Thermal and structural evolution of the South Tauern margin (Lappach, Südtirol): Evidence from stable isotope and structural studies

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The South Tauern margin is characterized by changing structures in west-east direction. Where the Austroalpine corridor between South Tauern window and Periadriatic Lineament is narrow (western portion, ca. 2 km) foliation dip to the north. In eastern portions, where this corridor widens towards ca. 20 km, the foliation plane dips towards south. There is an increasing amount of shortening induced by indentation of the Adriatic plate between western and eastern domains and the structural variation likely coincides with the external boundary condition. Within the study area the dominant foliation is vertical with pronounced subhorizontal stretching. In addition the structural assembly in the Lappach area is characterized by an additional structural element on map scale, the Lappach structure, that might by interpreted by large scale folding and/or shearing. We present structural and thermal data from this domain in order to constrain relation between thermal and structural activities and to explain large scale west-east trends in the structural evolution.

Dominant structures in the Lappach area include vertically foliated and horizontally stretched rocks associated with sinistral sense of shear. However, fabric and texture asymmetries are poorly developed. Hence, we interpret these features as result of pure shear dominated transpression and extrusion during Oligocene indentation tectonics. This deformation is overprinted by south-vergent folds that include a weakly developed axial plane cleavage, especially within inverted fold limbs.

Stable isotope data have been performed to constrain thermal history along a cross section from the South Tauern Window margin to the northern Zentralgneis. We used information from isotopic equilibrium/disequilibrium between calcite, muscovite and quartz separated rocks of very similar bulk composition (calcschists). Isotope ratios and calculated temperatures show equilibrium conditions between all phases in northernmost portions (close to Zentralgneis) and increasing disequilibrium towards the south. Generally, temperatures increase from the southern Glockner Nappe to the northern Zentralgneiss from ca. 400°C to 520°C. This temperature increase fits well with estimates of thermal conditions derived from quartz and calcite textures as well as from petrology. However, within single the southernmost Glockner Nappe, temperatures decrease from south to north. This area is characterized by intense folding (Lappach Fold) and faulting, therefore, thermal disturbances likely coincide with tectonic complications.

We argue that in early stages of fabric evolution in the Tauern Window the thermal overprint post-dated tectonic structures. By contrast, during the late tectonic evolution, the thermal paleo-isograde, “frozen” in isotope ratios of calcite, muscovite and quartz, have been refolded. We relate this late-stage structures with back-folding and back-thrusting of Tauern Window units onto the southern Austroalpine domain. Back-folding was strong along western sectors and weak along eastern portions of the South Tauern margin. Modeling of isotope ratios suggests that cooling and exhumation rates were high within the central Tauern Window and decreased towards the margin.

Re-Os and U-Pb age constraints for tungsten and molybdenum deposits in the Tauern Window, Austria

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The pre-Alpine units in the Tauern Window host economic tungsten and subeconomic molybdenum deposits at Felbertal and Alpeiner Scharte, respectively.

The Felbertal scheelite deposit in the central Tauern Window occurs in a Cambrian sequence (calc-alkaline metabasites, orthogneisses etc.) formed at an active margin, which was intruded by Variscan granitoids of mainly Early Carboniferous age. Molybdenite from the quartz cupola developed around one of these geochemically highly anomalous orthogneisses (K1-K3 gneiss 336 ± 19 Ma, Hoell and Eichhorn, 2000) has a Re-Os age of 345.3 ± 1.3 Ma. Molybdenite aligned parallel to the dominant foliation in a banded scheelite ore (K2 ore body) yielded Re-Os ages of 338.6 ± 1.3 and 340.2 ±