Multiple generations of pseudotachylytes from brittle to ductile regimes during exhumation of fault zones

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Fault-related pseudotachylytes found as simple veins or injected networks in fault zones are widely considered to record fossil earthquakes,i.e. events of seismic slip along faults within brittle to semi-ductile and ductile regimes. Fault-related pseudotachylytes, therefore, represent the closest sampling of the earthquake generation process at near focal depths. Two types of pseudotachylyte veins are documented: cataclasite-related pseudotachylyte (C-Pt) and mylonite-related pseudotachylyte (M-Pt), which were developed in two thrust zones: the Dahezhen shear zone in the Qinling-Dabie Shan collisional orogenic belt, central China, and the Woodroffe shear zone, Musgrave Mountains, central Australia. M-Pt is associated with mylonite-development and is overprinted by C-Pt. The foliations of M-Pt overprinted by mylonite are generally parallel to that of the country mylonite zone. The lineations within the M-Pt veins are generally oriented parallel to that of the country mylonite. The C-Pt veins cross-cut the foliations of mylonite and M-Pt, whereas M-Pt veins are overprinted by the mylonite. These facts show that the M-Pt formed cyclically in the ductile region due to propagation of seismic fracturing in the brittle regime down to the greater depth than the base of seismogenic zone. The coexistence of C-Pt, cataclasite M-Pt and mylonite in the same shear zones suggests that repeated seismic slips occurred in both the brittle and ductile portions of the crust during the exhumation of fault zones.