

Characteristics of Volcanic Activity at Sakurajima Volcano's Showa Crater During the Period 2006 to 2011

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Eruptive activity at the Showa crater of the Sakurajima volcano has steadily increased since it resumed in June 2006, and 2718 vulcanian eruptions occurred during the period from 2008 to 2011. In this paper, we clarify the characteristics of vulcanian eruptions at the Showa crater based mainly on ground deformation. A long-term extension of the ground of the Aira caldera and Sakurajima, repeating quasi-annual cycles of minor inflation-deflation, were obtained by GPS, tilt and strain observations. The inflation event that started in October 2009 was the largest. Major pressure source was estimated to be located at a depth of 12 km beneath the Aira caldera for the inflation and a minor source was obtained a depth of 5 km at the northern flank of Kitadake in addition to a source beneath Minamidake which has been known by previous studies. The magma plumbing system is composed of a major magma reservoir at a depth of ≈ 10 km beneath the Aira caldera and additional magma reservoirs at depths of around 5 km beneath the summit area from the north flank of Kitadake to Minamidake. Strain changes which indicate inflation were detected prior to explosions and the inflation strain lasted mostly 1 h. The strain changes were caused by a shallow pressure source less than 1.5 km. The inflation occasionally continued for more than 7 h with an addition of inflation of a deep source (4 km), which corresponds to the magma reservoir beneath Minamidake. The conduit to the Showa crater may be branched from the magma reservoir beneath Minamidake or from the major conduit connected to it. When inflationary ground deformation progressed at a high rate, the eruptive activity reached a peak from December 2009 to March 2010. This suggests that the accumulation of magma beneath the central cones of the Sakurajima volcano progressed simultaneously to a discharge of magma. The simultaneous progress of the accumulation and discharge of magma and the frequent occurrence of small vulcanian eruptions may be related to the small open conduit.

Key words: Sakurajima volcano, Showa crater, Minamidake crater, ground deformation, magma supply, vulcanian eruption

1. Introduction

Sakurajima is a post-caldera volcano formed at the southern rim of the Aira caldera. The central cones are Kitadake, Nakadake and Minamidake. Kitadake is the oldest cone. All the eruptions since the 8th century have occurred at the summit area of Minamidake and its flanks, including the sea area.

Eruptive activity has taken place continuously at the Minamidake crater since 1955. The eruptive activity is characterized by frequent activities of a vulcanian type, and the crater was quite active during the period from 1972 to 1992, with 4919 vulcanian eruptions and 2.4×10^8 tons of volcanic ash being emitted. Of particular note, 498 vulcanian eruptions occurred in 1974, 415 in 1983 and 452 in 1985. The mechanisms of the vulcanian eruptions have been studied mainly by seismological and geodetic obser-

vations. Tameguri *et al.* (2002) analyzed the explosion earthquakes associated with the vulcanian eruptions and proposed a four-source model with moment tensors to explain the waveforms of the explosion earthquakes. However, this seismological method cannot cover the entire process of vulcanian eruptions due to the insufficient frequency range of even the most broadband seismometer. Ishihara (1990) detected inflation of the ground prior to the vulcanian eruptions and the deflation associated with them by using water-tube tiltmeters and extensometers sited in an underground tunnel, and interpreted the inflation and deflation as being caused by magma intrusion at a depth of 2–6 km and by ejection of the magma product, respectively. Iguchi *et al.* (2008c) proposed a model for the process of vulcanian eruptions in which an explosive eruption is triggered by minor deflation, which is induced

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