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The source and longevity of sulfur in an Icelandic flood basalt eruption plume

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The Holuhraun fissure eruption (Bárðarbunga volcanic system, central Iceland) has been ongoing since 31 August 2014 and is now the largest in Europe since the 1783-84 Laki event. For the first time in the modern age we have the opportunity to study at first hand the environmental impact of a flood basalt fissure eruption ($>$1 km^3 lava). Flood basalt eruptions are one of the most hazardous volcanic scenarios in Iceland and have had enormous societal and economic consequences across the northern hemisphere in the past. The Laki eruption caused the deaths of $>$20% of the Icelandic population by environmental pollution and famine and potentially also increased European levels of mortality through air pollution by sulphur-bearing gas and aerosol. A flood basalt eruption was included in the UK National Risk Register in 2012 as one of the highest priority risks.

The gas emissions from Holuhraun have been sustained since its beginning, repeatedly causing severe air pollution in populated areas in Iceland. During 18-22 September, SO_2 fluxes reached 45 kt/day, a rate of outgassing rarely observed during sustained eruptions, suggesting that the sulfur loading per kg of erupted magma exceeds both that of other recent eruptions in Iceland and perhaps also other historic basaltic eruptions globally. This raises key questions regarding the origin of these prodigious quantities of sulphur. A lack of understanding of the source of this sulfur, the conversion rates of SO_2 gas into aerosol, the residence times of aerosol in the plume and the dependence of these on meteorological factors is limiting our confidence in the ability of atmospheric models to forecast gas and aerosol concentrations in the near- and far-field from Icelandic flood basalt eruptions.

In 2015 our group is undertaking a project funded by UK NERC urgency scheme to investigate several aspects of the sulfur budget at Holuhraun using a novel and powerful approach involving simultaneous tracking of sulfur and chalcophile metals through the melt and the volcanic plume. By combining petrological analysis, in-plume sampling of gases and aerosol, and plume dispersion modelling, we will address two principal research objectives related to understanding the sulfur systematics of the eruption: (1) To examine the sulfur budget as recorded in the erupted rocks in the form of dissolved sulfur and sulfide minerals, which break down on eruption and (2) To investigate the SO_2 lifetime in the atmosphere, by measurements in the both young and ageing eruption plume and plume dispersion modelling In addition we will analyse the characteristics of the aerosol mass necessary for health impact assessment.

We will carry out two field campaigns, in January 2015 (short daylight) and, if the eruption is still ongoing, in April 2015 (long daylight). Here we present the first results of our project following the winter campaign.