

Estimation of total SO₂ flux from Japanese volcanoes

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Emission rate of volcanic gas gives valuable information to retrace the size of magma engaged in the volcanic activities. Sulfur dioxide is the only gaseous components in volcanic gas that enables quantitative flux measurements, due to its strong absorption cross-section in UV wavelength range and its low concentration in the atmosphere unlike other major volcanic gas components such as H₂O and CO₂. The history of quantitative SO₂ flux measurements in volcanological community starts when the correlation spectrometer (COSPEC) was introduced in early 1970s. Sulfur dioxide flux measurements at Asama and Izu-Oshima volcanoes by Okita and Shimozuru (1975) is the pioneering work in Japan. From the last half of 1970s till today, SO₂ fluxes from Sakurajima, Aso and Asama volcanoes are strenuously measured including eruptive period of many volcanoes including Unzen (1990-1995) and Miyakejima (2000-) volcanoes. At Miyakejima volcano, unprecedented SO₂ flux of over 100,000 ton/day was observed in September 2000 (Kazahaya et al., 2003). From 2000s, a miniature UV spectrometer system such as COMPUSS is utilized for SO₂ flux measurements and now replacing the COSPEC. Since these miniature spectrometer systems are very light, we are now able to carry out the measurements at the summit crater. This enables us to measure SO₂ flux of a few ton/day, which was relatively difficult by using the COSPEC.

In this paper, we are going to compile the SO₂ flux data of past 30 years since 1975 and estimate the total SO₂ flux from Japanese volcanoes. In Japan, we have 108 active volcanoes, of which, about 60 of them has continuous fumarolic activities. Although there are some volcanoes which have few SO₂ flux data, most Japanese volcanoes have seismic, plume height and gas composition data for a long time period. Thus, we are able to review the SO₂ flux by investigating such extensive data sets. In the past, many researchers tried to estimate global SO₂ flux from volcanoes. Most of the estimations were carried out by summing up the reported SO₂ flux from different time periods without considering the status of volcanic activities. In this respect, our approach to estimate the total SO₂ flux from Japan is meaningful.

By briefly surveying the SO₂ emission of Japanese volcanoes in past 30 years, although there is about 60 fuming volcanoes, there is only about 16 volcanoes which has records of SO₂ flux of a few ton/day. Moreover, there is only 6 volcanoes that have been continuously emitting SO₂ over 50 ton/day. It is particularly worth noting that the total sum of SO₂ emission from Miyakejima adds up to 23 Mt by the end of 2006, which is far more larger than the 17 Mt SO₂ emission by the explosive eruption of Pinatubo. Excluding this distinct SO₂ emission by Miyakejima volcano, the average SO₂ flux from Japanese volcanoes is about 1.5 Mt per year for last 30 year. The 80 % of the flux are from volcanoes in Kyushu, especially, Sakurajima, Aso, Satsuma-Iwojima and Suwanosejima volcanoes. The reported global SO₂ emission per year is between 1.5 Mt and 50 Mt, however recent values are between 13 Mt and 28 Mt. The tallied up SO₂ flux from Japanese volcanoes in this study takes over 5% to 12% global SO₂ flux even though the SO₂ emission by explosive eruptions are uncounted. In the presentation, we report further investigated SO₂ flux from Japanese volcanoes and discuss on the characteristic of the SO₂ emission.