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Polyphase tectonics: New investigations of individual tectonic events and crustal flow in the SW Moldanubian Zone (Austria)

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It is already known that the Moldanubian Zone, a part of the Variscan Orogeny, has undergone a multi-phase metamorphic and kinematic evolution. In the last decades, several structural analyses focused on parts of the history, but a refinement of this progressive evolution is still missing. The focus of the present work is to differentiate structurally and geochronologically the sequence of tectono-metamorphic phases evidenced in the area of Strudengau (SW Moldanubian Zone, Austria).
Structural field data, cross-cutting relationships, analysis of macro- and microstructures and paragenetic relations as well as chemical and geochronological constraints shed a light to a polyphase tectonic model of the Moldanubian evolution. The oldest visible ductile event of the Strudengau area has been observed in HT-LP metamorphic gneisses, which show E-dipping foliation-planes (S1-fabric) with NW-SE directed lineations and large-scale folds showing lineation-parallel fold axis. The data suggest an early shortening in SW-NE direction. Overlying Gföhl Unit gneisses striking N-S preserve typical HT, in their inner part obviously decompression-induced anatectic conditions. They show N-S trending lineations and steep dipping foliation-planes (S2-fabric) crosscutting the S1-fabric of the previously described lithology. Marginally, these rocks have been strongly mylonitized under HT conditions. The geometry and extend of the observed HT-structures as well as the already known PT-path of the rocks suggest a large-scale crustal flow setting. Furthermore, younger structural overprints comprising a S3-fabric could be observed in the area of Strudengau. They have been imposed in an extensional regime that is characterized by localized low-angle shear zones with top-to-the NW movement. This event, called Strudengau-Shear-Zone-Event (STS-event), led to syntectonic folding with axial planes nearly parallel to the mylonitic foliation and stretching lineations. Sm/Nd and Ar/Ar chronology of a dyke cross-cutting S3-fabric elements shows a maximum age of 325 Ma for the STS-event that began under conditions of the lower amphibolite facies. The mylonites contain abundant white mica, but lack early chlorite. Further evolution of this event entered brittle conditions that led to development of normal faults showing NW-SE directed extension. Similarly, steep-dipping, NE-SW striking tension gashes suggest NW-SE oriented extension.
Cross-cutting relationships allow the distinction of a younger brittle regime, in which pre-existing fault planes were reactivated with top-to-the N-directed kinematics. Finally, conjugate sets with NW-SE and NE-SW striking fault planes developed. This orientation is consistent with the large-scale brittle systems of the Austrian part of the Moldanubian Zone, like the Danube, Rodel and Pfahl fault zones. Locally observed, top-to-the NE-directed thrust faults may indicate the beginning of the Alpine Orogeny.