

Contractional ground deformation during the inter-eruptive period at Usu volcano, obtained from InSAR and GPS observations

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Introduction: Usu volcano, which is located at the southern edge of Toya caldera in Hokkaido, is one of the most active volcano in Japan. It is widely known that clear precursory seismic activity and ground deformation take place just before an eruption. In contrast, there is little seismicity during the inter-eruptive period, but it is known that the lavadomes/cryptdomes continue to subside for a long time after the eruptions. Terrestrial and space-geodetic observations have shown the contractional deformation of the volcano. The terrestrial observation networks, however, are too sparse to obtain the spatial extent of the ground deformation. Yarai et al. (2000) showed the spatial extent by conducting InSAR analysis using JERS-1 data, but the result does not include the deformation after the 2000 eruption and the spatial resolution of the interferogram is not so good. We have applied an interferometric analysis to the satellite data of ALOS/PALSAR which was launched in 2006, and presented the results in previous JPGU meeting. From additional interferometric analyses and GPS observations, we have detected clearer and more comprehensive contractional ground deformation, and thus report the analysis results.

Analysis method: We conducted a differential interferometric approach using pair of images that have been acquired except during snow seasons. To remove topographic effects, we used 10 m mesh DEM data which was measured after the 2000 eruption by GSI. We process the SAR data from level-1.0 product, using a software package Gamma.

Result: Clear contractional deformation is successfully obtained from several independent image pairs commonly, especially the image pair acquired on 12/09/2006 and 17/09/2008 provides us a high-quality interferogram (perpendicular baseline: 45 m). The analysis result shows significant contractional deformation at Nishiyama and Kompira (eruption: 2000), the summit area (eruption: 1977-78), and Showa-Shinzan (eruption: 1943-45). The changes of LOS (line of sight) reach up to 10, 7, and 3 cm for Nishiyama and Kompira, the summit area, and Showa-Shinzan, respectively, during the 2-year observation period for the orbital path 58.

We further conducted GPS observation mainly at the summit area in May and November, 2008, and estimated the displacements at each site with comparison to the previous observation (November, 2006). The GPS analysis result show that the displacements with a few cm are observed at sites locating the summit area, while no significant displacement at the flank of volcano, suggesting that the deformation is localized within the summit area. All sites show subsidence, and their horizontal vectors point to O-Usu lava dome. The differences of the change of LOS between InSAR and GPS are estimated to be 1 cm more or less at all sites. Both the observations show consistent results.

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