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Degassing activity of Miyakejima volcano: Activities in the 10 years and their processes

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Miyakejima volcano continues the intensive degassing for almost 10 years after August 2000. The SO2 emission rate, peaked at about 50 kt/d at the end of 2000, significantly decreased down to 10 00t/d, but the degassing activity is more or less stable even at the present. We compile the volcanic gas data during these 10 years and combine them with other results, such as the melt inclusion study by Saito et al. (2010) to evaluate the degassing process of the volcano.
Volcanic gas composition measurements were conducted by the heli-borne measurement with cooperation with JMA at the beginning until 2003, and were conducted later by the application of Multi-GAS. Most significant feature of the degassing activity at the Miyakejima volcano is the stable composition of the volcanic gases for 10 years long. In particular, the CO2/SO2 mole ratio was 0.9-1.5, which is almost with in the instrumental errors, indicating the constant composition. In contrast, H2O/S mole ratio gradually increased from about 50 in 2004 to 100 in 2006. Although the twice difference is only slightly exceeded the instrumental error, the systematic changes in the composition indicate that the volcanic gases were mixed with similar amount of external water, such as groudwater. This estimate is consistent with the lack of high-temperature alteration areas around fumaroles in spite of the intense degassing activity, and with the relatively low temperature with maximum of 200C measured with the IR thermometer. The low RH(=log(H2/H2 O)) at about -5 also indicates that the gases were reacted at low-temperature conditions. Therefore, the changes in the H2O/S ratio was due to contribution of the groundwater and the composition of the gases discharged from the magma is likely constant.
The intensive and stable degassing at Miyakejima is likely caused by conduit magma convection. The constant volcanic gas composition regardless of the large decrease in the SO2 emission rates from 50 to 1 kt/d implies that there were no changes in the degassing mechanism and its intensive parameters such as degassing pressure, but the change was caused by the decrease of magma flux through the conduit. The previous petrological studies revealed that Miyakejima magma system consists of Andesite, Basalt and Primitive Basalt magmas. The eruptions in 2000 started with the andesite magma then sifted to the Basalt with traces of the Primitive Basalt. The analyses of melt inclusions in the eruption products of August 18, 2000 showed that the Basalt magma cannot directly derived by fractional crystallization of the Primitive Basalt, but needs degassing after the fractional crystallization, followed by CO2-flushing, implying that the amount of the Basalt is limited in the magma system (Saito et al., 2010), and the present degassing is likely originated from the Primitive Basalt. Minor ash eruption were repeated after 2000 and occurred also even recently. The ashes contain fresh glass fragments which are distinct from the eruption products of the 2000 eruption, indicating that the molten magma reaches close to the surface even now by the conduit magma convection (Geshi et al. 2009). Volatile content of the Primitive Basalt is H2O=2.0-3.5wt.%, S=0.05-0.20wt.%, and it H2O/S mole ratio agree well with the volcanic gas composition prior to the addition of the groundwater. Considering the 0.20wt.% S content of the Primitive Basalt, the emission of 24Mt of SO2 requires degassing of 6000Mt (2.2km^3) magma. The recent SO2 emission rate requires the degassing rate of 1x10^{6}m^3/d, or 4x10^{7}m^3/y. Geographical Institute of Japan (2009) estimated that inflation continues at a source of 10 km by

the rate of $2x10^7 m^3/y$ for about 10 years. This rate is comparable with the present degassing rate. The total amount of degassed magma during these 10 years corresponds to the magma accumulated in 100 years.

Keywords: Volcanic Gas, miyakejima