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The influence of sediment transport rate on the development of structure in gravel bed rivers

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Although adjustments of surface grain size are known to be strongly influenced by sediment transport rate little work has systematically explored how different transport rates can affect the development of surface structure in gravel bed rivers. Specifically, it has been well established that the transport of mixed sized sediments leads to the development of a coarser surface or armour layer which occurs over larger areas of the gravel bed. Armour layer development is known to moderate overall sediment transport rate as well as being extremely sensitive to changes in applied shear stress. However, during this armouring process a bed is created where, smaller gain scale changes, to the bed surface are also apparent such as the development of pebble clusters and imbricate structures. Although these smaller scale changes affect the overall surface grain size distribution very little their presence has the ability to significantly increase the surface stability and hence alter overall sediment transport rates. Consequently, the interplay between the moderation of transport rate as a function of surface coarsening at a larger scale and moderation of transport rate as a function of the development of structure on the bed surface at the smaller scale is complicated and warrants further investigation.

During experiments a unimodal grain size distribution (σg = 1.30, D50 = 8.8mm) was exposed to 3 different levels of constant discharge that produced sediment transport conditions ranging from marginal transport to conditions approaching full mobility of all size fractions. Sediment was re-circulated during the experiments surface grain size distribution bed load and fractional transport rates were measured at a high temporal resolution such that the time evolution of the beds could be fully described. Discussion concentrates on analysing the effects of the evolving bed condition sediment transport rate (capacity) and transported grain size (competence). The outcome of this research is pertinent to developing new methods of linking the development of bed surface organisation with near bed flow characteristics and bed load transport in gravel bed rivers.

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