Processes and Insights Into the Kinematic Evolution of Deep-Water Channels

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Abstract

Deep-water channel systems represent the primary conduits of terrestrial sediment to the continental margins and ocean basins. They are of crucial influence in the construction of continental margins and can host valuable resources as well as act as repositories of organic carbon.Initial work has suggested that deep-water channels develop their sinuosity early on, reach a planform equilibrium, and then undergo near vertical aggradation during which channel migration is limited and cutoffs are rare. High resolution 3D seismic-reflection data of a deep-water channel system located in the Eastern Gulf of Mexico presents a unique opportunity to document the kinematic evolution of its channel belt, showcasing continued lateral migration processes, significant downstream translation, and a neck cutoff occurring during aggradation. The neck cutoff resulted in a localized increase in bend curvature causing subsequent and relatively rapid meander expansion and downstream translation in that area.We explore how these kinematic processes influence the evolution of the resultant stratigraphic architecture and sandbody stacking patterns using a forward stratigraphic model and compare the belt statistics to a range of other submarine channel systems. Channel sinuosity increases from 1.0 to 2.2 as the channel aggrades. As a result, the aspect ratio (belt-width/belt-height) of the entire channel belt varies between 2.7 and 31, similar to the differences observed between comparing multiple different systems. Using a simple flow diagnostics tool that relies on single-phase incompressible flow suggests that channel geometries associated with cutoffs and channel-filling debris flows have a significant impact on sweep patterns and efficiency. Although submarine channels are relatively large, predictably structured, and overall well connected in

three dimensions, fluid flow in the reservoir is highly dependent on the locations of injectors and producers relative to the large-scale channel belt architecture; and it is difficult to predict without using realistic geologic models and flow simulations.

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