# Degassing kinetics of sulphur upon decompression in basaltic systems

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Understanding the sulphur-degassing processes of magmatic systems is of high importance to predict volcanic hazards. Various studies focussed on the fluid-melt partitioning of S at fluid-melt equilibrium [1]. By contrast, little is known about the kinetics of sulphur release upon decompression.

A three step procedure was utilized to study experimentally the degassing of sulphur-bearing fluids from alkali basaltic melts. First, anhydrous Mg-free alkali basalt was synthesized as starting material by melting an oxide and carbonate mixture at 1600˚C in a PtRh crucible. In a second step, volatile-bearing glasses were synthesized in an internally heated gas pressure vessel (IHPV) at fluid-undersaturated conditions. For runs at 1050˚C and 500 MPa the following components were loaded together with the Mg-free alkali basalt into Au capsules ($\sim$3.5 cm length, Ø 5 to 6 mm, 2 mm wall thickness): S as gypsum ($CaSO_4$ 2 $H_2O$), Mg as brucite ($Mg(OH)_2$) and deionized $H_2O$. At synthesis temperature of 1150˚C $Au_{80}Pd_{20}$–capsules were used and only gypsum and brucite were added to the capsules to avoid the formation of S-bearing fluids during heating which may cause corrosion of the capsule. The third step comprises isothermal decompression experiments with $\sim$150 mg of the synthesized material loaded into Au- (1050˚C) or Pt-capsules (1150˚C). Platinum (at 1150˚C) was used as capsule material, because it is more flexible and resistible upon pressure changes. The decompression experiments were conducted in an IHPV at log $fO_2$ of $\sim$QFM+2 (QFM: quartz-fayalite-magnetite buffer). The experimental charges contained $\sim$6.1 wt% $H_2O$ and $\sim$600 ppm S at 1050˚C and 5.2 wt% $H_2O$ and $\sim$1320 ppm S at 1150˚C. Pressure was released continuously from 400 MPa to 70 MPa at a decompression rate ($r$) of 0.1 MPa/s. The samples were either directly rapid quenched after decompression to preserve disequilibrium conditions or annealed ($t_A$) for 1 to 20 h to achieve (near-) equilibrium conditions. S was measured by EMP and $H_2O$ by FTIR, and the partitioning of S between fluid and melt is described by $D_S^{fl/melt}=$ wt% $S_{fluid}$ / wt% $S_{melt}$ using mass balance calculations.

Direct quench at 1050˚C yield $D_S^{fl/melt} = 56 \pm 14$. Subsequent annealing produced an initial increase of $D_S^{fl/melt}$ by $\sim$46 % ($D_S^{fl/melt} = 82 \pm 25$) after 2 h followed by a decrease of $\sim$41 % ($D_S^{fl/melt} = 50 \pm 30$) after 20 h annealing. First data at 1150˚C with $t_A$ of $\sim$1h and $\sim$2h indicate that $D_S^{fl/melt}$ is decreasing with $t_A$ and is higher by a factor of $\sim$1.4 compared to experiments at 1050˚C. Our results at (near-) equilibrium conditions ($t_A > 2$h) are comparable to earlier results of equilibrium experiments with basaltic compositions [2]. Additionally the higher $D_S^{fl/melt}$ values at disequilibrium conditions compared to (near-) equilibrium conditions indicate that the first fluid released from a fast decompressed magma may contain a larger S fraction than expected based on equilibrium experiments. To characterize the effects of varying $r$, $t_A$, temperature and volatile components (Cl) further experiments are planned.

[1] Webster & Botcharnikov (2011), *Reviews in Mineralogy and Geochemistry 73, 247-283*

[2] Lesne et al. (2011), *Journal of Petrology 52, 1737-1762*