PHYSICAL INTERPRETATION OF SLOW EARTHQUAKE MIGRATION PROCESS BASED ON A FRICTION LAW

Keisuke ARIYOSHI

Research Institute for Marine Geodynamics,
JAMSTEC (Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

contact: ariyoshi@jamstec.go.jp

Natural faults host various types of migrating slow earthquake phenomena, with migration speeds much lower than seismic wave speeds and different moment-duration scaling from regular earthquakes. To advance the obtained quantitative understanding of the migration process and long duration of slow earthquakes, I study a chain reaction model in a population of brittle asperities based on a rate- and state-dependent friction on a 3-D subduction plate boundary. Simulation results show that the migration speed is quantitatively related to frictional properties by an analytical relation derived here. The application of the analytical solution to observational results suggests that (i) the temporal changes of observed migration speeds for the rapid tremor reversal could be explained by about 70% reduction of the effective normal stress; (ii) effective normal stress for the deeper extension of the seismogenic segment in the western part of Shikoku is about 1.5 times greater than that in the central part. Applying rupture time delay between slow earthquake asperities for a duration longer than regular earthquake, I also conclude that (iii) the characteristic slip distance of rate-and-state friction for low-frequency earthquakes is roughly between 30 μm and 30 mm; (iv) the stress and strength drops of very low-frequency earthquakes is much smaller than 1 MPa.