Lower-crustal seismic slip: evidence from pseudotachylytes generated in the granulites of the Woodroffe Thrust, central Australia

aiming lin[1]

[1] Institute of Geosciences,Shizuoka Univ

Modern seismic observation techniques have enabled seismologists to accurately determine important seismic source parameters such as seismic moment, focus depth, and rupture parameters of earthquakes over a large magnitude range (Kikuchi, 2003). Although these advances, at short length scales, resolution of seismic methods is limited because of the complex propagation and wave attenuation effects near the Earth surface, and it is difficult to determine the details of rupture process below some length (Kanamori and Heaton, 1999). An alternative source of seismic information is recorded by the fault rocks generated in seismogenic fault zones. Fault-related pseudotachylyte is the only material that records fossil seismic events within both the brittle and ductile regions from the upper to lower crust.

Pseudotachylytes are found in the granulites within the Woodroffe Thrust, Central Australia, that contain typical melt-origin features, including injection occurrence, rounded and embayed clasts, and microlites within the fine-grained pseudotachylyte matrix. The granulite facies pressure and temperature are estimated to be about 8 kbar and over 700 C, respectively (Camacho et al., 2001). These granulite-related pseudotachylytes are overprinted in later deformation stages by three types of pseudotachylytes that are identified on the basis of structural and textural features, vein morphology and host rock: mylonite-related (M-Pt) and ultramylonite-related (Um-Pt) pseudotachylytes that are then transcut by cataclasite-related (C-Pt) pseudotachylytes. The overprinting occurred following uplift of the lower crust (granulites) through the brittle-ductile transition (M-Pt and Um-Pt) and into the brittle-dominated regime (cataclasite and C-Pt) in the upper crust.

The coexistence of multiple generations of voluminous C-Pt, M-Pt, and Um-Pt veins and granulite-related pseudotachylytes indicates that the pseudotachylyte veins represent a large number of major earthquakes and accompanying seismic slip over an extended period of seismicity on the Woodroffe Thrust. The timing and distribution of pseudotachylyte indicates that the earthquakes nucleated at the base of the brittle-dominated seismogenic zone and propagated down through the brittle-ductile transition into the ductile-dominated regime from the upper to lower crust.