



Size stratification in a Gilbert delta due to a varying base level: flume experiments.

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A foreset-dominated Gilbert delta is a delta that is dominated by sediment avalanches (i.e. discontinuous grain flows) over its front. It forms when a river flows into a basin or sea characterized by a flow depth that is much larger than the one in the fluvial reach, and the conditions are such that the transported sediment passing the brinkpoint forms a wedge at the topmost part of the foreset, which results in avalanches down the foreset and a fining upward pattern within the foreset deposit. A Gilbert delta is typically described in terms of a low-slope topset (resulting from deposition over the fluvial reach), a steep-slope foreset (resulting from sediment avalanches over the lee face), and a bottomset (resulting from deposition of fine sediment passing the brinkpoint as suspended load). The objective of the present study is to gain insight into the mechanisms taking part in Gilbert delta formation and progradation under variable base level conditions. In order to do so, three flume experiments were conducted in which the water discharge and sediment feed rate were maintained constant but the base level varied between the experiments: (I) constant base level, (II) a gradually rising base level, and (III) a slowly varying base level. The stratigraphy within the delta deposit was measured using image analysis combined with particle coloring. A steady base level resulted in aggradation over the fluvial reach in order to maintain a slope required to transport the supplied sediment downstream. Sea level rise enhanced the amount of aggradation over the fluvial reach due to the presence of an M1 backwater curve. The aggrading flux to the substrate was slightly coarser than the fed sediment. The sediment at the base of the foreset deposit appeared to become coarser in streamwise direction. Eventually, a fall of the base level induced an M2 backwater curve over the fluvial reach that caused degradation of the fluvial reach. Base level fall first induced erosion of the mobile armor that covered the fluvial reach. This led to an initial coarsening of the brinkpoint load (and foreset deposit). Once the mobile armour was eroded, base level fall led to degradation of the finer substrate, which resulted in a fining of the brinkpoint load and foreset deposit. The relation between the sediment size stratification and the base level change may be used for the reconstruction of the paleo sea level from the stratigraphy of ancient Gilbert deltas.