Deformation in the Greiner Shear Zone – Pfitsch Valley, Southwestern Tauern Window

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The Greiner Shear Zone is located within the Subpenninic core of the southwestern Tauern Window, Eastern Alps. It strikes SW-NE and separates the upright folded Zillertaler and Tuxer Zentralgneis Nappes from one another, whilst transecting their parautochthonous cover and allochthonous hanging-wall units. The Greiner Shear Zone is generally regarded as a transpressive shear zone, composed of multiple high strain zone splays, in which dextral, but dominantly sinistral shear sense indicators have been reported (Behrmann & Frisch 1990; Barnes et al. 2004). Deformation in the Greiner Shear Zone is pervasive and characterized by a sub-vertical foliation and west-southwest plunging lineation. However, the tectono-metamorphic history of the Greiner Shear Zone has not yet been fully clarified. To better constrain the structural architecture, kinematics, relative timing and spatial extent of the Greiner Shear Zone, geologic mapping within the Pfitsch Valley was carried out and structural data were collected. Optical and scanning electron microscopy analyses including EBSD were utilized to characterize the microstructure of deformed Furtschagl Schists incorporated within the shear zone. Deformed, inter-tectonic(ally grown) biotite porphyroblasts were characterized to ascertain the finite deformation history, as well as conduct a Schmid Factor analysis for (001)-slip of biotite grains, which is indicative of post-growth kinematics. Crystallographic dispersion axes of quartz grains were used to derive a vorticity axes distribution to better constrain the kinematics of the late Greiner Shear Zone. Furthermore, thermodynamic modelling using Theriak Domino was conducted to constrain the metamorphic evolution for shear zone samples stemming from the Furtschagl Schists, Venediger Nappe and Glockner Nappe.

Geologic mapping resulted in a new geologic map of the study area, and three cross-sections constructed perpendicular to strike of the Greiner Shear Zone of the Pfitsch Valley section. Unoriented biotite grains in the Furtschagl Schist are interpreted to have grown a) over a pre-existing foliation and b) prior to the (late) Greiner Shear Zone activity, the latter resulting in a co-planar fabric with a rather minute overprint of the pre-existing deformation fabric. Schmid Factor analysis on those biotites indicates a sub-horizontal to N-plunging, N-S directed compression direction which resulted in sinistral shearing at the time deformation was ceasing. Results of the crystallographic dispersion axis analyses suggest shallow NE to E plunging axes on a shallow N- to steep NW-dipping flow plane, respectively. Based on the petrological investigations and thermodynamic modelling, a clockwise pT-path from blueschist facies to amphibolite facies conditions of approx. ~570°C and 6.8-7.5 kb could be derived for the Furtschagl Schists of the Venediger Nappe. Peak amphibolite facies conditions occur at the transition from early, syn-kinematic Greiner shearing to an inter-tectonic phase (Tauern Crystallization) as indicated by garnet and biotite growth.

Therefore, post-Tauern Crystallization deformation of the Greiner Shear Zone within the Furtschagl Schists is the result of general shear dominated transpression at amphibolite facies metamorphic conditions, linked to sinistral strike-slip kinematics, which were active during N-S directed compression. The shear zone is further interpreted to exhibit a heterogenous monoclinic deformation symmetry, which is likely the result of an interconnected, anastomosing shear zone network.

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