

Sensitivity analyses of slip parameter estimation to hydrological and thermal properties

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Abstract

Enormous earthquakes repeatedly occur in subduction zones, and the slips along megathrusts, in particular those propagating to the toe of the accretionary prism, generate ruinous tsunamis. Although quantitative evaluation of slip parameters (i.e., slip velocity, rise time and slip distance) of past slip events for the shallow, tsunamigenic part of a fault is a critical component of characterizing such earthquakes, it is very difficult to constrain these parameters. Here we quantify these parameters for slip events that occurred along the shallow part of a megasplay fault and a plate boundary decollement in the Nankai Trough, off Japan. We applied a kinetic approach to profiles of vitrinite reflectance data obtained from Integrated Ocean Drilling Program (IODP) cores that intersected the slip planes of the two thrusts, and identified extremely slow and long-term slips in the megasplay fault and the frontal decollement.

The chemical kinetic method is useful to evaluate fault temperature and slip parameters. This has been introduced into various natural faults, however, this contains uncertainty due to its sensitivity to temperature which is dependent on various natural properties complicatedly. Therefore, we also discussed the effect of temperature dependence of thermal property or dynamic weakening mechanism for temperature calculation. We assessed the sensitivity of the calculation results to the measured thermal property and dynamic weakening effect caused by thermal pressurization.

Keywords: fault material, slip parameter, parameter sensitivity