

Ground deformation observed at the crater area of Tokachidake volcano

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Tokachidake is an active volcano that repeated magmatic eruptions in 1926, 1962 and 1988. Prior to these eruptions, phreatic eruptions had been confirmed from several years ago. Although there has been no magmatic eruption in the last 30 years, long-term expansion centered around the 62-2 crater has been observed since around 2006. One of the GNSS stations near the crater moved more than 50 cm in total till the end of 2017. Coinciding with this expansive crustal deformation, long-term demagnetization under the 62-2 crater has also been observed.

Repetitive GNSS observations around the crater for more than 10 years suggested the fluctuation of deformation area centered around 62-2 crater and Taisho crater. Analysis of the temporal change of the motion vector assuming an isotropic deformation source at these two places revealed that the two inflation sources expanded at a substantially constant rate as a whole while changing the rate complementarily. Since the assumed fluctuation source is extremely shallow and flowing out of hot muddy water at the bottom of the 62-2 crater has occasionally been observed, we consider that this long-term deformation reflects the mechanical response of the shallow hydrothermal system.

Geodetic observation revealed that the long-term expansive deformation turned into stagnation in the period from the end of 2017 to the beginning of 2018. Almost at the same time, the total magnetic force data showed change in its trend of demagnetization. Also, in the Furikozawa fumaroles, an expansion of the geothermal area and an increase in fumarolic activity have been reported since around 2017.

Under such circumstances, number of volcanic earthquakes and tremors temporarily increased from late May 2018. A volcanic tremor on May 29th which activated seismicity was accompanied by a tilt motion showing a stepwise subsidence in the crater direction. Therefore, we visually examined the tiltmeter record from January 2018 which were obtained at the station MTKW (about 650 m west of the crater). Although there were few tilt events until around the end of March, occurrence frequency of such event increased thereafter, and it further increased on May 29th. A total of 117 events were identified by the end of August, 10 events by the end of March, 30 events in April and May and 77 events by August. Tilt events generally show a stepwise subsidence in the crater direction, but careful examination of each event revealed that there are various types of events: tilt change following a small preceding phase, inflation–deflation pattern, gradual change more than a few minutes, and events associated with VLP-like seismic signals, etc. Examining the direction of the tilt motion vector at MTKW about these 117 events, almost 90 % shows subsidence in the crater direction of N120–135°E. For the event on May 29th, a preliminary analysis using tilt data around the crater showed that the tilt motion can be roughly explained by an isotropic deflation source of 130 m³ located at 1300 m above sea level slightly south of the 62-2 crater.

Summarizing the shallow activities of Tokachidake volcano, expansion of the geothermal area and increase in fumarolic activity appeared almost at the same time with the latest stagnation of long-term expansive deformation and demagnetization for over 10 years. Volcanic earthquakes and tremors

accompanying stepwise subsidence in the crater direction increased around the same time with the deflation of the crater area. We can roughly consider two hypotheses for the latest deflation: one is a decrease in the amount of hot water supplied from the deep part, and the other is a change in supply / release balance due to an increase in discharge amount from fumaroles. Expansion of the fumarolic area, increase of the fumarolic activity, and increase of the tilt event strongly suggest the possibility of the latter hypothesis, although it is difficult to discuss the amount supplied from the deep part.

Keywords: Volcano, Earthquake, Crustal Deformation, Hydrothermal System, Phreatic Eruption