Time-lapse magnetotelluric monitoring at four volcanoes in Japan

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By using the broad-band magnetotelluric (MT) data acquisition system (Metronix ADU-07 system) and the recently developed telluric loggers (NT System Design ELOG1K), we studied temporal change in resistivity structure at four volcanoes in Japan. The sampling frequencies were 32 Hz (00:00–23:50UT) and 1024 Hz (17:00–18:00 UT). The studied volcanoes and observation periods are noted below.
(1) Sakurajima: February to July, 2010 (6 MT sites); May 2011 to present (two MT site)
(2) Iwo-Yama, Kirishima volcanoes: March 2011 to present (a MT site)
(3) Mt. Fuji: June 2011 to April 2014 (a MT site)
(4) Kuju: May 2016 to present (a MT site and 4 telluric sites)
From these data, we estimated the daily MT response functions across a broad period range of 0.01–1000s. The analysis procedure is the same as in Aizawa et al. (2013). A common feature of the observed MT data is the annual variation on impedances. In usual, apparent resistivity increases in winter, and decreases in summer. At Mt. Fuji, MT data shows changes in apparent resistivity of approximately ± 20% at 0.125 s. While at Iwo-Yama, annual change in apparent resistivity is only ±1% at 0.125 s. These variations may be caused by the change in groundwater, but the simple rise and fall of groundwater table cannot quantitatively explain the MT data.
We have observed the change in MT response functions possibly due to volcanic activities. At Sakurajima, the geomagnetic response functions and impedances around 0.01 to 1s changes simultaneously on four sites, and were all explained by the resistivity change at a zone around sea level beneath an active crater. At Iwo-yama, Kirishima, the direction of induction arrows around 0.05 to 0.2 s change several degree since October 2017, when an eruption took place at 5 km away from the site; Shinmoe-dake crater. The change will be explained by using the 3-D resistivity structure model by Tsukamoto et al. (2018, JpGU).
To discuss the resistivity change by volcanic activity, it is important to discriminate an effect from local galvanic distortion. For this purpose, induction arrows, phase tensor (Caldwell et al., 2004), and Ssq impedance (Rung-Arunwan et al., 2016) are useful.

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