The Salt Tectonic Evolution of the North-Central Scotian Margin: Insights from 2-D Regional Seismic Data and 4-D Physical Experiments

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Salt deformation styles across the North-Central Scotian basin indicate variable rift basin styles and tectono-sedimentary environments with high sedimentation rates during the Jurassic and Cretaceous. Unsatisfactory results from deepwater exploration indicate new salt tectonics concepts must be developed to better understand the Scotian margin. Thus, new concepts must investigate the interplay between paleogeography, sediment supply, and rift basin geometry across the Scotian basin.

The Salt Dynamics Group use physical experiments and time-series optical strain monitoring to study the evolution and salt tectonics processes in the North-Central Scotian basin. Scaled experiment parameters are deduced from regional ION GXT NovaSPAN seismic sections to realistically simulate the first-order structures and depocenter evolution from early post-rift salt withdrawal to late post-rift formation of allochthonous salt systems.

Seismic transects show rift basin morphologies range from 2 tapering wedges across the Laurentian sub-basin to a proximal tapering wedge, intermediate high, and symmetric basin with step across the Abenaki and central Sable sub-basin, and proximal graben and ramp-flat geometry across the central Sable sub-basin. Experiment results confirm the appropriate timing of evolution for the regions with diverse structural processes including; 1) numerous passive downbuilding events throughout basin evolution; 2) extension focused in the Cretaceous forming salt nappe and tongue-canopy systems; and 3) minimal contraction in the Cretaceous. Results indicate diachronous salt extrusion beginning in the Laurentian sub-basin and advancing southwest into the central, then western Sable sub-basin. Results also indicate the rift basin geometry variations across the North-Central basin strongly controlled salt extrusion rates and sediment distribution. This created a structural transition in allochthonous salt styles from the migrating salt nappe system in the Laurentian sub-basin to an extensive salt tongue-canopy system in the Sable sub-basin during the Cretaceous.

The physical experiments regionally explain the evolution of salt structures and related depocenters, and the correlation between the subbasins in an integrative basin model. Mechanically constrained salt tectonic concepts and seismic interpretation templates deduced from the experiments may provide new insights into reservoir distribution across the deepwater Scotian margin.