

Timescale of metamorphism and U-Pb ages of the Sanbagawa Metamorphic Complex

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Timescale of high-pressure metamorphism is not well known, but is crucial for solid mass transport and fluid flux in the subduction zone. Here, we report timescale of high-pressure metamorphism for the Sanbagawa Metamorphic Complex in the area of 1:200,000 geological map of Matsuyama, western Shikoku, Japan.

We collected psammitic and pelitic rocks from the Iyo and Ozu units of the Sanbagawa Metamorphic Complex, weakly metamorphosed and non-metamorphosed Togano units of the southern Chichibu belt and non-metamorphosed Hanyama unit of the Shimanto belt. The samples are used for zircon U-Pb and phengite K-Ar dating. Histogram of detrital zircon U-Pb ages ($H(t_{zrn})$) of non-metamorphosed Togano unit is similar to $H(t_{zrn})$ of weakly metamorphosed Togano unit, and ages of the youngest cluster of detrital zircon U-Pb ages (t_{zrn-yc}) are 174.7 ± 1.9 Ma and 181.6 ± 1.4 Ma, respectively. The $H(t_{zrn})$ s of the Hanyama unit, Ozu unit and upper part of the Iyo unit are identical to each other. The t_{zrn-yc} s of the Hanyama and Ozu units, and the upper part of the Iyo unit are 111.3 ± 2.4 Ma, 110.3 ± 4 Ma, and 111.2 ± 2.9 Ma, respectively. This implies that protolith of the Ozu unit and the upper part of the Iyo unit, both units are a part of the Sanbagawa Metamorphic Complex, is the Hanyama unit of the Shimanto belt. On the other hand, the $H(t_{zrn})$ of the lower part of Iyo unit is quite different from those of the above-mentioned 3 samples, and the t_{zrn-yc} is 89 ± 1.0 Ma. The phengite K-Ar ages (t_{phn}) of the upper and lower parts of the Iyo unit are 83.8 ± 2.1 Ma and 86.9 ± 2.2 Ma, respectively.

Maximum value of the timescale of high-pressure metamorphism can be defined by the difference between the t_{zrn-yc} and the t_{phn} . The maximum value of the timescale for the upper part of the Iyo unit is 27 Myr, although that for the lower part of the Iyo unit is 2 Myr. Metamorphic zircon rims have grown around detrital zircon grains of the sample from the upper part of the Iyo unit suffered garnet zone metamorphism. Average of U-Pb ages of the metamorphic rims is 94.4 ± 1.2 Ma. It is inferred that the metamorphic zircon rim have grown at the peak temperature of the Sanbagawa metamorphism. Therefore, difference between the U-Pb age of the metamorphic rim and the t_{phn} should give minimum value of the timescale of the high-pressure metamorphism. The value is 11 Myr.

Results show that the timescale of high-pressure metamorphism ranges from <2Myr to 11-27 Myr in the same unit. The upper part of the Iyo unit suffered higher-grade metamorphism than the lower part of the Iyo unit. Numerical simulation of viscous fluids shows that lower viscosity part of metamorphic rocks, in which metamorphic dehydration reaction actively takes place, will be elongated by shear deformation, and intrude into lower-grade metamorphic rocks coming newly in the metamorphic field at deeper part of the subduction zone.

Keywords: Sanbagawa, metamorphism, metamorphic rock, zircon, U-Pb age