Insights into crustal structure and rift basin development off central and western Nova Scotia, Canada – a reflection seismic perspective

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The assembly and interpretation of an extensive reflection seismic dataset, collected mainly for hydrocarbon exploration over the past five decades, reveals new details about the crustal structure offshore Nova Scotia as well as the fill and development of overlying Triassic to Early Jurassic rift basins. Combined with the correlation, gridding, and depth conversion of the top of pre-Carboniferous crystalline basement, a widespread reflection consistent with a top mantle reflector (reflection Moho), and a number of sub-horizontal mid-crustal shear zones and synrift markers, a clearer picture is emerging about how the crust off Nova Scotia accommodated lithospheric extension and evolved from the synrift to postrift.

The results provide a direct measure of crustal thickness and insight into the distribution and character of brittle versus ductile crust, and show development of a distinct, segmented, and locally branching Moho high that tracks beneath the primary salt basin along the central and western parts of the margin. Brittle upper crust is thickest above platformal areas, where ten separate synrift basins developed. Flanking these are important border faults soling into multitiered mid-crustal shear zones probably corresponding to reactivated Paleozoic structural fabrics. Border faults are dominantly landward-dipping with subordinate seaward-dipping border faults flanking segments of some basins. The thickness of brittle crust diminishes abruptly beneath the present day slope, in some cases with highly rotated crustal blocks transported as rafts above comparatively thick intervals of ductile lower crust. In contrast to the platform, there are clear alternations between dominantly landward-and dominantly seaward-dipping border faults on the slope. Gaps between some brittle crustal fragments result in synrift strata directly overlying ductile crust.

There are some indications that lower crustal flow and deformation of overlying brittle rafts continued well into the Jurassic - in some cases providing a mechanism for postrift inversion. Layers of complex bright amplitude seismic reflections commonly veneer brittle rotated crustal blocks and are interpreted as volcanic rocks emplaced before or during the earliest periods of salt accumulation. The increased occurrence of suspected volcanic rocks may reflect enhanced melt production where the crust is thinnest, approaching the Moho high that underpins the primary salt basin.

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