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Effects of temperature and fluid pressure on the frictional behaviors of glaucophane schist

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The 2011 Tohoku earthquake (Mw 9.0) off the Pacific coast of Japan initiated at 24 km depth along the plate boundary. In order to understand the initiation mechanisms of the earthquake, it is essential to reveal the frictional properties of metamorphic rock which is expected to exist around the epicenters of major earthquakes at the Tohoku subduction zone. Thus, we have conducted friction experiments on glaucophane schist from Franciscan Belt, California at high temperature and high pressure using a gas-medium, high PT deformation triaxial apparatus at AIST. The rock samples were shaped into a cylinder with a precut surface at an angle of 30 degrees. The specimens are drilled through to the slip surface for ?uid conduit and distilled water is used as a pore fluid for wet experiments. Experiments are performed at temperature of 100-300^{o}C, axial loading speed of 0.1-1.0 micron/s, a constant confining pressure of 150 MPa and pore fluid pressure of 1-149 MPa. In this study special attention was paid to how a rate-depend parameter, a-b, in the rate and state friction law changes with temperature and fluid pressure.

Our preliminary results are summarized as follows. At 100^{o}C, a-b value shows positive at low fluid pressure, but it decreases to negative with increasing fluid pressure to effective pressure of 5 MPa. This implies that an earthquake could nucleate even at aseismic plate boundaries when fluid pressure increases significantly to reach very low effective pressure. At 200 and 300 ^{o}C, a-b value shows positive at any fluid pressures and the sliding surface behaves viscoelastically at the rapid change in sliding rate, although a-b at this temperature range is generally thought to indicate negative value. In widely accepted earthquake models of a subduction zone (e.g. Scholz, 1998), a seismogenic zone defines as that the rate-depend parameter becomes negative value at a temperature range of 100-300 ^{o}C. However, this model is based on the experimental results on granite which does not exist at subduction zones. It may be necessary to establish new initiation model of subduction earthquakes that is incorporated into the effect of not only temperature but also fluid or effective pressure on frictional property of metamorphic rocks. More detailed results including microstructural observation will be presented at the meeting.

Keywords: Glaucophane schist, Pore pressure, High temperature and high pressure, Frictional behavior