



## **Repeated pseudotachylytes generation events along regional scale faults: the Orobic and Porcile thrusts (Southern Alps, N Italy)**

Stefano Zanchetta (1), Paolo D'Adda (1), Valentina Barberini (1), Igor Maria Villa (1,2), and Andrea Zanchi ()

(1) Department of Earth Sciences and Geotechnologies, University of Milano Bicocca. Piazza della Scienza, 4- 20126 Milano (Italy). Contact: stefano.zanchetta@unimib.it, (2) Institute of Geological Sciences, University of Bern. Baltzerstrasse, 1+3 - 3012 Bern (Switzerland)

The Orobic Alps represent the central sector of the Southern Alps comprised between Lake Como and the Adamello batholith. Alpine deformation results in severe shortening by folding and thrusting of both cover and basement. The Orobic and Porcile thrusts form major, respectively E-W and ENE-WSW trending, tectonic structures along which the pre-Alpine basement is translated southward on the Permian-Triassic sedimentary cover. Both the Orobic and Porcile thrusts display a complex and long-lasting evolution with a first ductile stage defined by greenschist facies mylonites associated to folding and cleavage development in the footwall. The ductile-brittle transition is defined by the growth of cataclastic shear zones that overprints the ductile fabric. Pseudotachylyte fault and injection veins occur sporadically within both fault zones. All veins seem to originate from friction-induced melting of pre-existing cataclasites and ultracataclasites, derived from different lithologies (two mica gneiss, mica schists and K-feldspar gneiss).

Pseudotachylytes occurring along melt generation surfaces are typically zoned with a thin black wall along contacts with the wall rock, and a lighter dark grey to brass-like coloured part in the vein centre. Clasts derived from the wall rock consist of quartz, lithic fragments and minor plagioclase. The clast/matrix ratio decreases towards the vein centre contrary to the increase of the clast grain size. Reservoir veins, usually occurring along existing fractures or veins, are mainly not zoned and display a clast/matrix ratio close to zero, probably due to the "bottle-neck" effect.

$^{40}\text{Ar}/^{39}\text{Ar}$  isotope dating of pseudotachylytes matrix indicates the presence of two age clusters: Late Cretaceous and Early to Middle Eocene. Pseudotachylytes belonging to the old age group occur both in the upper and lower structural part of the fault zone (up to 150 m wide), whereas Eocene pseudotachylytes are concentrated close to the basement-cover contact.

In many cases re-melting phenomena of pre-existing pseudotachylytes were observed at the micro-scale. Old pseudotachylyte fragments with evident resorption features are present within new veins, and "intrusive" contact were locally observed between different vein generations. Different melt pulses along the same vein are differentiated on the base of clast/matrix ratios and chemical composition of both matrix and crystallites. Brittle deformation producing brecciation of old pseudotachylytes seems to be contemporaneous with new melt injection and flow, resulting in the coexistence, within the same vein, of old fractured pseudotachylyte layers and new, undeformed, ones.

Structural data relative to fault veins point out that both old and young pseudotachylytes formed along reverse fault planes with similar geometric features. This suggests that no significant changes occurred in the main stress axes orientations and resulting deformation structures correlated to the Late Cretaceous and the Eocene compressive deformation events along the Orobic and Porcile fault zones.

Field data,  $^{40}\text{Ar}/^{39}\text{Ar}$  ages, microstructural and mineralogical data on pseudotachylytes along the Orobic and Porcile thrusts reveal that repeated coseismic friction-induced melting occurred along same faults with a time interval in excess of 15 Ma. This implies that the seismic history of regional scale faults could be very complex and polyphasic, with successive long time range re-activations that can be individuated exploring the geological record associated to fault zones.