Hydrothermal Dolomite Reservoirs In Ordovician And Silurian Successions Of Eastern Quebec: A Future Success Story

Denis Lavoie*
Natural Resources of Canada, Geological Survey of Canada, Québec Division, 880 Chemin Ste-Foy, Quebec City, QC G1V 4C7
delavoie@nrcan.gc.ca

ABSTRACT

Hydrothermal dolomitization played a key role for Ordovician carbonates with significant production from the US mid-west to Ontario and New York.

On Anticosti Island, the Ordovician Romaine and Mingan formations recorded multiple events of dolomitization and hydrocarbon migration. In the Romaine, an hydrothermal event generated porosities imperfectly filled by high temperature saddle dolomite (T_h: 120°C) derived from a highly saline fluid (24 wt% $NaCl_{equi}$). A late and cooler hydrocarbon inclusion-rich calcite filled some pore space of this regional aquifer. High-temperature dolomite is documented in the Mingan Formation and occurs as a replacement phase. The dolomite is characterized by high temperature (T_h: 105°C) and saline (24 wt% $NaCl_{equi}$) fluid inclusions.

In Gaspé, highly brecciated and stratiform porous dolostones of the Lower Silurian Sayabec Formation and an underlying regional sandstone aquifer are coated with residual bitumen. The dolostone consists predominantly of replacive matrix dolomite. Saddle dolomite is found as pore filling cement in secondary pores. Oxygen stable isotope ratios ($\delta^{18}O_{PDB}$ = -18 to -15,3‰) and fluid inclusions (T_h: 160°C) of the saddle dolomite indicate high temperature of precipitation. The carbonates are locally dissolved and the scalloped surfaces covered by meteoric calcites. The meteoric event is related to a Pridolian sea level lowstand, it provides a first constraint on timing of the hydrothermal dolomitization and hydrocarbon charge of the Sayabec Formation in Gaspé.

For both Anticosti and Gaspé, the best potential source rocks are Upper Ordovician black shales. In both areas, the potential reservoirs (Mingan and Sayabec formations) formed early; hydrothermal fluids used basal aquifers and major extensional faults for circulation. On Anticosti, seismic profiles document the presence of platform sags and associated loss of seismic markers in untested extensional fault-bounded domains. In Gaspé, seismic programs document complex compressive structures in the Sayabec Formation and efficient structural traps are added to the stratigraphic (shaly facies) and diagenetic (tight non-dolomitized limestone) seals. Some “flat spots” in the Lower Silurian section in eastern Quebec suggests the presence of hydrocarbon-filled reservoirs.