

Verification and correction of matrix effect on water concentration of volcanic glasses by SIMS

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In the analyses of concentrations and isotope ratios by SIMS (Secondary Ion Mass Spectrometry), matrix-matched standard samples are required due to a matrix effect on correction coefficients. Regarding the water content of volcanic glasses, Miyagi and Yurimoto (Bull. Volcanol. Soc. Japan. 1995, v40, p349) reported that there is a matrix effect, but Hauri et al., (Chem. Geol. 2006, v235, p352) and Shimizu et al. (Geochem. J. 2017, v51, p299) reported that rhyolitic to basaltic glasses share a single linear calibration curve, and that the matrix effect was considered to be small.

In this study, we prepared ~50 volcanic glasses with foiditic, basaltic, andesitic, and rhyolitic compositions, that are collected from deep seafloor, or experimental products. Their H₂O contents were determined by the manometry method (rhyolitic glasses; Yamashita, J. Petrol. 1999, v40, p1497) or FTIR (Fourier transform infrared spectrometer), and were ranging from 0.02-4.8 wt%. The analyses were performed using CAMECA ims-1280HR at JAMSTEC, under the same conditions as Shimizu et al. (2017). The primary ion of Cs⁺ of 20 keV 0.5 nA with 10 keV of electron gun is used to analyze the 5 micron area on the surface of the volcanic glasses, and the ¹⁶OH/³⁰Si ratios were compared with H₂O contents.

We observed that the calibration curves of H₂O vs. ¹⁶OH/³⁰Si differed significantly depending on the composition of the volcanic glasses. At the same ¹⁶OH/³⁰Si ratio, the water content differed up to five times depending on the composition of volcanic glasses, and we verified that there was a matrix effect. Although the calibration curve slopes of water [H₂O/(¹⁶OH/³⁰Si)] weakly correlated with their SiO₂ content, they are more likely to be correlated with their molar weights (g/mol, a one oxygen mole basis) as King et al. (Am. Mineral. 2002, v87, p1077) reported. We suggest that matrix effect on H₂O content of volcanic glasses could be corrected with their molar weights, being applicable to volcanic glasses with any chemical composition.