Hydrobiogeochemical Features and Function Across Basins

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Project Abstract: *This element of the PNNL River Corridor SFA combines WHONDRS data and numerical modeling to provide transferable principles that integrate organic matter (OM) chemistry, microbial gene expression, biogeochemistry, and disturbance.* We extend the RCSFA to the globe using crowdsourcing to understand transferable principles and to further establish ESS as a global leader in open watershed science. We are leveraging WHONDRS data while shifting the sampling paradigm to efforts guided more directly by the community. New sampling campaigns are smaller than previous global efforts and emphasize environmental contrasts. For example, samples are being taken through time in an agricultural stream system across different hydrologic conditions. This leverages existing research studying stream hydrobiogeochemistry. In another instance, we partnered with EXCHANGE (WHONDRS-like part of COMPASS) and the University of Quebec to study OM chemistry from source to sea along the St. Lawrence River. This spans multiple environmental gradients and a long-term research program. There are many more sampling efforts, including expansion to additional continents such as Africa. We also continue to generate data from existing samples such as metagenomics via JGI. These data are part of the Genome Resolved Open Watersheds (GROW) database. GROW goes beyond the RCSFA and is an open resource for global river corridor genomics. WHONDRS data are also increasingly used to gain new hydrobiogeochemical insights. For example, Danczak et al. (2021) discovered 'thermodynamic redundancy' whereby OM thermodynamics are invariant despite changes in molecular composition of OM. Changes in the identity of organic molecules may not, therefore, translate into functional differences associated with thermodynamics. In a community-led paper, Mueller et al. (2021) showed a strong influence of natural OM over transformations of organic contaminants. Garayburu-Caruso et al. (2020) provided a global summary of OM chemogeography across surface water and sediments. They found continental-scale gradients in OM chemistry, indicating large scale drivers of chemical properties. We are also changing the paradigm of open science through global crowdsourcing using WHONDRS data to study OM chemistry. Crowdsourcing in this effort spans the entire research life cycle and due to a high level of interest, will be a special issue of crowdsourced manuscripts all using WHONDRS data. Another outreach effort is launching the ICON Science institute, in partnership with EXCHANGE and GROW. The institute, launching in summer 2021, will enable the use of ICON principles across all of science.