Integrating data sets to enhance the subsurface interpretation of the Carboniferous to Permian rocks of the offshore Sydney Basin, Nova Scotia, Canada

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Carboniferous strata of the Sydney Basin outcrop onshore Cape Breton Island and extend offshore beneath the Laurentian Channel and Burin Platform. The offshore portion of the basin, between Nova Scotia and Newfoundland, is the predominant focus of this study. Subsurface maps were generated using an extensive suite of 2D seismic surveys that vary significantly in vintage and quality across the basin. Exploration wells intersecting the seismic data are shallow and only provide calibration of the Late Carboniferous seismic stratigraphy for the western and nearshore regions. To enhance interpretation of these variable quality surveys with limited well control, additional data sets were integrated into the workstation environment; including modern topography, surface geology, gravity, magnetics and research seismic.

Many of the seismic surveys were collected in the 1980s or earlier and imaging artefacts such as conventional seafloor and peg-leg multiples present a significant interpretation challenge. A recent seismic survey collected on the eastern side of the basin has substantially improved imaging, providing a higher degree of interpretation confidence that was used to guide interpretation on neighboring poorer-quality surveys. In some areas, shallow, high-resolution research seismic profiles were vectorized and incorporated into the database. These shallow penetrating profiles helped to clearly distinguish higher amplitude flat-lying artefacts on the industry profiles from folded, dipping, and erosionally truncated Carboniferous and/or Permian strata. Significant efforts were also made to ensure that the shallow offshore geological interpretations are consistent with the stratigraphy exposed on Cape Breton Island. Likewise, exposed basement terranes in onshore areas were correlated with a moderate degree of confidence into offshore areas, with interpretations bolstered by the integrated gravity and magnetics data sets.

The integration and analysis of multiple data sets has reduced the many uncertainties that impeded an accurate subsurface interpretation of the Sydney Basin. Despite the remaining uncertainties, two significant observations can be made. (1) Pre-Carboniferous basement rocks are conceivably much shallower in the northern extent of the basin, consequently the overlying Carboniferous section thins to less than 1 km in some areas. (2) Horton Group rocks, and to a lesser degree the Windsor Group, may be localised and restricted to narrow grabens in the central Sydney Basin, thus occupying a less extensive area than previously interpreted.

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