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Sedimentology and Reservoir Characterization of the Emerging Cane Creek Play, Paradox Formation, Northern Paradox Basin, Southeastern Utah

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Abstract

The Pennsylvanian Paradox Formation of the northern Paradox Basin, southeastern Utah, is composed of ~30 cycles of thick salt (200–300 ft) interbedded with intervals of siliciclastics (<120 ft thick). The successions are interpreted as resulting from rhythmic sea level changes driven by glacial and interglacial climatic cycles in the southern hemisphere of the Pangean continent. During periods of glacial retreat and subtropical-arid climate, marine incursions via a northern tidal inlet, coupled with fluvial drainage and eolian processes, deposited siliciclastic and sulphate evaporites in a sabkha-type environment. Glacial maxima ceased open-marine connection and initiated closed-basin evaporative conditions that led to substantial salt deposition. Siliciclastic cycle 21, the Cane Creek (CC), is a targeted emerging resource/fracture play with a total oil production of ~10 MMBO and up to 215 MMBO of undiscovered resource. The CC is informally divided into three distinct zones. The upper A and basal C zones are composed of fabric-destructive and wavy bedded anhydrite, dolomitic mudstone, and organic- rich algal laminated mudstones (source rock). The middle B zone is low-permeability sandstone-siltstone (reservoir), generally wave rippled and burrowed. Collectively, these zones represent parasequences that internally contain meter-scale shallowing upward 5th-6th order cycles, similar to the progradation of shallow-marine sabkha tidal deposits of Abu Dhabi (Persian Gulf). New core obtained from the research stratigraphic well State 16-2 in the White Sands unit, northern Paradox Basin, shows typical anhydrite assemblages in the A zone but thicker reservoir packages (~40 ft) in the B zone compared to the central (~35 ft) and southern (~30 ft) areas. The C zone contains less anhydrite and more siltstone/sandstone, implying less restriction and increased sediment supply near a tidal inlet and/or by fluvial input from the Uncompahgre Plateau. Although reservoir packages are thicker in the north, they have low permeabilities (0.009–0.202 mD) and variable porosities (6%–17%) due to clay content, occluded macerals, and diagenetic anhydrite-dolomite-quartz-halite cements. Intergranular microporosity is scantly observed from planar light petrography but notable under scanning electron microscopy. Therefore, naturally occurring and possibly stimulated fractures may be essential for hydrocarbon recovery. Source rock analyses from northern core/cuttings also indicate deeper burial, positioned within the dry/wet gas window (VRo ~1.8), with laminated organic-rich mudstones that contain up to 15 wt% TOC. In comparison, the central (oil productive) and southern play areas have lower maturity (VRo 1.1 and 1.5, respectively). This initial depositional and reservoir characterization screening of the northern CC provides new insights to understanding depositional play extent, reservoir quality predictability, and rationale for burial history and structural controls.

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