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Discovery and Development of Jonah Field, Wyoming —A New TCF Gas Field in the Green River Basin

Jonah field is currently producing more than 175 MMCFG/D from over-pressured, fluvial channel sandstones in the Upper Cretaceous Lance Formation. The field was discovered in 1975, but because of market conditions and primitive stimulation methods, the field was not economic. In 1992, McMurry Oil bought the field, which consisted of three wells, and applied new drilling and completion technologies that unlocked the full potential of the play. Jonah field now has more than 90 wells and is poised to become the next TCF gas field in the Rocky Mountain region.

Principal production in Jonah field is from the Lance Formation of Maastrichtian age. The Lance is composed of lithic floodplain deposits and multiple channel complexes deposited on a large alluvial plain. Transport was eastward from ancestral highlands to the west. Braided stream deposition was dominant and can be segregated into a basal, low net-to-gross sandstone interval in the lower Lance, a high net-to-gross interval in the middle Lance, and another low net-to-gross interval in the upper Lance. Sandstones were deposited in channels 5–20 ft deep and 150–4000 ft wide, although some amalgamated sandstone intervals (i.e., Jonah interval) can be up to 100 ft thick and more than a mile wide. Changes in fluvial architecture and amalgamation of the sandstones are functions of changes in sediment supply and subsidence rate (accommodation space). Isopach maps of gross sandstone in the Lance Formation depict anomalously thick sandstones adjacent to major faults, suggesting paleostructural control on deposition. Near the top of the Lance is a shale that coincides with the top of the gas-saturated section.

Porosity and permeability in the sandstones are related to depth. Sandstones below 10,500 ft have less than 10% porosity and less than 40 microdarcies of permeability.

Sandstones above 8500 ft have up to 13% porosity and up to 1 millidarcy of permeability. Individual wells average of 600 ft of gross sandstone (range 260–1040 ft) and 335 ft net sandstone (range 190–570 ft). From shaly-sand log analysis, pay intervals average 7.5% porosity (range <6%–13%) and 43% water saturation (range 37%–71%).

Based on volumetric reserve analysis of the overpressured interval of the Lance using average pay thickness, porosity, and saturation, more than 100 BCF gas is in place per section. Estimated reserves of 0.7–13.0 BCF/well are based on decline curve analysis of completed pay.

Total organic carbon values for mudstones in the Lance Formation average 1.0% and are volumetrically significant over the 2500–3000 ft thick producing interval. Much richer source rocks are in thick coals in the Rock Springs Formation below the Lance. Data from production streams of early wells in the field show higher yields in the lower Lance (15–80 BO/MMCF) and lower yields (5–15 BO/MMCF) in the upper Lance. Pressure gradients in the field range from 0.55 to 0.59 psi/ft. Overpressure in the field results from continuous upward migration of petroleum into available pore space, possibly by seepage through microfractures.

Biographical Sketch

John W. Robinson is the exploration manager for McMurry Oil Co. He is responsible for providing geoscience expertise in McMurry's ongoing exploitation program of Jonah field, Wyoming, and for developing additional exploration opportunities in the Rocky Mountains. Prior to working for McMurry, he worked for Amoco Production Co., Forest Oil Co., and Snyder Oil Corp. In addition, he has taught at Colorado School of Mines and worked as a volunteer for the Branch of Petroleum Geology at the U.S. Geological

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Survey. He received B.S. and M.S. degrees in geology from San Diego State University and a Ph.D. in geology from the Colorado School of Mines. His research interests are fluvial sedimentology, multidisciplinary reservoir studies, and investigation of basin-centered pressure compartments. □