NORTH AMERICAN EXPLORATIONISTS

The Greater Natural Buttes Producing Area, Southeastern Uinta Basin, Utah: A Unique Model for a Basin-Centered Gas Accumulation

Logan MacMillan and Dan J. Hartmann

North American Explorationists Dinner Meeting – February 28, 1994
Social Period, 5:30 p.m., Dinner and Meeting, 6:30 p.m.
H.E.S.S., 3121 Buffalo Speedway

The Greater Natural Buttes Producing Area presently encompasses more than 400 square miles (1050 sq. km) in the southeastern Uinta Basin, Utah. Non-associated gas production from the field is from the predominately fluvial sandstone reservoirs in the Paleocene Wasatch and Colton Formations, and the underlying Maastrichtian Mesaverde Group.

Four independently-derived relationships demonstrate a unique Petroleum System. First, regional lithostratigraphic analysis of the Mesaverde Group and Wasatch Formation differentiate source rocks, reservoir rocks and seals. Potential source rocks are coals that are predominately Type III, humic-rich organic material, with high TOC content, These coals are concentrated in the basal Mesaverde Group, as well as disseminated throughout the remaining 2500 feet (800 m) of the Mesaverde. Potential reservoir rocks exist throughout the stratigraphic section of the Mesaverde Group and the 4000 feet (1350 m) of Wasatch Formation. Sandstones deposited in a fluvial and / or braid - plain environment are the predominate reservoir facies. Potential seals to gas migration are seen in a regional sense as lateral and vertical relationships of shales and low permeability sandstones in both the Mesaverde and Wasatch and the overlying Eocene Green River Formation.

Second, gas analysis of the produced gas in the Natural Buttes Producing complex demonstrates two key factors: 1) the source type is from Type III kerogen, and 2) Isotopic ratios differentiate both source-type differences and possible influences of migration. The gas produced from the Greater Natural Buttes Producing area is sourced from the thermally mature, Type III kerogen (coals) of the Mesaverde Group.

Third, the thermal maturity pattern of the deep Mesaverde coal deposits correlates with the higher Estimated Ultimate Recovery (EUR) from the wells completed in both the Mesaverde and Wasatch formation. Detailed true-scale structural cross-sections demonstrate that as the coal rank increases above a vitrinite reflectance of approximately 1.0, the gas column rises 750 feet (250 m) to include a zone in the Wasatch Formation (Chapita Wells zone) that has improved porosity and permeability. In addition, when the deep Mesaverde coal rank is greater than 1.0, over pressuring is demonstrated in the Chapita Wells zone.

Fourth, reservoir characterization and petrophysical modeling indicate characteristics similar to other regional central basin gas accumulations. Standard core analyses indicate that pore-throat characterization, formation water resistivities, and production characterization can provide a significantly better understanding of the mechanical log analysis for determination of pay sandstones.

When viewed in a regional perspective, the Natural Buttes Producing Complex demonstrates a significantly different model for a central-basin gas accumulation than those examples previously described in the literature (Basin Dakota of the San Juan Basin; Wattenburg "J" Sandstone in the Denver Basin, Elmsworth of the Deep Alberta Basin.) In the case of the Wasatch/ Mesaverde petroleum system of the Unita Basin, the gas-prone source rocks have expelled methane from the coals at the coal rank of Medium Volatile Bituminous, and that gas has displaced the free moveable water within the pore-structure over a vertical and stratigraphic thickness of 6500 feet (2170 m).

LOGAN MACMILLAN
Biographical Sketch –

Logan MacMillan is currently an independent petroleum geologist working with Rose Exploration Associates in Denver, Colorado. Logan has worked for companies representing the full spectrum of the upstream sector: majors (Amoco), large and small independents (Apache Corporation, Axem Resources, Bass Enterprises Production Company, and Petroleum Inc.) as well as consulting firms and individuals. His assignments, conducted throughout the Rocky Mountain region, include regional petroleum assessments down to detailed field studies for secondary and tertiary recovery projects.

Mr. MacMillan received a B.S. (1973) in Geological Engineering, an M.S. (1975) in Geology from the Colorado School of Mines, and an M.B.A., (1988) from the University of Colorado, Denver. He is a certified petroleum geologist and has presented and published technical papers on stratigraphy, specific oil and gas fields, generation and migration of hydrocarbons in the Rockies, and field evaluation techniques for regional hydrocarbon accumulation.