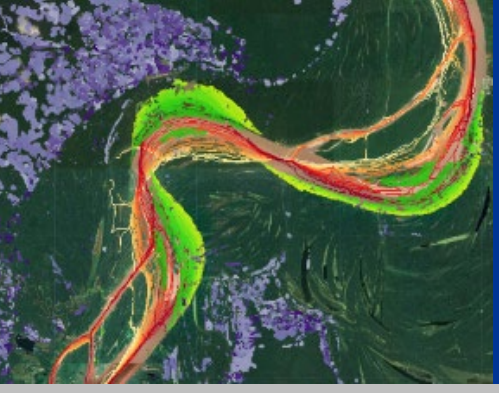

Geology & Environmental Science
University of Pittsburgh

Spring 2024 Colloquium Series

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Coal mine drainage contaminant trend prediction in an Appalachian basin, USA

ABSTRACT: Coal mine drainage (CMD) in Northern Appalachia, United States, is a major pollutant that impairs thousands of kilometers of waterways with acidic, sulfate-rich, metalliferous effluent for decades after mine abandonment. CMD chemistry typically improves over a decadal timeframe after its initial formation; however, complex site-specific hydrogeochemical processes complicate decisions on contaminant prediction and long-term treatment strategies.

Irwin Coal Basin (ICB), in the bituminous coalfield of Pennsylvania, is an excellent case study of Appalachia CMD because it contains a series of partly to completely flooded abandoned underground mines within the Pittsburgh Coal Seam with net-acidic to net-alkaline character CMD. Historical and recent water quality data for eight CMD sites across the ICB, plus mineralogy and cation exchange capacity of overburden lithologies, were analysed to quantify important reactants and evaluate spatial and temporal water-quality trends. Since the 1970s, all eight ICB discharges have become less acidic, with exponential decreases in acidity, SO4, and Fe concentrations; only two of the eight CMD are still net-acidic. Additionally, along a ~50-km flow path from northeast to southwest in the basin, as overburden thickness and residence time increase, CMD becomes more alkaline and Na concentrations increase. Progressive evolution of the first-flush composition is simulated with a geochemical evolution model using PHREEQC. The commonly observed net-acidic to net-alkaline spatiotemporal transition results from progressive groundwater dilution plus sustained water-mineral reactions involving pyrite and carbonates, and cation exchange by clays. Finally, various treatment strategies and costs for evolving conditions were evaluated with AMDTreat 6.0 software: initial flush, early net-alkaline, present-day alkaline, and future. As expected, costs decreased with improving water quality and implementation of passive technologies.

Bagels, donuts, and coffee available in SRCC 219 before the talk!

January 11, 2024
Thaw 104 @ 4:00PM