

## 2.093 Halogens role during the production of sulfate in tropospheric volcanic plumes.

Early Career Scientist

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Abstract:

Volcanic emissions are among the major natural sources of sulfur and reactive halogens in the atmosphere (i.e. chlorine and bromine). However, volcanic plumes are radically different environment compared to background atmosphere. Notably, reactive halogens can modify the budget of atmospheric oxidants via ozone depletion events (ODEs), thus they can affect dynamics of atmospheric oxidation. Moreover, there are still significant uncertainties pertaining to atmospheric oxidation of volcanic SO<sub>2</sub>, while growing evidence suggests that halogens can influence the atmospheric sulfate budget. Mass independent fractionations (MIF) can be used as quantitative markers to detect atmospheric pathways of reaction. The majority of the oxygen isotopic anomalies observed in sulfates originate from ozone and it is transferred during tropospheric oxidation of SO<sub>2</sub>. An oxygen isotopic chemistry scheme for sulfate is implemented into a photochemical box-model (CiTTYCAT) that contains a detailed description of tropospheric chemistry. The chemical scheme has been extended with heterogeneous chemistry of S(IV), S(VI) and halogen species, in both sulphate aerosols and cloud water droplets. The oxygen isotopes MIF scheme has been implemented to simulate the evolution of O-MIF of tropospheric sulfate. The model is used to determine pathways of sulfate formation during the oxidation of volcanic SO<sub>2</sub>, during both erupting activity and passive degassing. Comparisons within isotopic compositions of sulfate from volcanic deposits and modeled O-MIF confirm that SO<sub>2</sub> is oxidized by O<sub>2</sub>/TMI in the aqueous phase of condensing volcanic clouds. Finally, sulfate O-MIF suggests that during passive degassing volcanic SO<sub>2</sub> is oxidised by OH in the gas phase, and by H<sub>2</sub>O<sub>2</sub> in the liquid phase of sulfate aerosols.