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S and Cl degassing of hydrous Etna Basalt: an experimental study at 200 MPa and 1050 ˚C

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Magmatic degassing is strongly controlled by the amount and composition of volatile components, e.g. H_2O, S, Cl, F, Br, CO_2. The knowledge of the partitioning behaviour of these volatiles between melt and fluid phase at changing pressures and temperatures during magma ascent is fundamental to understand processes of volcanic degassing.

Aiuppa et al. [1] reported, that the S/Cl ratio of emitted gases from Mt. Etna is coupled to the eruption style. So it is of particular interest to develop models for volcanic degassing using both, experimental data and in situ measurements at active volcanoes.

This work is focused on fluid saturated ($\sim$ 12 wt.% total fluid) partitioning experiments of S/Cl between H_2O bearing fluid and hydrous alkali basaltic melt of Mt. ETNA, which were conducted in internally heated pressure vessels (IHPV) at T = 1050 ˚C, P = 200 MPa and fO_2 $\sim$ QFM+1.

The Cl concentration of the melt increases from 0.05 to 2.5 wt.% Cl with molar Cl concentration of the coexisting fluid, containing 0.3 to 19 mol% Cl and seem to be independent on sulfur concentration, with up to 1.0 wt.% bulk S (concentration of volatile component in the system, considering the total amount of fluid and melt), but is slightly reduced to 2.2 wt.% Cl at 1.8 wt.% bulk S (and 17 mol% Cl in the fluid).

The S concentration of the melt, coexisting with a fluid containing 0.06 to 10 mol% S, increases from 0.09 to 0.56 wt.% S. Furthermore, the S concentration in the melt is slightly influenced by the Cl concentration in the system. Thus, at highest bulk S

of 1.8 wt.%, the S concentration decreases from 0.56 to 0.45 wt.% S with increasing bulk Cl from 0.06 to 0.35 wt.% Cl respectively.

Although these experiments were performed under isobaric conditions, our data indicate, that at experimental conditions, both, the natural S/Cl ratio of 0.4 to 7.1 in the volcanic plume of Mt. Etna [1] and the natural S/Cl ratio of 0.4 to 2.1 in the basaltic melt inclusions [2] of corresponding erupted material (2002/2003 eruption), requires lower bulk Cl from 0.06 to 0.6 wt.% Cl (at bulk S of 1.8 wt.% and from $\sim$ 0.2 to 1.0 wt.% S, respectively). However, the lowest S/Cl ratio of 0.4, corresponding to the highest volcanic activity, could only be reproduced at high bulk Cl (from 1.8 to 3.5 wt.% Cl) and low bulk S ($\sim$ 0.5 wt.% S), leading to an S/Cl ratio of $\sim$ 0.2 in the melt. High S/Cl ratios ($\sim$ 5 – 7.1) in the volcanic plume, occurring at passive degassing, require lower bulk Cl (from $\sim$ 0.2 to $\sim$ 0.6 wt.% Cl) and higher bulk S ($\sim$ 1.0 wt.% S).

[1] Aiuppa, A., Frederico, C., Guidice, C., Gurrieri, F., Paonita, A., Valenza, M. (2004) *EPSL* 222, 469-483.

[2] Spilliaert, N., Métrich, N., Allard, P. (2006) *EPSL* 248, 772-786.