3-D analyses of healed and sealed, intragranular and transgranular cracks in granite near the Nojima Fault, Awaji Island

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3-D crack analysis is significant for evaluating the instability of rock bodies especially the path of fluid in rocks. 3-D analyses of healed and sealed intra- and trans-granular cracks in granitic rocks were carried out by various methods to obtain the paleo-stress field and aerial relationship of the crack density with the active fault. The oriented granitic samples were taken from one E-W route near the Nojima seismic fault, which strikes NNE-SSW and dips at a high angle to the east, Awaji Island, SW Japan.

Polished slabs cut to three right-angled surfaces (horizontal, vertical parallel to E-W, vertical parallel to N-S) were used for 3-D analyses.

Method:

1. Transgranular healed and sealed cracks: Three right-angled surfaces are observed separately with the naked eye and under the luminoscope (cathodeluminescence), and then traced from those images using Photoshop. Pseudo-3D analysis was done using rose diagrams of the orientation data from the three surfaces. We also cut vertically the cracks that were observed on the horizontal surface, and measured the real 3-D attitude of the cracks from the two perpendicular surfaces.

2. Intragranular healed microcracks in quartz grains: Microcracks are observed as alignments of tiny fluid inclusions in quartz grains, and thus we determined the attitude of microcracks using a U-stage.

Results:

1. The orientation of transgranular sealed and healed cracks concentrates nearly NNW-SSE from the sample near Nojima fault, however, they scatter in other samples at a distance from the fault. Results of pseudo 3-D analyses are concordant with those of real 3-D analyses when the crack concentrates one peak direction in each surface.

2. The orientation of intra-granular healed cracks in quartz give a nearly N-S strike and a vertical dip from all samples, and thus sigma-3 must be E-W. However, an E-W strike with vertical dip is also obtained from several samples. Such co-existence of two perpendicular peaks can be explained that the sigma-1 direction switches to sigma-3 just after the release of stress during fault movement in a brittle regime.

3. Results of the orientation of sigma-1 from both trans- and intra-granular healed cracks (N-S direction) and the oblique relationship between the strike of the fault and the paleostress suggests that the Nojima Fault has had recent dextral slip activity but must have been generated as a sinistral fault before the Miocene clockwise rotation of SW Japan. It was highly possible to be generated from Paleogene (c.50Ma) on the basis of zircon FT age of pseudotachylyte (Murakami et al., 2003).