

## The Early Paleozoic sea level record along Laurentia continental margin: significance for hydrocarbon reservoirs and exploration in eastern Canada.

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Sedimentation on an evolving continental margin followed the Late Precambrian break-up of Laurentia. In eastern Canada, the margin followed the shape of the St. Lawrence Promontory (Newfoundland) and the Quebec Reentrant (eastern Quebec), two prominent features inherited from rifting. The Cambrian-Ordovician sedimentary record consists of an initial passive margin stage followed by a more-or-less rapidly evolving foreland basin episode. During the Early Paleozoic, the continental margin consisted of shallow water platformal and deeper marine slope to toe of slope facies, these two major sedimentary belts are preserved in the St. Lawrence Lowlands platform and the Appalachian orogen, respectively.

Lower Cambrian to lower Mid-Ordovician passive margin sediments of the Sauk Sequence in Newfoundland consist predominantly of shallow marine carbonate facies with a temporal evolution from a high-energy narrow shelf to a low-energy wide platform. Coeval slope to deep marine siliciclastic deposits recorded the eustatic sea level fluctuations affecting the shallow marine setting. A significant unconformity marks the transition to the Tippecanoe Sequence. Tippecanoe sediments were deposited on a rapidly subsiding carbonate ramp at the margin of a foreland basin. The margin was buried under deep marine shales and overriding allochthonous nappes emplaced in medial Medial Ordovician.

The shallow marine record of the Sauk Sequence in southern Quebec is fragmentary. Preserved outcrops are restricted to Early Ordovician low-energy carbonate platforms although pre-Early Ordovician carbonate shelves are indirectly recognized in limestone clasts found in huge conglomerate debris flows deposited on the coeval continental slope. Facies in those clasts document the presence of a fairly similar carbonate platform to the one known in Newfoundland. By using the conglomerates as proxy for sea level lowstands, a preliminary sea level history can be proposed for the Quebec succession which reasonably matches what is known from Newfoundland. The transition to the Tippecanoe Sequence is also marked by a regional lower Mid-Ordovician unconformity. The Tippecanoe sediments were deposited on a long-lasting carbonate ramp at the margin of a foreland basin. The final drowning of the margin occurred only in medial Late Ordovician. A significant diachronism of 10-15 ma separated the end of the foreland basin episodes from Newfoundland to southern Quebec. This is related to the peculiar reentrant - promontory morphology of the margin which played a key role for the tectonosedimentary evolution of the foreland basin.

Hydrocarbon reservoirs are known in both major tectono-stratigraphic domains. In the St. Lawrence Lowlands, hydrocarbon reservoirs and production are found in Ordovician carbonates in southern Ontario and Quebec whereas in the Appalachians, reservoirs and production occur in tectonically remobilised passive margin platformal carbonates in Western Newfoundland and southern Quebec. For all this area, the documented presence of major sea level lowstands likely resulted in extensive meteoric diagenesis of platformal carbonates and possible karst porogenesis. Moreover, late low temperature hydrothermal events have been recognized in southern Quebec and Newfoundland and are responsible for late carbonate dissolution and porosity generation. Therefore, tectonic slices of Early Ordovician platformal carbonates could be regarded as significant candidates for hydrocarbon reservoirs along the entire external domain of the Appalachian Orogen. Other possible reservoir targets are the Early Ordovician slope quartzites found in eastern Quebec, these are locally porous and impregnated with bitumen.