Geophysical Research Abstracts
Vol. 13, EGU2011-12040-1, 2011
EGU General Assembly 2011

Magmatic gas composition and fluxes during the 2010 Eyjafjallajökull explosive eruption: implications for degassing magma volumes and volatile sources

Patrick Allard (1), Mike Burton (2), Niels Oskarsson (3), Agnès Michel (1), and Margherita Polacci (2)
(1) IPGP - Sorbonne Paris Cité, UMR7154, Paris, France (pallard@ipgp.fr), (2) Istituto Nazionale di Geofisica e Vulcanologia (INGV), Pisa, Italy, (3) Nordic Volcanological Center, Institute of Earth Sciences, Univ. Iceland, Reykjavik, Iceland

We report a unique dataset for the chemical composition and mass fluxes of magmatic gases that were powering the Vulcanian-type eruption of trachyandesitic magma at Eyjafjallajökull in early May 2010, then we discuss their implications in terms of magma degassing rates and eruptive processes. The composition of magmatic gases directly issuing from the eruptive vents was measured on May 8, by using OP-FTIR spectroscopy from the crater rim (850 m distance) and molten lava blocks/hot ash as IR radiation source. FTIR absorption spectra reveal a main gas component containing on average 91.6 mol% H2O, 8.0% CO2, 0.2% SO2, 0.13% HCl, 0.035% CO, but no detectable HF. A second Cl-richer gas component, with 3 to 6 time higher SO2/HCl ratio, was generated by enhanced chlorine loss during magma fragmentation into finest ash, as confirmed by analysis of ash leachates. Both S-Cl-F contents in ash and lava bomb samples and S/Cl and Cl/F ratios measured by solar occultation FTIR sensing of distal volcanic plume confirm a modest degassing of fluorine during the eruption. DOAS traverses under the volcanic plume gave most reliable SO2 fluxes of 4500-6600 tons/d on May 9, coherent with OMI satellite data [1], which imply daily co-emissions of 720000 tons of H2O, 150000 tons of CO2, 2000 tons of HCl and <200 tons of HF. During its trachyandesitic eruptive phase, Eyjafjallajökull volcano thus produced much more abundant gas, with a more hydrous and CO2-poorer composition, than during its first basaltic effusive phase [2]. In particular, it produced about bas much carbon dioxide as does European air traffic in one average day. From the pre-eruptive (0.14 wt%; [3]) and post-eruptive (0.03 wt%; this work) sulphur content of the trachyandesitic magma, we compute a magma degassing rate of 1E+06 m3/d (or 30000 kg/s, coherent with the eruptive column height) during intense explosive activity in early May 2010. HCl and HF gas fluxes are also compatible with syn-eruptive degassing of that amount of magma, suggesting minor SO2 scrubbing during magma-ice interactions at that time. In contrast, the inferred CO2 and H2O fluxes are by far in excess and suggest (i) a deeper-derived (basaltic?) CO2 supply to the eruptive degassing and (ii) a likely prevalent derivation of H2O from glacial meltwater. Based on these observations and published data for intruded and erupted magma volumes [4], we shall discuss the role of volatiles in the triggering dynamics and evolution of Eyjafjallajökull eruption.

[1] Carn et al., AGU Fall Meeting, V53F-08, 2010; [2] Burton et al., Gas composition and flux report, March 2010, http://www.earthice.hi.is/. [3] Sigurdsson and Mandeville, AGU Fall Meeting, V53F-06, 2010; [4] Sigmundsson et al., Nature, 468, 426-431, 2010.