Detection of increased heating and estimation of coseismic shear stress from Raman spectra of carbonaceous material in pseudotachylytes

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Frictional heat generated during earthquakes provides insight into the coseismic fault strength. To detect increased heating associated with faulting at seismic slip rates, we analyzed the Raman spectra of carbonaceous material in natural and experimental pseudotachylytes derived from argillite. The results indicate that the increased carbonization in pseudotachylytes relative to the host rocks could be detected when the ambient temperature is lower than 280 ˚C. This increased carbonization can occur in ~4–16 s and is preserved even after alteration of pseudotachylytes. The comparison between experiment and Raman data demonstrated that there is a correlation between the average shear stress and the Raman spectra in pseudotachylytes. The average coseismic shear stress estimated from the correlation was 1.8 MPa. The resulting apparent friction coefficient under hydrostatic conditions at depths of 4–6 km was ~0.03–0.05. Raman analysis of carbonaceous material-bearing pseudotachylytes will be useful for estimation of coseismic fault strength.

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