Geol. Paläont. Mitt. Innsbruck, ISSN 0378–6870, Band 25, S. 1–242, 2001

PERMO-TRIASSIC SEDIMENTARY RECORD AND CONTEMPORANEOUS THERMAL BASEMENT EVOLUTION IN THE DRAUZUG-GOLDECK-KREUZECK AREA (EASTERN ALPS / AUSTRIA)

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In the Austroalpine unit the primary relationship of the Permo-Triassic cover series to their original middle and lower crustal basement have been widely obliterated during the Alpine orogenetic events. Large parts of the sediments have been stripped off as cover nappes or cover nappes with the upper portions of their basement. These cover nappes experienced only a weak Eo-Alpine thermal imprint, whereas the remaining basement was effected by a metamorphic imprint of various grade.

The Permo-Triassic Tethyan sediments of the Austroalpine unit document an evolution from a fluvial to a shallow marine and, finally, to a carbonate platform environment. The sedimentary piles reach up to more than 3000 m in thickness and argue for a more or less continuous subsidence of the basement. On the other hand, a widespread Permo-Triassic high temperature/low pressure (HT/LP) metamorphic imprint of various grade has been recognised within the Austroalpine crystalline units (SCHUSTER et al., 1999; THÖNI, 1999). The relationship between the sedimentary and subsidence history of the cover successions and the contemporaneous metamorphic and thermal evolution of the crystalline basement has not been worked out until now. In this paper preliminary results from the Kreuzeck-Goldeck-Gailtal area are presented. There a section through a Permo-Triassic middle and upper crust up into the contemporaneous sediments has been preserved. The sediments are represented by the Drauzug Mesozoics, whereas the basement towards the north comprises, from top to the bottom, the Goldeck, Gaugen and Strieden Complexes.

The Gailtaler Alpen are a segment of the Permo-Mesozoic Drauzug (LEIN et al., 1997). An idealised section through the sediments is 3250 ± 250 m in thickness (BECHSTÄDT et al., 1976). The fluvial part is about 170 m thick and comprises the Permian sediments (Werchzirm and Griffen Formation) which contains layers of Permian quartzporphyric volcanic rocks, and the Skythian Buntsandstein Formation. The marine environment of the clastic Werfen Formation established at c. 245 Ma. In the Anisian a restricted shallow water environment is indicated by the Alpine Muschelkalk Formation. The Werfen and the Alpine Muschelkalk Formation together are ca. 500 m in thickness. The development of the Wetterstein carbonate platforms and intraplatform basins starts in the Ladinian (c. 235 Ma) indicating an open marine environment. These platforms comprise c. 1200 m of shallow water sediments. After a regressive phase in the Carnian, which is expressed by the terrigenous influence in the Raibl Formation, a second carbonate platform stage can be recognised. In the Gailtaler Alpen it is represented by the lagoonal Hauptdolomit, Plattenkalk, Kössen and Oberrhätriffkalk Formations. The thickness of the Norian and Rhaetian carbonates is about 1400 m.

The Permo-Mesozoic sediments transgressed unconformably onto the Gailtal Crystalline basement in the south and onto the Goldeck Complex in the north. The latter consists of phyllites with intercalations of chlorite schists and marbles that exhibit a prograde Variscan lower greenschist facies imprint (DEUTSCH, 1977). The underlying Gaugen Complex is dominated by coarse-grained micaschists and biotite-plagioclase gneisses with minor orthogneisses, amphibolites and marbles. It experienced a prograde Variscan medium-grade imprint and a retrograde overprint of very low to low-grade conditions. In the Strieden Complex two pre-Alpine metamorphic events can be identified: (1) A Variscan imprint reached upper greenschist facies conditions in the structural upper part and amphibolite facies conditions at medium pressures in the lower part. (2) The overprinting Permo-Triassic event shows HT/LP characteristics and a zonation with structural depth. In the uppermost part of the section features of the second imprint are scarce. Below an andalusite-zone, an upper sillimanite zone and a lower sillimanite-zone zone with partial anatexis can be observed (HOKE, 1990). Pegmatites are obviously related to this thermal event because they occur only in the lowermost andalusite zone and within the sillimanite zone. Peak metamorphic conditions occurred at 260 ± 20 Ma. Based on metamorphic grids peak conditions of 550 ± 50°C at 0.35 ± 0.1 GPa and 650 ± 50°C at 0.45 ± 0.1 GPa can be expected for the andalusite-zone and the sillimanite-zone respectively. The cooling history of the rock pile was investigated by Ar-Ar and Rb-Sr ages on muscovite and biotite. 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. Staurolite-garnet micaschists 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.

Based on these data an idealised rock column from the surface to about 15 km crustal depth and its evolution can be reconstructed: The Variscan metamorphic rocks cooled down below 400°C at about **310 Ma**. During the Permian, extension of the lithosphere caused condensation of the isotherms and a HT/LP metamorphic imprint. Peak metamorphic conditions occurred at c. **260 Ma** at an elevated geothermal gradient of c. 40°C/km. This gradient implies that the normal MOHO temperature of c. 800°C has already been reached at about 20 km depth. Heating caused intense magmatic activity expressed in pegmatites and volcanic rocks. Subsequently the rock column started to cool down to the steady state geotherm. At c. **245 Ma** a marine environment developed, indicating an isostatic equilibration of the lithosphere at sea level. After that a more or less continuous subsidence is indicated by the sedimentation of c. 3000 m of shallow water sediments. Ongoing extension, cooling of the lithosphere and thickening of the lithospheric mantle have been responsible for this subsidence, whereas loading with sediments had an opposite effect. At c. **200 Ma** a geothermal gradient of about 25°C/km has been reached and the rocks of the former andalusite and sillimanite zone cooled down below 400°C.

The crustal sequence described is not a unique situation, it represents the typical evolution of the southern part of the Austroalpine unit. This is indicated by comparable thicknesses of the sedimentary piles and by the widespread occurrence of the Permo-Triassic thermal imprint.

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