Experimental Modelling of Multiple Non-Climbing Ripple Set Beds from Suspended Particle Fallout

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Climbing ripples are commonly reported from deep-marine levee deposits and typically are interpreted to reflect “rapid” sedimentation rates, although the definition of “rapid” is never defined. In the Neoproterozoic Isaac Formation, however, climbing ripples are seldom encountered in either the proximal or distal levee regions. Instead, up to 40 cm thick beds consisting of multiple (up to 12) sets of non-climbing ripple cross stratification that grade from medium- to fine-grained sandstone are observed in the proximal levee. These beds thin laterally toward the distal levee where they become less than 10 cm-thick Tc turbidites made up of 1 - 3 non-climbing ripple sets.

Experiments were conducted to investigate the effects of sediment fallout rate on the climb angle of ripple cross stratified sets. More specifically, the experiments attempted to aggrade the bed but prevent the ripples from climbing appreciably. Fallout was controlled by dropping upper fine sand at different rates from four 1.23 m long bins placed side-by-side above a recirculating flume. This set up attempts to mimic the depositional conditions beneath a depositional turbidity current that has reached its transport capacity. In addition, current speed was varied between runs and influenced not only the rate of fallout but also suspended sediment concentration. Preliminary results show that flows with a fallout rate of 0.6 mm/min cause ripples to climb. Under these flow conditions, however, only about 10% of the ripple cross-stratified sets analyzed climbed appreciably (i.e. >5°), whereas the majority showed only negligible climb. Furthermore, the measured sediment concentration of these flows was only about 0.0002%. In contrast, flows with fallout rates of 1.4 mm/min resulted in the majority of ripple cross-stratified sets to steeply climb, some at angles up to 14° (sediment concentration was ~0.0006%). This suggests that the Tc turbidite facies observed in the proximal levee in the Isaac Formation were most likely deposited by quasi-steady to slightly depletive flows that flowed for long periods of time, in this case for at least 12 hours, and that local fallout rates were less than 0.6 mm/min.