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Stress inversion method from fault slip senses and its application to active fault data

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Stress inversion methods from fault-slip data usually require to observe fault surface orientation, slip orientation and sense of shear. However, the descriptions of fault geometry made by many researchers are sometimes imcomplete for lack of slip orientations. In such cases, Andersonian fault model may be applied in spite of the existence of oblique slip faults. This presentation introduces a stress inversion method for imcomplete fault-slip data, which is applied to the active fault data compiled by Tsutsumi et al. (this meeting) in the Kinki and Chubu districts, central Japan.

The stress inversion method used in this study was developed by Sato (2006). A fault-slip datum has constraint on stress state through the assumption that a fault slips in the direction of resolved shear stress (Wallace-Bott hypothesis). The constraint can be expressed as a region in the deviatoric stress space which is geometrically the surface of five-dimensional unit sphere. If a datum is imcomplete, the area of constraint should be large. The inversion method superposes the constraint regions from all observed faults to compose a fitness distribution on the sphere. Since the deviatoric stress space is a metric space with the measure of difference between stress tensors (Yamaji and Sato, 2006), the area of constraint region can be used as the weights in the superposition process. Finally, the stresses which give the maxima of fitness are picked up as optimal solutions.

The active fault data set from about 200 locations were analyzed, and a reverse faulting stress with WNW-ESE compression was obtained. Although the data included no information about slip orientations, stress could be constrained in a small area in the deviatoric stress space (within 20 degrees around the optimal solution) due to the variation of fault surface orientations. Most of fault data are concordant with the optimal stress, while a small number of outliers deviate by only several degrees in the stress space. The fact that single stress can explain almost all of active fault slip senses shows the uniformity of stress state in the district.

References

Sato, K., 2006. Tectonophysics 421, 319-330.
Yamaji, A. and Sato, K., 2006. Geophys. Jour. Int. 167, 933-942.

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