Sk-P042 Room: Poster Time: June 9 17:30-19:30

Resolution of classic inverse method and multiple inverse method applied to conjugate faults

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Conjugate faults were used to estimate the resolution of classic and multiple inverse methods. The latter identified four stresses. Three stresses cause the fault to slip in similar directions, so that they are equally plausible solutions. The other one is independent from the three stresses. The classic inverse method can separate stresses if the histogram of residuals show peaks. However, the method could identify only one stress.

Mesoscale faults can constrain paleo lithospheric stresses. Anderson's fault classification was usually used in Japan for such studies. However, such assumption is unsatisfactory in that conjugate faulting cause only plane strain of rocks that encompass the faults, though strains are usually three-dimensional. Inverse methods that have been developed since Angelier (1979) are able to estimate paleostresses that allow three-dimensional strains. However, those classic inverse methods have not enough resolution when they deal with heterogeneous fault-slip data. Multiple inverse method was recently proposed by this author to enable to separate stresses (Yamaji, 1999a).

The classic and multiple inverse methods are applied to the same data set to investigate the resolution. Twenty four reverse faults that crop out at an outcrop in the lower Miyazaki Group, Kyushu Island, Japan, were used for this study. They are unique in mesoscale faults in the area in that they encompass calcitic vein with slickenfiber lineations, suggesting that they moved more or less simultaneously. The direction of fault planes allow to divide them into two groups. Their intersection is perpendicular to the lineations, so that they are conjugate faults. Anderson theory indicate a paleostress with NE-SW trending sigma_1 axis.

Classic inverse method can separate stresses if angular misfits show multi-peaked histogram (Mino and Yamaji, 1999; Yamaji, 1999b). However, the method could yield only one stress: NNE-SSW trending axial compression with Phi=(sigma_2-sigma_3)/(sigma_1-sigma_3)=0.06. By contrast, multiple inverse method identify four stresses: (1) ENE-WSW trending axial compression, (2) vertical axial extension, (3) ENE-WSW trending triaxial (Phi=0.5) stress, and (4) NNE-SSW trending triaxial (Phi=0.7) stress. The fact is that the stresses (1) through (3) cause the faults to slip in the similar directions, so that they are equally plausible solutions. Yamaji (1999a) refer them as associated solutions. The fourth solution is independent from them. The solution that was obtained by the classic inverse method is similar to the solution (1). The classic method could idenfity only one solution from the conjugate faults.