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The Effect of Tectonic Tilting on Controlling Nearshore Deposition: Insights from the 3D Stratigraphy of the Cozzette Sandstone (Campanian), Book Cliffs, Colorado

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ABSTRACT: The Book Cliffs of eastern Utah and western Colorado have been pivotal in the development of outcrop-based sequence stratigraphic concepts for nonmarine to shallow marine siliciclastic depositional settings. Prior studies in this area, and more generally in the Cretaceous western interior foreland basin of North America, have concluded that nearshore accumulation is controlled for the most part by the interaction between oscillatory eustatic change and longer-term regional patterns of flexural subsidence. New outcrop and subsurface evidence reported here from the eastern Book Cliffs suggests that three-dimensional tectonic tilting at length scales of up to ~50 km (31 mi) and timescales of less than ~200 kyr also strongly influenced sedimentation. Continental ice sheets are known to have been small at the time. Documented patterns of accumulation are inconsistent with those expected from interactions of eustasy and regional flexure alone.

The upper Campanian Cozzette Sandstone Member of the Mount Garfield Formation consists of twelve lithofacies arranged into six lithofacies assemblages, inferred to have been deposited in shallow marine, marginal marine, and nonmarine depositional environments. Shallow marine facies are organized into six wedge-shaped units < 40 m thick, bounded by flooding surfaces, and separated into three larger-scale progradational to aggradational cycles. The successions are interpreted as shoreface-foreshore-swamp parasequences, and are erosionally overlain by fluvial and estuarine deposits. Both fluvial and estuarine accumulations are underlain by composite erosional surfaces, belonging either to two distinct incised valley fills, or to one composite fill. The proposed interpretation is based on high resolution correlations made from digital video and continuous photographs acquired during a helicopter survey of the member. This interpretation differs significantly from published cross-sections of the Cozzette, in which the sandstone is inferred to consist of at least two sheet-like shallow marine parasequences, truncated by sequence boundaries located at the top of the member.

Facies variations, stratigraphic thickness trends, and geometrical relationships reveal that three basinward-landward cycles of syn- to post-depositional tilting in the southern Piceance basin controlled accumulation within the Cozzette Sandstone. Differential subsidence to the southeast lead to the development of a northeast-trending clinoform rollover, while subsequent tilting to the north resulted in renewed accommodation. This process caused rollover orientations to trend eastward. After the deposition of three progradational to aggradational cycles, tilting towards the northeast resulted in bypass and the development of tectonically-induced sequence boundaries.

Speaker Biography: Andrew Madof is a stratigrapher in the Seismic Stratigraphy Geomorphology group in the Energy Technology Company at Chevron, in Houston TX. He was one of three people recruited by Henry Posamentier into his newly-formed group. Andrew has been with Chevron for 4.5 years, and has

worked on a variety of exploration, production, and research projects worldwide. Prior to coming to Chevron, Andrew did a PhD at Columbia University under Nick Christie-Blick, where his dissertation focused on the tectonic controls on clastic deposition. Currently, Andrew is interested in the relationship between seismic stratigraphy and geophysics, to better understand the stratigraphic evolution of clastic systems.

RMS-SEPM Main Page

RMS-SEPM Luncheon Page

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