High Temperature Silicified Zone as a Potential Caprocks for Supercritical Geothermal Reservoir

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A supercritical geothermal reservoir is a promising energy resource for the future. The previous researchers have studied the availability of such a reservoir, including the presence of fluid and the permeability. However, the characteristic of the cap-rock as an entrapment structure of the heat is yet to be known. Silica is the most abundant material in the earth's crust, and its solubility in water is dependent on the pressure and temperature. Silica in the form of quartz commonly occurs as veins, whether it generated from the up-flow of the deep-seated fluid trough the fracture network or the diffusion from the host rock. It is also found in the form of a narrow zone or lenses of relatively impermeable rock as cement at the transition between brittle and plastic zone. In this study, we research the silicified zone in the porphyry-Cu deposit as a potential caprock for a supercritical geothermal reservoir.
The study was conducted in Tazawako Granite Complex, Akita Prefecture, Tohoku District. The area consisted of volcano-sedimentary rock sequences of Paleogene to Neogene age were deposited around a basement of Cretaceous granitoid (Osawa et al., 1981). The silicified rocks are commonly granitoid with porphyritic texture; Quartz and Feldspar as a major phenocryst in the aphanitic quartz matrix. SEM-CL (Cathodoluminescence) was taken to provide a better image of the internal structure of the quartz in the silicified rock. The quartz can be divided into the primary quartz, which is the relic of former granodiorite, and precipitated at the magmatic stage. The brittle failure observed intensively crisscrossing the quartz. The temperature of host quartz determined by Ti-in Quartz geothermometer (Wark and Watson, 2006) is 601 –675^{0}C and the homogenization temperature of fluid inclusion in this quartz is ˜360 ^{0}C. The secondary quartz occurred as filling in the microfracture, identified by the dark and weak luminescence, and as an overgrowth of the primary quartz showing bright luminescence and weak zoning. The absence of Titanium and very low Titanium content were observed at this quartz. The fluid inclusion micro-thermometry conducted on secondary quartz shows a homogenization temperature of ˜300^{0}C.
The supercritical geothermal reservoir has a temperature typically at > 400^{0}C, which lies beyond the brittle region. The possible cap-rock for this system is the impermeable layer that formed between the brittle-plastic transition with a temperature of 370 –400^{0}C (Fournier, 1999). The homogenization temperature of fluid inclusion in the secondary quartz is relatively high (˜300^{0}C) compared to hydrothermal quartz vein (˜240^{0}C) found in the study area, and low compared to the primary quartz (˜360 ^{0}C) of host granodiorite. Although the homogenization temperature cannot show the actual temperature of quartz formation, it can describe that the secondary quartz in silicified zone formed at the temperature lower than the granodiorite (601 –675^{0}C) which formed in lithostatic condition, but higher than the hydrothermal quartz vein which formed at the hydrostatic condition. The condition of the secondary quartz formation may explain the absent or very low detection of the Titanium content of this quartz.

Keywords: Fluid inclusion, Supercritical Geothermal, Silicified zone

