Temporal variation in the shallow resistivity structure of Aso volcano before the phreatomagmatic eruption in September 2015, as inferred by ACTIVE system

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In Aso volcano, Central Kyushu, Japan, the latest two phreatomagmatic eruptions in September 2015 and October 2016 followed intermittent magmatic eruptions that started in November 2014 after 20 years of the quiescent stage. A research group of Aso Volcanological Laboratory, Kyoto University, has conducted five campaigns of ACTIVE (Utada et al. 2017) observations from May 2014 to August 2015, including the magmatic eruption period (from November 2014 to May 2015). ACTIVE is a controlled-source electromagnetic volcano sounding system consisting of transmitters with earthing electric dipoles and an array of induction-coil receivers that measure the vertical component of the induced magnetic field. Minami et al. (2018) revealed temporal variation in the three-dimensional (3-D) resistivity structure from August 2014 to August 2015, by focusing on the two campaign data sets. However, there remained the other three campaign data sets that have not used in the analysis, i.e. those obtained in May 2014, November 2014, and February 2015.

In this study, we performed three additional inversions to reveal detailed evolution of the hydrothermal system of Aso volcano before the phreatomagmatic eruption in September 2015. Using the five ACTIVE data sets (Fig. 1e), we resolved the evolution of the change in the 3-D resistivity structure from May 2014 to August 2015 into four snap shots of 3-D resistivity change models for Period 1 (May 2014 to Aug. 2014), Period 2 (Aug. 2014 to Nov. 2014), Period 3 (Nov. 2014 to Feb. 2015), and Period 4 (Feb. 2015 to Aug. 2015). In Period 1, which corresponds to the rainy season, the resistivity decreased in the surface layer, probably due to heavy rainfall. Furthermore, a resistive change was modelled just beneath the bottom of the first crater of Nakadake, which is consistent with the lowered water level and drying of the crater lake in this period. In Period 2, the surface resistivity in turn increased. It is likely because the surface layer dried after the rainy season. In Period 2, a resistive change 400 meter beneath the crater bottom was modeled in the same zone as Minami et al. (2018). This implies drying of the hydrothermal system driven by ascending magma just before the start of magmatic eruptions in November 2014. From Period 3 to 4, the trend of resistive change is reversed to conductive change at the depth of 400 m. We interpreted this change as recovering of ground water in the hydrothermal system after the peak of the magmatic activity in February 2015. Our results imply that phreatic eruptions can occur with very slight change in the hydrothermal system (Fig. 4d) compared to the magmatic eruption (Fig. 4b).

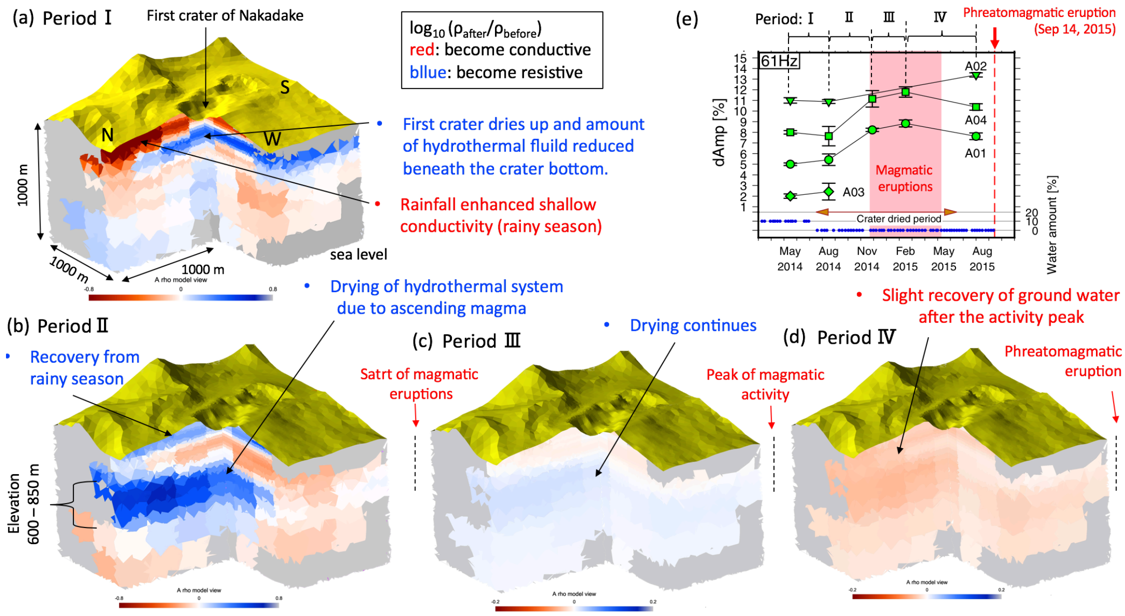

Fig. 1 3-D temporal variation models of the resistivity structure of Aso volcano before the phreatomagmatic eruption in September 2015 (Period Ⅰ to Ⅳ). Blue and red areas indicates zones that become resistive and conductive, respectively. Noticeable differences occur mainly before the start of the magmatic eruption in November 2014, possibly due to drying of the hydrothermal system. Just before the phreatomagmatic eruption, Period Ⅳ, light red color implies recovery of ground water in the hydrothermal system.

Main References

Minami, T., Utsugi, M., Utada, H., Kagiyama, T., & Inoue, H. (2018). Temporal variation in the resistivity structure of the first Nakadake crater, Aso volcano, Japan, during the magmatic eruptions from November 2014 to May 2015, as inferred by the ACTIVE electromagnetic monitoring system. *Earth, Planets and Space*, *70*(1), 138. https://doi.org/10.1186/s40623-018-0909-2.

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