Ground-based remote FT-IR measurements of volcanic gas chemistry at Sakurajima volcano, Japan

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Since the beginning of 1990's, ground-based remote Fourier transform infrared spectroscopy (FT-IR) has been applied to volcanic gas studies (e.g., Mori et al., 1993; Mori and Notsu, 1997; Oppenheimer et al., 1998, Love et al., 1998). We carried out the ground-based remote FT-IR measurements at Sakurajima volcano in the southern part of Kyushu Island, Japan. The volcano is only 10 km away from the center of Kagoshima city and is a very active volcano which has been frequently erupting since 1955. The volcano is continuously emitting 1000 – 3000 ton/day of SO_2 from the summit vent.

The measurements were carried out on March 31 and April 1, 1999 at Kurokami area (about 3.5 km East from the summit) and Sakurajima Volcano Observatory (SVO; about 5.5 km west from the summit), respectively. In Kurokami measurements, a solar scattering technique (Love et al., 1998) was used in the late afternoon when the Sun sets behind the summit. In contrast, in SVO measurements, we used a solar ocultation technique (Oppenheimer et al., 1998) early in the mornig during the Sun rises behind the volcanic plume. In the observed spectra, we identified four volcanic gas species, which are SO_2, HCl, HF and SiF_4. For the retrieval of column amounts of volcanic gas species, we employed a non-linear least-squares fitting of observed and calculated model spectra using HITRAN database. The retrieved molar ratios for HCl/SO_2 and HF/HCl were $2.4x10^{-1}$ and $1.0x10^{-1}$ for Kurokami measurements and $3.2x10^{-1}$ and $6x10^{-2}$ for SVO measurements, respectively.

In the presentation, we will compare the observed ratios with previously reported values obtained by direct plume gas analyses, and discuss on the chemistry of the volcanic gas emitted from Sakurajima volcano. We will also present some recent results from 2001 and 2002 field campaigns carried out at the volcano.

References

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Gradients in fluid composition accross vein selvages of the Nishisonogi Metamorphic Rocks, Southwest Japan

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Occurrence of vein selvages

The Nishisonogi Metamorphic Rocks are an ancient accretionary complex in southwest Japan. They belong to the epidote-blueschist subfacies and consist mainly of pelitic schist, basic schist and serpentinite. In the study area, the basic schist contains many retrograde dolomite + calcite veins having selvages on both sides. Approaching the veins, peak metamorphic assemblages of the basic schist (winchite + epidote + chlorite + calcite + albite + quartz) has been modified by progressive breakdown of winchite, epidote and calcite to illite and dolomite.

Chemical mass balance

Chemical mass balance in the selvages was calculated using the isocon method (Grant, 1986). The calculations revealed that CO_2 and K were added to the basic schist, and Ca, Mg and Fe were removed during alteration. The mass balance does not hold for these components between the vein + selvage and protolith as a whole. These findings suggest that the vein formation and metasomatism represent a process driven by fluid flow and long-distance element transport.

Reaction paths

Possible reaction paths between the vein-fluids and basic schist were estimated from the progressive change of mineral assemblage within the selvages. Phase relations in the system K_2O-Na_2O-CaO-MgO-Al_2O_3-SiO_2-H_2O-CO_2 were exam-ined on ionic activity diagrams. They indicate an increase in $\log f_{CO2}$ and decreases in $\log(a_{Ca2+}/\sigma_{Ca2+}a^2_{H+})$ and $\log(a_{Mg2+}/\sigma_{Mg2+}a^2_{H+})$ with progress of the alteration. This result is consistent with the chemical mass balance in the selvages presented above. A change in $\log(a_{K+}/\sigma_{K+}a^2_{H+})$ is poorly constrained on the ionic activity diagrams.

Conclusions

The chemical mass balance and reaction paths suggest concentration gradients of CO_2, K, Ca, Mg and Fe in fluids across the selvages. These gradients were probably produced by the infiltrating vein-fluids and drove the alteration processes.

References

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