Chapter 1

Executive Summary—Undiscovered Oil and Gas Resources of the U.S. Portion of the Michigan Basin


Chapter 1 of 4

Geologic Assessment of Undiscovered Oil and Gas Resources of the U.S. Portion of the Michigan Basin

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Introduction

In 2004, the U.S. Geological Survey (USGS) completed an assessment of the undiscovered oil and gas potential of the U.S. portion of the Michigan Basin (fig. 1). For this assessment, the Michigan Basin includes most of the State of Michigan, as well as parts of Illinois, Indiana, Minnesota, Ohio, and Wisconsin. The assessment was based on the geologic elements of each total petroleum system (TPS) defined in the basin, including (1) hydrocarbon source rocks (source-rock maturation and hydrocarbon generation and migration), (2) reservoir rocks (sequence stratigraphy and petrophysical properties), and (3) hydrocarbon traps (trap formation and timing). Using this geologic framework, the USGS defined 6 total petroleum systems and 13 assessment units (AUs) within the basin and estimated the quantity of undiscovered technically recoverable oil and gas resources present in the U.S. portion of the 13 AUs (table 1) (Swezey and others, 2005).

Figure 1. Map showing the location of the Michigan Basin, with the assessed area outlined in red.
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| Total petroleum systems and assessment units | Field type | Silurian Niagara/Salina TPS | | | | | | | | | Ordovician to Devonian Composite TPS | | | | | | | | | Ordovician Foster TPS | | | | | | | | | Precambrian Nonesuch TPS | | | | | | | | | Total conventional resources | | | | | | | | | Pennsylvania Saginaw Coal Bed Gas AU | | | | | | | | | Devonian Antrim Continuous Gas AU | | | | | | | | | Devonian Antrim Continuous Oil AU | | | | | | | | | Ordovician Collingwood Shale Gas AU | | | | | | | | | Total continuous resources | | | | | | | | | Total undiscovered oil and gas resources | | | | | | | | | [All tabulated results are for technically recoverable resources. Results shown are fully risked estimates. For gas fields, all liquids are included under the natural gas liquids (NGL) category. F95 represents a 95 percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Results are for the U.S. portion of the basin only. MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids; TPS, total petroleum system; AU, assessment unit. Gray shade indicates not applicable or not assessed quantitatively]
Total Petroleum Systems

The six TPSs identified in the Michigan Basin were (1) Precambrian Nonesuch TPS, (2) Ordovician Foster TPS, (3) Ordovician to Devonian Composite TPS, (4) Silurian Niagara/Salina TPS, (5) Devonian Antrim TPS, and (6) Pennsylvanian Saginaw TPS. Each TPS is named according to the petroleum source rock(s) of that system. For most of the systems, each TPS is associated with only one source rock. The Ordovician to Devonian Composite TPS, however, is a composite petroleum system with contributions from one or more of three different petroleum source rocks including Middle Ordovician Collingwood Shale, Middle Devonian Detroit River Group, and the Upper Devonian Antrim Shale.

Assessment Units

Nine of the AUs are characterized as conventional oil and gas accumulations, and four of the AUs are characterized as continuous accumulations. The nine conventional AUs are (1) Precambrian Nonesuch AU; (2) Ordovician Sandstones and Carbonates AU, which includes the Prairie du Chien Group, St. Peter Sandstone, Glenwood Formation, and equivalent stratigraphic units within the basin; (3) Ordovician Trenton/Black River AU; (4) Silurian Burnt Bluff AU; (5) Silurian Niagara AU; (6) Silurian A-1 Carbonate AU; (7) Devonian Sylvania Sandstone AU; (8) Middle Devonian Carbonates AU, which includes the Detroit River Group, Dundee Limestone, and Traverse Group; and (9) Devonian to Mississippian Berea/Michigan Sandstones AU. All of these conventional AUs were assessed quantitatively, except for the Precambrian Nonesuch AU. The four continuous AUs are (1) Ordovician Collingwood Shale Gas AU, (2) Devonian Antrim Continuous Oil AU, (3) Devonian Antrim Continuous Gas AU, and (4) Pennsylvanian Saginaw Coal Bed Gas AU. Of these four continuous AUs, only the Devonian Antrim Continuous Gas AU was assessed quantitatively.

Resource Summary

For the U.S. portion of the Michigan Basin, the USGS estimated the following quantities of undiscovered, technically recoverable oil and gas resources (table 1): (1) a mean of 990 million barrels of oil, (2) a mean of 11.4 trillion cubic feet of natural gas, and (3) a mean of 219 million barrels of natural gas liquids. The Ordovician Trenton/Black River AU has the greatest potential for undiscovered oil, with an estimated mean of 723 million barrels of undiscovered, technically recoverable oil. The Silurian Niagara AU also has a significant potential, with an estimated 211 million barrels of undiscovered, technically recoverable oil. The Devonian Antrim Continuous Gas AU has the greatest potential for undiscovered gas, with an estimated mean of 7.48 trillion cubic feet of undiscovered, technically recoverable gas. The Ordovician Sandstones and Carbonates AU (559 billion cubic feet), the Ordovician Trenton/Black River AU (2.00 trillion cubic feet), and the Silurian Niagara AU (1.08 trillion cubic feet) also have significant potential for undiscovered, technically recoverable gas.

Reference Cited