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Superplastic Flow of Reaction Products in Mylonites

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Superplastic flow of reaction products in mylonites is illustrated with three examples; granite mylonite along the Hatagawa Shear Zone in the Abukuma Mountains, and gabbro and lherzolite mylonites in the Hidaka Mountains, formed in the middle crust [1], in the lower crust and in the uppermost mantle [2], respectively. All these mylonites have matrix composed of monomineralic aggregate and fine-grained (≤50 μm) polymineralic aggregate. The monomineralic aggregate is of quartz, of plagioclase and of olivine in the granite, gabbro and lherzolite mylonites, respectively. The fine-grained polymineralic aggregate in the granite mylonite is of plagioclase, K-feldspar, quartz and biotite mainly derived from a myrmekite-forming reaction [1], while that in the gabbro mylonite is of orthopyroxene, clinopyroxene, hornblende, quartz, biotite and ilmenite mainly derived from a decomposition reaction of pyroxenes, and that in the lherzolite mylonite is of olivine, plagioclase,spinel, orthopyroxene and clinopyroxene derived from the phase transformation reaction from spinel lherzolite to plagioclase lherzolite [2].
The monomineralic aggregate is composed of dynamically recrystallized quartz, plagioclase or olivine grains which exhibit both shape and crystallographic preferred orientations, indicating their crystal plastic flow by dislocation creep. In contrast, the constituent grains of the fine-grained polymineralic aggregate largely exhibit neither shape nor crystallographic preferred orientations, suggesting their superplastic flow by grain boundary sliding. The fine-grained polymineralic aggregate makes up 50–60% of the granite ultramylonite and the lherzolite mylonite and controls the rheology of these mylonites, while the rheology of the gabbro mylonite is controlled by the monomineralic plagioclase aggregate making up its ≈60% and forming its stress-supporting framework.

Keywords: mylonite; granite; gabbro; lherzolite; reaction products; dislocation creep; grain boundary sliding; crystal plastic flow; superplastic flow.

References

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