
Hydrocarbons in the Paleozoic basins of eastern Canada: significant newly recognized potential

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The Cambrian to Middle Devonian successions at the continental margin of Laurentia consist of marine to continental sediments deposited during alternating passive margin and foreland basin episodes. Two significant orogenic pulses, the Ordovician Taconian Orogeny and the Late Silurian-Middle Devonian Salinian-Acadian event, controlled tectono-sedimentary patterns.

Good hydrocarbon source rocks are found in the Upper Ordovician foreland basin shales (TOC up to 14%, Type I/II), in the Middle Ordovician oceanic shales (TOC up to 10.7%, Type I) and in the Lower Ordovician passive margin shales (TOC up to 10.4%, Type I/II). Fair hydrocarbon source rocks are found in Lower - Middle Devonian foreland basin limestones and coals (TOC from 2% to 50%, Type II/III respectively). Maturation suggests that the Cambrian-Ordovician St. Lawrence Platform has a gas (southern Québec) to oil (western Newfoundland) potential; the coeval Humber Zone has a gas (Québec) to gas and oil (western Newfoundland) potential. The Late Ordovician to Middle Devonian Gaspé Belt has both gas and oil potential.

Clastic reservoirs are found in Cambrian-Ordovician passive margin and foreland basin coarse sandstone and conglomerate slope facies and in Silurian-Devonian nearshore sandstones. The potential for secondary carbonate reservoirs is recognized in the recent documentation of hydrothermally-altered carbonates (Lower to Upper Ordovician passive margin and foreland basin; Lower and Upper Silurian and Lower Devonian foreland basin). The recognition of hydrothermal dolomites is based on the burial scenario, tectonic framework, and detailed petrography and geochemistry. Production of natural gas and oil has recently started in the Lower Devonian dolomites in Gaspé. GC-MS and GC-IRMS fingerprinting of hydrocarbons, bitumen and potential source rocks indicate a most likely dominant Ordovician source. Based on crosscutting relationships and basin modeling, multiple events of hydrocarbon migration are recognized with a significant Late Silurian (syn-Salinian orogeny) and a late Early Devonian migration.

Traps and seals are multiple and include various stratigraphic (pinch-out, impermeable layers and unconformities), tectonic (fault closures, anticlines, duplexes and triangle zones), and diagenetic (HTD) types.

Exploration is picking up rapidly in these Lower Paleozoic basins in eastern Canada with large areas under exploration permits and promising recent drilling results.