SLAC Floodplain Hydro-Biogeochemistry SFA: Spatiotemporal Response of Soil-Gravel Bed Connectivity to Hydrological Transitions in an Intermountain Floodplain Aquifer

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Project Abstract: Riparian environments in the Intermountain West are often characterized by extensive interfaces between basal gravel/cobble alluviums and overlying fine-grained soils, which exhibit sharp redox and solute concentration gradients that mediate subsurface water quality. The biogeochemical function of these interfaces results from a tight coupling between hydrological and biogeochemical processes. In particular, the hydraulic connectivity between the gravel bed and the soil dictates the direction and intensity of solute exchanges, and consequently the capacity of the floodplain system to act as a sink or as a source for redox-sensitive nutrients or contaminants (*e.g.* Fe, C). Yet, the spatial evolution of this connectivity and its response to hydrological shifts remain poorly understood.

Our combined field and numerical modeling work on our field site of Slate River, CO, highlights the ways in which the gravel bed controls floodplain hydrology. Due to its large volume and hydraulic conductivity, the gravel bed acts as a preferential flowpath for regional subsurface flow in the down-valley direction, and shows a strong connection with surface water with fast response to hydrological shifts. In contrast, the overlying riparian soils correspond to a hydraulic transition zone between the gravel bed and the surface water, that accommodates smaller-scale hydro-geomorphological features such as the presence of a beaver pond. During snowmelt, rapidly rising water tables in the gravel bed impede downwards surface water infiltration and increase water residence times in the soil. During baseflow, declining water tables in the gravel bed drive more surface water into the soil and through the soil-gravel bed interface. Our work also indicates that the mostly downward flow direction at the soil-gravel bed interface may occasionally reverse, for instance in the return flow areas downstream of beaver dams, or in the distal areas from the stream where evapotranspiration becomes dominant over lateral surface water recharge. These results highlight how hydrologic dynamics and hydraulic connectivity help mediate intermountain floodplain function.