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Tectonic style and hydrocarbon potential in the Acadian fold and thrust belt, Gaspé Appalachians (eastern Canada)

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For the past century, the Gaspé Peninsula in the northern Appalachians has generated interest for oil and gas exploration. Although oil shows and seeps are abundant, oil production has been minor. The hydrocarbon potential is restricted to Late Ordovician to Early Devonian rocks of the Gaspé Belt and different play concepts have been explored throughout the years. The recent discovery of the JUNEX-Galt natural gas field has renewed interest for onshore hydrocarbon exploration in this area of eastern Canada.

The Mid-Devonian Acadian orogeny in the Gaspé basically involved dextral transpression. Compression within the transpressive belt was initially accommodated and distributed over the entire area through the development of structures such as folds, cleavage and N-directed transport along reverse faults. Continued deformation brought about further flattening of the folds and resulted in dextral transcurrent faulting along steeply dipping strike-slip faults. New field work and seismic data acquired by the Ministère des Richesses naturelles du Québec (2000-2001) suggest intense shortening during the initial compressive phase, S-verging folds and S-directed motion along N-dipping reverse faults. We propose a new tectonic model involving development of an early fold and thrust belt with deformation accommodated by folding, considerable tectonic wedging, blind N-directed thrusting, S-directed backthrusting, and a possible triangle zone followed by strike-slip faulting that partially dissected the FTB. The model is supported by microstructural, isotopic,thermal and fluid inclusion data as well as regional quantitative strain analysis data. Field work shows that fractures related to the strike-slip faulting event locally enhance permeability by connecting stratabound fold-related fractures thus rendering the fractured reservoir play in this area viable.

The JUNEX-Galt natural gas field is a classic example of such a tectonic setting. Gas is trapped in a folded and fractured Devonian limestone located between two regional strike-slip faults at a depth of about 2,250 meters. Geochemical analyses from recovered oils in the area indicate an Ordovician origin very similar to Ordovician oils from western Newfoundland. Large Ordovician anticlinorial structures imaged on old and newly acquired seismic lines underlie the Galt area and represent deeper plays located above blind thrusts deep within the Acadian fold and thrust belt.