Local thermal plume induced by intrusion of a syn-plutonic dike in the Tanzawa tonalite complex, central Japan

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In northern margin of the Miocene Tanzawa tonalite complex, central Japan, the anormalous complex of leucocratic and melanocratic rocks are accompanied by some syn-plutonic dike. The leucocratic rock and melanocratic rocks are often pared and sometimes delineate concentric structure. The leucocratic rock mainly comprise plagioclase with adcumulus texture, while hornblende in the host quartz diorite, leucocratic rock and melanocratic rock shows poikilitic texture. Bulk chemical composition of the host quartz diorite corresponds to the composition of sum of leucocratic and melanocratic rocks. Chemical composition of plagioclase, hornblende, pyroxenes are common to the host quartz diorite, leucocratic and melanocratic rocks. The temperatures of syn-plutonic dike and melanocartic rock are about 1000 degree C estimated by two pyroxene geothermometry, while that of the host quartz diorite is less than 800 degree C. It is suggested that heat released by the intrusion of the syn-plutonic dikes caused remelting of the mushy host quartz diorite to produce magmas of leucocratic and melanocratic rocks.

The calculated density of the plagioclase is $2.54*10^3$ kg/m^3 at 1000 degree C, considering thermal expansion. The estimated water content of the melt of melanocratic rock is 1.6 to 2.2wt.%, assuming that water content of hornblende of the melanocratic rock is 3 to 4wt.%. The estimated density of the melt of melanocratic rock is 2.73 to $2.78*10^3$ kg/m^3 at 0.15 to 0.20GPa and 1000 degree C, which is more dense than plagioclase. Therefore, plagioclase can float in the melt of melanocratic rocks. The remelted crystal mush of quartz diorite heated by the intrusion of syn-plutonic dikes was separated into floated plagioclase and inter-crystal melt, which solidified to form leucocratic and melanocratic rocks, respectively. Considering thermal expansion coefficient for solid host quartz diorite to be 2.00, the density of moderately solidified quartz diorite is estimated to be 2.76 to $2.77*10^3$ kg/m^3. The inter-crystal melt gravitationally moved upward as convective plume because the density of inter-crystal is less than that of the circumambient moderately crystallized quartz diorite over 910 degree C. The thermal plume consisting of the inter-crystal melt and overlying floated plagioclase up-welled to construct an umbrella at its moving head, which resulted in concentric structure composed of leucocratic rock and melanocratic rocks. The released heat by syn-plutonic dike could trigger local thermal convection to form several anormalous structure in northern edge of the Tanzawa tonalite complex.