High-resolution sulfur isotopes from ice cores: insights into climatic impacts of double eruptions over the past 2000 years

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The record of the volcanic forcing of climate over the past 2500 years is reconstructed primarily from sulfate concentrations in ice cores. Of particular interest are stratospheric eruptions, as these afford sulfate aerosols the longest residence time and largest dispersion in the atmosphere, and thus the greatest impact on radiative forcing. Identification of stratospheric eruptions currently relies on the successful matching of the same volcanic sulfate peak in ice cores from both the Northern and Southern hemispheres (a "bipolar event"). These are interpreted to reflect the global distribution of sulfur aerosols by the stratospheric winds. Despite its recent success, this method relies on precise and accurate dating of ice cores, in order to distinguish between a true 'bipolar event' and two separate eruptions that occurred in close temporal succession.

Sulfur isotopes can been used to distinguish between these two scenarios since stratospheric sulfur aerosols are exposed to UV radiation which imparts a mass independent fractionation[1]. Mass independent fractionation of sulfate in ice cores thus offers a novel method of fingerprinting stratospheric eruptions, and thus refining the historic record of explosive volcanism and its forcing of climate. Here we present new high-resolution (sub-annual) sulfur isotope data from the Tunu Ice core in Greenland and B40 ice cores from Antarctica over several eruptions, with a focus on major double eruptions that occurred within a few years of each other, and their climatic impact.

[1] Baroni, M., Thiemens, M. H., Delmas, R. J., & Savarino, J. (2007). Mass-independent sulfur isotopic compositions in stratospheric volcanic eruptions. *Science*, *315*(5808), 84–87. http://doi.org/10.1126/science.1131754