Abstract

The U.S. Energy Information Administration (EIA) is in the process of updating maps of the major lowpermeability oil and gas plays of the lower 48 states using publically available data and commercial well-level databases (Drilling Info Inc. and IHS Inc.). As a part of these efforts EIA has generated updated maps that characterize the structure, thickness, and geologic setting of the Utica play. The Utica petroleum system includes the Utica Formation and the underlying Point Pleasant and Logana formations. Each formation holds its own significance and characteristics; so maps have been produced for each individually, and for the entire interval, as well. Data from 1479 producing oil and gas wells across New York, Ohio, Pennsylvania, and West Virginia were assessed for geologic properties related to initial production and daily production volumes. Production profiles, gas-to-oil ratios, and recovery factors vary laterally and across three major Utica play stratigraphic units, Utica, Point Pleasant, and Logana formations. EIA's collection of thematic maps helps explain the location of “sweet spots” within the play area, distribution of oil-rich and gas-rich wells across the play extent, as well as forecast production trends.

Reference Cited

Major structural and tectonic features in the region of the Utica play

Structure map of the Utica Formation

Note: Map includes production wells from January 2010 through January 2016.
Thickness map of the Utica Formation

Thickness map of the Point Pleasant Formation

Thickness map of the combined Utica - Point Pleasant interval

The Energy Information Administration has produced new maps that characterize the structure, thickness, and geologic setting of the Utica shale play. From 2011 production from the Utica play has increased with more than 1700 wells drilled by November 2015. In order to help understand these production trends, the maps herein provide information that illustrates the underlying geology. The play includes both the Utica formation and the deeper Point Pleasant formation. Each formation has its own significance and characteristics; so maps have been produced for each individually, and as one whole unit. Additionally, this collection of maps helps to explain the distribution of producing wells within the play and the distribution of oil-rich and gas-rich wells. This study explains the depositional environment and major geological and tectonic features, provides structure maps, and also provides thickness maps.

The structural and tectonic features map provides a visualization of the geologic setting of the play area. Covering approximately 60,000 square miles, the Utica play spans parts of Ohio, Pennsylvania, New York, West Virginia, Kentucky, and Indiana. The Utica section was deposited in the Late Ordovician period about 450 million years ago. Groups of associated fossils, fine layer sequences reflecting moving currents, and erosional surfaces indicative of recurrent storms point to a depositional environment that was a shallow marine area that experienced frequent storms and algal blooms. This environment led to a deposition of interbedded shale and limestone with unconformities representing periods of erosion or non-deposition between the main layers.

The major structural features include the Cincinnati Arch, Findlay Arch, and Greenville Front that run in a north-south direction along the Western end of the formation. The Pine Mountain Fault, Pine Mountain Thrust, and the Blue Ridge Green Mountain Front run along the western edge of the Appalachian Mountains. The mountain building events during the deposition period left a number of faults in their wake that are important for oil and gas generation. There are Ordovician age faults and surface faults both in northeast-southwest and perpendicular northwest-southeast directions. A number of these faults coincide with subsurface features of the East Continent Rift Basin, Rome trough, and the Greenville Front. These major features represent points of weakness that often allow for enhanced movement and accumulation of oil and gas.

Utica is a stacked play and includes both the Utica Formation and the underlying Point Pleasant Formation; however, Point Pleasant is currently the targeted drilling formation because it is more productive. As each formation holds its own significance, subsea elevation contour maps representing the top surface of each have been constructed using point data from wells and outcrop data from the U.S. Geological Survey. These maps represent subsea depths and only roughly approximate drilling depth to reach the top of each formation.
Initial gas-to-oil ratios (GORs) of Utica and Point Pleasant wells through June 2016

Depth to the top of the Utica Formation in feet


In the southwest corner of Pennsylvania, the Point Pleasant Formation reaches subsurface depths of up to -13,000 feet and is shallowest at the junction of Ohio, Indiana, and Kentucky and along the outcrops. The Utica Formation reaches subsurface depths of up to -14,000 feet in a northeast-trending arc though Pennsylvania and also reaches its initial gas-to-oil ratios (GORs) of Utica and Point Pleasant wells through June 2016, shallowest at the junction of Ohio, Indiana, and Kentucky and along the outcrops. The area where most producing wells are found has a subsea depth ranging from -2,000 to -11,000 feet. Structure maps not only provide valuable drilling information, but they also lend insight into the distribution of oil and gas throughout the play. Temperature and pressure play a part in determining the amount of oil and gas in the formation and are a function of depth. These maps give a general idea of the spatial distribution of oil and gas based upon the depth to the top of the formation.

Thickness maps (isopach) for each formation individually and for the Utica play as a whole were constructed using point data from wells. For the Utica Formation map, the difference between the top of the Utica Formation and the top of the Point Pleasant Formation was used as a proxy for the Utica thickness. For the Point Pleasant thickness map, the top of the Point Pleasant Formation and the top of the underlying Trenton Formation were used to define the thickness of the Point Pleasant. The top of the Utica and the top of the Trenton were used to determine the combined thickness. The Utica Formation is thickest in western Ohio and the northwest corner of Pennsylvania, at 200-300 feet, and thins out to 50 or less feet in southern Ohio and northern Kentucky. The Point Pleasant Formation reaches a thickness of 200+ feet in central Pennsylvania and thins to less than 20 feet in the eastern half of Kentucky. The combined thickness of Utica and Point Pleasant is as thin as 100 feet or less where Ohio, West Virginia, and Kentucky meet. The thickness reaches over 300 feet in northwest and central Pennsylvania, and northeast and central Ohio. The area where the most productive wells are located has a thickness of 150 feet or more. The outlined area of highest organic content shows the continuous reservoir where productive wells would likely be drilled. This area has relatively high levels of total organic carbon (an indication of the amount of hydrocarbon in the rock) which is important for successful wells. Like structure maps, isopach maps provide valuable drilling information since thickness of the reservoir is one component of the decision to drill a well and the subsequent success. The above maps provide an idea of the potential thickness in a given area of the play. The Utica is one of several oil and natural gas formations with updated geologic detail. EIA earlier updated geologic maps for the Marcellus and Eagle Ford plays. Additionally, EIA published updated shapefiles for the following plays: Abo-Yeso, Bone Spring, Delaware, Glorieta-Yeso, and Spraberry; Bakken and Three Forks; Eagle Ford; Marcellus; Utica; and Niobrara.

Disclaimer
EIA play maps not intended for exploration geologists but are geared towards large scale analysis and assessment of technically recoverable resource.