Thermal maturity and organic petrology of the Upper Ordovician Utica and Lorraine shales, Southern Quebec, Canada

Omid Haeri Ardakani, *Geological Survey of Canada, Calgary Division, Omid.HaeriArdakani@NRCan-RNCan.gc.ca*
Hamed Sanei, *Geological Survey of Canada, Calgary Division, University of Calgary, Aarhus University, Denmark*
Denis Lavoie, *Geological Survey of Canada, Quebec Division*
Zhuoheng Chen, *Geological Survey of Canada, Calgary Division*
Nabila Mechti, *Junex Exploration, Quebec City*

Abstract

This study presents the preliminary results of the organic matter characterization of core samples from the Upper Ordovician Utica and Lorraine shales in the southwestern Quebec. Samples have generally fair TOC content of ranging from 0.08 to 2.25%. The current TOC content of samples represents only the remaining 94-98% of the residual carbon in the sample. Samples from the one of the study well sat the deeper section of the Utica Shale, are in the dry gas zone while shallower samples of Utica and Lorraine shales are in the oil generation window. The thermal maturity data obtained from the Rock-Eval's Tmax for the over mature samples is not reliable due to negligible S2content.

The major organic matter constituents of samples are matrix and migrated solid bitumen and chitinozoan skeleton. Organic carbon comprises of up to 4.7% in volume of total rock. A portion of organic matter in samples may contribute to porosity enhancement, such as matrix pyrobitumen, which is likely resulting from the formation of gas by secondary cracking of bitumen compounds. Porous matrix solid bitumen appear to formed during migration and dissemination of hydrocarbon into the porous clay fraction of the rock. This is often associated with significant bacterial sulfate reduction possibly in the early stages of generation and migration of bitumen. Based on organic petrology and Rock-Eval data it appears that the siltstone facies of the Utica Shale especially for the deeply buried section of the Utica Shale in this area acts as a reservoir rather than source rock.

Random vitrinite reflectance (VRo) measurement is shown to be a robust method for indicating the thermal maturity in these samples. Recent improvements in petrographic analysis allow accurate reflectance measurements on nanoscale spots, providing reliable information on thermal maturity. The reflectance has been measured on matrix and solid bitumen and chitinozoan skeletons. There is a significant agreement between bitumen reflectance and chitinozoan reflectance when they converted to vitrinite reflectance.