

Seasonal variations and cycling of sulfate using sulfur isotopes and concentrations from an unsaturated zone of a floodplain

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Floodplains can play a major role in the biogeochemical cycling of sulfur due to their interaction with river sulfate and atmospheric deposition of sulfur compounds.

In an effort to quantify SO₄ seasonal variations, cycling, and budgets in an alluvial aquifer in western Colorado (Rifle, CO, USA), the concentrations and sulfur stable isotopes of SO₄ within the pore water of partially saturated sediments have been monitored over a one year period from 2013 to 2014.

0.5m to 3m vertically resolved profiles were sampled bimonthly at 0.5m increments. At each of the profile locations, SO₄ concentrations decreased from 3 to 1.5m depth. The maximum concentrations were observed at the interface between the unsaturated zone and groundwater, with minimum values observed in the near surface samples. The δ³⁴S values increased from the unsaturated zone/groundwater interface to the surface. The variation of SO₄ concentrations and δ³⁴S values suggest the role of sulfate reducing microbial communities.

SO₄ concentrations and δ³⁴S values exhibited a strong seasonal variation. Maximum SO₄ concentrations (~65ppmv) were observed during the winter-spring time period, coinciding with the annual minimum in water table elevation. The minimum SO₄ concentrations were observed in the period from July to November and coincided with high water table elevations. Additionally, low concentration and maxima in δ³⁴S coincide with the maximum concentrations of N₂O (~10ppmv) associated with denitrification suggesting a seasonal shift of the redox potential in the alluvial aquifer.