

Cambrian Rogersville Shale (Conasauga Group) in the Rome Trough, Kentucky and West Virginia: A Potential New Unconventional Reservoir in the Appalachian Basin

2014 Eastern Unconventional Oil & Gas Symposium (EUOGS) – www.euogs.org

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KEYWORDS: Conasauga Group, Rogersville Shale, Rome Trough, shale gas, Cambrian, Kentucky

ABSTRACT

Research by the Rome Trough Consortium (RTC) at the Kentucky, Ohio, and West Virginia Geological Surveys from 1999-2002 refined the stratigraphic framework of a Cambrian-age extensional basin underlying the Appalachian Basin (Harris and others, 2004). This graben, called the Rome Trough, is filled with up to 10,000 ft of pre-Knox Group sedimentary rocks. Well log correlations indicate formations comprising the Cambrian Conasauga Group extend across parts of eastern Kentucky, and include in ascending order the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale, and Maynardville Limestone. Regional distribution of these formations and the underlying Rome Formation is controlled by extensional faults that were active during and after Conasauga deposition. Stratigraphic correlation of these units reveals the presence of a westward prograding carbonate ramp and distal intrashelf shale basin in the Rome Trough in eastern Kentucky. The Conasauga formations record several cycles of progradation and transgression from east to west into this basin.

Commercial hydrocarbon production from the Rome Trough includes the Homer Field in Elliott County, Ky. where sandstone reservoirs in the Rome and Conasauga formations have produced over 2 billion cubic feet of gas (Harris and Baranoski, 1996). Other Cambrian completions include short-lived gas and condensate production from the Exxon No. 1 McCoy well in Jackson County, W. Va., and the Inland Gas 529 White well in Boyd County, Ky. Two wells in Johnson County, Ky. have produced gas and condensate since the mid-1980's from fractured Nolichucky Shale near the Irvine-Paint Creek Fault. In order to identify the source of these hydrocarbons, the RTC analyzed numerous Cambrian shales from across the Rome Trough. Total organic carbon content (TOC) of these shales was less than 1 percent for all samples, with the exception of a core of the Rogersville Shale from the Exxon No. 1 Smith well in Wayne

County, W. Va. TOC for the Rogersville Shale in this core ranges from 1.2 to 4.4 percent, with T_{max} values of 460 to 469° C. Six additional Rock-Eval analyses from the Smith core confirmed the original data, with TOC of 1.2 to 4.75 percent, with T_{max} of 446-460° C. Low hydrogen indices, and T_{max} data indicate a thermal maturity in the wet gas-condensate window. The Rogersville Shale in this core is a dark gray fissile shale, interbedded with thinly-laminated and bioturbated siltstone. Hydrocarbon extracts from the Rogersville Shale core are geochemically very similar to produced condensate from Elliott and Boyd County, Ky., and suggest the Rogersville was the source of gas and condensate in the Homer Field. Gas chromatographs of the Cambrian oils are similar to Ordovician-sourced oils, with strong predominance of odd-carbon normal alkanes. Organic carbon in Ordovician source rocks has been attributed to *G. Prisca*, a marine alga, but this form has not been positively identified in the Cambrian Rogersville Shale to date.

Since the original RTC work, which focused on conventional reservoirs, the potential of unconventional shale gas reservoirs has become the focus of exploration in many onshore US basins. The Rogersville Shale has suitable thickness, mineralogy, organic content, and thermal maturity to potentially produce gas or liquids if fractured to improve permeability. The Rogersville Shale ranges in thickness from 200 to over 1,200 ft in eastern Kentucky and western W. Va. The top of the Rogersville ranges from approximately 7,000 to 10,000 feet below surface. X-ray diffraction analyses on six Rogersville Shale core samples shows an average composition of 38 percent quartz, feldspar and pyrite, 34 percent clays, and 28 percent carbonate. Mud logs provide an indication of the gas content of shales during drilling, but are scarce for Rogersville wells in eastern Kentucky. However, a mud log is available for the Exxon No. 1 Smith well in Wayne County, W. Va., where the Rogersville core was cut. It recorded elevated mud gas during drilling of the Rogersville interval, and indicates a drill stem test was conducted over the lower Maryville and upper Rogersville interval.

Interest in the unconventional resource potential of the Rogersville is increasing. Two deep tests have been permitted in the last year. The Bruin Exploration No. 1 Young well in Lawrence County, Ky. was permitted to 15,000 ft in the Rome Formation, and drilled in late 2013. Results of this well are being held confidential, but it appears to have tested a deep zone, and is currently shut-in. A second well, the Cabot Oil and Gas No. 50 Amherst Industries, was permitted in mid-2014 to 14,000 ft targeting the Rogersville Shale in Putnam County, W. Va. These wells are 18 miles west and 44 miles east along strike respectively, from the Exxon Smith core location. Challenges in developing a Rogersville Shale play include interpreting structure and stratigraphy in the deeper, fault-segmented parts of the Rome Trough, and predicting the distribution of organic-rich intervals. Due to the drilling depth to the Rogersville, economic viability of the play will depend on the production rates established and hydrocarbon type (gas vs. oil).

References

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Eastern Unconventional Oil and Gas Symposium, held November 5-7, 2014 in Lexington, Kentucky, USA.