

## Variations of Color and Leachate Contents of Volcanic Ashes from Sakurajima Volcano, Japan

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To understand magma degassing processes near the top of volcanic conduit, we investigated a series of volcanic ashes from the Sakurajima volcano, Japan. We describe temporal changes in the color and the amount of leachates (Cl, F, S) of ash erupted from 1981 to 2011. Based on the amount of leachates present, ash samples are classified into two major groups: one is with a molar S/Cl ratio of  $\sim 10$ , and another with S/Cl of  $\sim 1$  and that is relatively depleted in S. Ash samples that were erupted during 1981–1991 from the Minamidake summit crater belong to the latter group. Ashes erupted from the Showa crater in early 2008 belong the former group, of which the S content was found to decrease systematically through time, although in 2011, ashes of the latter group erupted for the first time from this crater. Based on coloration, the ash samples in this study are classified into two groups: one with a yellowish color, another with a less yellowish color. The coloration of the former group can be explained by the existence of yellowish native sulfur as well as other hydrothermally altered minerals. We observed positive correlations between the interval of successive eruptions and both the yellowness and the amount of ash leachates. Our interpretation is that the observed temporal changes in volcanic ash result from a transition in the amount of fumarolic sulfur accumulation in partly solidified magma near the top of volcanic conduit, which we interpret to reflect the mean residence time of the magma. The magma probably periodically renewed in response to ash eruption and/or magma convection near the top of the volcanic conduit.

**Key words:** Sakurajima; volcanic ash, color, volcanic gas, magma degassing, S, F, Cl

### 1. Introduction

Developing a sound understanding of magma degassing processes can ultimately yield clues to the mechanisms that cause volcanic eruptions (Eichelberger *et al.*, 1986; Eichelberger and Westrich, 1981; Jaupart, 1998; Kazahaya *et al.*, 1994; Melnik *et al.*, 2005; Papale *et al.*, 1998; Wilson *et al.*, 1980; Woods and Koyaguchi, 1994). The Sakurajima volcano is one of the best places for conducting petrological investigations of magmatic degassing processes, especially because fresh ash samples are frequently discharged by eruptions at relatively short time intervals. The volcanic activity of Sakurajima has been extensively monitored in recent years, including for example, the timing of eruptions, the height of volcanic clouds, thermal infrared imaging of the vent, SO<sub>2</sub> gas fluxes, volcanic earthquakes, and crustal deformation (*e.g.*, Iguchi *et al.*, 2008; Yokoo, 2009, Kazahaya *et al.*, this volume, Japan Meteorological Agency (JMA)). Here we describe temporal changes in the color and amount of leachates (Cl, F, S) absorbed on the ash. The analysis of ash leachates (Witham *et al.*, 2005) has been used in the past to estimate the composition of volcanic gases, and also in monitoring the stages of eruption of a volcano (*e.g.*, Nogami *et al.*, 2002).

In this study, the ashes were collected shortly after each eruption took place, without having exposed to rain. The analysis of the color of volcanic ash can provide information about the temperature and oxidation state of the post eruptive magma (Miyagi *et al.*, 1998; Miyagi and Tomiya, 2002; Moriizumi *et al.*, 2008; Yamanoi *et al.*, 2008).

### 2. Recent activity of Sakurajima

Over the past three decades, eruptions of the Sakurajima volcano occurred at the Showa crater and the Minamidake summit crater. The current center of volcanic activity is the Showa crater (N31° 34' 43", E130° 39' 45") located about 750 m above sea level on the eastern hill of the summit of Minamidake. Volcanic activity within the Showa crater commenced on 26 October 1939, and subsequently ceased by 1948. Since 1948, the Minamidake summit crater has been the only active volcanic center of the Sakurajima volcano, until eventually recommencement of volcanic activity in the Showa crater took place in June 2006. On 3 February 2008, explosive eruptions began within the Showa crater. Since mid-April 2008, red-hot ejecta have been observed at night by network cameras installed around the volcano. Seemingly in response to the

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