Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

River deltas: channelizing sandpiles with memory DOUGLAS JEROLMACK, University of Pennsylvania, MEREDITH REITZ, Columbia University — River deltas are wedges of sediment that are built via the lateral migration of self-channelizing rivers, but the timescale of this process is prohibitively long to observe in nature. Here we present laboratory results that allow us to examine how channels form and fill space to create a delta. Flow collapses into a single channel whose dimensions adjust to threshold transport conditions for the imposed sediment load. This channelization causes localized shoreline growth until the slope drops below a threshold value for sediment transport. This leads to deposition within the channel, with an upstream-migrating step akin to a stopping front in granular flows, which causes widespread flooding and the selection of a new (steeper) channel path. This cycle is remarkably periodic; delta slope oscillates between two thresholds - entrainment and distrainment - analogous to static and dynamic angles of repose. Selection of a new flow path is inherently stochastic, but previously abandoned channels act as significant attractors for the flow. Once a critical density of flow paths has been established, the flow oscillates among the same 3-5 channels indefinitely. These dynamics result in self-similar (quasi-)radial growth of delta lobes, which can be described using a simple geometric model. Despite its simplicity, the experimental system agrees well with what can be measured from natural deltas Thus, temporal and spatial patterns of deltas appear to be a robust result of mass conservation and transport thresholds.

Douglas Jerolmack
University of Pennsylvania

Date submitted: 02 Nov 2012 Electronic form version 1.4