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Initial exhumation of the Upper Austroalpine Unit along the Walchen Shear Zone (Styria, Austria)

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The timing of the Cretaceous Eoalpine Event in the Upper Austroalpine Unit (Eastern Alps) is well established. The phase of collision and nappe stacking with (W)NW-directed kinematics lasted from c. 135 Ma to c. 95 Ma and the phase of exhumation of metamorphic units through extrusion between thrusts with (W)SW-directed kinematics and large-scale normal faults with (E)SE-directed kinematics lasted from c. 95 Ma to c. 65 Ma. Large-scale normal faults are mostly documented in the hangingwall parts of the Upper Austroalpine Unit, while deformation in the footwall parts is rarely described.

We here present new data constraining the Walchen Shear Zone, which is a major shear zone formed during Eoalpine extrusion. The shear zone is located at the northern border of Eoalpine amphibolite facies rocks between the Wölz- and Ennstal complexes (Koralpe-Wölz Nappe System, Niedere Tauern). Evidence of Permian metamorphism is described in both complexes. The timing of Eoalpine peak metamorphism is however different. Allanite growth in the Ennstal Complex is dated around 105 Ma while prograde REE-rich epidote growth in the Wölz Complex is documented at 96-98 Ma (Stumpf et al., 2024). Note that the age in the Ennstal Complex is older than typical Sm-Nd garnet ages in the Koralpe-Wölz Nappe System (c. 95–94 Ma, Thöni et al. 2008).

The deformation along the Walchen Shear Zone affects rocks of the underlying Wölz Complex as well as the overlying Ennstal Complex. The shear zone could be traced on the surface for around 800 m perpendicular to strike (ca. 450 m in the Wölz and 350 m in the Ennstal complex). In general, the mylonitic schistosity dips moderately steep to the N(NW). The mylonitic strectching lineation is mostly subhorizontal or dips shallowly to the W(NW) or E(SE). The degree of deformation increases in the Wölz Complex towards the hangingwall, whereas the deformation is strongest in the footwall of the Ennstal Complex. The mylonitic deformation in light-colored mica-rich quartzite of the Ennstal Complex can be studied very well, especially in the area of the Walchen deposit. Quartz and calcite show evidence of dynamic recrystallization while garnet, feldspar and ankerite form porphyroclasts indicating that the shear zone was active under greenschist-facies conditions between 300 and 450 °C. C-type and C'-type structures in phyllosilicate-rich rocks, indicate a dominant top-to-W(NW) shear sense. For Ar-Ar dating, six samples of deformed quartz veins with coarse grained white mica as well as two fractions of white mica in a mylonitic impure quartzite were collected in both complexes along the shear zone. They show total fusion dates between 91-94 Ma, which are interpreted as formation or deformation ages. The kinematic and age data indicate that the Walchen Shear Zone is most likely related to the extrusion within the Koralpe-Wölz Nappe System.

Stumpf, S., Skryzypek, E. & Stüwe, K. (2024): Contributions to Mineralogy and Petrology, 179, 63 (2024). https://doi.org/10.1007/s00410-024-02130-3

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