

Insights into sulfate sources and water availability in the Atacama Desert through triple oxygen, strontium, and sulfur isotopes

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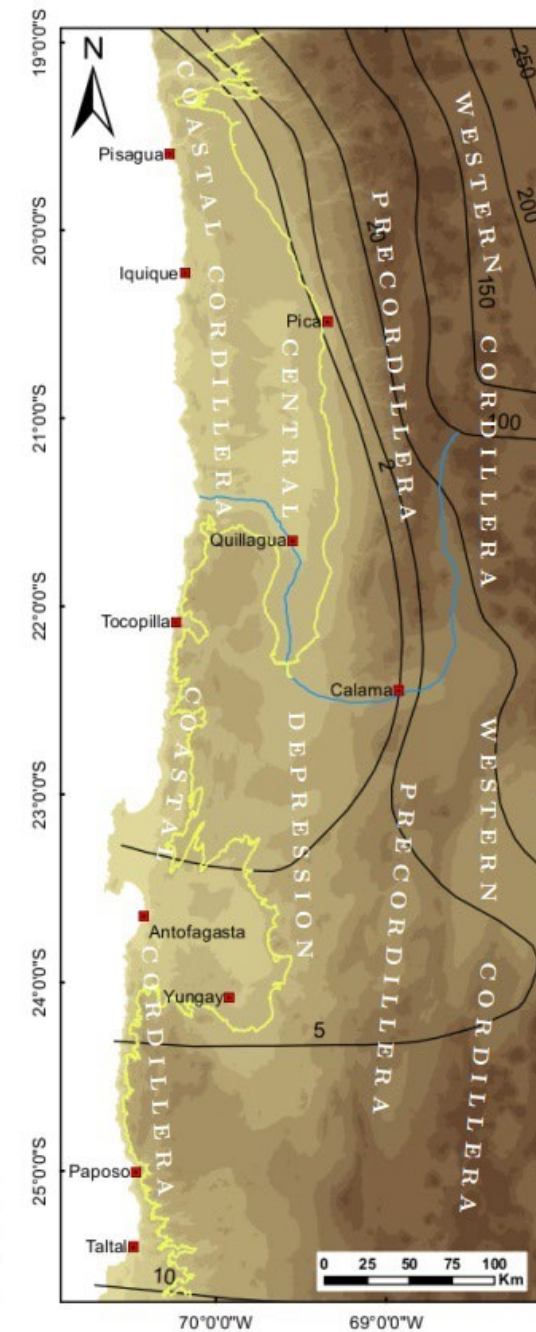
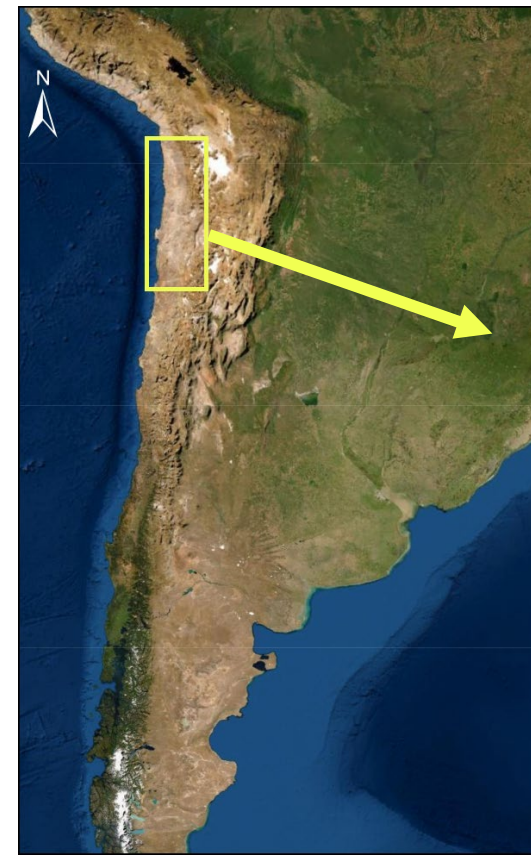
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Leibniz Institute for Baltic Sea Research, Geochemistry and Isotope Biogeochemistry, Warnemünde, Germany

University of Rostock, Department of Maritime Systems, Rostock, Germany

Atacama Desert



Sulfate Sources

primary atmospheric sulfate (PAS)

