SAFL Seminar Series

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St. Anthony Falls Laboratory Auditorium

Morphology and dynamics of a gravel-sand transition: Fraser River, British Columbia

Jeremy Venditti
Simon Fraser University
Burnaby, BC, Canada

Abstract:

The beds of alluvial river channels become finer grained moving downstream and often exhibit an abrupt transition from gravel to sand-bedded conditions. Most previous work documenting this phenomenon have focused on small upland streams where sediment supply to the channel is strongly connected to sediment delivery from hillslopes. Fewer studies have focused on the gravel-sand transition in large alluvial channels and none have documented the spatial variability through reaches where transitions occur. The downstream fining pattern observed in the Fraser River is widely cited as a classic example of an abrupt gravel-sand transition in a large alluvial channel. However, important questions regarding the exact current location of the transition, its morphology, and what controls its location remain unanswered.

Here, I present detailed observations bed material grain-size, river bed topography and fluid flow through the 15 km long reach where the transition is widely thought to occur in the Fraser River. Bed topography was measured using a multibeam echo-sounding system (Reson 8101 Seabat) at high flow (11,000 m3s-1) when all fractions of the bed material were mobile. Fluid flow and suspended sediment transport patterns were also mapped using an ADCP at 5 different flow stages during an annual snowmelt hydrograph. These observations indicate that there is a gravel front that occurs in the river at Yaalstrick Bar, the last bar along the river dominated by gravel (> 75% of the bar material > 2 mm). However, sorting patterns caused by the superior mobility of gravel over sand have lead to gravel patches on the upstream sides and surfaces of sand bars. There are also gravel patches along the thalweg through the apex of some river bends. Bedforms associated with sand-gravel mixtures appear on the river bed immediately downstream of Yaalstrick Bar in a sequence (sand ribbons, barchans, dunes) suggesting sand deposition from suspension. There is also a dramatic increase in bar amplitude downstream of Yaalstrick Bar, suggesting greater sand composition. Our fluid flow and sediment transport measurements do not indicate any significant downstream shear stress gradient at high flows, but there is more sand moving as bedload and suspended load in the sand-bedded part of the river. This can only happen if the sand supply from the gravel-bedded part of the river is intermittent. This implies that sediment dynamics in this transition are dominated by sand storage in the gravel-bedded reach at low flows and downstream release to the sand-bedded reach during large floods.