

Time sequence of the growth of albite porphyroblasts and garnets in the Sanbagawa pelitic schists of the Nagatoro area, Kanto Mountains, Japan

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The initiation of mineral recrystallization within a subducting oceanic plate marks the onset of dehydration within the subduction zone. The Sanbagawa metamorphic belt has been the focus of extensive research for several decades, making it one of the most thoroughly studied subduction complexes on Earth. It is now becoming possible to deal with the beginnings of recrystallisation, thanks to the new tools that have been developed to study the P-T conditions of lower grade rocks.

Low-grade pelitic schists in the Nagatoro area of the Kanto Mountains are known to contain garnet grains of a notably diminutive size, mostly with diameters ranging from 10 to 50 micrometers. They are euhedral to subhedral and mainly occur within micaceous lamellae that define the schistosity. The peak temperature experienced by the rocks in the area are estimated to be approximately 400°C or above. The temperature condition is optimal for garnet to start forming. It has been reported that the garnet grains in the Higuchi outcrop are unevenly distributed, and frequently contain garnet kernels with very different chemical compositions at their cores (Inui et al., 2020). It can be hypothesised that the kernels, most likely of detrital origin, initiated the process of garnet formation. Conversely, the timing of the formation of the diminutive garnet was ambiguous, owing to the same feature: its minute size, unusual kernels, and inubiquitous distribution.

In this study, the chemical zoning of the numerous garnet grains within a hand sample are examined in detail. About 15 % of the examined grains showed the kernel in the core of the Mn-rich part, demonstrated by the backscattered electron image. The kernels had the chemical composition of garnet but different from the surrounding part of the grain, and the shape was irregular. Almost all of the examined grains had a relatively large and homogeneous Mn-rich part in the centre, surrounding the kernel if the grain had one, and a relatively Ca-rich part at the rim. The Mn-rich part is called the mantle, and the Ca-rich part is called the rim, hereafter. The boundary between the mantle and the rim is very distinct. The chemical composition of the kernel varied among the grains in the same thin section. The chemical composition of the mantle and the rim was homogeneous within the sample, demonstrating the mantle and the rim grew under chemically controlled condition.

Some of the garnet grains occurred included in relic albite porphyroblasts. Most albite grains in the investigated sample are colorless and transparent, with a mean length of less than 0.2 mm. On the other hand, relic albite porphyroblasts are recognized as particularly large and conspicuous grains, dusty with abundant carbonaceous materials included. Albite porphyroblasts including carbonaceous materials occur abundantly in the pelitic schists of the higher grade zones of the Sanbagawa Metamorphic Belt. Inui et al. (2023) discovered evidence of size reduction, probably due to brittle deformation, of the albite porphyroblasts in the apparently low grade pelitic rocks. It is noteworthy that the garnet grains included within the relic albite porphyroblast were the only ones to be missing the Ca-rich rim. The homogeneous chemical composition of the Mn-rich mantles of the garnet inside and outside the albite porphyroblasts suggests that the mantle grew before the growth of the albite porphyroblasts, which is said to have occurred during the peak or just after the metamorphism. It is evident that the mantle part exhibits the true beginning of the formation of garnet, owing to the possibly detrital kernel. It is deduced that the Ca-rich rim of garnet overgrew after the formation, and most likely also after the deformation, of the albite

porphyroblasts.

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