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The role of Permo-Carboniferous graben systems in the development of the external Alpine massifs – an example from the Central Aar massif (Faernigen Zone)

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Permo-Carboniferous sedimentary and volcanic rocks occur not only in the Northalpine foreland, but also within the European Alps. Their occurrence often coincides with major Alpine tectonic boundaries, suggesting a causal relationship between graben-related extensional structures and their reactivation during Alpine inversion. To unravel this link, we investigate a number of former Permo-Carboniferous graben systems situated within the basement rocks of the Aar massif (Central Switzerland). Most of the grabens coincide with distinct E-W striking Alpine tectonic boundaries and are subparallel to the main extent of the external massif. Knowing the tectonic processes that lead to Alpine inversion of Permo-Carboniferous rift structures is therefore fundamental for a better understanding of the exhumation of external massifs.

The Faernigen Zone (Meiental, Central Aar massif) offers a unique opportunity to study this relationship. It comprises Permo-Carboniferous rocks, their Mesozoic sedimentary cover and is surrounded by polymetamorphic crystalline basement. Glacial retreat has uncovered fantastic, glacially polished outcrops that can now be studied in great detail. We present preliminary field observations and structural analyses from the Sustenpass area. At «Chli Griessenhorn», the Faernigen Zone is characterized by two steeply SSE dipping synclines, separated by an intermediate anticline. Tightly folded Mesozoic limestones make up the core of the synclines. They record a complex and multi-phase deformation history including folding and shearing. In the Mesozoic limestones, deformation was predominantly ductile and pervasive with only minor retrograde, brittle overprint. In the surrounding basement rocks, ductile deformation strongly localized in meter to decameter wide mylonitic shear zones. These are commonly overprinted in a brittle manner by subsequent cataclasis. Geometrical considerations suggest the Faernigen Zone has developed from a half-graben that was initiated in Permo-Carboniferous? times, reactivated during Jurassic rifting (possibly including syn-rift sedimentation) and inverted during the formation of the Aar massif in the Cenozoic. Alpine thrusting-related total displacement is in the range of 3 km, with a vertical component of up to 2 km. The dominant sense of shear for ductile and brittle deformation is top to the NW with a minor dextral component.

The Faernigen Zone is an excellent example of how pre-existing Permo-Carboniferous structures acted as crustal-scale instabilities dictating the position and nature of subsequent deformation. A detailed characterization of structures on all scales as well as their spatial and temporal evolution will enhance our understanding of Alpine inversion tectonics, especially with respect to the formation of the external massifs.