

# EXPERIMENTAL STUDY OF HETEROGENEOUS SEDIMENT TRANSPORT

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(received March 5, 1988)

## ABSTRACT

Although intensive observations of heterogeneous sediment transport in alluvial rivers during the past one or two decades have revealed many interesting phenomena, not enough is known about the effect of different grain size mixtures. Results of flume experiments on the transport of sediment mixtures of two grades are summarized:

(1) Slip-velocity, the relative velocity between the flow and a grain rolling along a smooth bed is proportional to local flow velocity surrounding the grain, but not to the grain density. Under a flow which is deeper than the grain size, transport velocity is proportional to grain size. It may be considered that slip-velocity is determined mainly by the viscous shear force acting on the grains rotating in a viscous fluid.

(2) Mixtures of coarse and fine sand with fines dominant are more mobile than uniform fine sand. Superior mobility of sediment mixtures can be explained by the effects of mixing on smoothing of the bed, exposure, and collision.

(3) Abrupt changes in the mobility of sand-gravel mixtures are determined by abrupt changes in bed states from smooth to congested. Sand controls the mobility of a mixture when the bed state is smooth; gravel controls mobility when the bed state is congested.

(4) Abrupt changes in the mobility of mixtures are also associated with changes in transport mode. When the coarse sand fraction exceeds a "critical mixture ratio", bedforms change remarkably and transport mode changes from mainly suspension to mainly traction.

(5) Vertical sorting caused by the development of bedforms results in sharp changes in the mobility of sediment mixtures. When the gravel content is higher than the sand content, sand grains settle among the interstices of gravel grains and the entire bed is covered by gravel. However, when the ratio of the sand exceeds the critical ratio, most of gravel grains are buried beneath sand.

(6) Some geomorphological features in alluvial rivers, such as longitudinal slope discontinuity, alternating repetition of scour and fill, and fan-head trenching, may be closely connected with the process of heterogeneous sediment transport.

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