Salt tectonics 4D analogue modelling of the north-central Scotia margin

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The post-rift evolution of the Sable, Abenaki and Laurentian sub-basins and their deepwater extensions at the north-central Scotian Margin was primarily controlled by the salt-basin geometries, original salt thicknesses, salt tectonics and sediment progradation during the Jurassic and Early Cretaceous. Understanding the role these laterally variable basin geometries and depositional systems had on salt mobilization and tectonics is critical for unraveling the complex deepwater stratigraphic framework of the Scotian deepwater slope and basin.

The Salt Dynamics Group integrates seismic interpretation with innovative analogue experiments to gain insight into the mechanics of thin-skinned salt tectonics and stratigraphy of the north-central Scotian basin. Seismic reflection and well data are comprised of the GXT NovaSPAN lines and public domain data. These data constrain the experiment setup, e.g. salt basin morphology, initial salt thickness, and sedimentation rates and patterns. Interpretation of seismic reflection data reveals that the salt basin morphology varies considerably along the margin. The Laurentian salt basin was formed by a set of asymmetric syn-rift half-grabens. The central Abenaki salt basin consists of a confined proximal rift graben separated from the wide and considerably deeper Sable rift-basin by a basement horst block. Southwest of Sable Island the basement high is absent and the salt basin is characterized by a small proximal half graben landward of the Sable sub-basin which was formed by a wide asymmetric rift graben. Variable salt thickness due to the complex rift morphology combined with asymmetric sediment input from the early Jurassic Laurentian fan and Cretaceous Sable delta has resulted in distinct structural salt domains and salt-controlled depocenters. The location and timing of major salt structures and allochthoneous salt nappe/canopy systems were controlled by salt basin morphology and sediment progradation. Major sediment influx triggered initial salt mobilization in the Laurentian area during the early Jurassic followed by salt nappe extrusion in late Jurassic. Southward and basinward directed sediment progradation and salt mobilization together with the formation of the Sable delta in the Early Cretaceous caused a diachronous and southward younging of salt-sediment systems and extrusion of allochthoneous salt nappes and canopies in the deepwater basin.

Using experimentally constrained salt tectonics concepts to improve seismic interpretation and to understand the uniqueness of the Scotian margin salt tectonics will positively impact hydrocarbon exploration that targets salt-controlled depocenters and basins formed by very high sedimentation rates, and thus potentially sand-prone zones and structures.