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Calculated garnet growth during metamorphism considering limited diffusion transport

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Previous works have suggested that the metamorphic porphyroblast growth is controlled by the diffusion transport of materials in the matrix (e. g., Cashman & Ferry, 1988). One of the arguments concerning the Sambagawa metamorphic belt, Japan, was that the core composition of the zoned garnet coincided with each other even if their grain sizes were different (Banno et al., 1986), which cannot be achieved by interface controlled growth. Another observation is that the spacing between neighbouring garnet grains correlated with the grain size (Toriumi & Nomizo, 2001). In this study, a simple forward model was used to explore the basic behavior of growing garnet considering limited diffusion transport in the matrix. The calculated garnet growth behavior was compared to those of natural garnet grains. The proper order of the effective diffusion coefficient in the matrix will be discussed.

The forward model proposed by Inui & Toriumi (2004) was used to simulate the Mg-Fe-Mn garnet formation consuming chlorite and quartz in the prograde condition of the Sambagawa metamorphism. Starting from a 5-mm-radius sphere of chlorite, the amount of garnet growth and the chemical composition was calculated at each P-T increment. Limited diffusion transport in the matrix was introduced as the diffusion distance. Several calculations were carried out, each run keeping its own effective diffusion distance of 5.0 mm (no limitation in diffusion), 3.0 mm, 1.0 mm, 0.3 mm, and 0.1 mm. In the model without diffusion limitation (where matrix chlorite was always homogeneous), the modelled Mn content in garnet neared zero before the Mg/Fe ratio in garnet started increasing. In contrast, the limitation in the diffusion transport resulted in the rise of Mg/Fe ratio in garnet before Mn nears zero, which was consistent with observations. The calculated amount of garnet growth increased dramatically as the temperature increased. Resulted size of the garnet grain was largely proportional to the diffusion distance. The diffusion distance of 0.3 ~1.0 mm, which corresponds to the diffusion coefficients of the order of $1*10^{-18}$ [m^2/s] ~$1*10^{-19}$ [m^2/s], seemed to produce grains with popular grain sizes of porphyroblast garnet in the Sambagawa belt.

Natural garnet grains of the Sambagawa pelitic schists from Besshi district, central Shikoku, were analysed to see if their growth rate change was consistent with the calculation. Chemical analysis was performed using the JEOL JXA-8200 WD/ED Combined microprobe analyzer at the Graduate school of Frontier Sciences, the University of Tokyo. P-T trajectories of two garnet grains were estimated using Gibbs method. The relationship between the chemical composition of garnet and the P-T condition was obtained. The volume of garnet that grew during the interval between two successive analyzed points was estimated by perfoming 2-D image analyses on the compositional mapping images of Mn. 2-D area analyses results were transformed to 3-D volume data assuming spherical garnet grains. Thus the growth amount of garnet was plotted against temperatures. Increase of growth rate in the higher temperatures (later part of growth) was observed, which was consistent with the modelled garnet behavior.

Banno, S., Sakai, C. & Higashino, T. (1986) Pressure-temperature trajectory of the Sanbagawa metamorphism deduced from garnet zoning. Lithos, 19, 51-63.

Cashman, K. V. & Ferry, J. M. (1988) Crystal size distribution (CSD) in rocks and the kinetics and dynamics of crystallization. Contrib Mineral Petrol, 99, 401-415.

Inui, M. & Toriumi, M. (2004) A theoretical study on the formation of growth zoning in garnet consuming chlorite. J Petrol, 45, 1369-1392.

Toriumi, M. & Nomizo, A. (2001) Diffusion-controlled garnet growth during Sambagawa metamorphism. Structural Geol (J Tectonic Res Gr Japan), 44, 47-57.