AOGS 2005

New Trend in Paleostress Analysis

ATSUSHI YAMAJI, KATSUSHI SATO and MAKOTO OTSUBO
Division of Earth and Planetary Sciences, Kyoto University, Kyoto 606-8502, Japan

The secular change in the state of stress at shallow levels in the crust not only sheds light on tectonics, but also helps design foundations and hydrocarbon explorations. Since the 1980s, the mathematical techniques, known collectively as stress tensor inversion, have been utilized for those purposes. The incorporation of the techniques of information engineering and higher dimensional geometry into the methodology for the processing of heterogeneous data sets is the new trend of this field. Fault-slip data are called heterogeneous, if the faults that provide the data were activated by multiple stresses.

Since the mid 1990s, numerical techniques of information engineering have been incorporated for the separation of stresses from heterogeneous data and their computerized sorting. The multiple inverse method[1] employs the generalized Hough transform, which was proposed for pattern recognition. The method has applied to several areas in Japan, and has succeeded in unraveling Plio-Pleistocene stress history with a temporal resolution of < 1 m.y.

Since the late 1990s, the geometrical interpretation of stress tensor inversion has been recognized to be useful for methodological advancement[2]. Recently, we have constructed a theoretical basis for stress tensor inversion to improve numerical techniques for the processing of heterogeneous fault-slip data. It is demonstrated that points on the five-dimensional hypersphere represent stress tensors to be determined by the inversion. Each fault-slip datum is expressed by a couple of unit vectors that are perpendicular to each other in the five-dimensional space. The admissible stresses for the datum are represented by a great circle arc upon the hypersphere with an arc length of 180°.

Based on this geometrical interpretation, (1) we have improved the resolution of the multiple inverse method, which can separate stresses from heterogeneous data, and (2) proposed one more method for the same purpose utilizing a pattern matching technique.

References

[1] Yamaji, A., 2000, *J. Struct. Geol.*, **22**, 441–452.
[2] Fry, N., 1999, *J. Struct. Geol.*, **21**, 7–21.