Fingerprinting the source of sulphur saturation in flood basalt eruptions

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Flood Basalt (FB) eruptions are considered to cause significant atmospheric perturbations, which have postulated associations with mass extinctions [1]. Recent studies of the Deccan Traps and Columbia River Basalt Group, demonstrate that only the earliest erupted lavas have been driven to S oversaturation, indicated by the presence of immiscible sulphides, unlike their later counterparts [2]. Compositional variations present in these FB provinces have been attributed to changes in volatile saturation during eruption, due to the assimilation of crustal material in the earlier eruptive stages [2], which may explain the S oversaturation present in these earlier magmas. In turn, this influences the nature of the eruption itself, enhancing an eruptions' ability to loft S gases and aerosols into the upper levels of the atmosphere as well as controlling the size, coverage, and impact of the aerosol cloud [1]. Regardless of magnitude, basaltic fissure eruptions maintain similar eruptive styles, nature, and eruptive products. It is therefore logical to improve our understanding of the climatic and environmental impacts of these events using smaller scale, well-documented, modern analogues.

This study uses established petrological techniques [3] [4] to determine S burden of an eruption combined with novel geochemical proxies to identify: (1) The source of volatiles to the magma, utilising the exceptional sensitivity of the ^{187}Re-^{187}Os radiogenic system to the presence of crustal material, to differentiate between the processes of fractional crystallisation and crustal assimilation; (2) Duration of volatile release; (3) The mechanisms of release into the atmosphere, using siderophile stable isotope systems (S, Cu, Zn) to identify the S species released into the atmosphere upon eruption, each having very different atmospheric impacts, indicating the volatile source redox conditions. The focus case studies are Laki 1783-84, S. Iceland and Nornahraun 2014-2015, N. Iceland eruption, with the latter providing a unique platform to verify the petrological and isotope methods, through real-time lava and gas sampling.

[1] Thordarson *et al.* (2008), GSLSP, **213**, 103-121. [2] Vye-Brown *et al.* (2007), EPSL. **368**, 183-194. [3] Thordarson,*et al.* (1996). BV, **58**, 205-225. [4] Devine *et al.* (1984) JGR, **89.**