Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS31-P22 Room:Convention Hall Time:May 21 18:15-19:30

Investigation of slip parameters and fault slip behavior in the shallow part of subduction zone on the basis of vitrinit

Yohei Hamada[1*], Arito Sakaguchi[1], Wataru Tanikawa[1], Yuzuru Yamamoto[1], Asuka Yamaguchi[2], Jun Kameda[2], Gaku Kimura[2]

[1]JAMSTEC, [2]The University of Tokyo

Enormous earthquakes repeatedly occur in subduction zones, and the slips along megathrusts, in particular those propagating to the toe of the forearc wedge, generate ruinous tsunamis. Quantitative evaluation of slip parameters (i.e., slip velocity, rise time and slip distance) of past slip events at shallow, tsunamigenic part of the fault is critical to characterize such earthquakes. Here we attempt to quantify these parameters of slips that may have occurred along the shallow megasplay fault and the plate boundary decollement in the Nankai Trough, off southwest Japan. We apply a kinetic modeling to vitrinite reflectance profiles on the two fault rock samples obtained from Integrated Ocean Drilling Program (IODP). This approach constitutes two calculation procedures: heat generation and numerical profile fitting of vitrinite reflectance data. For the purpose of obtaining optimal slip parameters, residue calculation is implemented to estimate fitting accuracy. As the result, the measured distribution of vitrinite reflectance is reasonably fitted with heat generation rate (Q) and slip duration (tr) of 16,600 J/s/m2 and 6,250 s, respectively, for the megasplay, and 23,200 J/s/m2 and 2,350 s, respectively, for the frontal decollement, implying slow and long-term slips. To compare these slip behaviors with those in other settings of shallow part of subduction zone, we measured vitrinite reflectance on fossilized analogue faults, exposed in the Miura-Boso accretionary complex (the Shirako fault and the Emi fault), and examined their slip parameters by the above method. The measurement is conducted by using a newly-developed optical microscopy which allows us to 2-dimensional reflectance measurement on polished slab samples. The obtained vitrinite reflectance profiles both show strong anomaly at the slip zones. The reflectance anomaly in the Shirako fault is also recognized at the outside of the slip zone as is the case for the megathrusts in the Nankai trough. The numerical analysis yields slip velocity and slip distance of 0.14 cm/s and 5.17 m, respectively, under the optimal parameters set of = 14,500 J/s/m2 and tr = 3,600 s. On the other hand, the reflectance anomaly at the Emi fault is limited only inside of the slip zone. This condition (i.e. the absence of reflectance anomaly in the host rock) is taken as a constraint to determine and tr for the Emi fault. The estimated slip parameters are then compared with previous reports. The maximum temperature, Tmax, for the Nankai megasplay fault is consistent with the temperature constraint suggested by Hirono et al. [2009]. On the other hand, the calculated temperature contradicts the estimation deduced from clay mineral analysis [Kameda et al., submitted]. This discrepancy might indicate that the Shirako fault has experienced two types of slips; faster slip which caused temperature increase only inside the fault and acceleration of illitization, and slower slip which keep a high temperature state for a while enough to heat up the host rock by thermal conduction. Two constraints are combined to estimate slip parameters for the Emi fault. One is that Tmax is 350-1100 C [Hamada et al., 2011], and another is the absence of vitrinite reflectance anomaly in the host rock. Slip parameter ranges defined by these constraints are relatively faster slip velocity (˜ 1m/s) and shorter displacement (˜ 1m) than those for other faults. These results show large variation of slip parameters in shallow part of subduction zone. Especially, slow slip velocity, long-term rise time and large displacement are recognized in the three fault zones (the megasplay, the frontal decollement and the Shirako fault). These parameters are longer and slower than typical coseismic slip, but are rather consistent with rapid afterslip.

Keywords: slip parameters, vitrinite reflectance, frictional heat