Sea Level Modulation of Deltaic Avulsion Processes

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

Abstract

The interaction of allogenic and autogenic processes controls the stratal architecture of, and facies distribution within, sedimentary basins. Therefore, understanding the interactions of these processes are crucial to better characterization of basin stratigraphy and improved prediction away from points of control (e.g., well data). Here, we used a three-dimensional numerical stratigraphic forward model to examine how high- and low-amplitude sea-level change analogous to icehouse and greenhouse settings may influence fluvio-deltaic avulsion processes and resulting sand distribution in a passive margin setting. Model results show that total deep-water sand volume is nearly invariant to the rate of relative sea-level change. The large-scale spatial distribution of sand differs between models with icehouse and greenhouse conditions: high amplitude sea-level changes led to localized deep-water sedimentation, while relatively low amplitude sea-level changes produced more laterally-extensive deposits. We attribute the similarity in total volume to the interaction of sea-level change rate and the time required to reach dynamic equilibrium as a result of avulsion processes. The difference in depositional pattern is likely the result of the presence (or absence) of significant shelfal incision, which minimized deltaic avulsion. Our results indicate that the amplitude or rate of relative sea-level change is not the primary control on the total volume of deep-water sand, but the influence of sea-level changes on fluvio-deltaic processes affects potential reservoir sand distributions. These results provide a framework for the timing and quantity of continental-margin sedimentation and deep-water sediment delivery, with applications to sequence-stratigraphic interpretations.