Spatio-temporal evolution in reflectivity in the source area of Tokachi-oki earthquake

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When micro-scale physical-and-chemical reactions within rocks affect macro-scale physical properties, we may be able to observe the temporal evolution of physical properties by monitoring reflectivity. Here we demonstrate a spatio-temporal evolution in reflectivity, which has been observed near the plate boundary shear zones before and after the 2003 Tokachi-oki interplate earthquake (MW8.0). From the evolution pattern and the aftershock observations, we attribute the change in reflectivity to gradual fluid flow, and estimate the subsequent permeability in the plate boundary shear zone to be 10ˆ-15 mˆ2. The magnitude of the reflectivity change implies a 1.6 % increase in porosity and a 2.2-5.6 MPa reduction in shear strength. Here Miyazaki et al. [2004] inferred the temporal change in shear stress on the plate boundary due to afterslip from GPS data, and it ranges from 0.1 to 0.7 MPa. Namely the decrease in shear strength estimated from the time-lapse survey is not as small as it can be disregarded. Therefore, as a hypothesis to test, we propose that expanded porous patches guided the seismic rupture propagation in the Tokachi-oki earthquake. Considering the earthquake recurrence and the gradual growth of LFP, we may be observing a lubrication process [Brodsky and Kanamori, 2001] or a break down of barriers [Seno, 2003] within the plate boundary shear zone, and it is also consistent with a long rise time in the rupture at the sub-asperity nearby LFP [Yagi, 2004].