Tournaisian Thrust-Belt and Related Transpressional Strike-Slip Zone Along the Southern Margin of the Moncton Subbasin, SE New Brunswick

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Tournaisian (Lower Carboniferous) deposition in the Moncton Subbasin (SE New Brunswick) consists of two sedimentary cycles: a lower grey-bed dominated Horton Group and an upper red-bed dominated Sussex Group. Both cycles ended with a period of basin inversion. The structural geometry of the basin inversion event following Sussex Group deposition is well-exposed along the southern margin of the Moncton Subbasin, where it impinges on the Caledonia Block, a pre-Carboniferous crystalline basement high (see Figure 1). This part of the Subbasin includes the historically productive Stoney Creek oil and gas field; the same play being currently the focus of renewed exploration activity. The source rock for the field is the oil shale of the Horton Group Albert Formation, with the interbedded and overlying sandstone providing the reservoir. A combination of structure and stratigraphy have produced the traps..

The geometrical framework to the end-Tournaisian (post-Sussex Group) inversion is that of a foreland thrust belt related to a right-lateral transpressive strike-slip zone (Figure 2). The thrust belt is preserved between Saint-Joseph and Prosser Brook to the east of the Prosser Mountain Fault, while the deeper levels, including the strike-slip zone itself, are exposed to the west of this fault between Prosser Brook and Elgin.

Frontal ramps dominate the segment of the thrust belt between Saint-Joseph and Peck Creek, best exposed in coastal section along the Petitcodiac River estuary (Belliveau and Boudreau villages). The Horton Group rocks and basal part of the Sussex Group succession display evidence for bedding-parallel slip and discrete thrust planes that ramp-up through the succession to the south. Box-profile folds and sheath folds are common in shale-dominated parts of the succession, while over-tightened chevron folds formed in more arenaceous intervals. Strain rates that exceeded deformation rates led to refolding of these bedding-parallel high strain zones, as well as hinge break-outs. All kinematic indicators relate to top-to-the-south overthrusting. Strain in the succession shows a marked decline up-section. Three large thrusts can be identified: the

Saint-Joseph, Caledonia and Dorchester Faults, that appear to be reactivated normal faults that originally controlled Horton and Sussex group deposition.

There are several sidewall ramps along the thrust belt, of which the best exposed is seen at Peck Creek. Here the Caledonia Fault is translated northward through a complex of splays, and the rocks of the Sussex Group show complex stratigraphic repetitions in an oblique duplex structure. Hanging and footwall folds are a common feature. Critically, in this section all the thrusts and related folds are truncated by the unconformity at the base of the lower Visean Hillsborough Formation. Despite the obliquity of this structure, kinematic indicators still show top-to-the-south translation.

Further west the thrust-belt is not as well exposed, but around Rosevale and Stuart Mountain a thrust-duplex imbricate zone affects the Horton and Sussex Group succession and incorporates slivers of the crystalline basement from the Caledonia Block.

The Prosser Brook sidewall structure terminates the thrust belt, translating the structure to the north, where the Prosser Mountain Fault offsets everything in a right-lateral oblique reverse sense. If the thrust belt continues west of this it must lie buried beneath the Pennsylvanian units to the north.

When Tournaisian rocks reappear west of Prosser Brook and west of the Prosser Mountain Fault in the Elgin area, the succession is thicker and more diverse, and shows no evidence of the bedding-parallel deformation that is so dominant to the east. Horton and Sussex Group rocks in this area are contained in fault-bounded panels forming a strike-slip duplex between the Gordon Falls and Lee Brook faults. Like the thrust-belt to the east, the folds and faults forming this strike-slip duplex are truncated by the unconformity beneath the lower Visean Hillsborough Formation. The Prosser Mountain Fault, by contrast, is a post-Visean, pre-Pennsylvanian structure.

Fault reactivation is a feature found all along the southern margin of the Moncton sub-basin, with structures such as the Saint-Joseph, Caledonia and Dorchester faults evidently controlling Horton and Sussex group deposition as normal faults, reactivating as thrusts during the end-Tournaisian inversion. The Dorchester Fault also reactivates later as a post-Visean thrust. More cryptically, the sidewall structures along the thrust belt have a relationship to older features, as all of them coincide with points where Sussex Group rocks overstep Horton Group directly onto the crystalline basement of the Caledonia Block. These sidewalls nucleate on older NW-trending features that also control Horton and Sussex Group deposition.

