Raman spectroscopic analysis of fault rocks in the Jurassic accretionary complex: implications for coseismic fault strength and displacement during subduction earthquakes

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Raman spectra of carbonaceous material (RSCM) have been used to estimate the maximum attained temperatures in sedimentary and metamorphic rocks. Recently, RSCM are also used for detection of a short-lived thermal event such as frictional heating on faults (Ito et al., 2017). We examined RSCM for the pseudotachylyte and the cataclasite in the thrust fault distributed in the coherent Jurassic accretionary complex in Inuyama area. The pseudotachylyte is ~2 mm thick and is originated from frictional melting of pelagic carbonaceous mudstone, representing a localization of coseismic slip. The cataclasite is ~10 cm thick and is characterized by fragments of black and gray chert in the carbonaceous mudstone matrix, showing distributed shear. The obtained RSCM indicate that increased carbonization occurs in the pseudotachylyte and the wall rock (gray chert) less than 2 mm from the pseudotachylyte boundary, which represents increased temperature and heat diffusion from the molten layer, respectively. In contrast, increased carbonization is not observed in the cataclasite, possibly due to small temperature rise associated with distributed shear at low slip rates. The average coseismic shear stress, which is determined from the correlation between the experimentally determined average shear stress and Raman spectra in pseudotachylytes (Ito et al., 2017), is 3.1 MPa. Assuming that mechanical work during earthquake faulting is converted to heat (Ujiie et al., 2007), the calculated coseismic shear stress yields 2.3 m fault displacement, which is consistent with the average coseismic displacement during M7 earthquake. RSCM are useful for detection of increased heating and estimation of coseismic fault strength, particularly when the temperature is high enough for frictional melting.

References

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Keywords: pseudotachylyte, carbonaceous material, Raman spectra, Jurassic accretionary complex

