High temperature metamorphism of Higo metamorphic complex and role of heat transport with melt migration

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A metamorphic thermal structure of the Higo Metamorphic Complex (HMC) and formation process of a thermal structure due to melt migration and solidification were studied. Reconstructions of geologic and metamorphic structures show that the HMC initially has a simple thermal structure where metamorphic temperatures and pressures increase toward lower structural levels. The initial thermal structure was collapsed by activity of E-W and N-S trending high angle faults. Pressure and temperature estimations with stabilities of mineral assemblages and thermobarometers show that a inferred geotherm of the HMC can be divided into two segments: geothermal gradient at higher structural levels has a low dP/dT slope and that at lower structural levels, it has a high dP/dT slope. This composite geotherm cannot be explained by heat conduction only. A mixture of solidified melt and solid such as diatexite and migmatite is exposed pervasively at lower structural levels. Such occurrences of migmatitic rocks suggest that the role of heat transported by melt migration is possibly dominant mechanism for controlling the thermal structure. Thermal modeling with melt migration and solidification shows the composite thermal structure can be formed by a change of the dominant heat transfer from a melt migration regime to a conduction regime with decreasing depth. The thermal modeling suggests that heat transported with melt will be released as latent heat mainly at the crossing point from a melt migration regime to a conduction regime. Instead of large syn-metamorphic plutons, pervasively distributed mixtures of solid and solidified melt, such as diatexite and migmatite, occurs at lower structural levels in the HMC. This observation is consistent with explanation that thermal structure of the HMC was mainly controlled by heat transported by melt migration.