Unrest event at Nakamachinesiri crater of Meakandake in 2019; insight from total magnetic field observations

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Mt. Meakan is an active volcano located at the southwestern tip of the Akan Shiretoko volcanic line in eastern Hokkaido. There is a Ponmachineshiri crater on the summit and a Nakamachineshiri crater on the northeastern flank. The eruptions in recorded history include intermittent phreatic explosions at the Nakamachineshiri crater and the Ponmachineshiri crater from 1955 to 1966 and the phreatic eruptions in 1988, 1996, 1998, 2006, 2008 at the Ponmachineshiri crater (Hokkaido Disaster Prevention Council, 1976). Since 2008, seismic activity has been concentrated almost beneath the Ponmachineshiri crater. In 2015, demagnetization and inflation below the Ponmachineshiri crater, and increase in fumarolic activity has been observed. On the other hand, although there is a difference in the density of the observation network between the craters, the ground deformation observations did not capture the activity beneath the Nakamachineshiri crater.

An increase in earthquakes beneath the Nakamachineshiri crater was observed in February and July-August 2019 (JMA, 2019). Prior to this seismic activity, ground deformation that had been observed since 2016, suggesting an expansion of 3 km deep at the northeastern foot of Mt. Meakan, turned to stagnation or deflation in 2018. The purpose in this study is to clarify the mechanisms of the activity beneath the Nakamachineshiri crater in 2019, comparison among the results of repeated magnetic field observations around the Nakamachineshiri crater since 2013, the seismic activity under the Nakamachineshiri crater, the activity of deep pressure sources, and the resistivity structure below the crater.

The observation of the total magnetic field at the Nakamachineshiri crater has not been performed in recent years. However, the Nakamachineshiri crater is still performing the active heat release from fumaroles and hot ponds. The activity under the crater has been expected. The survey of total magnetic field has been performed at 20 sites repeatedly. The data of reference point were provided by the Memambetsu Magnetic Observatory, Japan Meteorological Agency.

As reported by Tanaka et al. (2017, Volcanological Society of Japan), the results of the change in total magnetic field from 2013 to 2017 are modeled by demagnetization with a magnetic moment rate 1–2×10^{6} A m^{2} yr^{-1} at a depth of 200–300 m below the south wall of the Nakamachineshiri crater. No significant changes were observed in the trend from 2017 to 2018 and the amount of the magnetic moment rate. However, the change in the total magnetic field 2018–2019 was modeled with a spherical demagnetizing source, the depth was 360 m and the magnetic moment 9×10^{6} A m^{2} yr^{-1}, indicating that the deeply demagnetization was accelerated.
The comparison between the position of the spherical source of change in total magnetic field and the resistivity structure (Takahashi et al., 2018) reveals that the spherical sources estimated by the results from 2014 to 2018 are located within the low resistivity zone, containing the clay minerals and hydrothermal fluid, just beneath the Nakamachineshiri crater. The comparison also shows that the source of change in total magnetic field between 2018 and 2019 are beneath the low resistivity zone. The epicenter of earthquakes occurred around the Nakamachineshiri crater in 2019 are located at the 0-1 km below sea level which is deeper than the spherical source. There is a possibility that the activity of the

Nakamachineshiri crater in 2019 reflected the process of the fluid supply from the deep source to the shallow source beneath the Nakamachineshiri crater. The quantitative examinations such as the mass valance between the deep and shallow source are required to reveal the mechanisms of the activity beneath the Nakamachineshiri crater in 2019.

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