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Paving the way to understand Sulphur-35 deposition via precipitation in time and space by fine-tuning sample preparation and analytical method

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Sulphur-35 (³⁵S) is a cosmogenic radionuclide () that after rapid oxidation to sulphate enters the hydrological cycle via precipitation. Unlike many other tracers, ³⁵S provides direct evidence of stratospheric contributions to surface-level chemistry, which is critical for atmospheric and air quality modelling. Furthermore, ³⁵S can be used to reconstruct input functions for groundwater dating. Little is known, however, about how ³⁵S varies in precipitation as a function of time and space.

Traditional analytical approaches for ³⁵S have been limited and challenged by large sample volume requirements, complex processing steps, and high uncertainties in liquid scintillation counting. To address these limitations, a robust, field-deployable method, optimised for diverse hydrological matrices including precipitation, rivers, lakes, and shallow groundwater was developed (Wangari et. al. 2025). Specifically, for analysing ³⁵SO₄²⁻ in precipitation at the Isotope Hydrology Laboratory (IAEA) laboratory (Vienna, Austria), we achieved a reduction of required sample volumes to one Litre without compromising analytical sensitivity. First, this effort facilitates the event-based sampling which enables a finer temporal scale for ³⁵S, allowing to discern different atmospheric constellations. Second, this streamlined protocol significantly increases the ability to ease sample collection, storage and international shipping. The workflow has been optimized for traceability, eliminating laboratory handling error risks and maximizing the detection of ³⁵S in low activity measurements. Ion Chromatography is used to quantify potential losses of sulphate and consider different chemical compositions in precipitation. We discuss the purification steps used to eliminate interfering radionuclides, quenching agents, and chemiluminescence to reduce background and increase efficiency. Event-based precipitation ³⁵S data from Vienna demonstrates the prowess of this method and distinguish atmospheric processes throughout the study period.

Wangari, S., Harjung, A., Machado, D., McGuire, B., Schubert, M., Kopitz, J., Lin, M., Copia, L., and Bibby, R.: Field sampling, sample preparation and measurement of radio-sulfur in natural water samples, EGU General Assembly 2025, Vienna, Austria, 27 Apr–2 May 2025, EGU25-17720, <https://doi.org/10.5194/egusphere-egu25-17720>, 2025.

