

National Assessment of Oil and Gas

Assessment of Undiscovered Oil and Gas Resources of the Devonian Marcellus Shale of the Appalachian Basin Province, 2011

Introduction

Using a geology-based assessment methodology, the U.S. Geological Survey (USGS) estimated a mean undiscovered natural gas resource of 84,198 billion cubic feet and a mean undiscovered natural gas liquids resource of 3,379 million barrels in the Devonian Marcellus Shale within the Appalachian Basin Province. All this resource occurs in continuous accumulations.

In 2011, the USGS completed an assessment of the undiscovered oil and gas potential of the Devonian Marcellus

Shale within the Appalachian Basin Province of the eastern United States (fig. 1). The Appalachian Basin Province includes parts of Alabama, Georgia, Kentucky, Maryland, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The assessment of the Marcellus Shale is based on the geologic elements of this formation's total petroleum system (TPS) as recognized in the Appalachian Basin Province. These elements incorporate the characteristics of the TPS as a petroleum source rock (source rock richness, thermal maturation, petroleum generation, and migration) as well as a reservoir rock (stratigraphic position and content and petrophysical properties).

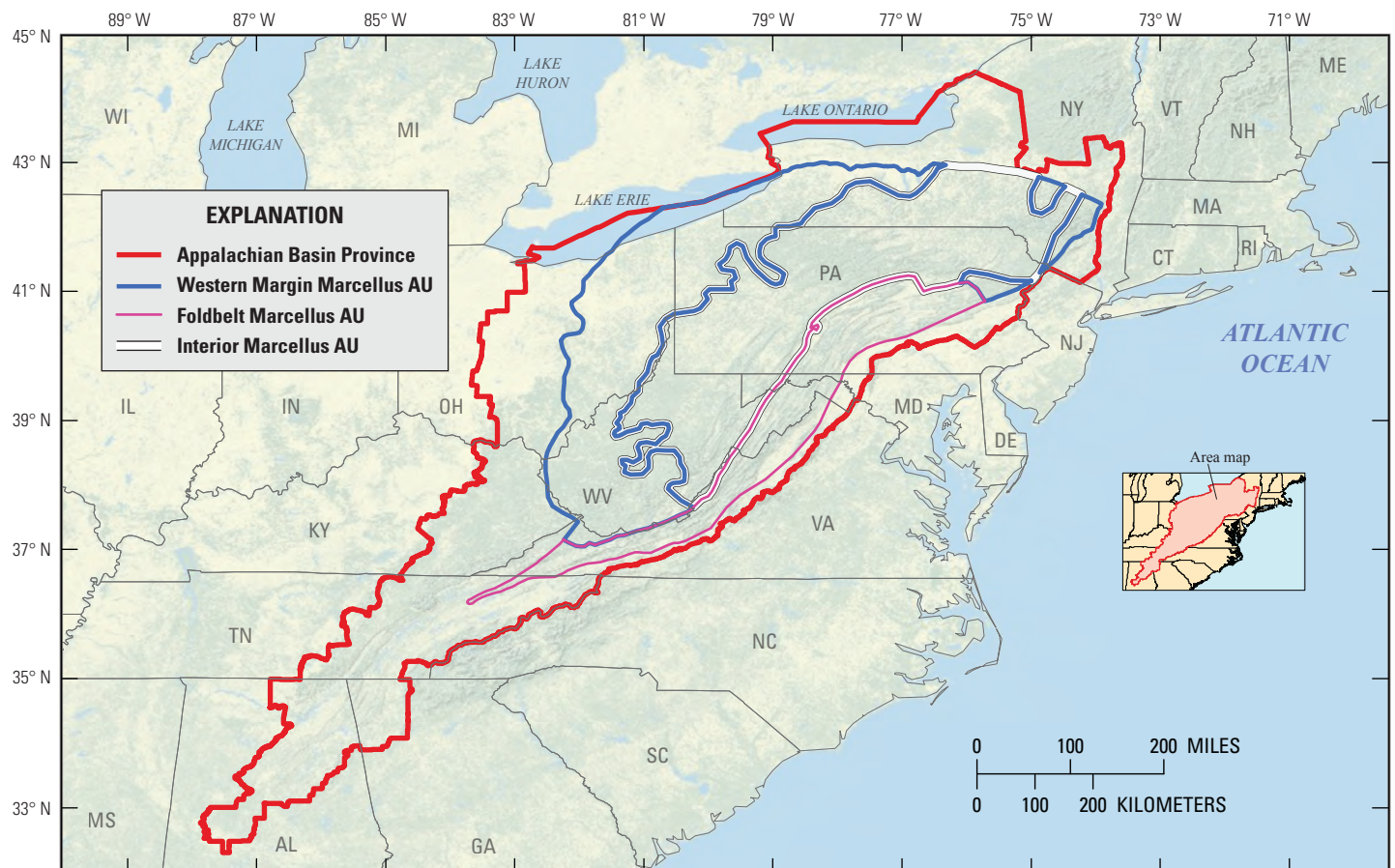


Figure 1. Map of the Appalachian Basin Province showing the three Marcellus Shale assessment units, which encompass the extent of the Middle Devonian from its zero isopach edge in the west to its erosional truncation within the Appalachian fold and thrust belt in the east.

Together, these components confirm the Marcellus Shale as a continuous petroleum accumulation. Using this geologic framework, the USGS defined one TPS and three assessment units (AUs) within this TPS and quantitatively estimated the undiscovered oil and gas resources within the three AUs (table 1). For the purposes of this assessment, the Marcellus Shale is considered to be that Middle Devonian interval that consists primarily of shale and lesser amounts of bentonite, limestone, and siltstone occurring between the underlying Middle Devonian Onondaga Limestone (or its stratigraphic equivalents, the Needmore Shale and Huntersville Chert) and the overlying Middle Devonian Mahantango Formation (or its stratigraphic equivalents, the upper Millboro Shale and middle Hamilton Group).

Resource Summary

The USGS assessed the technically recoverable, undiscovered continuous (unconventional) gas within the Marcellus Shale and estimated a mean of 84,198 billion cubic feet of gas and a mean of 3,379 million barrels of total natural gas liquids. The entire undiscovered gas and natural gas liquids resource is in a continuous accumulation and is contained within a single TPS, the Devonian Shale-Middle and Upper Paleozoic TPS (table 1). Ninety-six percent of the estimated resource resides within the Interior Marcellus AU.

