Sulfur supplied by basaltic magma injection into the magma feeding system of Asama volcano, central Japan – A melt inclusion study

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Asama volcano is situated at the junction of the volcanic fronts of the North Japan arc and the Izu-Mariana arc. Most of the erupted materials have andesitic whole-rock compositions. However, previous melt inclusion studies found no sign of primary andesitic melt and revealed that basaltic liquid formed a part of the ejecta [1].

For four eruption events of Asama volcano in the past 23,000 years, I here discuss a large sulfur supply by basaltic magma injections into the Asama magma system, based on microprobe analyses of olivine-hosted melt inclusions from the following eruption events; Itahana Brown Pumice fall (23 ka), Scoria in Komoro Pumice flows (11 ka), 1783 (Tenmei) Pumice fall (1783 AD), 2004 scoria fall (2004 AD).

In the evolution of Asama volcano, basaltic magma is believed to have been repeatedly injected into a long-lived crystal-rich felsic reservoir beneath the volcano [2]. The major phenocrysts (plagioclase, ortho- and clinopyroxene, and Fe-Ti oxides) were principally derived from the felsic magma and trapped sulfur-poor felsic melt inclusions (SiO_2 66-76wt%, S <400 ppm). In contrast, olivine (>Fo_{80}), a rare phenocryst in most cases, was derived from basaltic magma, trapping sulfur-rich mafic melts of basalt-basaltic andesite composition (SiO_2 48-65wt%, S <3600 ppm) before the mixing.

Olivine phenocrysts commonly include crystalline phases of esseneitic ($CaFe^{3+}AlSiO_6$) clinopyroxene, pargasitic amphibole, and a spinel solid solution (magnetite-hercynite-chromite), suggesting a high oxygen fugacity and hydrous conditions of the basaltic magma. Measured S-Kα wavelength shifts for the trapped melt indicate that the dominant sulfur-bearing species is SO_4^{2-} (> NNO + 1), with a corresponding high sulfur solubility in the magma. In most of the trapped melts, however, this primary high sulfur concentration was decreased by extensive early sulfide precipitation and distillation by vapor-boiling before the melt entrapment. High sulfur concentration is recorded in the composition of some pre-boiling, and the most mafic melt inclusions (SiO_2 48-53wt%). Basaltic magmas are expected to transport more than 3000 gram sulfur/tons of magma from the mantle source region into the felsic reservoir beneath Asama volcano.

[1] Anderson (1982) *JGR* **87,** 7047-7060. [2] Aramaki & Takahashi (1992) *IAVCEI Commission on Explosive Volcanism,* 1-60.

Noble gas isotopic compositions of mantle xenoliths in a kimberlite

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Oceanic island basalt (OIB) provides an important window into the heterogeneous Earth's interior. The terrestrial inventory of radiogenic noble gas nuclides such as ^{40}Ar implies that the OIB source is less degassed (e.g., [1]). Assuming a K content and $^{40}Ar/^{36}Ar$ of OIB source, we can evaluate non-radiogenic ^{36}Ar content of the source, which enables us to assess the degassing state of the Earth's interior. Mantle-derived xenoliths entrained by OIB magma are potentially useful to consider a pristine feature of OIB magma because the OIB magma might have been captured in a source mantle of the xenoliths during ascent of the magma. Kimberlite is regarded as OIB erupted at continents (e.g., [2]). Mantle xenoliths in kimberlite are often metasomatized by the host kimberlite and could inherit the noble gases.

Here we report noble gas isotopic compositions of nine mantle xenoliths in a kimberlite erupted in Siberia at 380 Ma. The xenoliths are appropriate samples to explore the kimberlite magma because they are well metasomatized by the kimberlite magma. The noble gas isotopic compositions are all dominated by both radiogenic nuclides and atmospheric components. Firstly we corrected the atmospheric contribution to $^{40}Ar/^{36}Ar$ using an assumed relationship with a solar-like end-member of Ne. Then we corrected the effect of radiogenic addition to He and Ar isotopic ratios as follows. Assuming that the mantle xenoliths originally had homogeneous noble gas isotopic compositions, the present radiogenic noble gas isotopic compositions of the xenoliths are mainly caused by subsequent addition of radiogenic nuclides. Thus $^3He/^4He$ and $^{40}Ar/^{36}Ar$ of nine xenoliths corrected for the radiogenic contribution should converge into the original compositions. Actually, subtraction of ^4He and ^{40}Ar from the measured $^3He/^4He$ and $^{40}Ar/^{36}Ar$ at a rate of measured $^4He/^{40}Ar^*$ shows a converged point with $^{40}Ar/^{36}Ar$ of ~1800 and $^3He/^4He$ of ~50 Ra in a diagram of $^3He/^4He$ vs. $^{40}Ar/^{36}Ar$. Combination of the $^{40}Ar/^{36}Ar$ with a K content of OIB source will elucidate degassing state and layered structure of the Earth's interior.

[1] Allègre *et al*. (1996) *Geophys. Res. Lett*. **23**, 3555-3557.
[2] Sumino *et al*. (2006) *Geophys. Res. Lett*. **33**, L16318.