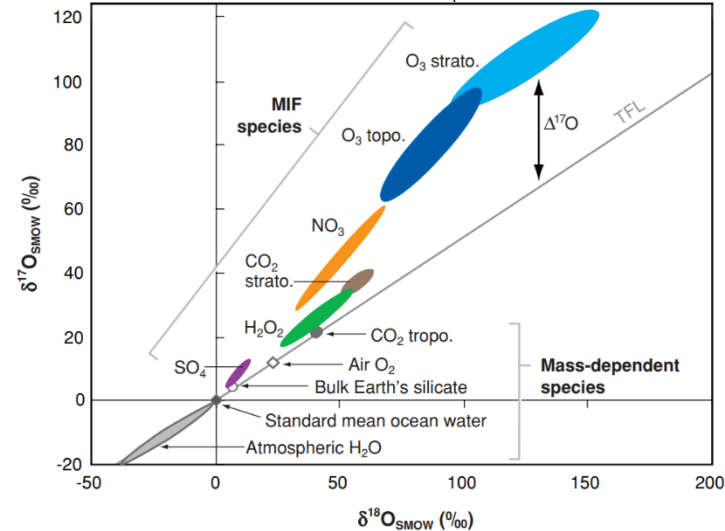
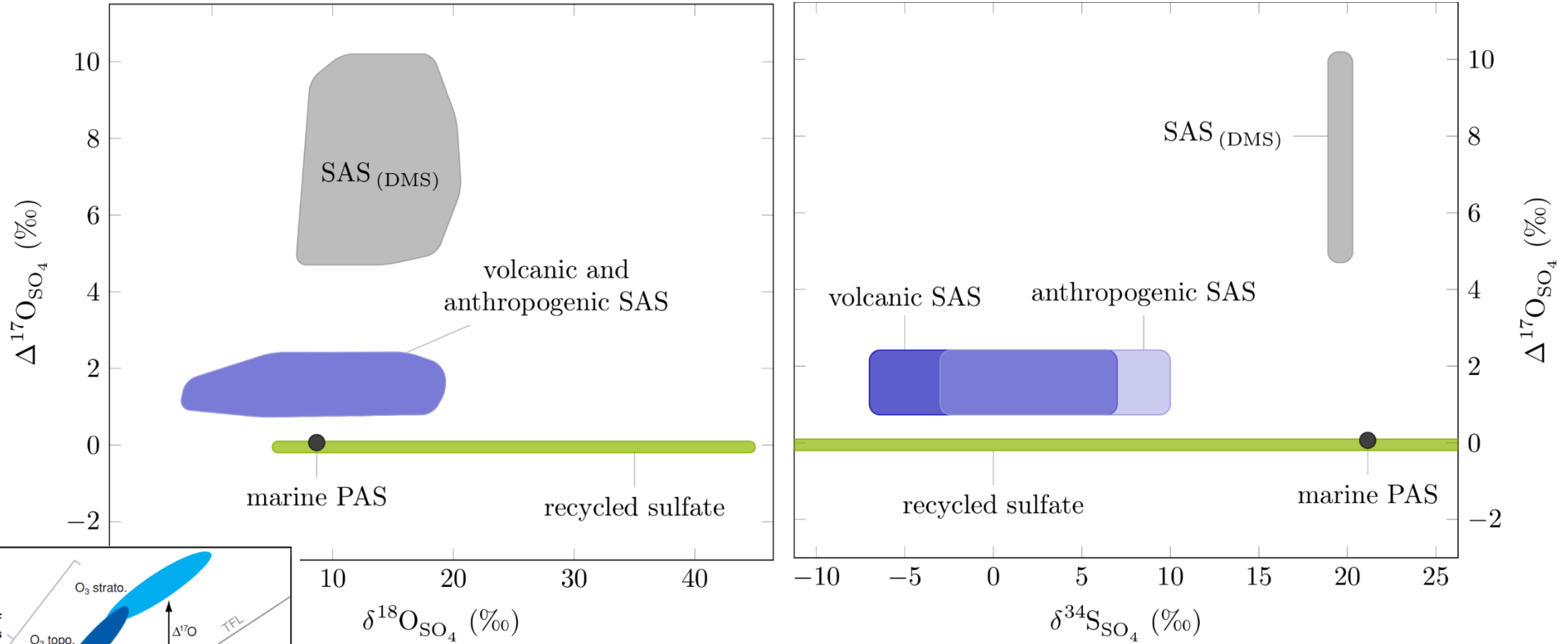
emmits into the atmosphere as sulfate

secondary atmospheric sulfate (SAS)

