合成開口レーダーにより観測された有珠山溶岩ドームの収縮: 1992-2017年

Posteruptive Thermoelastic Deflation of Intruded Magma in Usu Volcano, Japan, 1992–2017

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Secular ground subsidence at Usu volcano (Japan) has been reported around the eruption vents following the four eruptions in 1910, 1943, 1977, and 2000. However, the mechanisms accounting for the subsidence have not been well understood. In this study, we systematically investigated the posteruptive deformation at Usu volcano using interferometric synthetic aperture radar based on 111 JERS, ALOS-1, and ALOS-2 images acquired from 1992 to 2017. We also calculated quasi east-west and vertical ground displacements between 2006 and 2017. Our results show three localized deformation regions from west to east of Usu volcano with their locations corresponding to the 2000, 1977, and 1943 eruption vents, respectively. All the deformation sites show patterns of east-west contraction and subsidence. The extent and rate of posteruptive subsidence declined dramatically at the vent of the 2000 eruption site from 2006 to 2017, decreased gradually at the 1977 vent, and show a steady pattern for the 1943 site during 1992-2017. We ascribed the observed posteruptive subsidence to thermoelastic contraction of a sphere intruded at the time of the eruptions to constrain locations, depths, and volumes of heat sources with the assumption of the spherical source shapes. Thermoelastic modeling reveals that the heat sources are embedded at shallow depths not deeper than 400 m below sea level with volumes of about $(8.72 \pm 0.19) \times 10^6$, $(132.18 \pm 5.21) \times 10^6$, and $(49.51 \pm 2.02) \times 10^6 \text{ m}^3$ for the 2000, 1977, and 1943 eruption sites, respectively. The modeling also highlights the importance of underground water in assessing the thermal diffusion process and the associated posteruptive deformation.

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