Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

SCG62-08 Room:502 Time:May 2 11:00-11:15

Can clay minerals account for the non-asperity on the subducting plate interface?

KATAYAMA, Ikuo[1*] ; KUBO, Tatsuro[1] ; SAKUMA, Hiroshi[2] ; KAWAI, Kenji[3]

[1]Department of Earth and Planetary Systems Science, Hiroshima University, [2]National Institute for Materials Science, [3]Department of Earth and Planetary Sciences, Tokyo Institute of Technology

Seismicity along the subducting plate interface shows a regional variation, in which large earthquakes occur repeatedly at the strongly coupled patches that are surrounded by weakly coupled regions. This model suggests that the subduction plate interface is heterogeneous in terms of frictional properties; however, mechanism making the difference in strong and weak coupling is still not well understood. We consider this difference to relate to the alternation of plate interface due to aqueous fluids that result in the spatial distribution of clay minerals. In this study, we measured the frictional healing of clay minerals and discuss whether the frictional properties of clays can account for the weakly coupled non-asperity regions in the subducting plate interface.

We carried out a series of slide-hold-slide frictional experiments to examine the time-dependent frictional restrengthening of the simulated fault gouge. In the experiments, the axial loading was interrupted for periods ranging 10 to 3000 s after steady-state friction, and we measured the difference between the steady-state friction and the peak friction after each holding period. Mechanical data were recorded continuously with a sampling rate of 10 Hz and the frictional coefficient was calculated from the shear force divided by the normal force assuming zero cohesion.

The preliminary results show that the frictional strength of clay minerals (smectite and chlorite) slightly increases with holding time; however, the healing rate is significantly smaller than that of dry silicates such as quartz. Similar weak healing rate has been reported in the serpentinized simulated faults (Katayama et al., 2013). These experimental results suggest that the recovery of fault strength is different in materials, in which clay minerals show weak and slow recovery whereas dry materials show relatively quick and thereby strong coupling on the fault surface. Aqueous fluids that are released from the descending plate may change the mineralogy on the plate interface where clay minerals become dominant at the channel of fluid flow surrounding the unaltered dry patches that potentially act as a seismic asperity. Thus, the heterogeneous fluid pathway and spatial distribution of clay minerals may play a key role for the formation of asperity and non-asperity on the subducting plate interface.

Keywords: Interplate earthquake, Asperity, Clay minerals, Frictional experiment, Frictional healing