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Thermal anomaly map in low P/T type metamorphic belt -Case study of the Ryoke metamorphic belt in the eastern Yamaguchi

Yu Sugawara[1*], IKEDA, Takeshi[1]

[1]Kyushu University

Low P/T type metamorphic belts show that the slope of their field P-T curves is higher (60-150^{0}C/km) than any steady-state geothermal gradients of continental crust (De yoreo et al., 1991). This suggests that excess heat was supplied by any transport proses to form the low P/T type metamorphic belts. The traditionally proposed process is heat conduction from granitic melts (Hunson and Barton, 1989). Recently, Miyazaki (2007) proposed pervasive melt migration as a heat transport proses. In contrast, Hoisch (1987) proposed hot fluid as source of high geothermal gradient in the crust.

A thermal anomaly map would help evaluate the validity these models. In this study, we provide thermal anomaly map of low P/T type metamorphic belt by using petrological method in the Ryoke metamorphic belt in the eastern Yamaguchi Prefecture.

[Method 1]

We estimated pressure-temperature conditions of one sample from K-feldspar-cordierite zone, seven samples from the sillimanite-K-feldspar zone and four samples from the garnet-cordierite zone by using the garnet-biotite thermometer of Hodges and Spear (1982) and the relative geothermobarometry of Ikeda (2004). Addition of result of Ikeda (2004) enables us to reveal the thermobaric structure of this area. Isotherms are oblique to isobaric lines, suggesting that the crust has thermally heterogeneous at the same depth. We constructed thermal anomaly map that shows difference between metamorphic temperature and steady-state temperature at the depth (dT).

[Result 1]

We divide the study area into two domains where T is larger than 500^{0}C and smaller than 500^{0}C. The former domain contains garnet-cordierite zone, low temperature and pressure part of sillimanite-K-feldspar zone and K-feldspar-cordierite zone.

[Method 2]

We measured areal fraction of the Older Ryoke Granite (ORG) based on the geological map of Nishimura, et al., (1995).

[Result 2]

The areal fraction of ORG is larger in the domain of dT $<$500^{0}C than that of dT $>$500^{0}C. The domain of T $>$500^{0}C elongates subparallel to the gneissosity.

[Discussion]

The areal fraction of ORG being larger in domain of dT$>$500^{0}C suggesting that ORG could not be a heat source of Ryoke metamorphism. We proposed three alternative models.

1: Infiltration of high temperature H2O fluid that is not controlled regionally by the distribution of ORG (Hoisch, 1987).

2: Advection of the small amount of melt has slow flow velocity or long duration (Miyazaki, 2007).

3: Spatially dense injection of thin granitic melts.

The gneissosity subparallel to the long axis of the domain of dT $>$500^{0}C may support the model3.

Keywords: metamorphic rock, Low P/T metamorphic belt, Ryoke belt, Thermobaric structure, Thermal anomaly map