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Three-Dimensional Numerical Modelling of Eustatic vs Local Controls on Depositional Sequences

A three-dimensional numerical model of sediment transport and deposition in coarse-grained deltas is used to investigate the controls on depositional sequence variability. We consider the stratigraphic response to eustatic sea-level (amplitude and rates) and local controls, such as physiography, sediment supply and local subsidence. The development of key stratal surfaces, stratal geometry and facies stacking patterns show a systematic development with respect to stages in a eustatic sea-level cycle. However, even with constant sediment supply and a simple sinusoidal eustatic sea-level variation many of the features developed in the models are, by their nature, three-dimensional and two-dimensional analysis of the model results can lead to erroneous interpretations of the causes of along-strike variability. Local controls generate significant variability in depositional sequence development, including the timing and amount of fluvial incision during relative sea-level fall, and the timing and nature of transgression during rapid phases of relative sea-level rise. The model results suggest that different systems tracts may be coeval and that key stratal surfaces defining and subdividing depositional sequences may be of local extent. Furthermore, the results highlight pitfalls in sequence stratigraphic interpretation and problems in interpreting controlling processes from the preserved stratigraphic product.