Paleo-stress field transition determined by 3-D analyses of microcracks in the Ryoke granite, SW Japan

Hideo Takagi[1]; Kei Nishijima[2]; Shigenori Miwa[3]; Yoshiyuki Yokomizo[4]; Mamoru Enjoji[5]; Mizuno Takashi[6]

[1] Earth Sci., Waseda Univ.; [2] Earth Sci.,Waseda Univ; [3] Resources Engineering, Waseda Univ; [4] Earth Sciences, Waseda Univ.; [5] Inst. Earth Sci., Waseda Univ.; [6] JAEA Tono

3-D analyses of healed and sealed intragranular microcracks in quartz grains in the Late Cretaceous Ryoke granitic rocks have been carried out to obtain the paleostress field. Healed microcracks are observed as planar alignments of tiny fluid inclusions in quartz grains, and sealed cracks are observed as cracks cemented by other materials. The attitude of both microcracks is thus determined using a U-stage. To estimate the P-T condition of microcrack healing, we measured homogenization temperatures using fluid inclusions. The oriented granitic samples were taken from Nojima granodiorite along the Nojima seismic fault, Awaji Island, and Toki granite in Toki Town. Thin sections cut to three right-angled surfaces (horizontal, vertical parallel to E-W, vertical parallel to N-S) were used for 3-D analyses.

Awaji Island: The oriented samples are collected along two routes (18 samples from the Tokiwa-dam and 7 samples from Hirabayashi) along nearly normal to the Nojima fault. The orientation of intragranular healed microcracks in quartz give a nearly N-S strike with vertical dip from all samples, and thus sigma 1 must be N-S. The homogenization temperature obtained from fluid inclusions constituting healed microcracks ranges 160-280 C. The orientation of intragranular sealed microcracks concentrates two; NE-SW strikes with vertical dip, and horizontal. The results suggest the sigma 1 orientation as NE-SW.

Toki: More than ten thousand healed microcracks are measured from 21 oriented pieces of the core sample DH-15 drilled in the Toki granite. Five oriented samples are also obtained from outcrops around the core site. The orientation of healed microcracks concentrate NNW strike with vertical dip, and weak peak of horizontal one was also observed, and thus sigma 1 must be NNW-SSE. Although we have not measured sealed microcracks, reported meso-cracks in the core sample and from the field (Fujii, 2000) concentrate NE strike with high angle dip to the SE and subhorizontal, and thus sigma 1 must be NE-SW.

Paleo-temperature was estimated from homogenization temperatures and frozen temperatures, and if we assume the pressure about 2-3 kb, the crack-forming temperature must be 400-500C. From this estimation and cooling curve of the Ryoke granitic rocks (Tagami et al., 1988), healed microcracks must be formed in 70-55Ma. Accordingly, we must restore about 47 degree clockwise rotation of SW Japan arc at about 15Ma, then sigma 1 becomes about WNW-ESE in both Awaji and Toki. This trend coincide with the moving direction of the Pacific Plate at 74-53Ma, and thus it reflects regional stress field during late Cretaceous to early Paleogene. On the other hands, we have no evidence at the moment when sealed microcracks and meso-cracks are formed, however, the sigma 1 direction of NE-SW is not coincide with the regional paleostress field, which could be brought about the plate subduction. Thus if restoration of clockwise rotation is also applied for sealed microcracks and mesocracks, the sigma 1 was estimated as N-S, which is well coincide with the moving direction of the Pacific Plate at 53-48Ma.