

Depth distribution and fluid saturation of the fossil calderas and their relations with geofluid activities at NE Japan

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Arc magma is the main source of geofluid, and their depth distribution and H₂O content are important for understanding the dynamics of the upper crust. After the 2011 Great Tohoku-oki Earthquake, many earthquake swarms are observed under fossil calderas distributed in NE Japan (Okada et al., 2015). Shirasawa, Fukano, and Kawasaki calderas are ones of these calderas, and located approximately 15 km east from the present volcanic front. Especially under Shirasawa caldera, seismic reflectors and seismic low-velocity areas had been observed, indicating presence of geofluids. To understand the physico-chemical conditions under the fossil caldera, petrologic investigations are conducted using melt inclusions in the sediments of the fossil calderas. Depth distribution of the magma chambers, degree of H₂O saturation of the melt, and their relation with geophysical observations are revealed.

Melt inclusions in quartz obtained from these calderas are low-alkaline rhyolite, and its major and trace element compositional trends can be explained by fractionation of plagioclase±quartz. Entrapment pressure of melt was estimated from the pressure dependency of eutectic composition of plagioclase–quartz, and are 30–300 MPa, indicating the depth of magma chamber at 1–11 km. The H₂O contents of the melt inclusion are 2.8–5.5 wt%, with <38 ppm of CO₂. The pressure–H₂O content relations are close to solubility curve of H₂O in rhyolite melt, indicating that melt was water-saturated at least at the depth range of 1–6 km.

The depth distribution of magma chambers (1–11 km) and depth of water-saturation (1–6km) corresponds to a low V_s , V_p and high Poisson's ratio region (5–10 km) and seismic reflectors (2–5 km), respectively. Therefore, these regions are expected to be a geofluid reservoir consists of tonalitic plutonic rocks. Earthquake swarms occur beneath Shirasawa and Fukano calderas at the depth of 7–12 km, indicating that supply of geofluid under these tonalite fluid reservoirs.

Keywords: Fossil caldera, Geofluid, Melt inclusion, Arc magma