Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

SVC49-02 Room:102B Time:May 25 14:30-14:45

Hydrothermal system beneath the Jigokudani valley, Tateyama volcano, inferred from AMT surveys and hot spring chemistry

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We carried out AMT surveys and the analyses of hot spring water in the Jigokudani valley (JV), Tateyama volcano, Japan. The JV was formed by repeated phreatic eruptions some 40,000 years ago, and has laminated lacustrine sediments that are located at the base of an extinct crater lake. Currently, the JV is an active solfatara field dotted with hot springs and fumaroles, and has experienced several anomalous events indicating the increase in volcanic activity. The objective of this study is to clarify the characteristic of electrical resistivity structure where multiple phreatic eruption events occurred, and to investigate the spatial relationship between subsurface structure and recent volcanic activity. We collected the AMT data at 25 locations in and around the JV, and estimated a 3D resistivity structure using the inversion code of Siripunvaraporn and Egbert (2009). Electrical conductivity, temperature and pH were measured in 50 hot springs, and chemical analyses were performed on representative 12 samples of those springs. Hot springs in the JV showed features of strong acid Cl-SO4-type, and turned out to be derived from magmatic hydrothermal fluids because of the high ratio of Cl/SO4 concentration. A highly conductive region with thickness of approximately 50m was detected beneath the most active geothermal field, and was interpreted as representing clayey sediments. A slightly resistive portion was present beneath this layer and hot spring water of this area showed high ionic concentrations, which suggests that there are high temperature gases of magmatic origin. A deep feature of 3D resistivity structure suggests that such magmatic gases are provided from east of the JV, which is consistent with the location of seismically inferred magma reservoir.

Keywords: Resistivity structure, AMT, Tateyama volcano, Phreatic eruption, Hydrothermal system, Clay cap