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# Effects of fault orientation on the fault rock assemblage of exhumed seismogenic sources (Adamello, Italy)

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Which factors do affect the production of frictional melts (pseudotachylytes once solidified) during seismic slip? In this study, we discuss how fault orientation may determine the presence or absence of pseudotachylytes in fault rock assemblages formed under similar ambient conditions.

We compared two sub-vertical dextral strike-slip fault zones crosscutting the northern Adamello batholith (Southern Alps): the Gole Larghe Fault Zone (GLFZ) and the Passo Cercen Fault Zone (PCFZ). Both the fault zones cut similar host rocks (tonalites), were active under the same ambient conditions (9-11 km depth and 250-300˚C) and are formed by hundreds of subparallel cataclasite horizons exploiting precursor joints. However, in the GLFZ, cataclasites (cohesive fault rocks with no evidence of melting) are commonly associated with pseudotachylyte, whereas pseudotachylytes are very rare in the PCFZ. In contrast macroscopic veins filled with epidote + K-feldspar + quartz are common in the faults of the PCFZ but are very rare in the GLFZ. Another major difference between the two fault zones is their orientation: the PCFZ strikes N130˚, almost parallel to the direction of the inferred orientation of the regional $\sigma_1$ during faulting (N135˚). The GLFZ strikes N105˚, at an angle of about 30˚ from $\sigma_1$. Since both faults were seismic (they both have pseudotachylytes), we interpret the different orientation as the main cause for the difference in their fault rock assemblages. The faults within the GLFZ were activated as purely shear fractures with relatively high effective stresses normal to the fault ($\sim$90-110 MPa). Since the heat flow generated by a fault is proportional to the effective normal stress, heat flow, even for small seismic slips (few cm), was large enough for frictional melting to occur. The PCFZ was in a favorable orientation for an hybrid (extension+shear) mode of fracturing. Hybrid l fractures can be active at depth of 9-11 km only in presence of elevated pore pressures. High pore pressures are consistent with the observation that veining is diffuse along the PCFZ. The estimated effective stress normal to the PCFZ is very low ($<2$ MPa) and heat flow was too low for the production of frictional melts.