Coastal and Alluvial-Plain Architectural Elements of the Upper Cretaceous Williams Fork Formation, Southeast Piceance Basin, Colorado: Outcrop Analogs for Subsurface Reservoir Characterization

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In the southeastern Piceance Basin, the Williams Fork Formation produces natural gas from a genetically diverse assemblage of sandstone architectural elements that were deposited within alluvial-plain, coastal-plain, estuarine, and marginal-marine settings during Late Cretaceous time. At Mamm Creek field, three-dimensional static and dynamic reservoir models that are constrained to both outcrop-derived and subsurface data show how reservoir connectivity is sensitive to architectural-element type and width and varies with net-to-gross ratio. A component of this research that is important to subsurface reservoir characterization and, which is summarized herein, is the evaluation of reservoir analogs in the outcrop belt to the east and southeast of Mamm Creek field.

In the Mamm Creek area, the Williams Fork Formation is about 4,000 ft. (1,220 m) thick, and has three informal stratigraphic intervals (lower, middle, and upper). The lower Williams Fork consists of the Bowie Shale and Paonia Shale members. The Bowie Shale Member is about 600 to 1,000 ft. (183 to 305 m) thick, has a net-to-gross ratio of 30-60%, and was deposited in coastal-plain to marginal-marine settings. The Bowie Member also contains two wave-dominated shoreline sandstones (middle and upper) and the Cameo-Wheeler and South Canyon coal zones. The Paonia Shale Member is about 800 ft. (244 m) thick at Mamm Creek field, has a net-to-gross ratio of 30-60%, and was deposited in coastal-plain to alluvial-plain settings. The Coal Ridge coal zone is at the base of the Paonia Member. The middle-to-upper Williams Fork formation is generally undifferentiated and represents a transition to more sandstone-rich (net-to-gross ratio of ~50-80%) deposition within an alluvial-plain setting. Included in the upper Williams Fork Formation is the Ohio Creek interval of various authors.

Along the outcrop belt, which stretches for about 75 mi (123 km) and includes the southern Grand Hogback, the quality of the exposures is highly variable due to structural complexity, mass wasting, and vegetation. The best outcrops are at Rifle Gap, McClure Pass, near Paonia Dam, and along the North Fork of the Gunnison River near Bowie, Colorado. From a genetic perspective, eight non-marine architectural elements are present: 1) splay fan, 2) splay channel, 3) splay delta, 4) anastomosed channel fill, 5) simple-sinuous channel fill, 6) compound-sinuous channel fill, 7) low-sinuosity channel fill, and 8) amalgamated channel fill. From a stratigraphic perspective, architectural elements 1 through 5 are most common in the lower Williams Fork Formation, whereas types 5 and 6 define the middle Williams Fork. The upper Williams Fork is dominated by architectural elements 7 and 8.