forms within the atmosphere by oxidation

biological sulfate recycling
depends on water

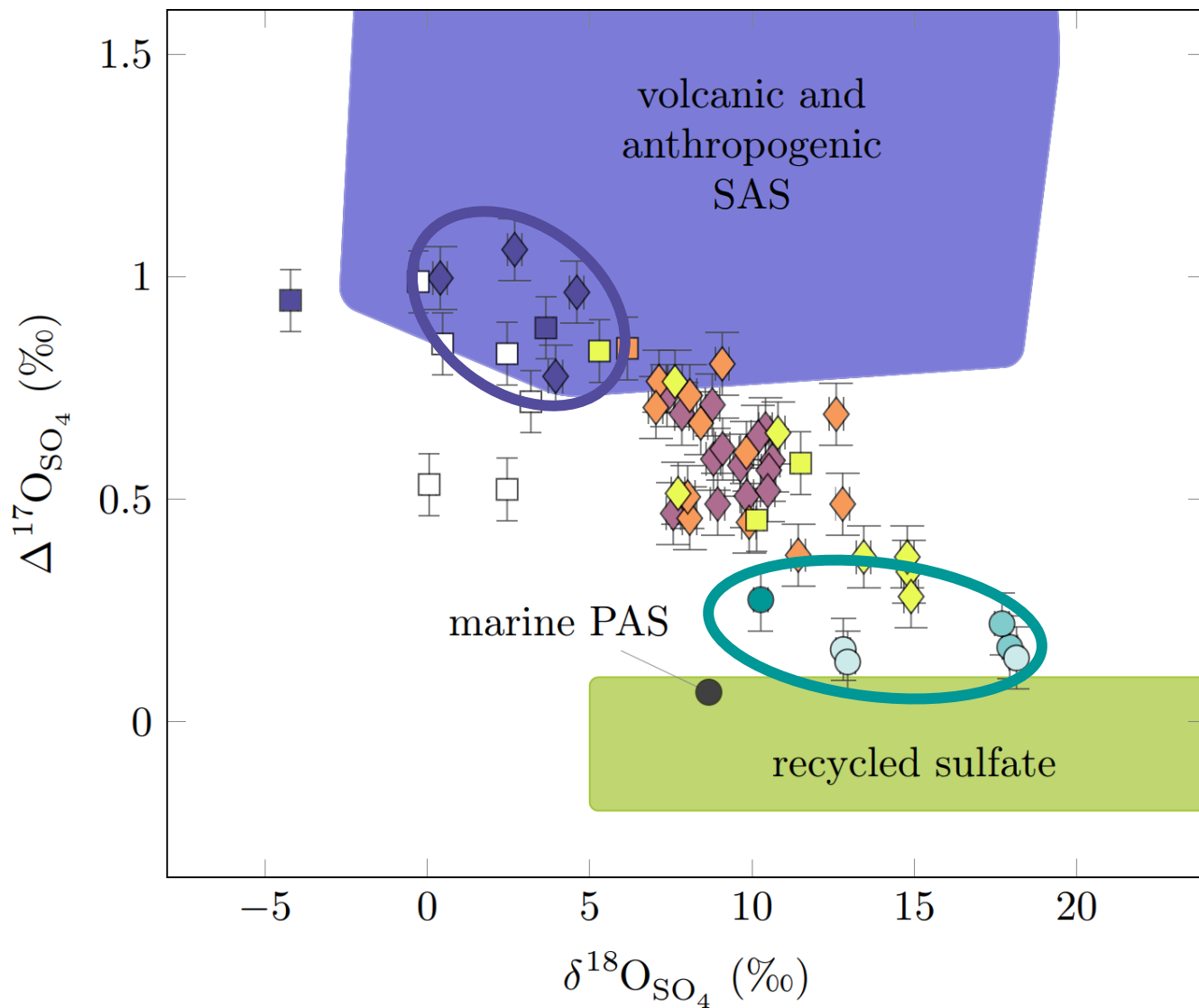
Sulfate Sources



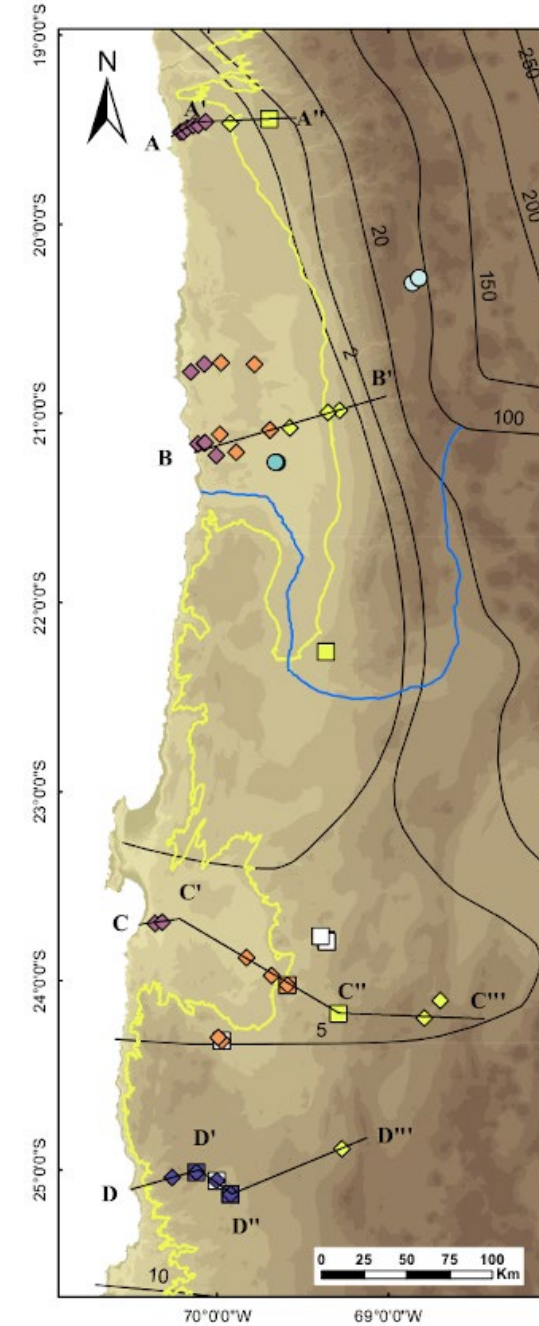
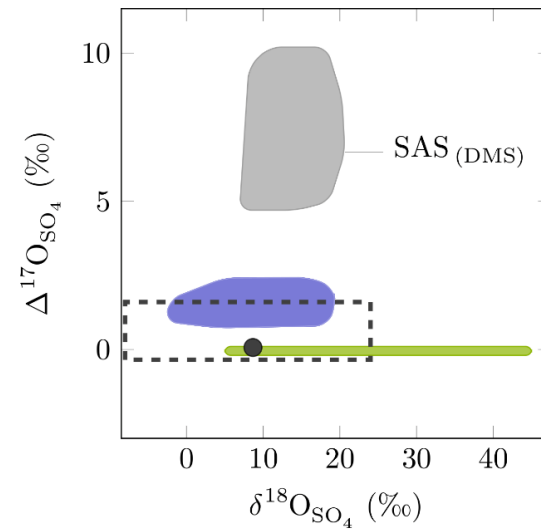
Thiemens (2006)

