Slip distributions and relation of slip-rate and shear stress for the Boso slow slip events

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Slow slip events (SSEs), which radiate no seismic waves, were detected 6 times off the Boso Peninsula since the GNSS observation in Japan started in 1996. This presentation shows slip distributions and stress changes of 6 SSEs, and discusses frictional properties on the plate boundary where the SSEs occur.

We used the daily F3 coordinate values of GNSS stations from the Geospatial Information Authority of Japan. The GNSS data were fitted with a time series model that takes account of the linear trend and seasonal variations in the data, and then the fitted data were smoothed. We made every 3 days transient movements from the smoothed data. From the 3 days data, we estimated slip distributions using ABIC inversion method. We calculated stress changes from the slip distributions using Coulomb 3.3.

The results show that the amount and location of the slip distributions differ each events. Maximum amount of slips is about 7 cm for 1996 and 2014 events, and 14-20 cm for the other events (2002, 2007, 2011, 2018). 1996 and 2014 events slipped at a location during the event. The other events, on the other hand, moved southward during the event. Shear stress changes were about 0.1-0.3 MPa at main slip areas. From graphs of logarithm of slip rate and the stress change, we can see starting phase, stable phase, and stopping phase for the SSEs. Slopes of the stable phase increase with depth.

The slopes of the stable phase represent (a-b)* σn, where σn is normal stress, from an equation of steady state friction for rate and state dependent friction low. Since the SSEs are quasi stable slip, the shear stress changes estimated from slip distributions may equal to frictional stress changes. Using also results of quasi stable slip simulation, we can estimate (a-b) and effective normal stresses from the slope of the stable phase for the SSEs. Assuming (a-b)=-0.003, the effective normal stresses are estimated about 2-20 MPa. These values are much smaller than lithostatic stresses at the depth. This indicates a possibility of very high pore pressure on the plate boundary.

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Keywords: slow slip, slip rate, stress change, effective normal stress, rate and state dependent friction low

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