Geophysical Research Abstracts
Vol. 17, EGU2015-9572, 2015
EGU General Assembly 2015

Pre-eruptive volatile and erupted gas phase characterization of the 2014 basalt of Bárðarbunga volcanic system, Iceland.

Baptiste Haddadi (1), Séverine Moune (1), Olgeir Sigmarsson (1,2), Pierre-Jean Gauthier (1), and Mathieu Gouhier (1)

(1) Laboratoire Magmas et Volcans, CNRS - UBP - IRD, Clermont-Ferrand, France (b.haddadi@opgc.univ-bpclermont.fr), (2) Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland.

The 2014 Holuhraun eruption on the Bárðarbunga Volcanic System is the largest fissure eruption in Iceland since the 1783 Laki eruption. The eruption started end of August 2014 and has been characterized by large emission of SO_2 into the atmosphere. It provides a rare opportunity to study in details magmatic and degassing processes during a large-volume fissure eruption.

In order to characterize the pre-eruptive magmatic composition and to assess the plume chemistry at the eruption site, lava and tephra were sampled together with the eruption plume. The basalt composition is olivine tholeiite with MgO close to 7 wt%. It is phenocryst-poor with plagioclase as the dominant mineral phase but olivine and clinopyroxene are also present together with sulphide globules composed principally of pyrite and chalcopyrite. The volatile (S, Cl and F) and major element concentrations were measured by the electron microprobe in melt inclusions (MIs) trapped in plagioclase and clinopyroxene and groundmass glass. The MIs composition ranges from fairly primitive basaltic compositions (MgO: 9.03 wt%) down to evolved qz-tholeiites (MgO: 5.57 wt%), with estimated pre-eruptive S concentrations of 1500 ppm. Tephra groundmass glass contains 400 ppm S, whereas Cl and F concentrations are respectively slightly lower and indistinguishable from those in the MIs. This implies limited exsolution of halogens but 75% of the initial sulphur content. Relatively to their total iron content, MIs are sulphur saturated, and their oxygen fugacity close to the FMQ buffer. The difference between the estimated initial volatile concentrations measured in the MIs and in the tephra groundmass (i.e. the so-called petrological method) yields 7.2 Mt SO_2, limited HCl and no HF atmospheric mass loading from the Holuhraun 2014 eruption. The SO_2/HCl molar ratio of the gas phase, calculated from the MIs, is 13 and 14, respectively, using average and estimated pre-eruptive S and Cl concentrations in the MIs.

Filter-pack sampling of the gas plume was performed 2 October 2014 few hundred meters to the W of the active crater row. Filter packs were composed of three filters in series: one PTFE filter to collect particulate phases, followed by two impregnated filters to trap major gaseous species (SO_2, HF and HCl). Sulphate (SO4) and halide (Cl- and F-) ion concentrations were determined by ion chromatography. The SO_2/HCl molar ratio in the erupted gas phase at the eruption site is 29-46, only slightly higher than that estimated from the MIs.

Trace element volatility and fluxes are discussed elsewhere (Gauthier et al., 2015) but the average SO_2 flux calculated from lava volume estimate end of November as 1.2 km3 (Gouhier et al., 2015) is close to 1100 kg/sec. This is the highest SO_2 flux ever estimated from gas plume measurements.

References:
Gauthier et al. (2015) Trace element degassing patterns and volcanic fluxes to the atmosphere during the 2014 Holuhraun eruption, Iceland. EGU General Assembly 2015.
Gouhier et al. (2015) Retrieval of lava and SO_2 long-lived emissions using MSG-SEVIRI data during the 2014 Holuhraun eruption. EGU General Assembly 2015.