Effects of thermal pressurization acting locally on a fault -Slip, stress drop and radiated energy-

Yuta Mitsui[1]; Kazuro Hirahara[2]

[1] Dept. Geophys., Kyoto Univ.; [2] Geophysics, Sciences, Kyoto Univ.

Pressurized pore fluid by thermal expansion at a fluid-saturated fault is considered to promote the fault slip, when frictional heating with the high-speed slip stands out [*Sibson (1973)*]. This mechanism may act effectively only where the frictional heating with the high-speed slip stands out, namely the fault geometry is nearly flat and the shear zone of the fault is narrow enough. Such a flat region may not occupy the whole region of the large earthquake source with the length of several kilometers to several ten kilometers. It may rather exist locally. *Wibberley and Shimamoto (2005)* suggested such a region where thermal pressurization acts effectively is observable as an asperity by seismic wave analyses.

Now, regarding the effects of thermal pressurization on the stress drop and the dynamic rupture characteristics, lots of numerical calculations have been executed in the past several years [i.e. *Bizzarri and Cocco (2006)*]. However, no studies have investigated how thermal pressurization acting locally on the fault affects the spatial distributions of the coseismic slip amount, the stress drop and the radiated energy on the whole fault. Besides, those studies take strong assumptions, such as a constant slip rate or an initial artificial nucleation, and ignore the view of an earthquake cycle.

On the basis of the above, we construct the two-dimensional earthquake cycle model with local thermal pressurization. It is based on [*Mitsui and Hirahara (2007)*] which takes a planar fault in a two-dimensional homogeneous elastic half-space and the rate- and state- dependent friction law involving pore dilatation.

The numerical results show: [1]The coseismic slip amount is not quite affected by localized thermal pressurization and does not form spatially heterogeneous distribution [2]The stress drop and radiated energy are quite affected by localized thermal pressurization and form spatially heterogeneous distributions. These results may support the suggestion by *Wibberley and Shimamoto (2005)* that the region which thermal pressurization acts on effectively is observable as an asperity by seismic wave analyses, via the significant radiated energy (stress drop). However, our results also present that the coseismic slip amount on the “asperity” (=large radiated energy region) is not significant. This fact implies that we should reconsider the simple substitution, a great deal of the radiated energy (stress drop) for the large slip amount.