Partitioning of S(-Cl) and S-isotopes between fluid and andesitic melt

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Isothermal decompression experiments were conducted at ~1030°C in IHPV. A hydrous S-(Cl-)bearing silicate melt with a composition close to Krakatau andesite was used as starting material. Pressure was released continiously from 400 MPa to 70 MPa using a novel type of automatic high-pressure valve. Decompression rates range from slow (~0.0005 MPa/s) to very fast (~0.1 MPa/s) and oxygen fugacity (fO_2) ranges from QFM+0.5 to QFM+3.5. The samples were directly quenched after decompression or further annealed for 1 to 48.5 h at final conditions. The partitioning coefficient of S between aqueous fluid and andesitic melt ($D_s^{fl/m}$) was determined by measuring S, Cl (EMP) and H_2O (FTIR) in the quenched glasses and subsequent mass balance calculations. SIMS was used to determine the isotopic abundance of sulfur ($\delta^{34}S_{melt}$) in the glasses. A suite of silicate standards with known $\delta^{34}S$ was used for SIMS calibration. XANES at ANKAs SUL-X beamline (Germany) was conducted to evaluate the sufur speciation in the experimental products.

For directly quenched samples, $D_s^{fl/m}$ was observed to increase significantly at QFM+0.5 from 59 ± 17 to 252 ± 103 with decreasing decompression rate (~0.1 MPa/s to ~0.0007 MPa/s). Upon further annaeling (1 to 48.5 h), at QFM+3.5 $D_s^{fl/m}$ decreases from 337 ± 124 to 24 ± 1. In addition, the molar $(S/Cl)_{fluid}$ ratio increases exponentially with increasing $(S/Cl)_{melt}$ at QFM+1.8. XANES measurements may have revealed significant amounts of H_2S in fluid inclusions at $fO_2 \leq$QFM+1.2 while at $fO_2 \geq$QFM+1.8 predominantly SO_2 seems to be present. Preliminary SIMS data indicates a major influence of fO_2 on fluid/melt fractionation of S isotopes upon degassing. $\delta^{34}S_{melt}$ decreases by 3.2-5.4 ‰ at QFM+1.2 and increases by 2.1-3.1 ‰ at QFM+3.5 if ~90% of the S in the melt is released. Thus, the isotopic fractionation is slightly larger than predicted by the model of de Hoog *et al*. [1] but in agreement with the data of Mandeville *et al*. [2] for oxidizing conditions. Hence, combining S and Cl data in volcanic gases with *in situ* sulfur isotope analyses might become a powerful tracer to forecast volcanic eruptions in near future.

[1] de Hoog, J.C.M., *et al*. (2001), *EPSL* **189**, 237-252. [2] Mandeville, C.W. *et al*. (2009), *GCA* **73**, 2978-3012

Rapid dyke emplacement as an eruption trigger Dabbahu Volcano, Ethiopia

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Dabbahu is a quaternary, central volcano situated at the northern end of the Manda Hararo rift segment in the Afar region of Ethiopia. Magmatic rift segments have formed over the past ~3 Ma as faulting and volcanism have focused into localised regions [1]. In 2005 a small rhyolitic ash eruption and extrusion of a small pumice dome from the Da'Ure vent on the northern flanks of Dabbahu coincided with the largest dyke opening event ever measured [2].

Olivine crystals from an early 65 kyr basaltic flow at Dabbahu are composed dominantly of Mg-rich cores (700-1000 μm) with narrow (10-50 μm) Fe-rich rims. The timescale since the intrusion of this new magma batch and eruption was investigated by diffusion modelling of multiple elements (Fe-Mg, Mn, Ni and Ca) in four crystals. Olivine crystals were forward modelled from an initially homogenous composition using a semi-infinate open boundary, finite difference model for Fe-Mg, Mn and Ni, and where possible Ca. Co-existing clinopyroxene crystals indicate a magmatic temparature of ~1176°C. Calculated timescales from Fe-Mg (0.75-8.92 days), Mn (1.27 -4.05 days) and Ni (0.94-8.11 days) are all similar to each other, demonstrating the strength of this method and the short residence times of these crystals in the final magma after the growth of the Fe-rich rims.

Elevated seismicity associated with the 2005 dyke intrusion at Dabbahu volcano persisted for only 4.5 days before moving south [2]. These timescales are comparable to those obtained from olivine profiles in the > 65 kyr Dabbuhu eruption. We infer that the olivine crystals preserve an early record of dyke intrusion, during the initial shield building episode of Dabbahu volcano, similar to the 2005 event.

[1] Barberi and Varet, (1977), *GSA bulletin* **88**:1251-1266. [2] Wright, Ebinger, Biggs, Ayele, Yirgu, Keir & Stork (2006), *Nature* **442**:291-29.