Poster #21-14

Impacts of Transient Hydrologic Conditions on Metal and Carbon Cycling in the East River Floodplain

Christian Dewey,[1*] Patricia Fox,[2] Dipankar Dwivedi,[2] Carl Steefel,[2] Peter Nico,[2] and Scott Fendorf[1]

[1] Stanford University, Stanford, CA;
[2] Lawrence Berkeley National Laboratory, Berkeley, CA

Contact: cwdewey@stanford.edu

BER Program: SBR
Project: Student Travel Award

My research contributes to two DOE-funded projects: a university project (Stanford University) and a subproject of the LBNL Watershed Function SFA. The goal of the university project is to understand principal controls on carbon cycling in floodplains, while the goal of the SFA subproject is to understand the impact of floodplain sediments on river chemistry. My specific objective is to determine the impacts of transient hydrologic conditions (seasonal snowmelt, beaver dam construction) on exports of carbon and metals from meander sediments to the East River. My work toward this goal consists of: (1) instrumenting three-dimensional well-fields for hydrologic and biogeochemical characterization of meanders, and conducting high-frequency sampling of river, groundwater, and sediments at these sites; and (2) developing reactive transport models of meanders - including calibration and validation. Not only has this work led to an understanding of the processes controlling carbon and metal exports from floodplain sediments and their sensitivity to hydrologic transients, it also facilitates quantification of the effluxes of carbon and metals from the sediments to the river. Furthermore, the combination of fieldwork and modeling has revealed that oxidizing and reducing zones are spatially and temporally distributed in floodplain, and that these distributions act as a central control on fluxes of dissolved metals and carbon into river waters.

My research over the last two years centered on two summers (2017, 2018) of fieldwork at East River. This work is essential for both the university project and the SFA subproject, and includes installation of piezometers for groundwater sampling, rhizons for sampling pore-water from the unsaturated zone, and pressure transducers for recording groundwater levels. Surface and groundwater samples were collected for measurement of pH, electronic conductivity, redox potential, and temperature. Further, sediment cores were collected and examined for organic matter and metal chemistry. This summer (2019) will be my third field season in the East River area, continuing my examination of floodplain processes driving biogeochemical cycling of carbon and metals and their export into river waters.

Alongside fieldwork, I developed 2D and 3D reactive transport models (PFLOTRAN) of meanders posited to be hotspots of reactivity. With the models (validated with the high-resolution temporal and spatial data collected over multiple field seasons) I quantitatively integrated the hydrologic and biogeochemical processes in the meanders. The models facilitate quantification of carbon and metal fluxes from meander sediments to the river, and they reveal the sensitivity of the processes controlling fluxes to hydrologic changes.