Experimental evidence for effects of heating rate on thermal maturation process of carbonaceous materials during earthquake slip

*Shunya Kaneki[1], Tetsuro Hirono[1]

1. Graduate School of Science, Osaka University

Quantitative estimation of frictional heat produced in the fault zone is one of the keys to understand the slip behaviors of an earthquake. Irreversible thermal maturation process of carbonaceous materials, which is very sensitive to maximum temperature, is reported to be a great indicator for frictional heat. In fact, such maturation process could be strongly affcted by not only ambient temperature but also heating rate. However, several previous studies have only conducted heating experiments with heating rate of ~1 ˚C s^{-1} to detect heat recorded in fault rocks, which is markedly lower compared to that of earthquake slip (several tens to several hundreds of degrees per second).
In this study, we have conducted heating experiments with two different heating rate (~1 and ~100 ˚C s^{-1}) on carbonaceous materials retrieved from an ancient plate-subduction fault, and carried out IR and Raman spectroscopies, and py-GC/MS analysis to examine whether heating rate could affect the maturation process of carbonaceous materials. Results showed that maturity of carbonaceous materials after heating with 100 ˚C s^{-1} is lower than that after heating with 1 ˚C s^{-1}. By performing numerical simulation based on one-dimentional thermal diffusion equation, we have re-evaluated maximum temperature of the targeted fault to possibly reach 900 ˚C during past earthquakes, which is much higher than that estimated in the previous study (600 ˚C). We concluded that maturation of carbonaceous materials is strongly affected by heating rate, and such effects must be considered when we estimate maximum temperature from carbonaceous materials.

Keywords: Frictional heat, Carbonaceous materials, Heating rate, Spectrometry

