

Assessing baseline near-surface bedrock and groundwater geochemical data prior to shale gas exploration and development – the case of the Utica Shale, Quebec, Canada

D. LAVOIE^{1*}, A. MORT², O. HAERI ARDAKANI²,
H. SANEI², G. BORDELEAU¹, C. RIVARD¹
AND J.C. AZNAR³

¹Geological Survey of Canada – Quebec office, Quebec City,
QC, Canada, G1K 9A9 (*correspondance:
denis.lavoie@NRCan.gc.ca)

²Geological Survey of Canada – Calgary Office, Calgary, AB,
Canada

³Institut National de la Recherche Scientifique – ETE, Quebec
City, QC, Canada

In eastern Canada, the Ordovician Utica Shale is a potential shale gas producer. In 2010, exploration came to a halt pending an environmental review. The Geological Survey of Canada has initiated a bedrock and groundwater-focused pilot research project near Quebec City. Twenty-five private water wells were sampled and 4 shallow (50 m) wells were drilled, cored and sampled for water chemistry and rock organic geochemistry. In addition, 250 sites were sampled for pore-space radon and hydrocarbons in soils.

The shallow bedrock geology is dominated by Upper Ordovician shales and sandstones. Rock-Eval and organic matter reflectance results suggest that thermal maturity increases southerly from oil to condensate windows. GC and GC-MS analyses of core extracts document the presence of low but detectable concentrations of C1 to C20 hydrocarbons.

Most water samples have significant concentrations of dissolved hydrocarbons including mostly methane, as well as ethane and propane in a few wells. The presence of dissolved hydrocarbons in groundwater is fairly well established in southern Quebec, although their source (biogenic versus thermogenic) remains ambiguous. The presence of dissolved propane indicates that some of the hydrocarbons are thermogenic in origin. Gas wetness and isotopic ratios ($\delta^{13}\text{C}$, $\delta^2\text{H}$) of methane suggest mixed thermogenic and biogenic origin. Areas with elevated radon, methane, ethane and butane in soils are located close of the Appalachians – Platform contact, a sector with high concentrations of hydrocarbons dissolved in groundwater.