

The 60 years history of atmospheric formation pathways responsible for sulfate based on triple oxygen isotopic composition of sulfate preserved in SE-Dome ice core

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The atmospheric sulfate is important for both climate change and air quality; it influences radiation forcing and cloud's lifetime, and accounts for major components in fine particulate matter mass in urban regions with affecting visibility and public health. The emitted SO₂ is oxidized by OH radicals in the gas-phase, but modeling studies suggest that the large proportions (~80%) of global sulfate production were occurred in the aqueous-phase. However, the treatment of aqueous-phase in cloud pH set in atmospheric chemistry-transport models had the largest impact for atmospheric sulfate concentrations. Due to the lack of critical understanding for the chemical processes responsible for sulfate production, it is difficult to predict future changes in [SO₄²⁻] and its effects on climate and air quality.

To help address this, here we use mass-independent oxygen isotopic composition ($\Delta^{17}\text{O}$) of sulfate providing insight into past oxidation pathways responsible for sulfate formation. We present $\Delta^{17}\text{O}$ of SO₄²⁻ obtained from a 90.45 m depth ice core drilled at a high-elevation dome site in southeast Greenland called SE-Dome, covering the last 60 years. We found that $\Delta^{17}\text{O}$ of SO₄²⁻ with low during the 1960s-1970s and high in after the 2000s. This increase in $\Delta^{17}\text{O}$ of SO₄²⁻ indicates that sulfate formation pathways responsible for sulfate changed after 1960 to the present along with declining SO₂ emission. In the presentation, we will discuss the enhanced role of a oxidation processes contributing to increase $\Delta^{17}\text{O}$ of SO₄²⁻, and its implication to the changes in atmospheric chemistry though the changes in anthropogenic activities. This provides insight into direct and indirect effects of anthropogenic activities to the air quality by changing sulfate formation pathways. These functions, so called "chemical feedback", should be considered for making efficient mitigation policy for climate change and air quality by controlling emission of anthropogenic pollutants.

Keywords: stable isotope, Sulfate, Triple oxygen isotopes, Chemical feedback