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Seismic Modeling of a Tidal-Bar / Incised-Valley Complex: Sego Sandstone of Eastern Utah

The Sego Sandstone Member (Campanian) of the Mancos Shale comprises four fourth-order tidal-delta and shoreline successions cut by lowstand distributary channels and incised valleys. It crops out extensively in the Book Cliffs of eastern Utah. Information from outcrop, including detailed stratigraphic framework, rock velocity, facies, sedimentology and petrography, were combined with adjacent subsurface sonic and density logs to create a series of seismic models that illustrate how stratal relationships and architecture of tidal-bar complexes, channels, and valleys are represented in seismic.

Images designed using Freehand and Adobe Photoshop graphics software were loaded to MatLab and modeled using a vertical incidence algorithm. Density and velocity values measured from the outcrop and subsurface facies accurately represented real-world values and relationships among facies and strongly determined impedance response. The 1-D and 2-D seismic models were constructed using several frequencies, trace spacings, and section thicknesses.

Results show that delineation of architectural elements depends on their dimensions (width, thickness, and length), seismic frequency, and trace spacing. Thinning of elements often removed them from the resolution window and caused a simulation of erosion or lap-out on the seismic section. Although seismic response across key bounding surfaces (lowstand unconformities, transgressive surfaces, maximum flooding events, and regressive surfaces of marine erosion) varied according to cross-surface facies associations, their regional extent formed a continuity of seismic response, enabling long-distance correlation. Within the tidal-bar complex, the relationship between tidal-bar sands and overlying, highly bioturbated bar tops, imaged in seismic, can easily be mistaken for an unconformity.

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