Chemical zoning of garnet and plagioclase in the Sambagawa metamorphic rocks from the Asemigawa river area, Shikoku

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The rocks that suffered the highest grade metamophism in the Sambagawa metamorphic belt (the oligoclase-biotite zone) are well exposed along the Asemigawa-river in central Shikoku, Japan.

Pelitic schists from the oligoclase-biotite zone and the neighboring albite-biotite zone along the Asemigawa-river were sampled and were analyzed. Mineral assemblage was muscovite + chlorite + garnet + plagioclase + quartz +/- epidote +/- biotite +/- calcite. Plagioclase grains are large, with the diameter more than 1 mm, and round in shape, which made them traditionally called the albite spots. Schistosity was formed by muscovite grains which anastomose around the plagioclase spots. Garnet grains were mainly euhedral, with the diameter of several tens of micrometers to several hundreds of micrometers. Smaller garnet grains were more densely distributed in the muscovite-rich layers compared to the quartz- or plagioclase-rich layers. Muscovite did not anastomose around the smaller garnet grains. Instead, muscovite grains were clearly cut by the euhedral garnet rim. Chlorite tails were sometimes formed at the sides of garnet grains which seem dissolved at the rim.

Chemical analyses of garnet showed that there were two groups of garnet grains. Group A garnet grains tend to be larger and have the same chemical trend from the core to the rim within each thin section. Group B garnet grains are smaller and more clearly euhedral, have different chemical trajectory with each other in a single thin section. Some of the group B grains show intrasectoral chemical zoning, which indicate disequilibrium growth condition. The occurrence of equilibrium and disequilibrium garnet grains are the same as those observed in Besshi district, Shikoku. Chemical analyses of plagioclse was carried out and it was obtained that samples from the albite-biotite zone also have Ca zoning within plagioclase (anorthite fraction was less than 5 mol%, approximately). Chemical mapping images revealed that Ca in plagioclase often increased exclusively at the rim of two sides of the grains, as if Ca-rich parts only grew into the direction of the mineral lineation of the whole rock. In some samples, Ca decrease was observed before (inside) the Ca increase at the rim.

Garnet and plagioclase both seem to have two different growth stages. The order of their growths and its implication to the peak to retrograde metamorphic condition of the Sambagawa metamorphic belt will be discussed.