

Use of Sulfur Isotopes to Monitor Dissolved Sulfate Derived from a Fly Ash Disposal Site, North-Central Colorado

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A pilot-scale field demonstration of the beneficial use of fly ash to fill depressions from gravel mining provided an opportunity to evaluate the impacts of ash leaching on ground water quality. Concentrations of dissolved constituents commonly leached from fly ash, such as Ca, SO₄, Na, Cl, B, Se, were periodically measured over nine months in pore waters of two trenches filled with 400 tons of ash, and in a network of eight monitoring wells located 10-125 ft. downgradient. The sulfur isotopic composition of dissolved sulfate also was measured because preliminary data indicated a strong isotopic contrast between $\delta^{34}\text{S}$ of sulfate leached from original fly ash [8.5 ± 2.3 per mil (‰)] and sulfate in local ground water (-2.1 to -3.5 ‰). Despite similar concentrations of dissolved sulfate (1000 to 1500 mg/L) in waters from the two trenches and in a background well upgradient from the trenches, sulfur isotope-based mixing calculations showed that three downgradient wells had temporally variable contributions (10 to 35 percent) of ash-derived sulfate. Sulfate $\delta^{34}\text{S}$ analyses are readily available at modest cost, are conservative indicators of mixing in oxidizing environments, and are easily integrated with other water quality measurements. For example, the amount of fly ash-derived sulfate in well waters correlated positively with dissolved boron (<1 to 35 ppm), another strong indicator of fly ash leachate identified at the study site. Large contrasts in sulfur isotopic composition are a condition of this application and are most likely to be found at fly ash disposal sites or land application sites that are removed from coal mine sites or power plants.

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