Considerable positive $\Delta^{17}\text{O}$ values are only observable in SAS. Biological recycling leads to $\Delta^{17}\text{O}$ that converge towards 0‰. High $\delta^{34}\text{S}$ values originate from marine sulfur.

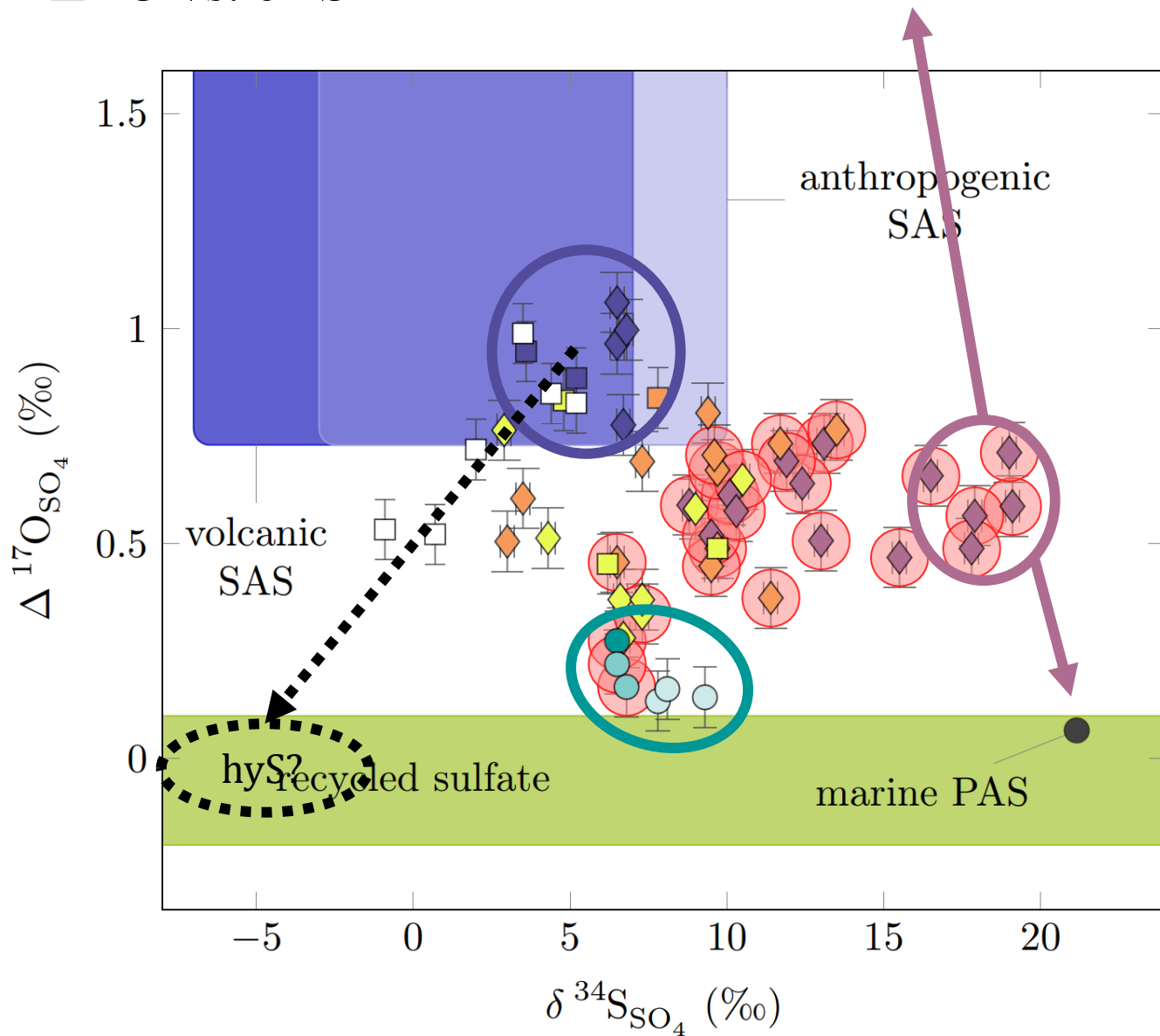
$\Delta^{17}\text{O}$ vs. $\delta^{18}\text{O}$



