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PERMO-TRIASSIC METAMORPHIC EVOLUTION OF THE KREUZECK-GOLDECK MOUNTAINS (CARINTHIA, AUSTRIA)

by

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Introduction: The Austroalpine basement units had long been regarded as a product of the Variscan and probably Caledonian orogeny only, until an increasing number of geochronologic and petrologic studies documented that an Eo-Alpine eclogite to amphibolite facies metamorphism was actually dominant in most of the units. Only the southernmost basement blocks remained almost unaffected by this geotectonic event, thus defining a boundary, the "Southern limit of Alpine Metamorphism (SAM)" within the Austroalpine [1]. Even more, a widespread Permo-Triassic high temperature/low pressure (HT/LP) metamorphic imprint of various grade has recently been recognised within the Austroalpine [2, 3]. A continuous section through Permo-Triassic middle and upper crust, up to the Permian sedimentary cover, has been preserved south of the SAM, in the Kreuzeck-Goldeck-Drauzug area. In this abstract we present geochronological and petrological data on the pre-Alpine evolution of the Strieden Complex which represents the lower part of this section.

Petrography: The Strieden Complex shows a zonation expressed in mineral assemblages, the occurrence of pegmatites and typical cooling ages for different structural levels. The deepest structural levels and rocks of highest metamorphic grade are exposed in the north, immediately south of the SAM. The whole sequence is tentatively divided from north to south in a lower and upper sillimanite zone, andalusite zone, staurolite zone and garnet zone.
Garnet zone: The uppermost part of the Strieden Complex consists of garnet-chlorite-muscovite-schists and subordinate amphibolites which exhibit a polyphase deformation (D_m, D_n). The metapelites are characterised by the syndeformational assemblages Grt + Chl + Ms + Pl + Qtz + Ilm ± Bt ± Pg. Garnet porphyroblasts are up to 1 cm in diameter and sometimes contain inclusions of chloritoid.
Staurolite zone: Going north, and downward in the section, gneisses occur, intercalated with layers of garnet-two-mica-schists. The mica schists exhibit an assemblage of Grt + St + Bt + Ms + Pl + Qtz + Ilm.

Andalusite zone: Further below centimeter-sized andalusite porphyroblasts occur, obviously restricted to staurolite- and garnet-rich layers. Andalusite, as well as large biotite flakes are overgrowing the pre-existing microfabrics and the garnet porphyroblasts.
Staurolite is resorbed and forms dismembered inclusions with identical optical orientation, indicating their formation during prograde breakdown of staurolite by the reaction St + Ms ⇔ And + Bt + Qtz + H_2O. In the lowermost part of the andalusite zone fibrolitic sillimanite appears.
Sillimanite zones: The upper sillimanite zone is characterised by the occurrence of sillimanite and the disapperance of staurolite [4]. An overprinting ductile deformation (D_o) becomes more prominent with structural depth. Staurolite and garnet act as porphyroclasts during D_o; sillimanite growth is syndeformational. The lower sillimanite zone is characterised by the absence of garnet. In the metapelites sillimanite is intergrown with biotite and aligned to the dominant schistosity of the rocks. Sillimanite also forms millimeter-sized patchy pseudomorphs after garnet, indicating prograde breakdown of garnet by the reaction Grt + Ms + Qtz ⇔ Sil + Bt + Pl + H_2O. The amount of muscovite is decreasing with depth. Anatectic melting is indicated locally by concordant neosome layers of Pl + Or + Qtz ± Bt ± Sil whereas plagioclase porphyroblasts are overgrowing the residual sillimanite-biotite schists. Pegmatites are frequent in the sillimanite zone.

Petrology and Geothermobarometry: Based on microfabrics and the deformation history two metamorphic events can be identified in the Strieden Complex: The older exhibits moderately high-pressure metamorphic conditions and is characterised by garnet-chlorite-muscovite-schists (± biotite, paragonite), grading northwards into staurolite- and rarely kyanite-bearing schists. Thermobarometric calculations yielded 590 ± 20°C, 8.5 ± 1.5 kbar for the garnet-chlorite-muscovite-schists and 570°C ± 50 and 8 ± 1.5 kbar for the staurolite zone. The overprinting HT/LP event produced andalusite-bearing mica-schists and andalusite-quartz-veins and transformed the northernmost rocks into biotite-rich sillimanite-mica-schists with local anatexis. Andalusite-bearing rocks apparently are only partly reset: Average-PT-data for the full assemblage (grt-sta-and-bt-mus-plag-qtz) yields around 6.5 ± 1.4 kbar and 600 ± 50°C, which is way outside the stability limit of andalusite. Based on the breakdown of staurolite in the andalusite stability field conditions of c. 550 ± 50°C at 3.5 ± 1.0 kbar would be expected. The sillimanite-schists and -gneisses are relatively well equilibrated, however the determined PT-conditions of 580 ± 40°C and 4.5 ± 1.4 kbar are low with respect to the occurrence of anatectic mobilisates and the prograde breakdown of garnet.

Geochronologic data: A Variscan age of the first event is indicated by a Sm-Nd garnet isochron age of 342 ± 3 Ma from the staurolite-garnet micaschists and from Ar-Ar ages on muscovite of around 310 Ma (see below). The timing of the HT/LP event, which dominates the northern part of the section, was determined by Sm-Nd garnet isochron ages on magmatic garnets from a weakly deformed (RS35/00) and a deformed (RS43/99) pegmatite. Calculated with orthoclase and the whole rock they yielded well defined Permo-Triassic isochron ages of 261 ± 3 Ma and 229 ± 2 Ma. The cooling history of the rock pile was investigated by Ar-Ar and Rb-Sr ages on muscovite respectively biotite from several zones of the section. The Ar-Ar plateau ages on muscovite, which are interpreted as cooling ages below c. 400°C exhibit Variscan ages (RS7/00: 316 ± 4 Ma; RS8/00: 311 ± 3 Ma; RS24/00: 312 ± 3 Ma) below the transgressive Permo-Mesozoic sediments and decrease with structural depth. From the garnet muscovite schists 287 ± 2 Ma (RS55/99) and 286 ± 2 Ma (RS58/00) were determined.

A staurolite-garnet-mica-schist yielded 225 ± 3 Ma (RS4/00) and 210 ± 2 Ma (RS14/97), whereas 212 ± 2 Ma (RS69/00) and 205 ± 2 Ma (RS13/97) have been measured for the andalusite zone. The lowest age of 193 ± 2 Ma (RS43/00) has been found in the sillimanite zone.

Conclusions: The Strieden Complex represents a Variscan metamorphic basement that was situated at upper to middle crustal level in Permo-Mesozoic times. Extension caused a Permo-Triassic HT/LP overprint at an elevated geothermal gradient. Peak metamorphic conditions were reached at about 260 Ma. After that relaxation of the isotherms caused slow cooling. Middle crustal rocks cooled down below 400°C at about 200 Ma. A more detailed PT-profile and an interpretation of disequilibrium features in the transition zone between dominantly Variscian and Permo-Triassic metamorphism will be given at the conference.

References

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