Coexistence of slow earthquakes and megathrust earthquakes on the shallow plate boundary fault: Numerical simulation study on fault ruptures along the fault rock samples acquired by ocean drilling science

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Recent geophysical observations have revealed that slow earthquakes have repeatedly occurred along the shallow plate boundary fault off Kii Peninsula. On the other hand, onland geology of tsunami deposit shows that coseismic rupture also occurred along the shallow plate boundary fault. In addition, a series of international ocean drilling expeditions by NanTroSEIZE project acquired fault rock samples of the dé collement at this region. Heating anomalies observed in rock samples provide further evidence of coseismic ruptures there, whereas microstructural observations of the same fault rock samples suggest slow deformation on this décollement, which could be interpreted as slow earthquakes. Although evidences for coexistence of slow earthquakes and megathrust earthquakes on the same fault have piled up, its mechanism has not been understood. This study aims to demonstrate that numerical model considering dilatancy hardening (DH) and thermal pressurization (TP) could explain their coexistence with the physical properties at the shallow accretionary prism.

Fault rocks in the shallow accretionary prism can be regarded as poroelastic medium, in which porosity plays an important role to control its physical properties. Hence, we estimate physical properties of acquired fault rock samples, such as thermal conductivity and permeability, using XCT data and empirical conversion functions by Yabe et al. (2019, doi: 10.1186/s40623-019-1097-4) and others. We use profiles of estimated physical properties for the input to numerical models of Suzuki and Yamashita (2014, doi:10.1002/2013JB010871), which simulates fault ruptures in the poroelastic medium considering DH and TP. We will report the simulated slip behaviors on the fault.

Keywords: Fault rupture simulation, Poroelastic, Megathrust earthquakes, Slow earthquakes

