Detection of crustal deformation owing to volcanic activity of the Oana crater in the Mt. Azuma area using interferometric synthetic aperture radar and pressure source estimation

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The Mt. Azuma area is a group of basalt-andesitic volcanoes located in southern Tohoku on the boundary between Yamagata and Fukushima prefectures and consists of many stratovolcanoes and monogenetic volcanoes. The Sendai District Meteorological Observatory regularly records crustal deformation at the Oana crater and clinometer tilt changes at Jododaira on the eastern side of the Oana crater have been observed since late July 2018, indicating expansion of the shallow part of the crater. We estimate surface displacement associated with volcanic activity, which appears to have been active from July 2018 until May 2019, using data obtained from interferometric synthetic aperture radar (InSAR) analysis. This method offers particular advantages such that observation points on the ground are not required as well as the ability to refine a detailed spatial pattern of surface displacement. We use seven PALSAR-2 datasets collected between May 17, 2017 and October 29, 2019. The results show that as much as 13 cm of surface displacement in the direction approaching the satellite occurred on the Oana crater between October 18, 2018 and May 14, 2019. We apply the Markov chain Monte Carlo method to the spherical source model proposed by Mogi (1958) to estimate the pressure source depth responsible for the surface displacement. Our results indicate a source depth of ~240 m from the ground surface, which is similar to that of 200–600 m estimated reported by Yoshida et al. (2012) from the Mogi model using GPS data. The depth determined here is also in good agreement with that estimated by Yamasaki et al. (2010) (~300 m) using a thermal demagnetization source from total magnetic force observations, and is expected to be a hydrothermal reservoir. Additionally, the composition of sulfur dioxide and hydrogen sulfide has changed since the onset of expansion in July 2018. The displacement is likely caused by the migration of volcanic gas or other pore fluids into the hydrothermal reservoir under the Oana crater.

Keywords: InSAR, crustal deformation, Mt. Azuma

