“Weak” and “Strong” Interactions: The Coevolution of Autogenic Processes and External Forcing in Experimental Deltas

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Physical experiments of depositional geomorphology and stratigraphy have proven very useful in the analysis of diverse autogenic processes in landscape evolution. This is largely because similar braided and distributive channel patterns emerge in sediment transport at experimental scales, and over time permit study of self formed surface kinematics and patterns of erosion and deposition. The growth of new insights from and interest in experimental landscapes is timely for predictive stratigraphy in industry today, where the distillation of autogenic and allogenic records in subsurface architecture has important implications for the exploration and development of hydrocarbon reservoirs. Towards that end an important hurdle will be to quantify the types and magnitudes of dependence (or general independence) of internal processes on the external conditions.

A qualitative approach to the problem may be to consider that the extent to which one can resolve external stratigraphic records is related to the extent to which the external signal is capable of overprinting autogenic filtering. We quantify the autogenic filter as the magnitude of topographic effects from sediment storage and release, and the magnitude of external forcing by the rate of change of the boundary conditions. We use this method to explore the rich variety of interactions between the internal and external components of experimental basin filling, and have good reason to hypothesize relatively weak and strong autogenic responses to changing allogenic conditions, due largely to the degree to which changes in external forcing suppress or enhance deposition, respectively.