WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: OH2361

Title: Origin and Transport of Radioactive Ra-226 in Coal-Mine Effluent, Perry County, Ohio

Focus Categories: Radioactive Substances, Geomorpological and Geochemical Processes

Keywords: Radium-226 in mine effluent

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Congressional District: 12

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Abstract

Abandoned coal mines in southeastern Ohio are continually discharging acid waters even in places where mining has ceased more than 30 years ago. Coal is enriched in radioactive uranium (U) and thorium (Th), which decay by emission of alpha, beta, and gamma rays to stable isotopes of lead (Pb). In particular, U-238 decays to the radioactive isotope Ra-226, which is a divalent cation and has a half-life of 1600 years. This isotope has been detected in the ferric hydroxide precipitate of the acidic tributaries of Rush Creek, located near New Lexington in Perry County, Ohio. Rush Creek and its tributaries are precipitating ferric hydroxide because the water is contaminated by acid mine-drainage due to abandoned coal mines. At low pH, the water is enriched in Ra-226 and little of this isotope is sorbed to the ferric hydroxide. As the water is transported downstream to higher pH values (~8), the radium ions are removed from the water as more cations are sorbed to suspended ferric hydroxide particles. Therefore, the aqueous geochemistry of radium causes this element to be in solution in acidic mine-effluent (pH = 2 to 4) and to be removed from the water by sorption on colloidal ferric hydroxide particles under near-neutral conditions (pH = 5 to 7).

The purpose of the study is to emphasize that radioactive daughters of U-238 and Th-232 are present in the effluent of abandoned coal mines in Ohio. In addition, we propose that the fraction of Ra-226 sorbed to ferric hydroxide is a function of pH from 3 to 8. A suite of water samples will be collected from Rush Creek in order to conduct laboratory experiments in which a saturated solution of sodium hydroxide is added to the water samples in aliquots to produce final pH values ranging from 3 to 8. Ferric hydroxide will precipitate from each aliquot and will be recovered and analyzed by gamma-ray spectrometry. We expect that the ferric hydroxide precipitated near acid-neutral pH values will have greater concentrations of Ra-226. It is expected that the Ra-226 concentrations will rise with increasing pH, reach a maximum, and then decline so that there is a pH zone of maximum radium concentration.