Morphodynamics of downstream fining in rivers with a unimodal sand-gravel feed

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Over sufficiently long distances, the bed sediment of rivers most commonly becomes finer in the downstream direction. There appears to be no single driver for this. The chief drivers are often thought to be abrasion and selective deposition of coarser material. Downstream fining may be accompanied by a transition point, or transition reach from a gravel-bed to a sand-bed configuration. In some cases such transitions may be relatively sharp, but in other cases they may be more diffuse. The transition itself has been attributed to a) breakdown of clasts into constituent crystals b) depletion of the gravel through deposition, c) damped collisional abrasion of finer grains, and d) rainout of sand from suspension. Here we explore downstream fining using an input sediment that is purely unimodal. Any gravel-sand transition should be produced purely by the internal interactions in the model. The model focuses on the interaction of grains of different sizes, ranging from fine sand to cobbles. The following assumptions are used. 1. The input sediment is taken to be an undifferentiated mixture of sand and gravel with no bi- or multi-modality. 2. Abrasion and other kinds of grain breakdown are neglected. 3. The long profile of the river is assumed to consist of a channel and a floodplain, and is assumed to be undergoing slow subsidence. 4. Sediment conservation is specifically accounted for in all grain size ranges. 5. Relations for bedload transport and sediment suspension are to be grain size-specific, with exactly the same relations used for sand and gravel The goals of the modelling exercise are a) to develop a model of downstream fining of sand and gravel in which both are treated in exactly the same way, and b) to see if the interplay between sand and gravel can spontaneously give rise to a relatively sharp transition from gravel to sand.

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