Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SSS29-P03 Room:Convention Hall Time:May 24 18:15-19:30

Effect of humidity on frictional healing of montmorillonite

TETSUKA, Hiroshi[1*] ; KATAYAMA, Ikuo[1]

[1]Department of Earth and Planetary Systems Science, Hiroshima University

According to time-predictable model for characteristic earthquakes, a stress increases at a constant ratio in interseismic period, and an earthquake occurs when the stress reaches a certain constant stress (Shimazaki and Nakata, 1980). This model has been applied for long-term forecasts for the Tokai earthquake, the Nankai earthquake. The ratio of stress increasing depends on the frictional healing effect which is the effect of the strength recovery with logarithm of hold time. In subduction-zones, smectite plays a key role for frictional behavior in surfaces of oceanic plates, and which has shown very low coefficient of friction (Ikari et al., 2007; Ujiie et al., 2013). Moreover, water distribution, hence humidity, contribute to the non-uniform clay minerals and its saturation along subduction-zones (Zhao et al., 2009). Previous studies investigated the effect of humidity on frictional healing of bare quartzite and quartz, alumina and soda-lime glass powders, which results that the frictional healing increases with increasing relative humidity (Dieterich and Conrad, 1984; Frye and Marone, 2002; Scuderi et al., 2014). However, the effect of humidity on the frictional healing of smectite has not well understood, therefore, we examined the effect of humidity on frictional healing of montmorillonite (a type of smectite) with comparison to quartz.

We conducted slide-hold-slide test (10, 30, 100, 300, 1000, 3000s) at 15MPa normal stress and 3μm/s shearing velocity. The experiment are carried out at four humidity conditions, 1) in deionized water with a water tank at room temperature, 2) at room temperature and humidity, 3) at room temperature and humidity after having been dried samples at 100 ℃ for 24 hours, 4) at 100 ℃ with a heater after having been dried samples at 100 ℃ for 24 hours.

We found the result that the frictional healing of montmorillonite decreases with increasing relative humidity, which is opposite to that observed in the experiments for quartz. The negative correlation between frictional healing effect and relative humidity on montmorillonite can be explained by the weakness of interlamellar cohesion due to expanding distance between layers in montmorillonite.

The smaller the frictional healing effect, the smaller stress recover in interseismic period. Assuming that the time-predictable model is correct, the smaller stress recover in interseismic, the longer recurrence time of earthquakes. Therefore, it is expected that the recurrence time of earthquakes is long in areas are wet and in which montmorillonite abound.

Keywords: smectite, frictional healing, humidity