断層摩擦発熱指標としての炭質物熱熟成反応における繰り返し地震イベントの影響

Experimental investigation of cumulative effect on thermal maturation of carbonaceous material as a proxy for earthquake slip

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Estimation of the maximum temperature recorded in fault rocks gives us important information about earthquake enegetics and fault slip behavior, because the frictional heat is directly related to dynamic parameters and to fault-weakening mechanisms. The thermal maturity of carbonaceous material (CM) has received considerable attention as a new temperature proxy because the organochemical characteristics of CM change irreversibly with increasing temperature. Various approaches by using infrared and Raman spectroscopies, elemental composition analyzer, biomarker method, and vitrinite reflectance measurement have been performed. However, for more accurate estimation of frictional heat, not only shear-enhanced mechanochemical effects but also chemical kinetics should be considered. In particular, cumulative effect by repeated earthquake events, related to the kinetics of the maturation, has not well understood. Here we demonstrated repeated heating events on bituminous coal and anthracite by using a tube furnace. We heated the samples 1, 10, and 100 times under conditions of 100, 300, 500, 700, 900, 1100, and 1300 degree C and 40-s heating duration, and conducted infrared and Raman spectroscopic analyses on the samples after heating. The disappearance of aliphatic C-H at 500 degree C were observed on all samples, and the intensity ratio of D and G bands on the Raman spectra of all samples increased beyond 700 degree C. Thus, we could conclude no significant cumulative effect on the thermal maturation of CM under rapid heating, indicating that the detected temperature on a fault corresponds to the largest earthquake slip event.

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