Structure of the Western Cumberland Basin: Implications for Coalbed-methane Exploration

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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 probably more than 8 km thick. Previous hydrocarbon exploration has focused on anticlines cored by Mississippian Windsor and Mabou groups, with targets in the underlying Horton Group. New seismic profiles in the Cumberland Basin show reflectors that can be traced to surface, allowing correlation with surface mapping. The basin is currently a target of exploration for coalbed methane.

Subsidence and tectonism in the Cumberland Basin were clearly in part controlled by differential flow of Windsor Group evaporites, which may have begun as early as late Viséan time, and which continued intermittently through the Namurian and Pennsylvanian. Non-marine clastic units were deposited in synclinal minibasins, and abut against adjacent evaporites or are truncated beneath internal unconformities.

In the western part of the Cumberland Basin, known as the Athol Syncline, the Joggins Formation, famous for preserved upright fossil trees, thins conspicuously eastward onto an evaporite-cored antiform at Springhill. To the south, a transition in the character of reflectivity suggests a lateral facies change, and map relationships indicate that coal-bearing units interdigitate with conglomerates of the Polly Brook Formation. At depth, reflectors identified as representing the Namurian Mabou Group appear to rest directly on basal Windsor Group at an evaporite weld, indicating that the entire thickness of evaporites was evacuated, mainly during Pennsylvanian subsidence. Early Westphalian evaporite withdrawal is largely responsible for the great thickness of coal-bearing Cumberland Group strata.

Farther east, in the area of the Tatamagouche syncline, a much thinner Cumberland Group overlies the Mabou Group with clear angular unconformity. Traced to depth, the Mabou also thickens into a synclinal minibasin, which subsided into evaporite-bearing Windsor Group. The Cumberland Group succession is much thinner in this area, and lacks the thick coals present in the west. This is probably because evaporite withdrawal occurred earlier, during Namurian time.

These relationships suggest a tectonic history in which initial evaporite movement was triggered in the eastern basin by transtension along the north edge of the Cobequid Highlands, which is aligned east-west in this area. A subsequent change in the relative motion on basin-bounding faults led to overthrusting in the eastern Cumberland Basin, and initiated evaporite withdrawal in the Athol Syncline. The tectonic history has a major influence on the distribution of coal-bearing units, and is a significant factor in coalbed-methane exploration.

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