The Influence of Fluvial Channel Architecture on Joint Characteristics: Examples from Mesaverde Outcrop, Douglas Creek Arch, Colorado

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Fracture surveys were conducted within the Cretaceous Mesaverde outcrop on the northern Douglas Creek Arch to understand the influence of variations in fluvial architecture on joint characteristics. Fundamental questions include whether joints would be restricted to individual sand bodies within multi-story, amalgamated channel complexes, if and how spacing and orientation varies as a function of bed height from channel axis to margin, and whether joints would form in beds that exhibit a large number of sedimentary structures, such as lateral-accretion surfaces within point-bar deposits.

Data was systematically collected along scanlines at outcrops along West Creek, Philadelphia Creek, Little Indian Draw, and Rocky Point Draw. Preliminary interpretations indicate the presence of three joint sets in the region, including a primary ~E-W set, secondary ~NE-SW set, and tertiary NNW-SSE set. The secondary NE-SW set parallels many of the map-scale normal faults within the region. Fracture Spacing Ratios (the mean mechanical layer thickness divided by the median fracture spacing) provide a normalized measure to compare joint density among different joints sets occurring within a range of sand body dimensions. A wide range of values were found within mechanical layers having a variety of mean thicknesses. The primary sets often have lower FSRs than subsequent sets that comprise cross-joints. Another, more commonly attributed cause for high FSRs is close proximity to faults. At Rocky Point Draw high FSRs exist along the primary joint set that parallels adjacent faults, whereas the cross-joints do not have a significant decrease in spacing. We also observe constant FSRs within individual beds that vary in height, indicating spacing varies as a function of mechanical layer thickness within the same sand body. Furthermore, joint heights are sometimes restricted to single sand bodies within multi-storied, amalgamated channel complexes, and do not often occur in beds with closely-spaced lateral-accretion surfaces. The nature of the erosional surfaces that form mechanical boundaries varies among the outcrops, but includes soft-sediment deformation and basal-lag deposits in many cases. These intriguing observations provide fundamental statistics for populating joint characteristics within a reservoir model that incorporates a facies-based classification scheme for fluvial reservoirs.