Exsolution mechanisms of microtexture of alkali feldspar in granite porphyry from the Kose granitic mass, Nara, Japan

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Microtexture of rock-forming minerals provides information on the growth history of individual minerals and thus on the history of the rock containing them. Exsolution textures, for example, are closely associated with the cooling rates. Alkali feldspar, one of the common minerals in acidic igneous rocks, generally exsolve on a coarser scale than any other silicate because diffusion of the alkali cations, K and Na, is relatively fast. Therefore, study of the exsolution textures in alkali feldspar is important for presuming the cooling history of felsic rocks. In the present study, microtexture of alkali feldspars in a porphyritic rock was examined to discuss the genesis of the rock by methods of petrographic microscopy, scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The rock sample used is a cordierite-biotite granite porphyry intruded in the Kose granite mass, Nara Prefecture. Mineral assemblages of both the phenocrysts and groundmass are commonly quartz, alkali feldspar, plagioclase, biotite and cordierite.

Alkali feldspar phenocryst is divided into core (Or54-64) and rim (Or63-67) regions by arrays of quartz inclusions. Petrographic microscopic and SEM observations reveal that the core regions are composed of textually-distinct two kinds of parts, in a presence and absence of the well-developed lamellar texture. The parts with no lamellar texture look like homogeneous, but the further TEM observation shows a presence of the fine lamellar texture even in the homogeneous part (hereafter, named as cryptoperthite). The composition in such homogeneous parts ranges Or54-63 and is slightly lower Or contents than those of the regions with the lamellar intergrowth (hereafter, named as microperthite) (Or60-64). The boundary between in the fine lamellae is unclear, and the branching of lamellae is rarely observed. Moreover, the periodicity of lamellar spacing is almost regular (about 50 nm). These features suggest that the cryptoperthite might be formed due to the *spinodal decomposition* mechanism. In contrast, the interfaces between adjacent lamellae are linear and sharp, and the periodicity is irregular (about 800 nm) in the microperthite area. These features suggest that the microperthite might be formed due to the *nucleation and growth* mechanism.

The coexistance of crypto- and micro-perthitic exsolution textures in alkali feldspar from acidic igneous rocks has been reported (e.g. Hashimoto et al., 2005; Lee et al., 1995). Lee et al. (1995) reported platelet of cryptoperthite (below 75 nm in thickness) between films of microperthites in alkali feldspar in the Shap granite. They inferred that both were exsolved at two nucleation events, that is, microperthitic films was first formed by heterogeneous nucleation at higher temperature, and subsequently cryptoperthitic platelets grew between the coarser exsolution films by homogeneous nucleation at lower temperature. In contrast, in the present study, coexisting texture of lamellar crypto- and micro-perthites was presumed to be formed by two distinct mechanisms, spinodal decomposition process and nucleation and growth process. By taking a kinetic effect (namely, a time-temperature-transformation diagram) into consideration, the present microtexture in the alkali feldspar phenocryst can be explained to be formed each exsolution textures close on same stage.

References

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