Preservation Potential of Primary Depositional Fabric in Event-Dominated Muddy Shelf Settings: A Semi-quantitative Facies Model

Bentley, Samuel J.[1] (1) Earth Sciences, Memorial University of Newfoundland, St. John's, NF, Canada.

Muddy shelf deposits derived from river discharge account for much of the sediment accumulating in modern oceans. Such deposits preserved in ancient successions are also volumetrically significant. Hydrodynamic observations and models produced over the past decade have elucidated depositional controls on such deposits, particularly regarding newly recognized classes of gravity-driven sediment flows that are partially supported by turbulence from a combination of waves and currents. Complementary studies have described modification of such deposits by post depositional processes such as bioturbation and consolidation, with respect to the character of preserved sedimentary fabric. To date, the effects of these interacting processes have not been integrated to provide an overall facies perspective on preserved deposits.

The goal of this study is to combine and explore these two lines of inquiry, muddy shelf sediment dynamics and post-depositional modification, to create a semi-quantitative facies model for preserved sedimentary fabric in these event-dominated sedimentary systems. This is accomplished by integrating the results of an analytical model for wave-enhanced sediment-gravity flows (developed by Carl Friedrichs and Don Wright), with a numerical model for interacting event sedimentation and bioturbation. Three cases of wave/gravity-driven sediment flux are considered: moderate (Eel Shelf, N. California), high (East Cape, North Island New Zealand), and very high flux (Gulf of Papua , and Amazon Shelf). Rates of bioturbation and event-driven sedimentation are derived from process studies over event to seasonal timescales, and modeled long-term deposition rates are integrated and tuned to match known sediment accumulation over centennial timescales (measured by radioisotope geochronology).

Results show that extensive primary depositional fabric is preserved only under the highest deposition rates averaged over near-annual timescales. For moderate and high flux settings, primary depositional fabric is thus best preserved near the mid-shelf maximum in deposition rate (for example, on shelf clinoform foresets or near the center of a mid-shelf mud belt). However, for the highest fluxes, fluidized bed conditions in both topset and foreset zones of clinoforms are hostile to macrofauna, resulting in reduced bioturbation rates and increased primary fabric preservation compared to lower flux cases.