Project Summary

Particulate organic matter (POM) transport and transformation at the terrestrial-aquatic interface

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This project examines the input and metabolism of particulate organic matter (POM) in near-surface riverbed sediments at the PNNL SFA Hanford 300 Area study site, where large fluctuations in water stage drive periodic fluid flow into or out of the hyporheic zone. Such POM input has the potential to strongly impact the biogeochemistry of both the river itself as well as the hyporheic zone (or, more broadly, the hyporheic corridor) that is connected hydrologically to the river. The central hypothesis of our project is **that advective introduction of POM into permeable riverbed sediments will result in its accumulation to levels much higher than the input concentration, which in turn will drive relatively rapid rates of microbial carbon and nutrient (N) metabolism. Additionally, we hypothesize that POM degradation may result in the export DOC and/or inorganic nitrogen into the underlying hyporheic zone.**

Current research efforts are examining in situ POM deposition and its potential degradation in the Columbia Riverbed using custom designed “POM traps” and in situ DO measurements to develop a qualitative model of POM and DO consumption in riverbed sediments to inform our laboratory mesocosm and column experiments. Smaller-scale, horizontal column experiments using Hanford Formation sand, sieved to remove fines, and POM, grown from a Columbia River inoculum, reveal that POM is primarily removed through filtration and a large portion of the POM is remobilized upon flow reversal. This data has been used to develop a quantitative model describing POM immobilization and remobilization. Larger-scale vertical column experiments, using ashed Columbia Riverbed sediment, have revealed that at high POM densities, both settling and advective transport are critical factors in vertical POM movement, with filtration also being the primary POM retention mechanism. This research directly addresses priority research objectives related to the need to quantify and predict how hydrology drives fine-scale biogeochemical processes in surface-subsurface systems, as well as quantifying how biological, abiotic-biotic interactions and molecular transformations control the mobility of nutrients and critical biogeochemical elements.