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Brittle deformation during Alpine basal accretion and the origin of seismicity nests above the subduction interface

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Geophysical observations on active subduction zones have evidenced high seismicity clusters at 20-40 km depth in the fore-arc region whose origin remains controversial. We report here field observations of pseudotachylyte networks (interpreted as evidence for paleo-seismicity) from a high grade continental terrane accreted to the upper plate in the blueschist facies during the Paleocene Alpine subduction. Millimeter to cm-thick pseudotachylyte veins found in the core of the unit comprise clasts from the host, as well as newly formed Ti-rich garnet rims, ilmenite needles, Ca-rich plagioclase, biotite microliths, sulphide droplets and hercynite micro-crystals. Mineralogy and textures point to co-seismic formation temperatures greater than 1500°C. 39Ar-40Ar dating yields a 51-54 Ma age range for the most pristine veins from the unit core. The base of the unit, which exhibits synchronous ductile and brittle seismic deformation under fluid-present conditions, underwent metamorphic re-equilibration at c. 40 Ma in the greenschist facies. Calculated rheological profiles combined with field observations suggest that pseudotachylytes from the dry core of the unit record micro-seismicity (Mw $\sim$3) formed under very high differential stresses (> 500 MPa) while the sheared base of the unit underwent repeated brittle-ductile deformation at much lower differential stresses (< 40 MPa) in a fluid-saturated environment. These results demonstrate that some of the seismicity clusters nested along and above the plate interface may reflect the presence of stiff tectonic slivers (e.g. tectonically eroded terranes, seamounts…) acting as repeatedly breaking asperities in the basal accretion region of subduction zones.