

Geologic Characterization of the Newly Acquired State 16-2 Cane Creek Research Core, Pennsylvanian Paradox Formation, Northern Paradox Basin, Southeastern Utah

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Abstract

The Cane Creek (CC) unit within the Pennsylvanian Paradox Fm. of the northern Paradox Basin, SE Utah, is often touted as one of the last remaining emerging unconventional tight oil plays in the U.S., with wells capable of producing up to 1500 BOE per day. However, the drilling history of the CC play has been fraught with challenges and disappointment. To help with this effort, the U.S. DOE awarded funding to the Energy & Geoscience Institute at the U. of Utah and the Utah Geological Survey to develop the tools and strategies necessary to tap into this underutilized resource, while minimizing environmental impact. One important project milestone occurred in Dec. 2020 with the drilling of the State 16-2 research well with industry partner Zephyr Energy. Drilled in the White Sands federal unit near the town of Green River, Utah, the well spudded in the Tununk Mbr. of the Cretaceous Mancos Shale and terminated near the base of the Paradox Fm. Cuttings were collected at 50-foot intervals starting at 1620 ft (Jurassic Carmel Fm.) down to the top of the Paradox Fm. (6250 ft). To obtain a more detailed geologic record of the upper Paradox, cuttings were collected at 10-foot spacing and 31 rotary sidewall cores were recovered from specific clastic units. Core of the CC unit (as well as the underlying salt and thin clastic 22) was taken from 9632–9728 ft. The new core shows typical anhydrite assemblages in the upper CC (A zone), but thicker siltstone/very fine sandstone reservoir packages in the middle B and lower C zones compared to CC cores in the central and southern parts of the play. This might imply that the northern area experienced less open-water restriction and increased sediment supply from a possible proximal tidal inlet and/or fluvial input from the Uncompahgre Plateau. Although reservoir packages are thicker in the north, they still 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 scantily observed from planar light petrography but notable under scanning electron microscopy. The core also displays significant fracturing, with one set (lower angle) filled with halite and a second set (higher angle) filled with calcite. Source rock analyses from the numerous, thin organic-rich mudstones (TOC up to 15 wt%) indicate deeper burial compared with play areas to the south, with maturity in the dry/wet gas window (VRo ~1.8). Zircon (U-Th)/He thermochronometers corroborate maximum paleo-temperature estimates ($\leq 180^{\circ}\text{C}$) within parts of the CC play and date them to a relatively brief period ca. 70 Ma. This newly acquired core in the northern part of the basin will greatly enhance understanding of the lateral deposition and reservoir variations of the CC and provide new insights into understanding hydrocarbon play extent, reservoir quality, and rationale for overall burial history and structural controls.