DEPOSITIONAL FRAMEWORK OF THE MESAVERDE FORMATION, WIND RIVER BASIN, WYOMING

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ABSTRACT

The Mesaverde Formation defines a Late Cretaceous shallow- to non-marine clastic wedge [up to 600 meters (1968 feet) thick] developed in the Wind River Basin, Wyoming. The formation has been, and is currently, an exploration target for gas, but defining successful exploration strategies is hampered by the Mesaverde's notoriously complex facies mosaic. We have integrated a data set utilizing detailed field mapping, facies descriptions, petrographic analysis, wire-line log correlations, and subsurface architectures interpreted for a small number of seismic lines, to construct a basinwide depositional framework for the Mesaverde strata. The resulting sequence stratigraphic interpretation permits us to recognize four major subdivisions that can be traced from the non-marine into shallow marine settings; these units are distinct from, and their inferred timelines cut across, the traditionally defined lithostratigraphic units of the Mesaverde and related units. For example, the Cody-Mesaverde formational boundary can be shown to be time-transgressive such that the oldest non-marine Mesaverde lithologies are genetically related to laterally equivalent shallow marine sandstone and mudstone typically attributed to the Cody. A preliminary palynological data set for the Mesaverde is presented that supports this depositional framework.

Within the non-marine subdivisions of the Mesaverde Formation, detailed lateral mapping and measurement of channel sandstone and associated facies reveal that a two-fold architectural arrangement of stratal geometries can be recognized. The first consists of amalgamated channels (high density stacking) that form tabular sandstone bodies up to 50 meters (164 feet) in thickness (e.g., as developed in the lowermost Mesaverde unit and Teapot Member in the Maverick Springs area). The second is characterized by vertically and laterally isolated channel sandstone (low density stacking) encased in interfluve lithologies (e.g., middle Mesaverde unit in the Maverick Springs area).

Our work has further corroborated that the basal unconformity of the Teapot Member defines a major surface of erosion, which cuts down section towards the west and south. Palaeocurrent data imply a reorganization of depositional slopes from the southeast-dominated sediment transport directions of the middle Mesaverde to the easterly-dominated directions of the Teapot. Recently published U-Th-He data from the Wind River Range indicate that cooling and uplift occurred ~75Ma, consistent with the timing for the Teapot unconformity and basin reorganization proposed above.

The diversity of facies within the Mesaverde Formation, and the difficulty arising from lateral and vertical facies changes and non-marine to marine correlation in the subsurface, has complicated reservoir exploration. Our results offer a paleogeographic and depositional model that can be used to refine and direct subsurface exploration strategies.

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