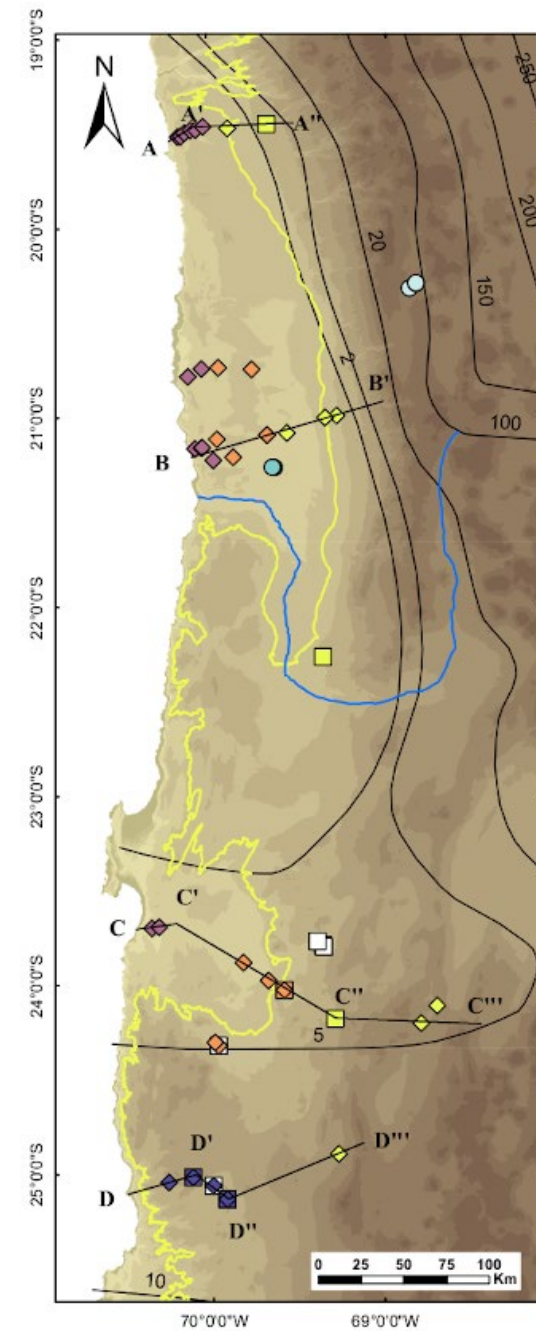
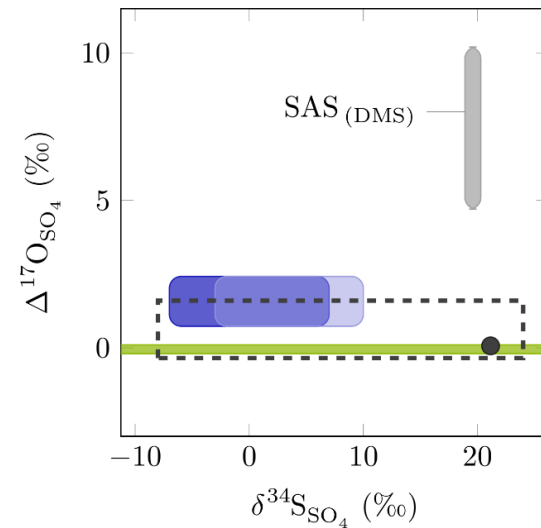
- ◆ High CC surface
- High CC subsurface
- ◆ Low CC surface
- ◆ CD surface
- CD subsurface
- ◆ PC surface
- PC subsurface
- Na_2SO_4 subsurface
- Llamará GW
- Salar de Llamará
- Salar del Huasco



