
Carboniferous tectonics, sedimentation and evaporite mobility in the Cumberland and Kennetcook basins

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The Cumberland Basin of Nova Scotia, a large depocentre in the Late Paleozoic Maritimes Basin, contains a Carboniferous succession that is more than 6 km thick. Industry seismic profiles show unusually good resolution of even steeply dipping reflectors, which can be traced to surface and identified using existing geological maps. The geometry of reflectors provides information on the subsidence history of the basin, and indicates a complex interplay between tectonics and evaporite movement. There is a conspicuous difference in history between the eastern and western parts of the basin.

In the eastern basin, the Pennsylvanian Cumberland and Pictou groups onlap southward on to basement rocks of the Cobequid Highlands, and on to Devonian volcanics of the Fountain Lake Group. However, to the north, in the central part of the basin, the Cumberland Group rests with clear angular unconformity on the late Mississippian Mabou Group, identified by tracing reflections to surface along the flanks of the evaporite-cored Claremont anticline. The Mabou Group is conspicuously wedge-shaped in cross-section, with overall geometry that suggests deposition in a half-graben that subsided into underlying Windsor Group evaporites (also identified by tracing them to surface at the Claremont anticline). However, the southern margin of the Mabou-filled basin is clearly bounded by a normal fault against basement, within which reflections can be traced to outcrop in the Devonian Fountain Lake Group. These relationships indicate that Namurian normal faulting was tectonically initiated but triggered the withdrawal of Windsor Group evaporites. Internal reflections within the Windsor Group suggest earlier episodes of mobility and minibasin formation, probably beginning soon after the deposition of thick lower Windsor evaporites.

In contrast, the western Cumberland Basin, in the Athol syncline area, shows no unconformity at the base of the Cumberland Group. Instead, an extremely thick and variable Cumberland succession overlies a thinner Mabou stratigraphy which does not show conspicuous thickness or facies variation. The Mabou Group in this area appears to rest on an evaporite weld, marking the Pennsylvanian withdrawal of thick Windsor evaporites. Subhorizontal reflections, poorly resolved beneath the evaporite weld, probably represent basal Windsor, Horton, or Fountain Lake Group. They can be traced beneath much of the basin and continue subhorizontally under the north edge of the Cobequid Highlands.

A difference in the orientation of the basin margin between the eastern and western areas may explain the difference in basin history. In the west, the basin margin strikes ENE, whereas

the subsurface fault that bounds the eastern basin strikes almost E-W. In Mississippian time, dextral strike-slip motion along ENE-striking faults in the western basin led to transtension in the east, allowing development of half-graben and triggering expulsion of evaporites during Mississippian time. A change to more E-W tectonic transport in Pennsylvanian time led to transpression in the west, thrusting a wedge of Fountain Lake Group into the basin, and triggering withdrawal of remaining evaporites beneath the Athol syncline. The striking difference between the western and eastern areas has important consequences for resource exploration in the Cumberland Basin.