Sediment Dynamics from the Summit to the Sea
(Proceedings of a symposium held in New Orleans, Louisiana, USA, 11–14 December 2014) (IAHS Publ 367, 157-162, 2014)

The effect of coarse gravel on cohesive sediment entrapment in an annular flume

KEN GLASBERGEN[1], MIKE STONE[2], BOMMANNA KRISHNAPPAN[3], JAMIE DIXON[4] & ULDIS SILINS[5]

1 GeoProcess Research Associates Inc, Burlington, Ontario, Canada

2 Geography and Environmental Management, University of Waterloo, Waterloo, Ontario, Canada
mstone@uwaterloo.ca

3 Environment Canada, Burlington, Ontario, Canada

4 City of Calgary, Calgary, Alberta, Canada

5 Department of Renewable Resources, University of Alberta, Edmonton, Alberta, Canada

Abstract While cohesive sediment generally represents a small fraction (<0.5%) of the total sediment mass stored in gravel-bed rivers, it can strongly influence physical and biogeochemical processes in the hyporheic zone and alter aquatic habitat. This research was conducted to examine mechanisms governing the interaction of cohesive sediments with gravel beds in the Elbow River, Alberta, Canada. A series of erosion and deposition experiments with and without a gravel bed were conducted in a 5-m diameter annular flume. The critical shear stress for deposition and erosion of cohesive sediment without gravel was 0.115 Pa and 0.212 Pa, respectively. In experiments with a gravel bed, cohesive sediment moved from the water column into the gravel bed via the coupling of surface and pore water flow. Once in the gravel bed, cohesive sediments were not mobilized under the maximum applied shear stresses (1.11 Pa) used in the experiment. The gravel bed had an entrapment coefficient (ratio between the entrapment flux and the settling flux) of 0.2. Accordingly, when flow conditions are sufficient to produce a shear stress that will mobilize the armour layer of the gravel bed (>16 Pa), cohesive materials trapped within the gravel bed will be entrained and transported into the Glenmore Reservoir, where sediment-associated nutrients may pose treatment challenges to the drinking water supply.

Key words erosion; cohesive sediment; entrapment; sedimentation; gravel bed