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Understanding Hydrobiogeochemical Drivers of Metal Export from Coal Creek, Colorado

Wei Zhi¹, Li Li², Jason Kaye³, Yuning Shi³, Carl Steefel⁴ and Kenneth Williams⁴

¹ Department of Energy and Mineral Engineering, Penn State University.

² Department of Civil and Environmental Engineering, Penn State University

³ Department of Ecosystem Science and Management, Penn State University,

⁴ Earth Sciences Division, Lawrence Berkeley National Laboratory

Contact: Li Li [lili@enr.psu.edu]

This project aims to develop predictive understanding of *key drivers of metal export at the watershed scale*. Metals association with dissolved organic carbon (DOC) is well documented at the laboratory scale. Preliminary data for Coal Creek, Colorado, have indicated similar connections – the concentration and discharge relationships of metals such as Cd and Zn mirror those of DOC demonstrating strong flushing (chemodynamic) behavior, in contrast to the chemostatic behavior of geogenic species that are the products of chemical weathering. In other words, in the high elevation Coal Creek watershed, most metal export occurs during the high flow - spring melt period (4.5% of the time), contributing disproportionately high fractions of 37% and 49% to the total annual water and DOC export, respectively. In this project we will 1) develop an integrated hydrobiogeochemical model at the watershed scale to systematically explore the connections among hydrological processes, soil carbon decomposition into DOC, and metal export; 2) apply the model to understand key drivers of metal export from Coal Creek.

In particular, we are developing a bioreactive module bio-RT to simulate processes including soil carbon stabilization, soil carbon decomposition into DOC, as well as complexation between DOC and metals. The module will be written in general framework and not for a particular watershed. All specifics of particular biogeochemical systems and watersheds will be communicated through input and output files. We will ultimately integrate bioRT into the IDEAS codes. Such a modeling tool is important not only for Coal Creek, CO, but also for other human-impacted watersheds including those in Appalachian Basin that extends thousands of miles. Human activities including historical mining and current natural gas production have threatened water resources that are important for tens of million people. Predicting capabilities are also essential in understanding the responses of these contaminated watersheds to changing climate.