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# Fossil rocks of slow earthquake detected by thermal diffusion length

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Fault motion has been estimated by diffusion pattern of frictional heating recorded in geology (e.g., Fulton et al., 2012). The same record in deeper subduction plate interface can be observed from micro-faults in an exhumed accretionary complex. In this study, we focused on a micro-fault within the Cretaceous Shimanto Belt, SW Japan to estimate fault motion from the frictional heating diffusion pattern.
A carbonaceous material concentrated layer (CMCL) with ∼2m of thickness is observed in study area. Some micro-faults cut the CMCL. Thickness of a fault is about 3.7mm. Injection veins and dilatant fractures were observed in thin sections, suggesting that the high fluid pressure was existed. Samples with 10cm long were collected to measure distribution of vitrinite reflectance (Ro) as a function of distance from the center of micro-fault. Ro of host rock was ∼1.0%. Diffusion pattern was detected decreasing in Ro from ∼1.2%-∼1.1%. Characteristic diffusion distance is ∼4-∼9cm.
We conducted grid search to find the optimal frictional heat generation per unit area per second (Q (J/m̂2/s), the product of friction coefficient, normal stress and slip velocity) and slip duration (t(s)) to fit the diffusion pattern. Thermal diffusivity (0.98*10̂8m̂2/s) and thermal conductivity (2.0 w/mK) were measured. In the result, 2000-2500J/m̂2/s of Q and 63000-126000s of t were estimated.
Moment magnitudes (M0) of slow earthquakes (slow EQs) follow a scaling law with slip duration and its dimension is different from that for normal earthquakes (normal EQ) (Ide et al., 2007). The slip duration estimated in this study (∼10̂4-∼10̂5s) consistent with 4-5 of M0, never fit to the scaling law for normal EQ. Heat generation can be inverted from 4-5 of M0, corresponding with ∼10̂8-∼10̂11J, which is consistent with rupture area of 10̂5-10̂8m̂2 in this study. The comparisons in heat generation and slip duration between geological measurements and geophysical remote observations give us the estimation of rupture area, M0, and earthquake style, for geological records.