Beyond Traditional Fluvial Heterogeneity Models - Investigation of Tight Sandstones and Near-Surface Diagenesis in Late Jurassic to Early Cretaceous Paleovalley Outcrops of the U.S. Western Interior

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In the vicinity of Green River, Utah, outcroppings of uppermost Morrison Fm. and lower Cedar Mountain Fm. reveal channel belt and floodplain deposits of the internal drainage of the North American Cordillera. Remarkably, the depositional architecture of meander scrolls and channel bodies is exposed over more than 750 km2 and largely escaped erosion because of intensive silica cementation. For this study we investigated selected outcroppings of a well-exposed meander scroll and an exhumed fluvial channel segment to reconstruct parts of this fluvial system. Within the fluvial sandstone bodies, domains of extremely reduced porosity/ permeability are due to intensive silica cementation, which define zones of significant vertical and lateral extent. Their distribution contrasts with traditional heterogeneity models for fluvial reservoirs, which predict spatial variations and continuity of facies merely on the basis of depositional processes.

Sedimentological data and geometrical relationships within these outcrops indicate a change in fluvial style from single, strongly sinuous channels to multiple, linear ones. Features such as pedotubules, peds, cutans, and calcite soil nodules, combined with soil microfabrics are indicative of postdepositional alteration of floodplain sediments by pedogenic and/or shallow groundwater processes. In channel belt deposits supporting evidence is provided by the crosscutting relationships between diagenetically modified ‘tight’ sandstones and unaltered reservoir lithologies. In addition, floating-fabrics and circumgranular chalcedonic rinds, contrasting packing indices and intergranular volumes in silica- and non-silica cemented domains are present. These features are likewise common in silcretes and are indicative of silica cementation during or very shortly after deposition and not due to reactions in the mesogenetic realm.

Realistic reservoir models rely on the accuracy of facies models. Geoscientists apply them not only to assist in the interpretation of existing data but to complement datasets in areas where understanding is incomplete. Near-surface diagenesis has significant implications for reservoir characterization. Although the recognition of such an origin is complex as diagnostic signals typically fade with burial (Pisciotto, 1981). Nevertheless understanding the effects of near-surface diagenesis is critical to evaluate the controls on compartmentalization of fluvial reservoirs.