

Geologic structure of the Sanbagawa Metamorphic Rocks in western Shikoku and deformation pattern of viscous fluids

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The Sanbagawa Metamorphic Rocks are high-pressure metamorphic rocks formed at depth deeper than lower crust. During exhumation, it is expected that the metamorphic rocks should suffered large-scale deformation. I created geological map of the Sanbagawa Metamorphic Rocks in the Iyo-Nagahama district, western Shikoku, and compared the geologic structure and patterns of viscous fluid under simple shear deformation.

The Sanbagawa Metamorphic Rocks in the Iyo-Nagahama district can be divided into Uchiko and Iyo units 1). The Uchiko unit is mainly composed of pelitic schist, and the Iyo unit is mainly composed of mafic schist. The Iyo unit can be also divided into lower, middle and upper subunits. The lower subunit is composed of mafic, siliceous, pelitic and psammitic schists. The middle subunit is mainly composed of thick mafic schist. The upper subunit is composed mainly of mafic and pelitic schists. The lower and middle subunits suffered metamorphism equivalent to that of chlorite zone in central Shikoku. In both subunits, mineral assemblage of epidote + glaucophane + albite + chlorite + quartz occur in mafic schist, and no garnets appear in pelitic schist. In the upper subunit, albite porphyroblast occur in pelitic and mafic schists, and garnet appears in pelitic schist. Therefore, metamorphic grade in the Iyo unit increases toward upper structural levels. Phengite K-Ar ages obtained by this study and previous study 1) yield 78.7 ± 2.0 - 88.1 ± 2.2 Ma for the Iyo unit, and 90.6 ± 2.3 - 94.6 ± 2.4 Ma for the Uchiko unit.

An E-W trending antiformal fold develops in the Iyo unit at central part of the district, and the schistosity dips gently to north at northern side of antiformal fold, and dips gently to south at southern side of the antiformal fold. Recumbent fold with a few km wavelengths is inferred by detailed mapping of red-colored siliceous schist of the middle subunit of the Iyo unit in western part of the district. Folds with sub-horizontal axial plane also develop at outcrop scales in the Iyo unit.

Pressure and temperature in high P/T metamorphic rocks, such as the Sanbagawa Metamorphic Rocks, drastically increase in perpendicular to schistosity. Formation of this type of P-T structure may require tectonic displacement under simple shear. I examined structural evolution of viscous fluids with different viscosity under simple shear deformation. The system consists of high viscosity fluid (10^{23} Pa s) and low viscosity fluid (10^{21} Pa s). Both fluids are sandwiched by solid plates. Layering structures slightly oblique to shear direction are assumed as initial configuration. Shear deformation were induced by two plates moving to the opposite direction with 1 to 10 cm/y. Results show that folds with a few cm to few km wavelengths are formed during evolution of pattern under simple shear deformation. Although the comparison of the results with natural observation is insufficient, the results suggest that tectonic displacement of metamorphic rocks formed at different P-T and formation of large-scale folds may take place simultaneously under simple shear deformation.

1) Banno, Y., et al. (2010) Geology of the Ozu District. Quadrangle Series, 1:50,000, Geological Survey of Japan, AIST, 58p.

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