High HCl flux from Miyakejima volcano, Japan

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Introduction

Halogen gases play an important role in gas chemistry in the atmosphere. Miyakejima volcano, Japan, started to erupt in June 2000, and after the collapse to form a big summit crater with 1300m x1400m in diameter and 450m in depth, huge amount of volcanic gas has continued to emit from the southern rim of new crater bottom. SO_2 flux determined by COSPEC showed an average flux to be 42000t/day (Sep-Dec 2000), 27000t/day (Jan-Jun 2001) and 16000t/day (Jul-Dec 2001) (GSJ, AIST, 2002). So roughly 10Tg (=10^{12}g) of SO_2 was released for 1year Sep.2000. In this work, we determine HCl/SO_2 ratio of the volcanic gas to evaluate the HCl flux from Miyakejima volcano.

Observation

HCl/SO_2 ratio of volcanic gas was determined using a remote FT-IR spectroscopic method, which our group has developed (Mori et al., 1993; Mori and Notsu, 1997). IR absorption spectra of volcanic gas were obtained at 4 remote sites a few km apart from the volcanic plume, in Dec.2000 and Mar.2001. In this observation, sun light scattered by cloud or plume was used as an IR light source.

Result and Discussion

Measured HCl/SO_2 mole ratios were 0.05-0.08 for dense volcanic gas with white color, and 0.09-0.12 for transparent to pale-colored volcanic gas. Since the former gas is thought to be abundant in steam mist, possibly dissolving part of HCl, the original HCl/SO_2 ratio just after gas emission from the vent could be 0.09-0.12, which is within the range of indirect estimation; i.e. dissolved Cl/S mole ratio in alkaline solution contacting air-diluted volcanic gas (GSJ, AIST, 2002). Assuming the HCl/SO_2 ratio of volcanic gas was constant for 2000-2001, annual HCl flux was calculated 0.5-0.7 Tg/yr. This value is similar to HCl flux of Etna volcano in non-eruptive stage (0.6 Tg/yr), roughly 10% of the global volcanic flux (0.4-11 Tg/yr) and 20% of the global anthropogenic flux (3.0 Tg/yr) (Francis et al., 1996). Such high HCl flux from Miyakejima volcano, combined with high SO_2 flux, resulted in acid rain, affecting local environment. Taking into consideration that HCl emission of sea salt origin from ocean is as high as 300 Tg/yr (Symonds et al., 1988), the global effect of HCl emission from Miyakejima seems negligible.

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Reactions of biogenic ligands in the presence of metals – what can we learn from studying anthropogenic chelating agents?

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There are many studies emphasizing the importance of chelation on *metal* bioavailability, plant uptake, toxicity, transport, adsorption, distribution and fate. Conversely, *chelating agents* are also affected by the presence of metals. The presence (and identity) of a coordinated metal ion can substantially affect chelating agent adsorption, precipitation, ligand-assisted dissolution, metal mobilization, chemical degradation, photodegradation, and biodegradation. Strong chelating agents occur in natural waters predominantly in the form of metal complexes. Therefore, a discussion of the fate of a chelating agent *always* has to address the presence of metals and how they interact with the chelating agents.

Many biogenic compounds such as siderophores, phytochelatins, and organic acids are potent chelating agents that influence mineral weathering, metal cycling and bioavailability in the environment. Based on the knowledge gained with anthropogenic chelating agents, we can expect that the reactions of the biogenic ligands in the environment will also be determined by the metals they are bound to.

The reactions of organic chelating agents of the group of the aminopolycarboxylates (e.g. EDTA) and the phosphonates in the presence of metals will be discussed. Topics will include adsorption, ligand-assisted dissolution, mobilization of metals, and chemical degradation. The results from the anthropogenic compounds will then be used to predict the potential influence of metals on the reactions of biogenic ligands such as siderophores in heterogeneous systems.