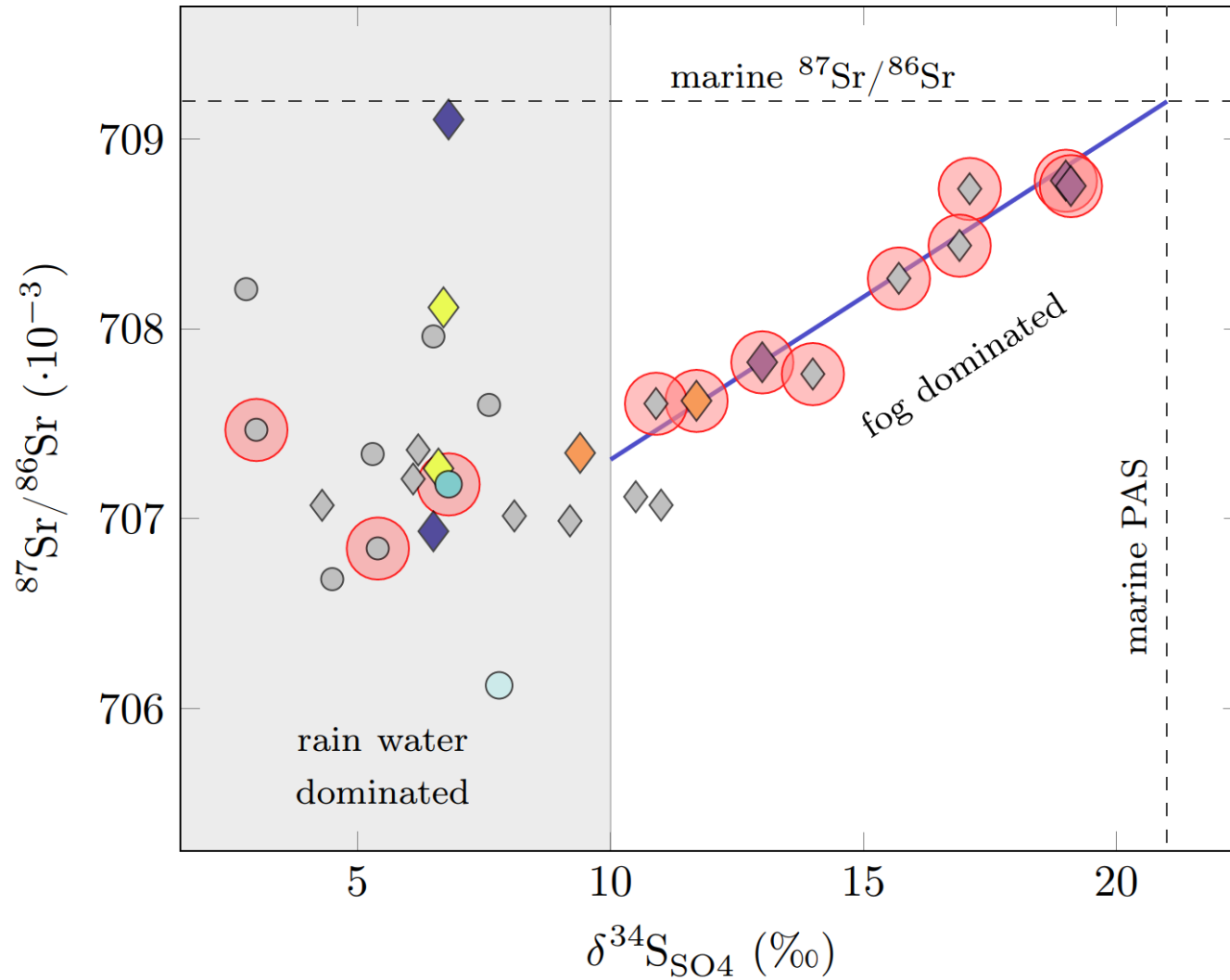
$\Delta^{17}\text{O}$ vs. $\delta^{34}\text{S}$



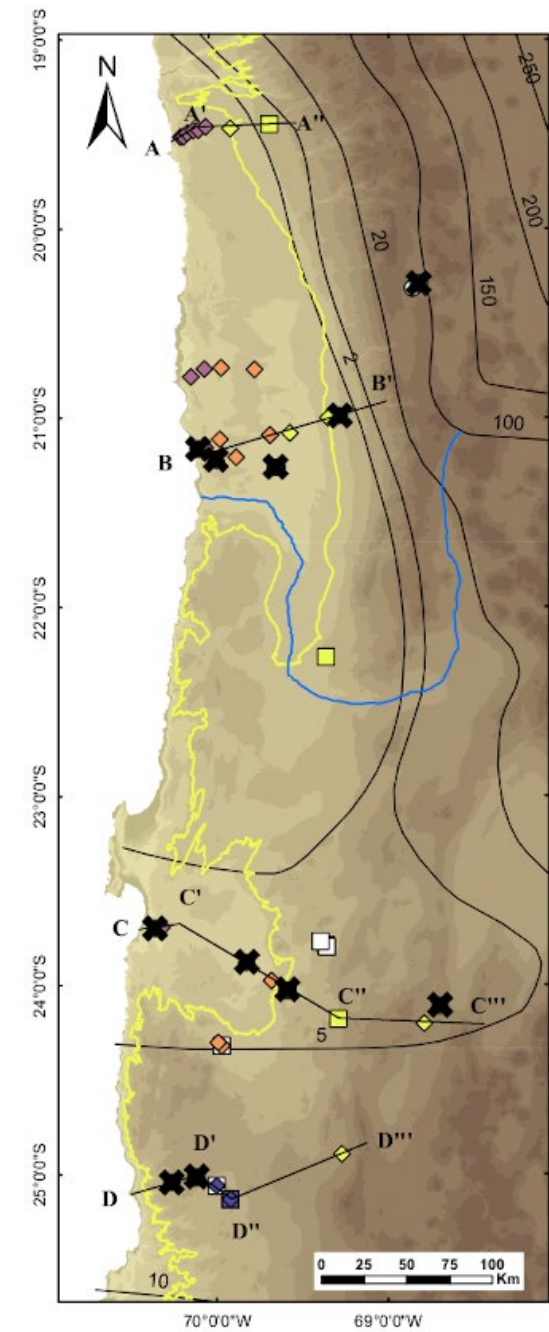
- ◆ High CC surface
- High CC subsurface
- ◆ Low CC surface
- ◆ CD surface
- CD subsurface
- ◆ PC surface
- PC subsurface
- Na_2SO_4 subsurface
- Llamará GW
- Salar de Llamará
- Salar del Huasco



