Comparative analysis of analogue modelling results and seismic profile data from the slope diapiric subprovince II and III of the Scotia margin

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Recent petroleum exploration on the Scotia margin has yielded poor results as new wells drilled into the shallow-water shelf and along the deep-water continental slope struck no economic hydrocarbon deposits. This lack of recent exploration success is likely not indicative of hydrocarbon deficiency, but rather shows that better understanding of the Scotia margin's geological complexity and basin structural evolution is required for future successful exploration. To further our understanding of the Scotia margin, we carried out a comparative analysis

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of analogue modeling results and seismic data from the slope diapiric subprovince II and III. Our goal was three fold: to develop a digital seismic database of offshore Nova Scotia at Dalhousie University; to reinterpret available seismic data from the targeted area for future petroleum system modeling and comparison with existing analogue models; and to provide guidance for future analogue experiments simulating the tectono-sedimentary processes in the study area.

We created initial Dalhousie University digital database of high-quality seismic data from offshore Nova Scotia that includes GXT NovaSPAN and Lithoprobe profiles. Four 2D seismic lines from the GXT NovaSPAN survey and one 2D Lithoprobe line were carefully reinterpreted, including picks depicting stratigraphic boundaries and outlines of all salt structures present. A 3D scaled analogue model with a symmetric rift graben structure and thick salt (~2 km when scaled) representing a possible Triassic basement configuration in the Scotia Basin was structurally analyzed and retrodeformed. Salt structures identified in the analogue model were compared to those in the seismic images. Structural restorations of the analogue model through time constrained the evolution of the salt deformation structures and provided insight on the formation mechanism of salt structures within the Scotia Basin. The simplified analogue model setup of the Scotia Basin developed similar salt structures as seen in seismic images, showing that analogue models can provide useful insight into the evolution of passive margin salt basins. Many salt structures were correlated between the model and the seismic images including allochtonous canopy systems and salt nappes, welds resulting from salt withdrawal both in the basement and canopies, and passive diapirs of varying width particularly in the slope regions. Nevertheless, further joint analysis of other Dalhousie Salt Dynamics Group analogue models and available seismic data is necessary for detailed guidance of future analogue experiments.