Declining Sulfur in Agricultural Watersheds

Air pollution legislation to control fossil fuel sulfur emissions and the associated acid rain has worked—perhaps leading to the need for sulfur fertilizers for crop production. Sulfur is an important crop nutrient, but limited information is available about sulfur inputs, outputs, and balances in tile-drained agricultural fields and watersheds in the upper Midwest.

In an open access article in the July–August 2016 issue of the *Journal of Environmental Quality*, researchers estimated long-term sulfur inputs and outputs in tile-drained agricultural watersheds, including measurements of sulfate in tiles and rivers. Sulfate concentrations and yields steadily declined in the Embarras (from ~10 to 6 mg S L^{-1}) and Kaskaskia rivers (from 7 to 3.5 mg S L^{-1}) during the sampling period, with an overall –23.1 and –12.8 kg S ha^{-1} yr^{-1} balance for the two watersheds. There was evidence of deep groundwater inputs of sulfate in the Salt Fork watershed, with a much smaller input to the Embarras and none to the Kaskaskia. Tiles in the watersheds had low sulfate concentrations (< 10 mg S L^{-1}) similar to the Kaskaskia River, unless the field had received some form of S fertilizer. Added sulfur was transported quickly to surface waters, however.

Although atmospheric deposition was much less than outputs (grain harvest + stream export of sulfate), riverine transport of sulfate reflected the decline in inputs (deposition today is about 25% of the peak amount 40 years ago). Negative watershed S balances suggest a small annual depletion of soil organic S pools, and S fertilization will likely be needed at some future date to maintain crop yields.

Adapted from David, M.B., L.E. Gentry, and C.A. Mitchell. 2016. Riverine response of sulfate to declining atmospheric sulfur deposition in agricultural watersheds. J. Environ. Qual. 45:1313–1319. View the full open access article online at http://dx.doi.org/doi:10.2134/jeq2015.12.0613

Many power plants burn coal that releases sulfur into the atmosphere, but coal use has declined and scrubbers are used to remove sulfur from flue gases. In this sample from an Illinois mine, pyrite is visible as gold flecks in the center of the coal. *Photo by Debra Levey Larson, University of Illinois.*

Thermal Desorption Alters Soil Physical Properties

Increasing energy development in the Northern Great Plains exposes agricultural land to higher risk of accidental releases of petroleum products during extraction and transportation. Ex situ thermal desorption is a remediation technique commonly used to reduce petroleum hydrocarbon concentration in soil, but very little information is available describing the effects of this process on soil properties.

A study in the July–August 2016 issue of *Journal of Environmental Quality* examines the effects of thermal desorption at 350°C on soil physical and hydraulic properties. Further, researchers discuss the implications of these effects on agricultural productivity.

Compared with untreated soils, soils treated by thermal desorption had less soil organic carbon, surface area, and total aggregation. These physical characteristics dictated altered water balances in the treated soils, wherein saturated hydraulic conductivity increased more than 400% and water retention decreased at field capacity and wilting point.

These changes, revealed by direct comparison between treated and untreated samples, indicate that plant productivity may be diminished following thermal desorption treatment. However, in a broader context, the properties of the treated soils in this study are similar to many other soils commonly used for crop production. Thus, for petroleum hydrocarbon releases on agricultural land, ex situ thermal desorption may rapidly reduce hydrocarbon concentration while allowing for reuse of agricultural soil.

Adapted from O'Brien, P.L., T.M. DeSutter, F.X.M. Casey, N.E. Derby, and A.F. Wick. 2016. Implications of using thermal desorption to remediate contaminated agricultural soil: physical characteristics and hydraulic processes. J. Environ. Qual. 45:1430–1436. View the full article online at http://dx.doi.org/doi:10.2134/jeq2015.12.0607

Thermal desorption unit used to treat the soils in this study.