$^{87}\text{Sr}/^{86}\text{Sr}$ vs. $\delta^{34}\text{S}$



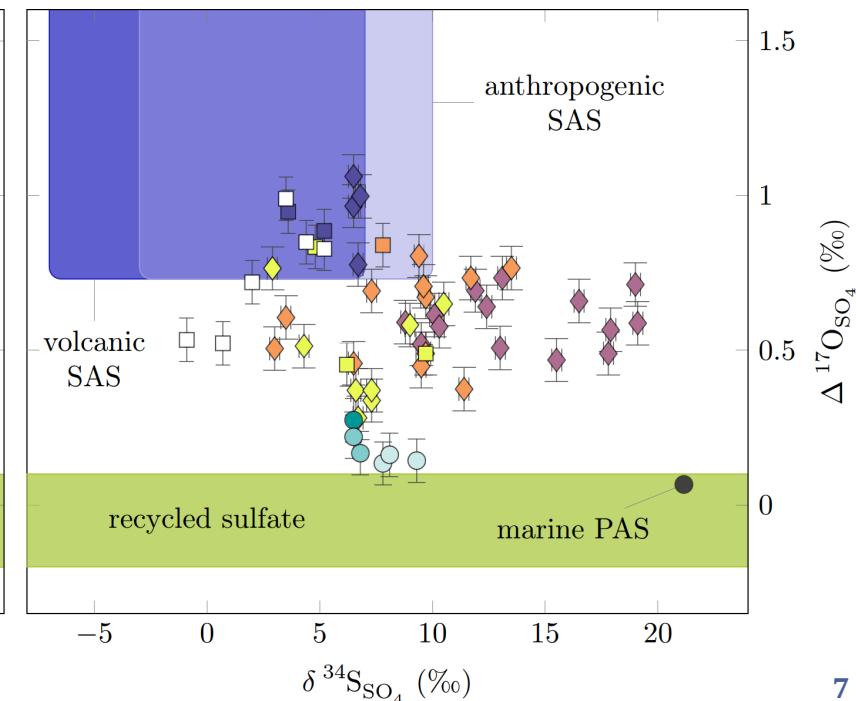
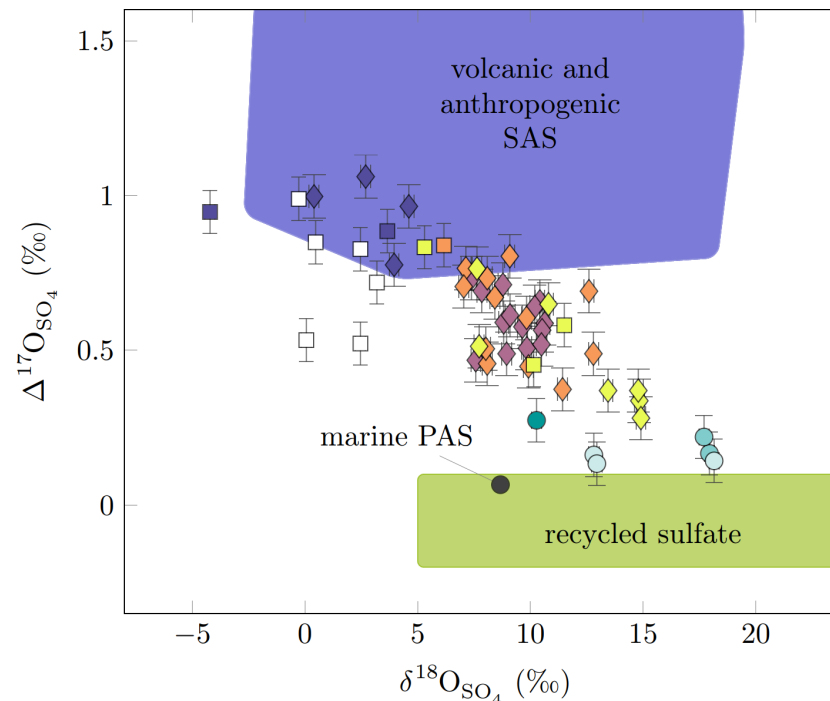
- High CC surface
- Low CC surface
- CD surface
- PC surface
- Salar de Lllamará
- Salar del Huasco
- Streams and salars (Rech et al. 2003)
- Sediment (Rech et al. 2003)



