetamorphosed country rocks were sampled near Waidbruck and contain the mineral assemblage muscovite + chlorite + albite + biotite + garnet + quartz $\pm$ K-feldspar. Calculated Variscan $P-T$ conditions reached 0.56 GPa $\pm$ 0.09 and 507 $\pm$ 13˚C. Approaching the contact with the granodiorite, three different zones can be discerned within the contact aureole, based upon mineralogical and textural features. Approximately 300 m from the granite contact, the outer contact aureole (zone I) occurs. The rocks from this zone are characterized by two texturally and chemically different generations of micas, where the younger generation formed according to the reaction clinochlore + K-feldspar = phlogopite + quartz + muscovite + H_2O. Zone II is characterized by the appearance of cordierite due to the reaction muscovite + phlogopite + quartz = K-feldspar + cordierite + H_2O. The inner contact aureole (zone

III) starts approximately 50 m from the granite contact and shows typical hornfelses. This zone is characterized by the first occurrence of andalusite most likely due to the breakdown of muscovite: muscovite + quartz = K-feldspar + andalusite + H_2O. In the innermost area, ca 5 m from the granite contact, spinel and corundum occur.

In addition to thermobarometry (multi-equilibrium methods, two-feldspar thermometry), which yields T ranging from 350 – 400˚C (zone I) to 475 – 520˚C (zone II) to 543 – 613˚C (zone III). Calculations of pseudosections with the program PERPLEX (Connolly, 2005 written comm.) in the system NCKFMASH, by using quartzphyllite and hornfels samples yields $P - T$ conditions, which are in very good agreement with the calculated $P - T$ data. Calculations involving thermally unmetamorphosed Variscan quartzphyllite samples always yield mineral assemblages, which are identical with petrographical observations. Although the calculated peak assemblages in the hornfelses agree with the petrographic observations, the sequence of mineral assemblages, which formed during the Permian thermal event, does not agree with the observed mineral sequence (cordierite stable before andalusite, garnet stable). Calculation of $f\mathrm{O}_2$-buffered (hematite-magnetite) pseudosections yields a correct sequence of mineral assemblages, but Fe^{2+}-bearing phases such as Fe- staurolite, garnet and biotite are not stable anymore, indicating that these $f\mathrm{O}_2$ conditions might be too oxidized. Nonetheless, these calculations still indicate the important role of changing $f\mathrm{O}_2$ during the contact metamorphic event and calculations involving additional $f\mathrm{O}_2$-buffers are planned. Many samples within this contact aureole are hampered by a lack of diagnostic minerals (e.g. cordierite) for phase equilibrium calculations, which is due to lower Al_2O_3 content of the samples. Calculations show that the Al_2O_3 content of the samples must be higher than 18 wt.% for cordierite to form.