Computational Stratigraphy (Compstrat) in Tight Rocks: Building Numerical Relationships of Interbedded Sand and Mud Through Flume Experiments

Ryan Wilson[1], Tao Sun[2], Juergen Schieber[3], Zalmai Yawar[3]
[1]Chevron; [2]Chevron Energy Technology Company; [3]Indiana University

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Heterogeneity in unconventional reservoirs occurs from basin-scale to the pore-scale, and capturing these heterogeneities through process-based geologic models is required for exploration and optimization success. Variability occurs as a function of depositional environment, accommodation, and sediment supply and composition. Understanding sediment transport in fine-grained sedimentary systems has seen a paradigm shift due to flume studies that show a significant bedload component in transport processes, resulting in heterogeneous interbedded and interlaminated deposits. Whereas silty laminae can be attributed to partitioning phenomena during bedload transport of flocculated muds, the implications of interbedded muds and sands are less clear. Because of potential bed erosion downstream of sand ripples, and the load imposed by sandy layers, one may wonder whether water-rich surface muds would be eroded prior to active sand accumulation or would collapse due to the added weight. For interpreting ancient mudstone successions with sandstone interlayers this question is critical, because much of the initially deposited muds may subsequently have been lost to erosion. Flume experiments show that in the case of water-rich muds (~85 vol % water), fine to medium sand can migrate across and be deposited on top of these water-rich substrates without significant basal erosion and fabric collapse. The experiments instead show co-deposition of layers of sand and flocculated mud (Yawar and Schieber, 2019, Experimental Co-Deposition of Sand and Flocculated

Mud From Moving Muddy Suspensions — Implications for Shale Sedimentology: AAPG Annual Meeting, Abstr. Vol.) under uniform bed shear stress, implying the same physical conditions for both sand and mud deposition. Extending to the rock record, the presence of sand layers in mudstone successions therefore does not automatically imply that a substantial portion of the mudstone record has been “erased”. Sand layers interspersed with water-rich muds have high initial permeabilities and should therefore greatly enhance migration of fluids from compacting strata. Potentially this can also lead to high permeability zones of the final deposits and could be a critical element for unconventional reservoir quality. As a result, we incorporate the experimental results in process-based computational stratigraphy models to establish numerical relationships of shale deposition and transport for 3D predictions of finer scale reservoir heterogeneity and rock properties.

AAPG Datapages/Search and Discovery Article # 91200 © 2020 AAPG Annual Convention & Exhibition Online, Sept. 29- Oct. 1.