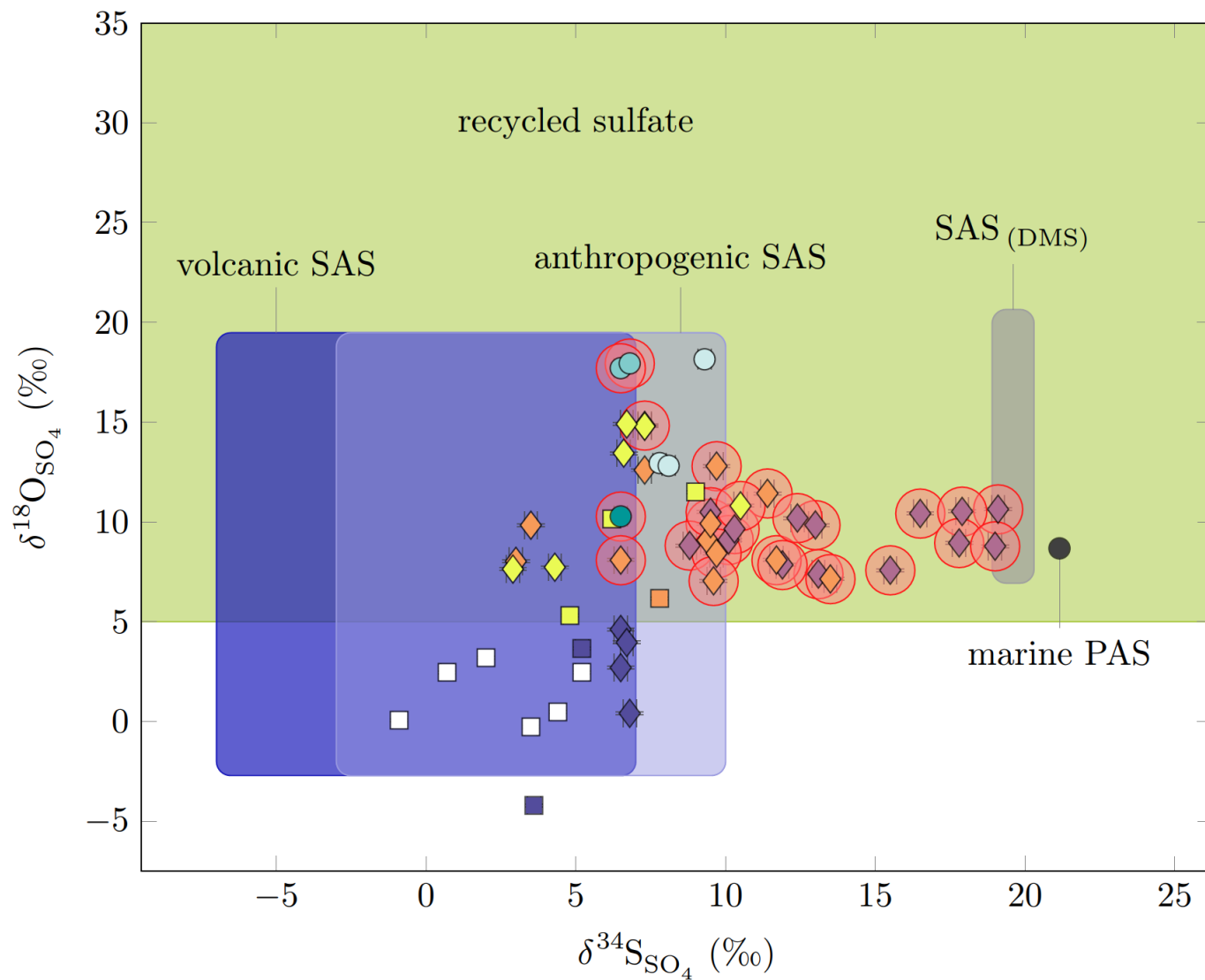
Take Home Messages

- The inverse relationship between $\delta^{18}\text{O}_{\text{SO}_4}$ and $\Delta^{17}\text{O}_{\text{SO}_4}$ serves as an indicator for sulfate recycling and thus, indirectly reflects water availability.
- High $\Delta^{17}\text{O}_{\text{SO}_4}$ values ($\sim 1\text{‰}$) reflect low contributions from other sulfate sources than SAS and indicate low degrees of biological sulfate recycling.
- Multi isotope analyses allow the identification and even quantification of different sulfate sources and the biological sulfate recycling.

**Thank you for your
attention!**



$\delta^{18}\text{O}$ vs. $\delta^{34}\text{S}$



- ◆ High CC surface
- High CC subsurface
- ◆ Low CC surface
- ◆ CD surface
- CD subsurface
- ◆ PC surface
- PC subsurface
- Na_2SO_4 subsurface
- Llamará GW
- Salar de Llamará
- Salar del Huasco

