Strain-softening processes of granitic mylonites in Ryoke Metamorphic Belt in the Sennan area, Osaka, Japan

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The deformations of continental crusts are heterogeneous and often localize into narrow shear zones. The localization must be results of some kinds of strain-softening processes, such as formation of inter-connected weak layers, development of crystallographic preferred orientation and change in deformation mechanism due to deformation induced grain-size reduction. The microstructures of granitic mylonites consisting of porphyroclasts and fine-grained matrix with banded structures may record these strain-softening processes.

Granitic mylonites from an upper greenschist facies mylonite zone in Ryoke metamorphic belt, SW Japan show three types of microstructure with increasing mylonitization: (1) mylonites, (2) banded mylonites and (3) banded ultramylonites. The microstructural changes from mylonites to banded ultramylonites have occurred through fracturing of plagioclase porphyroclasts, K-feldspar replacement by myrmekite, K-feldspar precipitation in fractures and tails and dislocation creep of quartz. In addition:

(1) The modal proportions (30-40%) of weak phases (quartz and biotite) are high enough to connect each other before the development of banded structures.

(2) Quartz bands deformed by dislocation creep without evidences of mechanism change to diffusion creep or grain-boundary sliding even in the banded ultramylonites.

(3) Fine-grained poly-phase bands, consisting of plagioclase + K-feldspar (+ quartz + biotite), have not been weaker than quartz bands.

Therefore, dislocation creep of quartz aggregates has controlled the mechanical properties of these mylonites at all stage of mylonitization. The main strain-softening processes that worked during the mylonitization were gradual increase in modal proportion of weak matrix (but not weaker than quartz bands) and it may not be remarkable but moderate weakening.