



The Grain-size Patchiness of Braided Gravel-Bed Streams: Example of the Urumqi River (northeast Tian Shan, China)

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In gravel-bed rivers, sediments are sorted into patches of different grain-sizes. For single-thread streams, it has long been shown that this local granulometric sorting is closely linked to the channel morpho-sedimentary elements. For braided streams, this relation is still unclear. In such rivers, many observations of vertical sediment sorting has led to the definition of a surface and a subsurface layers. Because of this common stratification, methods for sampling gravel-bed rivers have been divided in two families. The surface layer is generally sampled by surface methods and the subsurface layer by volumetric methods. Yet, the equivalency between the two kind of techniques is still a key question. In this study, we characterized the grain-size distribution of the surface layer of the Urumqi River, a shallow braided gravel-bed river in China, by surface-count (Wolman grid-by-number) and volumetric (sieve-by-weight) sampling methods. An analysis of two large samples (212 grains and 3226 kg) show that these two methods are equivalent to characterize the river-bed surface layer. Then, we looked at the grain-size distributions of the river-bed morpho-sedimentary elements: (1) chutes at flow constrictions, which pass downstream to (2) anabranches and (3) bars at flow expansions. Using both sampling methods, we measured the diameter of more than 2300 grains and weight more than 6000 kg of grains larger than 4 mm. Our results show that the three morpho-sedimentary elements correspond only to two kinds of grain-size patches: (1) chutes composed of one coarse-grained top layer lying on finer deposits, and (2) anabranches and bars made up of finer-grained deposits more homogeneous in depth. On the basis of these quantitative observations, together with the concave or convex morphology of the different elements, we propose that chute patches form by erosion and transit with size-selective entrainment, whereas anabranch and bar patches rather develop and migrate by transit and deposition. These patch features may be typical of shallow braided gravel-bed rivers and should be considered in future works about on bedload transport processes and their geomorphologic and stratigraphic results.