Rivers and other inland water systems are key sites of biogeochemical transformation and storage; they are also distinct ecosystems, geomorphological agents and conduits for material transport across continents to the oceans. Biogeochemical activity in rivers is often conceptualized as occurring predominantly in the water column. However, by far the largest amount of biogeochemical activity takes place within the riverbed, either at or just below the surface. This occurs because the concentration of organic matter (OM) and associated microorganisms is several orders of magnitude higher than the concentration in the water column. Such dynamics have fundamental implications for CO2 and/or CH4 production and efflux as well as retention and/or release and transport flux of other nutrients (e.g. N, P) associated with POM decomposition.

Current research efforts are focused on quantifying the short-term (< 0.5 day) accumulation of POM in simulated, permeable riverbed sediment. We have examined the transport and accumulation of fresh algal POM in column reactors packed with Hanford sand and fine-grained silt and clay. Additionally in batch experiments, we have determined that isolated humic acids (HA) can also provide electron donating equivalents to drive dissimilatory iron reduction (DIR), while at the same time serving as electron shuttles that accelerate DIR. Evidence of this phenomenon was provided by the overrepresentation of putative genes coding for enzymes that break down complex lignocellulosic material and (to a lesser extent) aromatic compounds in experiments containing HA. The potential for microorganisms to utilize a small but significant portion of HA is consistent with the emerging view of soil organic carbon as a continuum of variably decomposable organic compounds. The next phase of our research will investigate longer-term (2-4 week) decomposition dynamics of POM in permeable sediments under advective flow.