"Exceptional" Turbidite Systems in High-Latitude and Tectonically Active Settings and the Obsolescence of Ubiquitous Sequence Stratigraphic Models

Armitage, Dominic A.[1]; Covault, Jacob A.[2] (1) ConocoPhillips, Houston, TX. (2) Geological and Environmental Sciences, Stanford University, Stanford, CA.

Popular models for the development of deep-sea turbidite systems hypothesize their initiation during falling sea level, when voluminous sand-rich sediment bypasses the continental shelf through incised valleys. Resulting submarine fans are predominated by large erosional canyons and depositional leveed channels on fan surfaces that lap onto the lower continental slope. However, recent studies of turbidite-system development across high-latitude, glacially influenced margins and tectonically active margins show that the timing of initiation, developmental processes, and turbidite architectures can vary from those predicted by such widely used models. Here, two “exceptional” turbidite systems are compared from the high-latitude, passive Southwest Scotian Slope offshore southeastern Canada and the tectonically active California Borderland. The high-latitude Scotian Slope is sensitive to climatic variability associated with rising sea level during glacial-to-interglacial transitions and, as a result, received voluminous coarse-grained sediment from subglacial outwash. Large subglacial pulses of sediment contemporaneously carved out a line of shelf-indenting canyons, which transition to straight, wide, and flat-based channels that coalesce near the base of slope. These contemporaneous canyons and channels provided sediment to submarine fans generally characterized by coarse-grained, braidplain-plain-like turbidite architectures. Canyon-and-channel activity in the California Borderland is not as sensitive to sea-level fluctuations during glacial cycles. Rather, tectonic activity maintained a relatively narrow shelf, which facilitated canyon-head incision across the shelf nearly to the modern beach. During falling and lowstands of sea level, fluvial systems provided sediment to canyon-head point sources; however, during highstands of sea level, such as at present, littoral cells are important contributors of longshore-drift-transported sediment to canyon-head point sources at narrow segments of the shelf. Turbidite architectures include predominantly erosional slope conduits and sand-rich base of slope fan lobes. Results of this study highlight exceptions to the general “rules” of deep-sea deposition. Furthermore, are such high-latitude and tectonically active margins and their turbidite systems really that “exceptional” in the first place?