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Isotope insights into sulfate loads and sulfur cycling in a heavily polluted river network

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Sulfate isotopes in a heavily polluted river network

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The Spree is the major river system in NE Germany, with about 380km in length and a catchment of more than 10,000 km^2. While intensive open pit lignite mining in the upper catchment has significantly altered the hydrology and hydrochemistry over the last century, River Spree is at the same time a critical supplier of drinking water to the city of Berlin. Acid mine drainage is the major contributor to the river water sulfate load, which frequently exceeds the drinking water limit of 250mg L^{-1}. Increasing summer drought and low-flow regimes are projected to intensify this situation in the future. The sulfate pollution in River Spree has induced a significant shift in biogeochemical regimes, in particular in those compartments of the river network where low flow velocity is supportive to sediment accumulation and bacterial sulfate reduction. Secondary effects include the mobility of iron and phosphorus, and entail critical consequences for the aquatic ecosystem.

In this contribution, we discuss the results of an integrated study of hydrochemistry and sulfate and water isotopes in the Spree river network. We put particular emphasis on

(1) Differentiating major geographic and functional sulfate sources and sinks in the Spree river network based on sulfur and oxygen isotopes in river sulfate

(2) Quantifying these sources and sinks by simple endmember models, and identifying limitations of this approach

(3) The role of biogeochemical sulfur cycling (reduction/reoxidation cycles and intermediates) in retention spaces of the river network and the consequence for prevailing isotope signatures.