Tectonic evolution of the Moncton Subbasin, southeastern New Brunswick: new evidence from field and subsurface data

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After 150 years of study, there is little consensus as to the tectonic history and setting of the Moncton Subbasin. The northeast-trending faults that define the predominant structural grain in the subbasin have been interpreted in all possible ways, that is, as normal, reverse, sinistral or dextral faults. An incomplete knowledge of the subbasin stratigraphy has led to difficulties in integrating structural and stratigraphic observations. As a result, the fine details of the sense and timing of fault movements, and their relationship to the overall tectonic history, have remained incompletely understood. The problem has been compounded by the lack of outcrop (major fault zones in the Moncton Subbasin are poorly exposed), the lack of adequate displacement markers and the lack of time constraints. In this study, field observations and interpretations of seismic reflection profiles are used to constrain the timing with respect to subbasin stratigraphy, and sense, of fault movements, leading to a more detailed picture of the tectonic history of the basin. Two areas where subsurface data are available were studied: the Hillsborough area, straddling the Petitcodiac River approximately 25 km south of Moncton; and the McCully area, an area of active natural gas exploration approximately 5 km northwest of Sussex.

The geological history of the Moncton Subbasin is a history of deposition punctuated by unconformities and disconformities related to periods of NW-SE tectonic contraction, uplift and basin inversion. In detail, normal-faulting and formation of half-grabens during deposition of the Horton Group terminated during a period of tectonic contraction resulting in a major unconformity. Renewed normal-faulting occurred during deposition of the Sussex Group, and terminated during a bedding-parallel deformation event prior to deposition of the Hillsborough Formation. Marine transgression led to deposition of the Windsor Group. Marine regression was followed by deposition of the alluvial sediments of the Mabou Group. Evidence from seismic reflection profiles shows that local southeast-directed thrusting occurred during Mabou Group deposition. A basin-wide unconformity separates Mabou Group rocks from the overlying Cumberland and Pictou groups. Cumberland Group rocks are folded into an anticline above the Penobsquis salt structure, and are cut by salt-linked faults. This, coupled with evidence of tectonic contraction associated with salt-structure formation and evidence from other parts of the Maritimes Basin, suggests that salt tectonics occurred during Westphalian B basin inversion.