Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20215

Reassessing the timing and climate impact of the 1783 Laki eruption: new insights from high time resolution ice core analysis

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The 1783 Laki eruption in Iceland is one of the largest eruptions of the Common Era and is estimated to have injected 100-200 MT of sulfate into the atmosphere as well as 15 km^3 of tephra. Various climate anomalies coincide with this eruption, including and an exceptionally hot summer, and cold winter in Europe and various reports of persistent "dry fog" over Western Europe and even North Africa. However, key uncertainties remain about the timing and duration of this event and whether these northern hemisphere climate impacts were directly linked to Laki.

To better understand the timing and climatic impact of Laki we analysed an exceptionally high time resolution record of a key Greenland ice core (NGRIP, which gives us ~10 samples/year). Here we present sulfur isotope records for this event. These analyses can provide detailed information about the eruption timing, injection height and plume chemistry.

Sulfur isotopic results for $\delta^{34}S$ shows a positive trend from -6 ‰ to 4 ‰ through the eruption $\Delta^{33}S$ shows a similar positive trend with values from -0.13‰ to 0.16 ‰ indicating a dominant tropospheric/lower stratosphere transport pathway. We interpret this small but measurable $\Delta^{33}S$ trend as evidence for a SO_2 self-shielding effect and/or a very minor stratospheric S emission. This record present also a good consistency with previous Isotopic record of Laki eruption in Greenland Ice core.

Our ice core proxy evidence suggests a limited north hemisphere climate impact consistent with recent modelling efforts that also suggest Laki eruption would have had little or no direct impact on the climate of the year 1783-1784.