Using time resolved laser spectroscopy to probe apatite containing europium and curium.

KIEL HOLLIDAY[1]*, MORITZ SCHMIDT[2] AND THORSTEN STUMPF[3]

[1]Institut für Nukleare Entsorgung, Hermann-v.-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany (kiel.holliday@kit.edu)
[2]Argonne National Lab Chemical Sciences and Engineering Division Argonne, IL, 60439 USA (chlordioxid@arcor.de)
[3]Institut für Nukleare Entsorgung, Hermann-v.-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany (thorsten.stumpf@kit.edu)

Fluoro- and hydroxo-Apatite was synthesized at low supersaturation, close to equilibrium conditions, in the presence of europium or curium. Time resolved laser fluorescence spectroscopy was used to identify and characterize the nature of Eu/Cm sorption and incorporation within the mineral phase. Using site-selective excitation different interactions can be isolated. The lifetime and emission spectra were analyzed at each site that was identified. The number of hydrating waters was determined by the lifetime measurement and used to distinguish species that are sorbed to the surface from those incorporated into the bulk. Emission spectra were measured to determine the symmetry of the site being occupied by the sorbed or incorporated trivalent cation and determine the substitution for non-equivalent calcium positions. The effect of anion (i. e. fluoride, hydroxide) was also investigated because it is only present in the inner sphere of one of the calcium positions. The results from this study were used to characterize the interaction of trivalent actinides such as Pu, Am, and Cm with phosphate mineral phases relavent to nuclear waste repository performance and gain fundamental understanding of the processes governing the sorption, incorporation, and retention of such radioactive contaminants.

Microbial community structure and methylmercury production in a managed wetland ecosystem

J.M. HOLLOWAY[1]* C.T. MILLS[1], M.C. MARVIN–DIPASQUALE[2], C.N. ALPERS[3], L. WINDHAM-MYERS[2] J.A. FLECK[3] AND M.B. GOLDHABER[1]

[1]U.S. Geological Survey, Denver, CO 80225, USA (*correspondence: jholloway@usgs.gov)
[2]U.S. Geological Survey, Menlo Park, CA 94025, USA
[3]U.S. Geological Survey, Sacramento, CA 95819, USA

The Yolo Bypass Wildlife Area (YBWA), located east of the San Francisco Bay Area in northern California, is a wetland area managed for flood control, rice cultivation and migratory waterfowl habitat. The YBWA receives runoff from the Sierra Nevada and Coast Range, where historic gold and mercury mining left a legacy of elevated mercury concentrations associated with soils and stream sediments. A study was initiated in 2007 to address seasonal, spatial and process-level constraints controlling methylmercury (MeHg) production in the YBWA. One component of this study was to evaluate microbial community structure associated with wetland soils using microbial membrane phospholipid fatty acids (PLFAs) which are a quantitative measure of viable bacteria. Certain PLFAs (e.g. i17:1ω7c and 10Me16:0) are produced in abundance by sulfate reducing bacteria (SRB) which are known to mediate mercury methylation. Concentrations of these specific PLFAs have been shown to correlate with methylmercury production in other environments.

Total PLFA concentrations were a function of soil moisture (r^2=0.6) Highest PLFA concentrations were associated with cattail-dominant permanent wetland soils (170 - 290 nmol PLFA per g soil). Total PLFA concentrations in agricultural soils were associated with methlyation potential (r^2=0.6). However, the relative concentrations of PLFAs indicative of SRB had an inverse relationship with methylation potential. Methylation potential and total PLFA concentrations were not strongly correlative for wetland soils.

These data, together with concentration data for iron, sulfate, MeHg and other consitutents in wetland surface waters, indicate that methylation by SRB was not the dominant mechanism for forming MeHg in the YBWA, suggesting other metabolic pathways (e.g. microbial iron reduction) contributed to mercury methylation.