PhD
Size segregation in bedload sediment transport
Vancouver, Canada – Grenoble, France

Transport of bedload, the larger material that is transported in stream channels, has major consequences for public safety, for the management of water resources, and for environmental sustainability. Most particularly, in mountains, steep slopes drive intense transport of a wide range of grain sizes.
As discussed recently (Frey and Church 2009)*, an important reason for our limited ability to predict sediment flux is that we have no general understanding of grain-grain interactions in stream channels, especially due to a very wide range of grain size leading to grain size sorting or segregation. This phenomenon largely modifies fluxes and results in patterns that can be seen ubiquitously in nature such as armoring or downstream fining (Fig. A). Most studies have concerned the spontaneous percolation of fine grains into immobile gravels, because of implications for salmonid spawning beds, placer mineral concentration, and stratigraphical interpretation.
However when the substrate is moving, the segregation process is different as statistically void openings permit downward percolation of larger particles. This process has been extensively studied in industrial contexts where segregation of granular or powder materials is often non-desirable. Both processes are likely to occur in natural streams. The objective of this PhD subject is to **study both segregation processes simultaneously**.

This experimental PhD will largely rely on two series of experiments made with two-or three size identical materials with carefully chosen size ratios:

- a first series will use natural sand and gravel material in classical mobile bed hydraulic flumes; this series will be conducted in the recently built state of the art Hydraulic laboratory of the Dept of Geography at UBC, Vancouver, Canada;
- A second series will use spherical glass beads in the two-dimensional channel at Cemagref, Grenoble, France. This channel permits investigation at the scale of the particle. Two-size mixtures have been investigated in a previous study, a starting point for these new investigations (Fig. B);

This PhD will be jointly supervised by Pr. M. Church (UBC, Vancouver, Canada) and Dr P. Frey (Cemagref and Univ. Joseph Fourier, Grenoble, France) with possible enrollment in both Universities.
The duration will be typically 4 years with 1 to 2 years to be spent at Cemagref, Grenoble, French Alps.

Contacts

Cemagref

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UBC

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Funding : $C19,000/yr. Additional funding available.
Profile : Mechanics (fluid or solid) or Physics (granular, fluid) or Civil eng. (hydraulics, sediment transport)
Required : fluent English, motivated by experiments, excellent academic background, programming skills

*Frey P, Church M. 2009. How River Beds Move. *Science* **325:** (18 September 2009) 1509-1510.