Formation of high-T and low-P metamorphic complex due to upward migration of melt in the hot crust

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A simple thermal modeling with melt migration and solidification was applied to formation of high-T and low-P metamorphic complex. In the simple model, 30 km thick crust, constant temperature at the bottom of the crust, and constant input rate of melt from the bottom of the crust were assumed. Subsidence of the solid crust was also assumed as counter flow of melt migration.

Bottom temperature is set as 850 ˚C at which dehydration melting of biotite + quartz should take place. Evolution of the system strongly depends on advection of latent heat by melt migration and solidification. The net heat input into the system is equal to the product of the latent heat, volume fraction and velocity of melt migration. Volume fraction of melt decreases with decreasing temperature. Therefore, positive feedback relation exists between melt migration and increase in the crust temperature.

The simple model was applied to formation of the Early Cretaceous Higo Metamorphic Complex (Miyazaki, 2004). Assuming that volume fraction of solidified melt in migmatite is less than 60 %, filed P-T array of the Higo Metamorphic Complex (HMC) can be explained by high melt migration rate; the net heat input rate of 280 mW/m2 at the bottom of the crust was maintained during 1.5 Myr.

The same model was also applied to formation of the Late Cretaceous Ryoke Metamorphic Complex in Yanai district (RMCY). Petrological data of Ikeda (2004) and geological data of Higashimoto et al. (1983) were used for evaluation of the model. Areal fraction of granitic rocks in RMCY is estimated at 70-90 %. Areal fraction of granitic rocks and P-T array of peak metamorphic conditions can be explained by the simple model under the following conditions; the net heat input rate of 120 mW/m2 (north to middle region) to 40 mW/m2 (south region) were maintained during 10-30 Myr. Although metamorphic T/P ratio in RMCY is very similar to that in HMC, areal fraction of granitic rocks in RMCY is much larger than that of the HMC. The large areal fraction of granitic rocks in the RMCY can be explained by smalle input rate of melt and longe duration of melt migration in comparison with the HMC. Metamorphic T/P ratio in the south region of the RMCY is smaller than that in the north - middle region of the RMCY. Evaluation by the simple model suggeststhat input rate of melt at the bottom of the crust in Late Cretaceous time decreased from the middle to south in the RMCY.