The Marcellus Shale is divided into three AUs within the formation's extent in the Appalachian Basin—the Western Margin Marcellus AU, which encompasses the western extent of the formation and west of the Appalachian Structural Front (ASF); the Interior Marcellus AU, which is the central extent of the trend and west of the ASF; and the Foldbelt Marcellus AU, which is east of the ASF. The total area of these three AUs extends from southern New York to northeastern Tennessee and from central Ohio to western Virginia and Maryland.

The Western Margin Marcellus AU includes the formation where it is less than 50 feet (ft) thick, ranges in depth from less than 2,000 ft to more than 9,000 ft, and contains strata that range in current levels of thermal maturity from pre-peak oil to past-peak gas. The Interior Marcellus AU contains the Marcellus Shale that is 50 feet thick or more, ranges in depth from less than 2,000 ft to more than 11,000 ft, and contains strata that range in current levels of thermal maturity from peak oil to past-peak gas. The Foldbelt Marcellus AU contains the Marcellus Shale within the Appalachian fold and thrust belt, ranges in thickness from a few feet to more than 350 ft thick, ranges in depth from outcrop to more than 11,000 ft, and contains strata that range in current levels of thermal maturity from peak gas to past-peak gas.

Table 1. Appalachian Basin Province assessment results.

[Results shown are fully risked estimates. For gas accumulations, all liquids are included as natural gas liquids (NGL). 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. AU, assessment unit, BCFG, billion cubic feet of gas. MMBNGL, million barrels of natural gas liquids; TPS, total petroleum system]

Total Petroleum System (TPS) and Assessment Units (AU)	Field type	AU probability	Total undiscovered resources							
			Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean
Devonian Shale-Middle and Upper Paleozoic TPS										
Foldbelt Marcellus AU	Gas	1.0	345	698	1,410	765	0	0	0	0
Interior Marcellus AU	Gas	1.0	41,607	76,078	139,106	81,374	1,497	2,982	5,938	3,255
Western Margin Marcellus AU	Gas	1.0	1,002	1,907	3,629	2,059	57	113	224	124
Total undiscovered resources			42,954	78,683	144,145	84,198	1,554	3,095	6,162	3,379

Marcellus Shale Assessment Team

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For Further Information

Supporting geologic reports on the Marcellus Shale resource assessment are in preparation. More information about the Marcellus Shale and other oil and gas assessments, the assessment methodology, and the TPS and assessment units can be found at the USGS Energy Resources Program Web site (<http://energy.usgs.gov/>).