Experimental Mudstone Sedimentology - Making the Connection Between Flume Studies and the Rock Record

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We conducted experiments in deposition and erosion of muds with a specially designed flume that allows clay floccules to move under natural conditions. Contrary to conventional wisdom, flocculation produces deposition prone aggregates that form bedload ripples and accrete into contiguous beds at flow velocities that suffice for lower flow regime transport and deposition of sand. Similarly deposited shales in the rock record should show subtle nonparallel lamina geometry, basal downlap, and top truncation of laminae. Such features have now been found in shales from a variety of settings. Our experiments show a systematic evolution of muddy bedforms in response to sedimentation rate, flow velocity, and initial sediment concentration. A "phase diagram" of muddy accretionary beforms and of identifying criteria for the rock record is a long term goal of these efforts.

Current erosion of soft water-rich muds (70 wt. % water) produces mm to cm-sized fragments that can travel for long distances and are re-deposited as flow velocities decline. After compaction, the resulting deposits have a lenticular laminated texture that is familiar from the rock record. Lenticular lamination in shales has commonly been attributed to accumulation of planktonic fecal pellets or compaction of densely spaced burrows, but re-deposition or soft shale clasts is a viable alternative. Petrographic criteria allow distinction between different modes of formation in a given case.

Experimental approaches inform us about shale sedimentology and put in doubt many previously held notions about mud deposition. Depositional processes also affect the texture of the accumulating mud and have implications for fabric development and porosity during burial.