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The late-Alpine fault network of the Central-Eastern Alps

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The Periadriatic fault system represents the main tectonic divide between the Europe-vergent collisional wedge of the Alps (Alpine domain s.s.) and the south-propagating fold-and-thrust belt (Southalpine domain). In the area between Merano and Valles (NE Italy) the Periadriatic lineament is part of a complex fault network comprising strike-slip, thrust and detachment faults. Most of these faults display a long-term activity under ductile and then brittle conditions. In this contribution we present preliminary results of a regional-scale study of this fault network, aimed at better understanding the boundary and environmental conditions of deformation at the regional scale.

The Periadriatic lineament itself, the Passiria fault, the Giovo fault, the Pennes-Mules and the Rio Masul shear zones, the Brenner detachment and the Sprechenstein-Mules fault are the main segments of the studied fault network, whose evolution has not been completely understood, even if several studies in the past years started to reveal relationships between folding events and fault nucleation, relative displacements and the rheological evolution of single lineaments.

The Brenner W-dipping low-angle detachment juxtaposes Austroalpine basement units with contrasting metamorphic imprints (hanging wall) with the deeply exhumed Penninic units of the Tauern tectonic window (footwall). The Brenner detachment southern tipline lies in the Vipiteno area. In this area we suggest a triple junction between the Giovo, the Sprechenstein-Mules, and the Brenner line itself, but many details of this area are still to be resolved. In any case, the Sprechenstein-Mules fault

represents the connection between the Brenner Detachment and the Periadriatic lineament, whilst the Giovo fault should provide a linkage to the fault network to the SW. The structure and evolution of the Pennes-Mules and Masul shear zones is still largely unknown. Both of them display a complex evolution with ductile structures overprinting brittle ones and vice-versa. The Pennes-Mules shear zone extends with an E-W/ENE-ESE strike from Val Passiria to at least Mules. A thick shear zone, including strongly deformed mylonitic ortogneiss and deformed but poorly metamorphic metasediments, characterizes this structure. Stretching lineations within mylonites mainly suggest a top to the S/SW oblique sinistral thrusting. The mylonitic shear zone is overprinted by brittle-plastic shear zones showing S-C and S-C' fabrics and sub-horizontal striations suggesting dextral shearing. The fault zone is cut by the Passiria Fault to the west. The Rio Masul fault zone develops in the hanging wall of the Merano-Mules line, a few kilometres to the north and along the same trend, merging with it in Val Sarentino. Also this shear zone is cut by the Passiria fault to the west. The Forst fault (southern branch of the Passiria fault) forms a restraining band between Quarazze and Val Passiria, passing from left-lateral strike-slip motion to an oblique thrust characterised by a thick cataclastic zone. Inversion of fault populations measured along this line suggests a strike-slip regime with a N-S direction of maximum compression, indicating an important clockwise rotation of the stress axes occurring since Middle Miocene. A left-lateral offset of 15-20 km has been proposed across the Passiria fault by Viola et al. (2001), who correlate the Giovo fault zone with the Thurnstein mylonites, exposed west of Merano, showing similar kinematics and greenschist facies mylonitc fabrics.

Many of these crustal-scale shear zones share a common rheological evolution. A transition from phyllosilicate-rich greenschist facies mylonites (phyllonites) to brittle-cataclastic deformations can be observed in several cases, which is the result of the progressive exhumation history. Generally this rheological evolution is evidenced by an asymmetric distribution of fault rocks around the fault core, with mylonites exposed only in the most exhumed block (hanging wall for faults with a reverse component, footwall for faults with a normal component). Hence, a great opportunity to characterize fault zones at different depths, completely spanning the plastic-brittle transition and the earthquake's source zone, is provided by this area. Particularly interesting will be the study of the pseudotachylyte-mylonite associations shown by some of these lineaments, such as the Merano-Mules and the North Passiria faults, which might imply the nucleation or propagation of earthquakes in the plastic crust.