

Vertical ground deformation associated with the volcanic activity of Sakurajima volcano, Japan during 1996-2012 as revealed by repeated precise leveling surveys

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Sakurajima volcano is an andesitic stratovolcano located in southern Kyushu, Japan. It is situated on the southern rim of Aira caldera. The flank and summit eruptions have been repeated during historic times. The current eruptive activity at the summit crater began in 1955. In addition, the eruptive activity at Showa crater on the eastern slope of the volcano started in June 2006 and the activity has increased in recent years. The total number of explosive eruptions since 1955 exceeds 11500 in 2012.

Repeated precise leveling surveys have been conducted in and around this volcano. Associated with the intense eruptive activity since 1973, the ground subsidence around the northern and the central parts of Sakurajima had continued until 1991. The ground around the northern part of Sakurajima was observed to be uplifted when the eruptive activity was gradually decayed since around 1991-1996 (Eto et al., 1997).

In this paper, we discuss the recent vertical ground deformation in and around Sakurajima volcano revealed by the repeated precise leveling surveys conducted in 2007-2012. The ground uplifts are detected in Sakurajima volcano and around Aira caldera to be centered in the caldera as the main feature during the period from 1996 to 2012, similar to the previous results during 1991-1996. From the detailed analysis based on a spherical source model, the inflation sources are located at 8.8-10.8 km depth beneath the center of Aira caldera during the periods of 1996-2007, 2009-2010 and 2011-2012. It is indicated that the magma storage at the magma reservoir inferred at 10 km depth beneath Aira caldera is progressed during the periods. In the period of 2007-2009, a shallow inflation source is located at 4.3 km depth beneath the northern part of Sakurajima. It suggests the magma movement towards shallow part of Sakurajima volcano from 10 km depth beneath Aira caldera, although the estimated amount of magma input is small. In the period of 2010-2011, on the other hand, a shallow deflation source is located at 3.5 km depth beneath the summit crater, caused probably by the recent increase of the volume of the ejected magma associated with the eruptive activity at Showa crater.

Considering the estimated volume increase at the inflation sources, it is indicated that the total of about 1.2×10^8 m³ magma is inferred to have additionally stored beneath Aira caldera during the period from 1991 to 2012. The ground uplift around the northern part of Sakurajima at the time of December 2012 caused by the progressing magma storage recovers and further exceeds the height level in around 1973, when the intense summit eruptions during the 1970s and the 1980s started. These results suggest the immanent potential of the next intensive eruptive activity of this volcano.