Enhanced resolution of stress tensor inversion by using fault instability analysis

*Katsushi Sato[1]

1. Division of Earth and Planetary Sciences, Graduate School of Science, Kyoto University

Modern stress tensor inversion techniques for fault-slip analysis are based on the Wallace-Bott hypothesis which assumes that the slip directions and shear stress vectors are parallel. The hypothesis has an advantage in the applicability to high pore fluid pressure conditions and low friction faults, since the magnitudes of shear and normal stresses are not evaluated. However, the hypothesis gives only loose constraint on stress from observed faults in exchange for the wide applicability, which causes poor detectability of stresses.

This study tries to improve the detectability by introducing the fault instability (Vavrycuk et al, 2013; Sato, 2016) into the stress tensor inversion. The fault instability is defined as the nearness of the point representing shear and normal stresses on Mohr diagram to the line of Coulomb failure criteion. The fault instability is imposed on the fitness of a stress candidate to a fault-slip datum as a weight. Since the calculation of fault instability requires the friction coefficient, this study used several values of friction coefficient and compared the results.

The new method was applied to natural meso-scale fault-slip data. The faults cutting the Awa Group (Chiba Prefecture, central Japan) newly gave a reverse-faulting regime of stress in addition to normal faulting ones which can be detected by a conventioanl technique. An E-W trending tensional stress was newly detected from the faults cutting the Sekinan Group in the Beppu-Shimabara graben (Oita Prefecture, southwest Japan) where N-S trending extensional tectonism is ongoing. These resutls showed the improved resolution of stress tensor inversion by the incorporation of fault instability.

References
Sato, K., 2016, Journal of Structural Geology, 89, 44-53.
Vavrycuk, V., Bouchaala, F. and Fischer, T., 2013, Tectonophysics, 590, 189-195.

Keywords: stress tensor inversion, fault-slip analysis, fault instability

