Heat transport system predicted from geothermal gradient recorded in the Higo Metamorphic Rocks

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The Higo Metamorphic Rocks suffered andalusite-sillimanite type metamorphism. Their high grade part is characterized by wide occurrence of migmatite and diatexite and suggests that mixture of melt and solid widely existed at peak metamorphism. Because distribution of post peak-metamorphic large pluton is restricted, it is expected that the original thermal and pressure structure is preserved. Slices and blocks of the Higo Metamorphic Rocks are bounded by late stage high angle faults. I make many lithologic column sections and carried out metamorphic zonation for each slice. Within a single slice, metamorphic grade increases toward apparent lower structural level. Between slices bounded by E-W high angle faults, metamorphic grade of a slice located in the southern side is always higher than that in the northern side. Correlating of metamorphic grade with lithologic column sections, it is expected that metamorphic temperature increases simply toward apparent lower structural level.

Using garnet-biotite geothermometer (Hodges and Spear, 1982) and garnet-plagioclase geobarometer (Hodges and Crowley, 1985; Hoisch, 1990), estimations of pressure and temperature were carried out. The results as follows; biotite zone (upper part of the Higo Metamorphic Rocks) T=600, P=2.9 kbar, sillimanite zone (Kfelspar-silimanite zone) T=620, P=3.0-3.3 kbar, low grade part of garnet-cordierite zone T=690-800, P=3.3-3.7 kbar, hgih grade part of garnet-cordierite zone and OPX zone T=850-860, P=6.0-7.2 kbar. Estimated pressures and temperatures are consistent with mineral assemblages. Pressures and temperatures for high grade part of garnet-cordierite zone and OPX zone in this paper are similar to those estimated with other geothermo-barometers by Obata et al. (1994) and Osanai et al. (1998). Pressures and temperatures from biotite zone to low grade part of garnet-cordierite zone in this paper show low pressure and high temperature conditions, these conditions explain occurrence of andalusite rimed by sillimanite at low grade part of garnet-cordierite zone.

Estimated pressures and temperatures show that the Higo Metamorphic Rocks originally had a simple thermal structure where temperature increases toward lower structural level. In addition to this, apparent geothermal gradient at upper structural level of the Higo Metamorphic Rocks is steep, although that at lower structural level is gentle. If this shape of geotherm is steady-state one, its origin cannot be explained by heat transport only with conduction in solid rock. Rapid transport of heat and homogenize of temperature are required in the lower structural levels. In the Higo Metamorphic Rocks, large amount of migmatite and diatexite, which represent mixtures of melt and solid, are found at lower structural level. Therefore, convection of melt is possible mechanism for rapid transport of heat.