



Assessing the atmospheric and climatic effects of basaltic fissure eruptions. A case study Nornahraun, North Iceland, 2014-2015.

Catherine Gallagher (1,2), Kevin Burton (1), Thorvaldur Thordarson (2), Charlotte Vye-Brown (3), Richard Brown (1), and the IES eruption Team

(1) Department of Earth Sciences, Science Labs, Durham University, Elvet Hill, Durham DH1 3LE, UK. (katec@hi.is), (2) Institute of Earth Sciences, The University of Iceland, Sturlugata 7, Askja, 101 Reykjavík, Iceland., (3) The British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, UK.

A volcanic eruption's ability to release sulphur gases into the atmosphere is one of the critical factors in assessing their climatic and environmental effects, because it is directly linked to the potential H_2SO_4 aerosol burden produced [1]. Basaltic fissure eruptions loft large amounts of sulphur into the atmosphere because of the efficient degassing of volatiles and halogens from the magma at the vent [2-4] coupled with the high sulphur yield of basaltic magma. The common nature of this style of eruption and its products, regardless of magnitude, means that our understanding of the exact processes which influence atmospheric chemistry and environmental impact is very important.

The Nornahraun fissure eruption in North Iceland that began on the 31st August 2014, has quickly become one of the best documented eruptions of its kind, through systematic monitoring and sampling by the Institute of Earth Sciences eruption team and The Icelandic Meteorological Office. As a result it is an excellent modern analogue for historic or ancient basaltic fissure eruptions, for which the amount of degassing can only be estimated through petrological and geochemical methods. It also serves as a timely testing platform for novel geochemical proxies. This study uses the exceptional sensitivity of the ^{187}Os - ^{187}Re radiogenic system to the presence of crustal material [5], and highly siderophile stable isotopes Cu, Zn and S to indicate the chemistry and degassing of the melt carrying S to the surface. The geochemical isotopic proxies will be tested using established petrological methods and gas emission data.

This study concentrates on determining the following key parameters:

- (1) The source of volatiles in the magma indicated through the pressure dependence of S solubility.
- (2) The mechanism of aerosol and gas release into the atmosphere is dictated both by the chemistry of the melt that controls the S species (H_2S , SO_2 or FeS_2) present [6], and by the mechanism of transfer.
- (3) The amount of volatiles released during a basaltic fissure eruption both at the vent (>70%) as well as during lava transport [2-4]. This uses the petrological method of Devine et al (1984) and a two-stage degassing model [3] to establish the total S budget.
- (4) The duration of atmospheric loading of volatiles in an eruption, which affects the residence time of these gases and aerosols.

The Nornahraun event provides the opportunity to verify the gas species and aerosols present in the atmosphere. By utilising the very well documented Nornahraun eruption, better constraints can be obtained on the atmospheric effects of well-known historical eruptions such as Laki 1783-84. Scaling up of such models to large flood basalt eruptions may shed light on their climatic effects and postulated association with major mass extinctions.

[1] Thordarson, T. et al. *Geol. Soc. London. Spec. Publ.* 213 (2003), 103-121.

[2] Guilbaud, M.-N. et al. *Journal of Petrology* 48.(2007), 1265-1294.

[3] Thordarson, T. et al. *Bulletin of Volcanology* 58.(1996), 205-225.

[4] Metrich, N. et al. *Contrib Mineraology Petrol* 107.(1991), 435-447.

[5] Gannoun, A. et al. *Science* 303.(2004),70-72.

[6] Burgisser, A., Scaillet, B. *Nature* 445.(2007), 194-197.

