

Significant surface deformations at Okmok volcano, Alaska, detected by GPS and InSAR measurements

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Okmok volcano on Umnak Island in the eastern part of Aleutian arc, Alaska, is a shield type volcano with a 10 km-wide caldera. This volcano is one of the most active volcanoes in this region, it has erupted more than 10 times in the last century. The latest eruption of this volcano occurred in early February 1997, when the ash plume reached up to 10 km above sea level and large amount of basaltic lava flow covered an area of about 8-9 km² on the caldera floor.

Okmok volcano is a good target of InSAR (Interferometric Synthetic Aperture Radar) measurements due to its low elevation, gentle terrain and little vegetation. Actually, significant surface deformation associated with the 1997 eruption was detected by InSAR measurements [e.g. Lu et al., 2005]. Although InSAR is useful technique, there are several defects in the ability of detecting the surface deformation. The data from GPS measurements can compensate and verify the InSAR data. Annual GPS campaigns were carried out at Okmok volcano between 2000 and 2003. Surface deformation detected by these GPS measurements reveals that Okmok volcano has been inflating during 2000-2003 at a variable inflation rate. Total displacements over three years are as large as 15 cm of maximum radial displacement inside the caldera and more than 35 cm of maximum uplift at the caldera center. Inflation pattern showed simple radial outward displacements from the caldera center and significant uplifts. A buried spherical pressure source as a magma chamber located at the depth of about 3.1 km beneath the geometric center of the caldera was able to explain the observed data. These results are generally consistent with the results from InSAR measurement for same periods, and reveal a discrepancy of the source's volume increase for the period 2002-2003. The data derived from GPS and InSAR measurements show that magma has accumulated at same location and depth beneath the center of the Okmok caldera at different rates after the 1997 eruption. The amount of volume increase in the source is estimated to be about 0.028 km³ during 1997-2003. It means that 25-40 % of the volume erupted in the 1997 eruption, has been already replenished in the shallow magma chamber.

Okmok volcano is among a limited number of volcanoes in the world being monitored by both GPS and InSAR techniques. Additional InSAR data from the Japanese new satellite ALOS will be expected to detect more detailed surface deformation, and collaboration between GPS and InSAR measurements contribute to understand a magma system of Okmok volcano.