Geophysical Research Abstracts
Vol. 21, EGU2019-13434, 2019
EGU General Assembly 2019

Coupling between bedform migration, deposition of fine suspended particles, and hyporheic exchange flux

Shai Arnon (1), Yonathan Teitelbaum (1), Jonathan Dallmann (2), Colin Philips (2), Rina Schumer (3), Nicole Sund (3), and Aaron Packman (2)

(1) Ben-Gurion University of the Negev, Zuckerberg Institute for Water Research, Sde-Boker, Israel (sarnon@bgu.ac.il), (2) Northwewstern University, Civil and Environmental Engineering, Evanston, USA, (3) Desert Research Institute, Division of Hydrologic Sciences, Reno, USA

Hyporheic exchange is an ecologically important process that controls the exchange of nutrients between the water column and the bioactive streambed. Fine suspended particle deposition induces clogging and reduces hyporheic exchange flux, with potential significant effect on stream-groundwater interactions as well. Fine suspended particle deposition has primarily been studied with a focus on the streamwater perspective (i.e. particle concentrations in the water), while the detailed depositional implications were largely overlooked. To fill this gap, we conducted experiments to study the coupled behavior of sand-clay transport and deposition patterns, and their effect on hyporheic exchange flux. Experiments were conducted in a recirculating flume (640 cm X 30 cm) packed with homogeneous sand. Consecutive additions of kaolinite clay were done over a period of a few weeks. Hyporheic exchange flux was quantified after each clay addition using salt tracer additions. Exchange was also observed visually by adding a dye tracer to the overlying water at the beginning and end of the experiment of the experiment. High-frequency timeseries of bedform morphodynamics and water column kaolinite concentrations were measured during the whole period of the experiment. Vertical profiles of kaolinite concentrations in the bed were measured using cores.

We observed kaolinite deposition and streambed clogging in all experiments. Unlike the case with stationary bedforms, in which clay accumulates primarily on the stoss side of each bedform, moving bedforms redistributed the deposited kaolinite and shifted the location of hyporheic inflow as the bedforms propagated downstream. This led to kaolinite accumulation primarily below the maximum scour depth of the series of bedforms. The clogging pattern led to a reduction in hyporheic exchange flux but not to complete clogging of the bed. However, the location and extent of the clogging layer may have a more drastic effect on stream-groundwater interactions than on hyporheic exchange flux. These experimental results represent unique observations of the effects of fine particle deposition on hyporheic exchange dynamics under mobile bed conditions, and are expected to be modulated by losing and gaining fluxes. These results are important for understanding the multi-scale complexity of exchange fluxes in rivers with both bedform-induced hyporheic exchange flow and reach-scale patterns of up- or down-welling groundwater.