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Huge uplift event of Iwoto: Estimation of gravity change based on the result of gravimeter calibration in Sapporo-Naha

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Ogasawara-Iwoto is the volcanic island located to 1200km south of Tokyo. It has a caldera with the diameter of 10km, and its central and southwestern part appears on the sea surface. One of characteristics for its volcanic activity is to have the large uplift rate, and National Research Institute for Earth Science and Disaster Prevention (NIED) has revealed occasional ×occurrence of huge uplift events and distribution of its crustal deformation (Ukawa et al., 2006). NIED started gravity survey from 1996, and Ukawa (2006) suggested involvement of magma in a huge uplift event. Though continuous subsidence had been observed from early 2003, it rapidly changed to uplift in mid-2006. Its uplift decelerated with time after 2007, but it rapidly re-accelerated in Feb. 2011. According to GNSS observation by NIED and GSI, the amount of uplift from re-acceleration to Apr. 2012 reached 2m. In late April of 2012, discolored water was found around Iwoto, and uplift activity slowed down after that. To investigate crustal deformation and gravity change associated with this event, we carried out GNSS campaign observation and gravity survey. We presented the result of GNSS campaign observation in fall meetings of the geodetic society of Japan and the volcanological society of Japan. We also presented preliminary result for gravity survey, but there was a problem on uncertainty for temporal change of scale factors of used gravimeters (Scintrex CG-3M #284 and #371). To estimate scale factors of their gravimeters, we carried out gravity survey between Sapporo and Naha. In this presentation, we show temporal change of scale factors revealed from this calibration and gravity change of Iwoto estimated using its result.

In gravimeter calibration, we measured gravities at NIED (Bosai-BS), GSI (Tsukuba-GS and Tsukuba-FGS), Haneda airport (Haneda-GS), Chitose airport (Chitose-GS), Hokkaido University (Sapporo-GS), and Okinawa Meteorological Observatory (Naha-GS and Naha-FGS). In estimation of relative gravity, we assumed that the drift rate was constant, and estimated gravities and the drift rate simultaneously. Then we estimated scale factors so that estimated gravities corresponded to those of JGSN96 (Geospatial Information Authority of Japan, Geodetic department, 1997). Since Sapporo-GS was moved to new benchmark, we used gravity measured by GSI. Estimated changes of scale factors from those in 2006 were $+2\times10^{-5}$ and -1×10^{-4} for #284 and #371, respectively. Temporal changes of scale factors are not orderly, and then obtained scale factor is different significantly from estimated value by the linear approximation. Therefore it indicates that consideration of temporal change of scale factor is important in survey of large gravity difference.

Estimating gravity at the benchmark in Iwoto (IWO101), estimated gravities from #284 and #371 were consistent within 0.027mGal, and its average was decrease of 0.734mGal from that in 2006. Uplift in this period was 3.05m, and then gravity change rate with respect to uplift was -0.241mGal/m. This gravity change rate is in good agreement with that for the 2001-2002 huge uplift event by Ukawa et al. (2006). This result suggests that the huge uplift event from 2006 has been caused by the magma with the similar density to that in the 2001-2002 event.

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Keywords: Iwoto, gravity, scale factor, magma