

Seismic slip recorded in the pseudotachylyte veins formed along the coseismic shear zone of 2008 Wenchuan earthquake

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Tectonic-generated pseudotachylytes formed by friction-melting during seismic faulting have been widely accepted as Fossil Earthquakes (Lin, 2008). In addition to melt-origin pseudotachylytes, some veinlet cataclastic rocks formed at shallow depths within fault zones are also considered to record seismic slip, i.e. injection veins of fault gouge (Lin et al., 1994, Lin, 1996), crushing-origin pseudotachylyte (Lin, 1996; Shigetomi and Lin, 1999; Kano et al., 2004; Janssen et al., 2010), and injection veins of fault breccia (Sibson, 1986) that occur as both simple veins and complicated network veins within fault zones. Although many studies have documented that veinlet cataclastic rocks are probably related to seismic faulting, a lack of field and petrologic evidence means that it remains disputed more or less as to whether they actually preserve a record of seismic slip. This study presents a representative example of crushing-origin pseudotachylyte veins which are found in the coseismic shear zone of the 2008 Mw 7.9 Wenchuan earthquake, and discuss its formation mechanisms and seismotectonic implications.

The 2008 Mw 7.9 Wenchuan earthquake produced a ~285-km-long surface rupture zone along the pre-existing active faults within the Longmen Shan Thrust Belt. Field investigations reveal that dark-aphanitic pseudotachylyte veins occur as a thin fault vein of <3 mm bounded on the fault plane along which principal slip occurred during the 2008 Mw 7.9 Wenchuan earthquake, and injection veins in the coseismic shear zone along the pre-existing fault zone. Microstructural analysis and powder X-ray diffraction data indicate that these pseudotachylyte veins are mainly composed of fine-grained crystalline materials and fragments sourced from the country rock of silt-mudstone with little or without glassy material. On the basis of the meso- and micro-structural features and X-ray diffraction analytic results, we conclude that the pseudotachylyte veins were produced by coseismic comminuting with little melting and partially were injected in the fault zone during the 2008 Wenchuan earthquake. Our findings confirm the ideas that i) dark-aphanitic pseudotachylyte veins can be generated by crushing with little melting and rapid injection during seismic faulting, and ii) crushing-origin pseudotachylyte veins also record seismic slip events within seismogenic fault zones as an earthquake fossil, as with melt-origin pseudotachylyte veins.

Keywords: 2008 Mw 7.9 Wenchuan earthquake, Longmen Shan Thrust Belt, seismic slip, pseudotachylyte, earthquake fossil, seismogenic fault zone