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by ***David M. Thomas, III***
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Upper Ordovician Montoya Sequence Stratigraphy and Chert Porosity in the Southeastern Delaware Basin, West Texas

The Upper Ordovician Montoya Group, of the southeastern Delaware Basin, was deposited approximately 450 million years ago on a carbonate ramp in a shallow marine environment as a 2nd-order sequence. Four formations—the Cable Canyon, Upham, Aleman, and Cutter—comprise four unconformity-bounded 3rd-order sequences within the Montoya: Sequence I of LST siliciclastics and carbonates, TST limestone/chert and a HST limestone, sequence II of TST limestone/chert and HST limestone, sequence III of TST limestone/chert and HST limestone and sequence IV of TST limestone/chert and HST carbonate. The LST and the HST are essentially chert free. The chert-bearing facies occurs in the TSTs where 20 to 60 percent of the rock is chert. The upper Aleman pay zones, the primary Montoya gas reservoir, contains a number of cyclic TST chert-bearing and HST chert-free limestones. Movement of the silica-bearing upwelling water from south to north resulted in early silicification that was influenced primarily by relative sea level and sedimentary facies. During TST deposition, the relatively higher partial pressure of CO_2 in the deeper water and the organic acid from decomposition of organic matter enhanced silicification. During HST grainstone deposition, high-energy waves, storm and tidal currents forced the near-shore, higher temperature, higher salinity/lower CO_2 content water deeper, resulting in chert-free facies. Three stages of silica diagenesis controlled the porosity evolution: first stage, dissolution of metastable matrix and bioclasts as the siliceous upwelling water began to replace the primary interstitial water enlarged interparticle pore spaces and created moldic porosity; second stage, silica precipitation on pore walls to form a silica rim that partially replaced the metastable grains resulted porous chert; and third stage, continuous silica precipitation completely filled the pores forming tight chert. Deposition during HST before completion of chertification protected remaining open porosity from occlusion by continued chert precipitation.

Three gas-reservoir intervals, Cutter, Aleman and Upham, have been drilled and reportedly developed. The reservoir porosity in the Cutter Formation in the northern portion of the study area occurs primarily in the dolomite that developed within the HST skeletal grainstone with some minor contribution from porous and fractured chert. The Upham reservoir tested in the southern part of the study area included porosity at the top of the HST grainstone and fractures in the transgressive chert. The upper Aleman is the primary Montoya pay and contains a number of high-frequency sequences and high-frequency sequence sets of TST chert-bearing and HST chert-free limestones. The reservoir porosity is predominantly from the chert. Reduced interparticle, moldic, small pore and micro porosities in the chert with some minor porosity developed in the dolostone and limestone provide the primary gas reservoir. The Aleman was developed using horizontal technology in the Block 16 area by Mobil, with the first horizontal well drilled and completed in 1999. Production to date has been approximately 88 BCF from 40 wells with peak production of 90 MMCFD and an estimated ultimate recovery of approximately 400 BCF. ■

Biographical Sketch

David M. Thomas, III serves as Exploration Manager of the Southern Region for Tom Brown, Inc. in Midland, Texas. He received his undergraduate degree from the University of New Mexico in 1977 and a Master of Science degree in geology from the University of Oklahoma in 1997. Prior to his employment with Tom Brown, Inc., Mr. Thomas served as a geologist for Pure Resources, Senior Staff Geologist for Mobil E&P U.S. Inc. and Senior Geologist for Conoco, Inc. in Midland, Texas. In Oklahoma, he was a Research Assistant at the University of Oklahoma and ran his own company, Trey Resources, Inc., for over 14 years.