Relative gravity changes in Aso Volcano (Kumamoto Prefecture) observed from 2015 to 2018

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Gravity measurement is one of the most effective methods to understand mass variations due to volcanism. In Aso Volcano, Kumamoto Prefecture, spatiotemporal gravity variations have been monitored by repeated relative gravity measurements every several years since 1964 (Yoshikawa et al., 2009). Gravity data was frequently collected 3-4 times every year during the active period of Aso Volcano from 2011 to 2016 and revealed spatiotemporal variations in hydrothermal mass under the volcano (Sofyan et al., 2016). However, any gravity data has not been collected after March 2016 due to Kumamoto Earthquake which occurred in April 2016. Since the volcanism became quieter after a phreatic explosion was observed in October 2016, a series of volcanic activities including the quiet period should be discussed in terms of mass variations to predict future volcanic activities. In order to monitor gravity changes in Aso Volcano after the volcanically active period, we repeated relative gravity measurements in May, August and November 2017, and in March, May, August and November 2018. We measured relative gravity values at gravity points around Aso Volcano using CG5 relative gravimeters owned by Kyushu University and Aso Volcanological Laboratory (CG5-KYU and CG5-AVL, respectively) and a LaCoste relative gravimeter G680 owned by Graduate School of Science, Kyoto University (LC-G680). We also collected continuous gravity data using CG5-AVL at the AVL station even when it was not used for the campaign gravity measurements, in order to understand the long-term instrumental drift. A gravity value relative to AVL was obtained for each point and survey, by correcting the effects of instrumental height, tide, instrumental drift, and scaling factor. The spatiotemporal absolute gravity data was then calculated, using the absolute gravity values measured at reference stations. We finally estimated the spatial distributions of the absolute gravity change around Aso Volcano before and after Kumamoto Earthquake. We found that the absolute gravity increased at the gravity points around the Aso crater. Since this absolute gravity change includes the effect of crustal deformation due to Kumamoto Earthquake, we subtracted the effect from the absolute gravity values using the quasi-vertical deformation data derived from the InSAR analyses (Geospatial Information Authority of Japan) and the typical gravity gradient value of -0.2 mGal/m. We found that the residual of the absolute gravity change still increases by up to 0.1 mGal at the areas of Kusa-senri and the Naka-dake crater, which implies mass accumulation under these areas. In the future, we will model time variations of the volcanic mass distributions in the volcano and compare them with the spherical pressure source proposed by the leveling data (Sudo et al., 2016). In addition, the gravity data should be repeatedly obtained and reprocessed more accurately, by considering the spatial variation of the gravity gradient value and correcting the effect of ground deformation using the continuous GNSS data.

Keywords: gravity change, crustal deformation, mass variation, Aso Volcano

