High-Frequency Carbonate-Siliciclastic Interactions in Siliciclastic-Dominated Systems: Distinguishing Between Coeval and Reciprocal Sedimentation in a Lower Cretaceous Epeiric Sea

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April 9, 2014 Wednesday 8:30 A.M. AAPG Annual Convention and Exhibition, Houston, TX

Abstract

The presence of carbonate strata within siliciclastic-dominated marine successions poses serious challenges for palaeoenvironmental reconstructions and reservoir characterization, and unambiguous interpretations can emerge only when the spatial vs. temporal relationship between carbonate production and siliciclastic input is well understood. This study documents high-frequency sequences (probably of 4th-5th order) formed during Greenhouse conditions (Hauterivian) and Transitional/Icehouse conditions (Valanginian) in the epeiric sea of the Neuquén Basin, which were investigated across outcrop and subsurface transects parallel to depositional dip. Hauterivian high-frequency sequences (< 25 m thick) comprise coarsening-upward successions from offshore siliciclastic mudstones and siltstones with storm-related beds, passing into lower-shoreface bioturbated sandstones. Cross-bedded mixed deposits are capping the successions, and both biogenic (bivalve-dominated) and non-biogenic (ooids) carbonate grains are common. These high-frequency sequences, bounded by flooding surfaces, represent mostly normal regressive conditions during low-amplitude, likely eustatically-controlled, relative sea-level changes. Coeval sedimentation occurred in the upper-shoreface setting, but carbonate shedding was negligible basinward. Valanginian high-frequency sequences, though similar in scale and duration, have a different internal architecture. Carbonate-dominated strata are bounded by erosional surfaces, they have a wider range of facies (ooid grainstones to skeletal wackestones), and commonly show a retrogradational staking. Carbonate packages are overlain by shallowing-upward, pure siliciclastics successions, comprising from offshore mudstones to shoreface cross-bedded sandstones. Carbonate and siliciclastic packages represent contrasting depositional systems and reciprocal sedimentation. A carbonate-dominated ramp developed during transgressive conditions, whereas deltas and associated shoreface system formed during progradational (highstand) conditions. Eustatic-based, sea-level changes alone cannot explain these high-frequency cycles. In addition, severe intracyclic climate changes from arid (carbonates) to humid (siliciclastics) phases could have trailed sea-level rises and highstand conditions, respectively. Glacial-interglacial climatic shifts are common in icehouse conditions, and could have taken place in the relatively cold Valanginian period.

AAPG Datapages/Search and Discovery Article #90189 © 2014 AAPG Annual Convention and Exhibition, Houston, Texas, USA, April 6–9, 2014