The end-Tournaisian inversion is controlled by a regional transpressive right-lateral strike-slip structure. The deep-levels of this system are exposed in the Elgin area as a strike-slip duplex of Horton and Sussex Group rocks, while the shallower levels along the southern shoulder over the Caledonia Block comprise a foreland thrust belt. Geometry is complicated by later faults, such as the Prosser Mountain Fault, the reactivation of older normal faults as thrusts, and subsequent fault reactivation. Many of the features of the thrust-belt are controlled by older structures that in turn controlled deposition of the Tournaisian sequence.

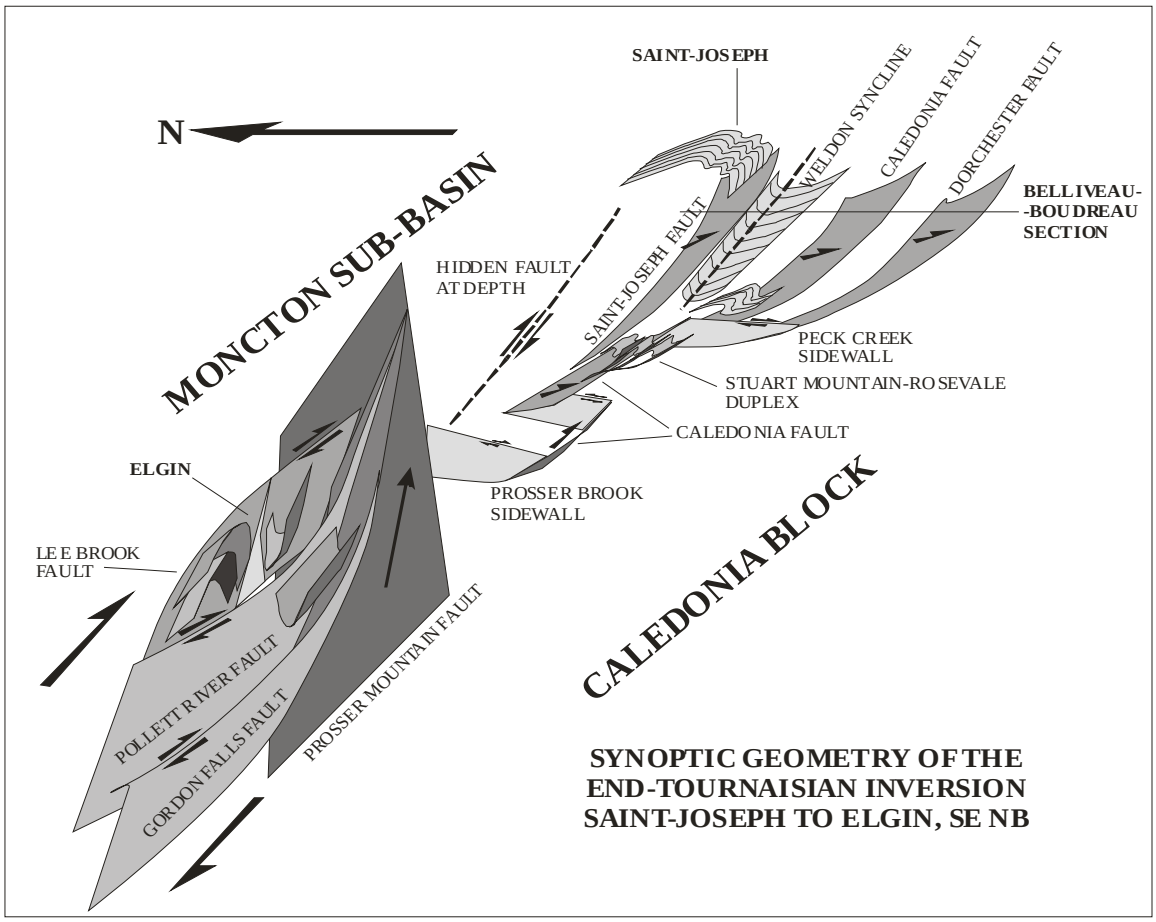
SAINT-JOSEPH
N
WELDON SYNCLINE
CALEDONIA FAULT
DORCHESTER FAULT
BELLIVEAU-
-BOUDREAU
SECTION
MONCTON SUB-BASIN
HIDDEN FAULT
AT DEPTH
SAINT-JOSEPH FAULT
PECK CREEK
SIDEWALL
STUART MOUNTAIN-ROSEVALE
DUPLEX
CALEDONIA FAULT
ELGIN
PROSSER BROOK
SIDEWALL
LEE BROOK
FAULT
CALEDONIA BLOCK
POLLETT RIVER FAULT
GORDON FALLS FAULT
PROSSER MOUNTAIN FAULT
SYNOPTIC GEOMETRY OF THE
END-TOURNAISIAN INVERSION
SAINT-JOSEPH TO ELGIN, SE NB

Figure 1.