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The Simplon Line fault rocks: reworking of inherited mechanical anisotropy and weakening mechanisms

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The Simplon Fault Zoneis a late-collisional low-angle normal fault of the Western Alps. The fault activity lead to differential exhumation of the hangingwall and footwall. During the fault activity the hangingwall is characterized by brittle deformation only. On the other hand, the footwall is characterized by a 1 km thick shear zone (the Simplon Fault Zone), which continuously evolved, during exhumation, from amphibolite facies conditions to brittle-cataclastic deformations. Due to progressive localization of the active section of the shear zone, this evolution results in a layered structure, with higher temperature fault rocks preserved at the periphery of the shear zone, and cataclasites occurring at the core (indicated as the Simplon Line). The nucleation of cataclasites, which develop after greenschist facies mylonites, have been studied at the periphery of the cataclasite zone. It is characterized by fractures, micro-faults and ultracataclasite seams that develop along the mylonitic S/C/C' fabric, exploiting the weak phases mainly represented by muscovite and chlorite. This kind of brittle activation of a preexisting mylonitic fabric has been reproduced in a rotary shear apparatus at 1 mm/s. Approaching the proper fault core, both the thickness and frequency of cataclasite horizons increase, and, as their thickness increases, they become less and less foliated. The fault core itself is exposed only in a few outcrops. In some cases it is simply represented by the thicker cataclasite horizon. In other cases, these cataclasites have been dissected by a network of calcite veins, possibly related to carbonate lenses that have been dragged along the fault zone, and probably indicating episodic events of anomalously high fluid pressure. In conclusion, weakening mechanisms that may be considered for the Simplon Line include (1) the exploitation of the mechanical and textural anisotropy, represented by the S/C/C' mylonitic foliation, and (2) some later, and probably episodic, events of elevated fluid pressure, evidenced by calcite veins at the fault core.