Variations in Rifting Style and Structure of the Scotian Margin, Atlantic Canada, from 3-D Gravity Inversion

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The rifted continental margin off Nova Scotia displays considerable variation in rift geometry, basement faulting styles, and depositional patterns. The margin marks the transition from a volcanic-style margin in the SW, as observed along the US Atlantic margin, to a dominantly non-volcanic style. Velocity models derived from refraction profiling highlight the different responses of the southern, central, and northern margin to extension, and the variability in the nature and width of the transition zone separating thinned continental crust from oceanic crust. Serpentinized mantle is present in the transition zone beneath the northeastern margin, whereas a large volume of igneous material comprises part of the transition on the southern margin. Identifying the nature of the volcanic to non-volcanic transition remains one of the challenges in understanding the formation of this margin.

We used regional gravity data and a 3D inversion approach to examine regional crustal thickness and extend seismic-based interpretations along the margin. Constraints on Moho, crust and sedimentary layers were provided by the refraction models and several cross-sectional profiles of deep multichannel seismic data. The GRAV3D inversion algorithm (Li and Oldenburg, 1996; 1998) was used to obtain a sub-surface 3D density anomaly distribution. Initial constraints included bathymetric data and depth to basement estimates based on interpretation of single and multichannel seismic data. Density anomalies of prisms representing sedimentary rocks were allowed to vary during the inversion to stratify densities within the sedimentary column as needed. Deeper mesh prisms were allowed to vary from an initial assigned background density within a broader range that allowed the inversion to determine the crustal and subcrustal geometries from the gravity data and initial constraints.

Predictions from the model include a regional map of Moho structure, and depth slices that allow comparison with the seismic interpretations. The current model successfully predicts features such as the variable width of extensional thinning of the continental crust and the northward thinning of oceanic crust as seen in the velocity models. A misfit still exists for the southern part of the margin, where igneous material is most prevalent. We are continuing to work on this area to better define the extent of igneous material and resolve the area of transition to a non-volcanic style of rifted margin.