Overview of the typical Pilot Shale section ("South Slope") through the Joana Limestone, view north, central Confusion Range.

Abstract

Detailed stratigraphic examination and extensive sampling of a ~1000-ft-thick surface section of the Devonian-Mississippian Pilot Shale from the central Confusion Range in western Utah demonstrates clear potential for hydrocarbon production. Total organic carbon measurements from dark gray, calcareous and noncalcareous mudrocks, particularly in the lower parts of the formation, range from 1.4 to 2.4 wt.%, and Tmax values fall mostly in the oil potential window (438–449°F). The Pilot could be gas-productive elsewhere as a result of commonly recognized hydrothermal activity in both Nevada and Utah.

Overall, the Pilot Shale in Utah is heterogeneous, as the mudrocks are stratigraphically admixed with calcareous siltstones, micritic to organic limestones, occasional red beds, and fine-grained sandstones. The Pilot is representative of an offshore and locally deep basin setting influenced by tectonic activity of the Antler orogeny in central Nevada. The Pilot in this locality progressively shallows upward in an oscillatory fashion toward the overlying shelfal Mississippian Joana Limestone. The shallowest deposits in this section consist of distinctive red beds and oncolitic limestones. A near-complete surface gamma-log transect substantiates this overall trend and provides a valuable correlation to a nearby subsurface penetration, and possibly to future wells. Based on both lithologic and biostratigraphic conclusions involving previous conodont work, the lower Pilot is a clear facies equivalent to the Devonian Guilmette Formation and to its formational equivalents elsewhere. The upper Pilot is a lateral equivalent to shallow-water restricted carbonates and clastics, exposed both to the east and south (e.g., Pinyon Peak Limestone, Victoria Peak Quartzite, Fitchville Formation). Parenthetically, the Pilot is exceedingly variable in other sections measured to the west (Nevada), but these sequences also reveal potential for an unconventional hydrocarbon resource.

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• Surface work in the central Confusion Range of western Utah has revealed an overall shallowing upward sequence within the Devonian-Mississippian Pilot Shale, although this trend is clearly oscillatory. A single red bed, an oncolitic limestone, and sand-enriched units are all located in the uppermost 300 ft. A prominent lowstand initiated the red bed, oncolitic limestone, and surfaces of erosion and occurs below the contact with the overlying Joana Limestone (Mississippian).

• Not surprisingly, the most organic-rich intervals are found in the lower part of the ~1170-ft section where organic-rich siltstones, mudrocks, and deep-water limestones are present.

• Extreme stratigraphic variability should be expected in the Pilot Shale, as exhibited by additional work both in Utah and in Nevada, and by the extensive literature on the Devonian of the western U.S. in particular. Conodont work done here and elsewhere provides additional evidence for this lithostratigraphic conclusion.

• Surface gamma-ray logging of this section has at least allowed correlation to other nearby wells in spite of some obvious compositional variability. One major purpose of this study involved achieving some success with surface-to-log correlation for future exploratory efforts.

• Porosity from surface samples is especially observable in the organic-rich dolomitic siltstones (or silty dolomites), and true calcareous siltstones appear well cemented by calcite and have low porosity as a result. A single sample of organic phosphate also exhibits intercrystalline voids. Permeability in all cases should be modest because of the relatively small pore sizes associated with fine-grained mineralogical constituents and textural details.

• Organic geochemistry is favorable for hydrocarbon production in spite of apparent siliciclastic abundance. TOC values in selected samples are generally in the 1–2% range, and Tmax measurements indicate propensity for liquid hydrocarbon potential.