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Aeromagnetic 3D subsurface imaging of geothermal areas - A case of Akita-Yakeyama Volcano, northeast Japan

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Akita-Yakeyama Volcano is located at the northwestern edge of the Sengan Geothermal Area, northeast Japan, where many geothermal features such as fumaroles and hot springs are observed as well as many Quaternary volcanoes. In this area, geothermal explorations had been actively conducted since mid-1970s and four geothermal power plants are being operated now.

Magnetic analyses had been conducted in and around Akita-Yakeyama Volcano to reveal the regional and local subsurface structures of the area (Okuma, 1998; Okuma and Suto, 1987). A magnetic modeling, with known structural and magnetic parameters, had been conducted to reveal a detail subsurface structure of Akita-Yakeyama Volcano (Okuma, 1998). The magnetic model is composed of five polygons: three of them correspond to granitic intrusions below the northern flank, while rests of them correspond to the buried Old-Tamagawa Welded Tuffs below the southern flank. The northern polygons show the depth extent of the granitic intrusions or the local Curie isothermal depth. The southern polygons indicate a subsurface convex structure, implying the existence of a concealed old volcano associated with the Old-Tamagawa Welded Tuffs. These analyses were very useful to better estimate the subsurface structure related to the geothermal activity of the study area but it took much time to conduct the modelling.

Recently an aeromagnetic 3D subsurface imaging method has been developed (Nakatsuka and Okuma, 2014) and takes an important role in 3D visualization of subsurface structures especially in active volcanic regions (Okuma et al., 2009). Therefore we have applied the method to interpret the magnetic anomalies of Akita-Yakeyama Volcano. The resultant magnetization intensities were superimposed on the same cross-sections of the previous study. In the N-S cross-section crossing the summit of the volcano, magnetization highs are well imaged below the northern flank, corresponding to the granitic intrusions. Whereas, negative magnetizations lie below the southern flank and are associated with the reversely magnetized the Old-Tamagawa Welded Tuffs. In the E-W cross-section on the northern flank, magnetization highs are centered below the northwestern flank, suggesting higher subsurface temperatures than below the northeastern flank. Apparent negative magnetization intensities lie below Mt. Kurasawa south of Akita-Yakeyama Volcano and correspond to the wide distribution of the reversely magnetized Tamagawa Welded Tuffs (Suto, 1987).

Keywords: aeromagnetic survey, magnetic anomaly, geothermal area, Akita-Yakeyama Volcano, forward modelling, 3D imaging