Fluvial Architecture of the Tertiary Middle Wasatch Formation in Three Canyon, Utah (Outcrop Study): Implication for Reservoir Down-Spacing and Drainage

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Three Canyons is a world class 3-D outcrop created by modern-day fluvial processes of the Green River in Utah. This setting provides a unique window into the middle Wasatch for reservoir scale evaluation of facies, architectural elements, and sediment stacking patterns. This high net-to-gross interval is characterized by seventeen facies that stack in organized facies assemblages to form five architectural elements: 1) channels, 2) accretionary deposits, 3) flat-based tabular sand deposits, 4) nonchannelized tabular sand-silt deposits, and 5) non-channelized muds.

Individual channel elements amalgamate to form multistory, cut-and-fill channel complexes. The average width to thickness (W/T) ratio for an individual channel element is 69; with the average thickness of an amalgamated complex being 19 m (62 ft). The average W/T ratio of a channel complex is 13. The accretionary bodies display an average W/T ratio of 56, whereas the flat-based tabular-sand deposits average 40. Finally, the nonchannelized tabular-silt deposits have a width to thickness ratio of 169.

Analysis of stacking patterns documents a unique hierarchy and systematic temporal change in the depositional system. Although the channels cannibalize each other and nonchannelized overbank muds, it is uncommon that they erode into the flat-based tabular sand deposits or the non-channelized tabular sand-silt deposits. The accretionary deposits tend to occur stratigraphically above and often down-lap onto the channel complexes, showing an evolution in depositional style. The flat-based tabular sand deposits and the non-channelized tabular sand-silt deposits are isolated within the non-channelized overbank muds; however, the flat-based tabular deposits tend to be spatially isolated within larger non-channelized overbank mud deposits. The amalgamated and isolated sand elements have different reservoir geometries and create different challenges for drainage optimization when working with these same bodies in the subsurface.

Subsurface correlations of nearby producing fields display similar sized sand geometries as those described in outcrop. Therefore, Three Canyon provides a unique visual and quantitative analog to demonstrate reservoir connectivity and implications of wellbore down-spacing. A well placed 1,320 ft from a pre-existing well would encounter 66% new sands bodies that were not penetrated by the first wellbore. In contrast, a well placed 660 ft away from a pre-exiting wellbore would only encounter 33% new sand bodies. Because the middle Wasatch is dominated by amalgamated multistory channel complexes and high W/T aspect ratio sand bodies it displays more efficient reservoir drainage than other fluvial systems in the basin, thus requiring fewer wells.