Geophysical Research Abstracts
Vol. 13, EGU2011-12046, 2011
EGU General Assembly 2011

The 14 April – 22 May 2010 summit eruption at Eyjafjallajökull volcano, Iceland: Volatile contents and magma degassing

Thorvaldur Thordarson (1), Chris Hayward (1), Margaret Hartley (1), Olgeir Sigmarsson (2), Ármann Höskuldsson Höskuldsson (2), and Guðrún Larsen (2)

(1) School of GeoSciences, University of Edinburgh, Edinburgh, UK, (2) Institute of Earth sciences, University of Iceland, Reykjavik, Iceland

The unexpected disruption to aviation over Europe during the 14 April-22 May 2010 explosive eruption at the Eyjafjallajökull volcano, Iceland, was primarily caused by the large proportions of fine ash generated by the event and consistent westerly airflow over Iceland during the 39 days of activity. The 2010 summit eruption produced about 0.1 cubic km (DRE) of benmorite tephra containing between 10-20% of extremely fine ash ($\leq$10 micrometers). Three main phases are identified in the eruption: a) an initial intraglacial phase lasting from 14-19 April, featuring rapid succession of Vulcanian-type explosions; b) about 14 day-long (19 April-3 May) phase of weak magmatic explosions and lava emission; and c) a renewed, moderately intense, intermittent Vulcanian-type explosions lasting another 21 days. In order to fully understand fragmentation processes that produce large amounts of fine ash, it is important to assess the role of magmatic volatiles and degassing mechanisms.
Here we present results on major element composition as well as initial and residual volatile (sulphur, chlorine, fluorine, water and carbon dioxide) concentrations in the Eyjafjallajökull summit eruption as determined by analysis of 14 melt inclusions (MI), hosted by plagioclase, olivine and pyroxene phenocrysts, and 78 analyses of glass groundmass obtained from a suite of 7 samples representing the initial phase (first 7 days) of eruption. The composition of the groundmass glass of the tephra (SiO_2 = 61.13$\pm$1.08 wt%) and the MIs (SiO_2 = 58.59$\pm$2.52 wt%) is benmorite. Volatile concentrations in the MIs are 0.063$\pm$0.024 wt% S, 0.269$\pm$0.026 wt% Cl and 0.168$\pm$0.0418 wt% F, 1.7 wt% H_2O, and the CO_2 content ranges from 0.11 – 0.13 wt%. The corresponding groundmass (residual) values for the benmorite groundmass glasses are 0.031$\pm$0.006 wt% S, 0.277$\pm$0.019 wt% Cl and 0.171$\pm$0.019 wt% F, 0.58$\pm$0.17 wt% H_2O and 0.014$\pm$0.014 wt% CO_2. These data indicate that 50-60% of the sulphur and water and about 90% of the carbon dioxide was released upon venting. The Cl and F do not appear to have been released in any significant amounts. These data indicate that the total mass of sulphur released into the atmosphere by the initial phase of the Eyjafjallajökull summit eruption was $\leq$0.1 megaton.