

Estimation of the Metamorphic *P-T* Condition and Age of the Oki Gneisses: Implication for the Paleoproterozoic High-Temperature Metamorphism

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The Oki gneisses which were metamorphosed by high-temperature metamorphism occur in the northeastern part of Oki-Dogo Island, and they are composed of migmatite gneiss, pelitic gneiss, and granitic gneiss and so on. It has been considered that the Oki gneisses were formed during early Paleozoic and were regionally metamorphosed at ca. 250 Ma (Suzuki and Adachi, 1994). On the other hand, two metamorphic events of amphibolite facies (3-4kbar, 580-680°C) and granulite facies (750-820°C) have been reported (Hamada et al., 1996), but it is unclear that the metamorphic age of ca. 250 Ma represents amphibolite or granulite-facies metamorphisms. In this study, U-Th-Total Pb Chemical Isochron Method (CHIME) dating combined with the textures in the rocks was carried out to link the metamorphic ages and *P-T* conditions to elucidate the formation process of the Oki gneisses. We found that monazites included in garnet show the age range of ca. 1900-2100 Ma, implying that the Oki gneisses were suffered the high-temperature metamorphism during the Paleoproterozoic.

On the gneisses collected from Togo River and Choshi River in Oki-Dogo Island, polarization microscope observation, quantitative chemical composition analysis of each mineral, and mapping of garnet and monazite composition were carried out. The metamorphic *P-T* condition was estimated using garnet-biotite-plagioclase-quartz geothermobarometer (Perchuk, 1985; Hoisch, 1990). The CHIME age was measured at Nagoya University based on the mapping and texture of monazite.

The Mg concentration of garnet core in the Oki gneisses is higher than those of garnet rim, indicating that the Oki gneisses were suffered retrograde metamorphism after peak metamorphism. The peak and retrograde metamorphic *P-T* conditions from samples along the Togo River were estimated using the compositions of garnet core and rim, resulting in 718-758 °C, 6.4-8.8 kbar and 508-654 °C, 2.1-6.6 kbar, respectively. Also, the peak and retrograde metamorphic *P-T* conditions from samples along the Choshi River are 803-829 °C, 9.0-10.3 kbar and 638-695 °C, 4.4-5.9 kbar, respectively. These results indicate that the metamorphic grade of the gneisses along the Choshi River were higher than those of the gneisses along the Togo River.

The Y₂O₃ concentrations of monazites included in the garnet core of the sample along the Togo River are 1.7-2.2 wt%, and they yield the CHIME age of 1999-2089 Ma. In contrast, monazites included in the garnet rim contain the age of ca. 259 Ma in addition to the ages of 1893-2084Ma, and the younger one shows a relatively low Y₂O₃ concentration. The monazites in the peripheral part of the garnet yield the ages of ca. 232-250 Ma and ca. 162-168 Ma, and the latter one shows a relatively high Y₂O₃ concentration. These results indicate that the Oki gneisses were metamorphosed by not only the Permian-Triassic metamorphism, but also the Paleoproterozoic high-temperature metamorphism (ca. 720-760°C, 6-9kbar). The existence of the Paleoproterozoic metamorphism suggests that the protolith ages of Oki gneisses are remarkably older than generally thought (i.e. early Paleozoic). In the future, we will clarify the relationship between the Paleoproterozoic and the Permian-Triassic metamorphism in the Oki belt to compare those in the North/South China massifs and the Gyeonggi/Yeongnam massifs in

Korea.

Keywords: Oki, metamorphic rock, CHIME, geothermobarometer