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## Under-explored Plays in the Northwestern Appalachian Basin: Opportunities for the Independent?

The first drilling for petroleum in the Appalachian basin occurred in 1859 with Drake's well in Pennsylvania. Since then thousands of wells have been drilled with most to depths of less than 4,000 feet. Reservoirs have been discovered and produced from the Cretaceous, Devonian, Silurian, Ordovician and Cambrian. Reservoirs include carbonates and clastics generally deposited in shallow marine conditions. Structural, stratigraphic, or fracture/solution-enhanced stratigraphic traps are documented. Source rocks are believed to be primarily Silurian and Ordovician.

Early exploration focused on Cretaceous and Devonian traps some of which were enhanced by nitro-fracturing. In the 1970s and 1980s the Silurian Medina-Clinton sandstones were extensively drilled for gas. More recently Ordovician Trenton-Black River carbonates with enhanced solution porosity are targeted. In addition, Upper Cambrian Rose Run sandstones of the Knox Formation are being drilled in Ohio. These are erosional remnants trapped along the Knox Unconformity. Other Cambrian reservoirs are found in structural traps and stratigraphic pinch-outs along regional highs. Discovered reserve estimates for the basin are 36 trillion cubic feet (TCF) of gas produced and 8 TCF of gas remaining to be produced. The USGS estimated total undiscovered reserves are 70 TCF of gas and 54 million barrels of oil.

In the northwestern portion of the Appalachian basin (Ohio and western Pennsylvania) only about 70 wells have reached the base of the Cambrian section. In comparison, thousands of wells have been drilled to at least the Ordovician. Similarly, there are hundreds of producing fields in the post-Ordovician section and about 30 producing Cambro-Ordovician fields. One explanation given for this situation is the difficulty in identifying deeper traps and the

predicted poor quality of the reservoirs. Both of these problems are real but the use of modern exploration and production tools along with higher product prices should produce commercially attractive prospects.

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In the Cambro-Ordovician section three under-explored plays exist. These are the basal Cambrian Mount Simon Sandstone trapped in pinch-outs or across basement highs, Cambrian sandstones trapped in anticlines and Ordovician Trenton-Black River limestones in fracture-enhanced structural/stratigraphic traps. Each of these plays is proven in the basin. The Mount Simon produces in western Pennsylvania, the Knox in eastern Ohio and the Trenton-Black River in

New York and central Ohio. The USGS has not quantified the undiscovered field sizes for the Mount Simon. For the Knox the USGS estimates minimum, median and maximum gas fields of 3, 8 and 250 BCF, respectively. For the Trenton-Black River estimated minimum, median and maximum gas field sites are 3, 18 and 750 BCF, respectively. With average drilling depths between 5,000 and 10,000 feet and gas values above \$4 per thousand cubic feet, these reservoirs are interesting candidates for exploration by independent operators. ■

### Biographical Sketch

DANIEL BENDIG has a MSc degree from the University of London in stratigraphy, an MA degree from SUNY at Buffalo in geology and a BS degree from the Ohio State University in physics. He is a member of the AAPG (DPA Certified Petroleum Geologist), a member of the HGS and SIPES. His career has been as a geophysicist with a major working in Houston, Indonesia, England and Scotland. He is now an independent working on the petroleum potential of the Appalachian Basin.