

Impact of hyporheic zone on biogeochemical cycling of carbon

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Biogeochemical gradients that exist within the hyporheic zone play a key role in cycling carbon, both organic and inorganic. To investigate the impact of various processes on the fate and transport of carbon in the hyporheic zone, we develop a biogeochemical reaction network and integrate it into the flow and reactive transport code PFLOTRAN. The model includes representations of aqueous speciation, mineral precipitation/dissolution reactions, sorption, and microbially mediated redox reactions. The specific objectives of this study are to (1) identify biogeochemical zonation of variables due to hyporheic exchanges and (2) quantify the local fluxes of carbon that influence the larger scale carbon cycling. Three-dimensional reactive flow and transport simulations are carried out to describe the hyporheic exchange of carbon in two different hydrogeologic settings: (a) Rifle floodplain bordering the Colorado River and (b) the lower East River system, a high elevation catchment in western Colorado. The Rifle floodplain displays relatively flat topography and consists of a single aquifer discharging into the Colorado River, while the lower East River site has a rolling-to-mountainous topography with multiple river meanders extending over a distance of 11 km (Figure 1).

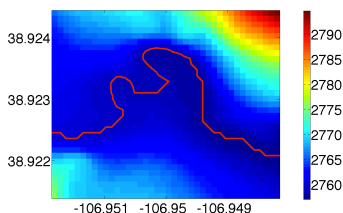


Figure 1: Map displaying DEMs (m) and Lower East River meandering along its path

Simulation results show the importance of including the activity of chemo(litho)autotrophs in predicting CO₂ fluxes at the Rifle floodplain into the Colorado River. In the lower East River site, preliminary results indicate that intra-meander hyporheic zone flow and reaction leads to lateral redox zonation as well as significantly influences the flux of both organic and inorganic carbon into the stream system. Efforts are underway to upscale the local carbon cycling displayed with individual stream meanders to the larger East River system, in part by making use of the high performance computing platform provided by PFLOTRAN.