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A Tale of Two Basins – Petroleum Play Types and Prospectivity in the Chidley and Hawke Basins, offshore Labrador Canada

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Summary

The Hawke and Chidley Basins, located offshore Labrador, represent two highly prospective, yet undrilled regions within the Mesozoic and Cenozoic-aged basins on the Labrador margin. These basins, which are separated by the Cartwright Fracture Zone, are the focus of the 2025 Call for Bids and hold significant petroleum potential, supported by advanced seismic imaging and integrated geoscientific datasets.

Labrador's shelf (Hopedale and Saglek basins) has a proven working petroleum system with 4 TCF of natural gas recoverable and an oil show. However, the slope to deepwater Hawke and Chidley Basins remain largely unexplored but show promising signs of active petroleum systems.

Modern seismic data, including 2D and 3D long-offset broadband surveys, have played a crucial role in understanding the potential for hydrocarbons in both basins. This paper examines the geological framework, seismic interpretations, source rocks, reservoir potential, and evidence of hydrocarbon migration in these two regions, highlighting their future exploration prospects.

Theory/Method/Workflow

Both the Hawke and Chidley Basins are studied using an array of seismic, geochemical, and geological data. The initial seismic imaging of both basins began in 2011 with the acquisition of 2D long-offset broadband data. Over the next decade, a total of 33,000 line kilometers of 2D seismic data was acquired over the region, which was interpreted to delineate the basin boundaries, fault systems, and sedimentary environments. In addition to the 2D data, two 3D seismic PSTM surveys were acquired over the Chidley Basin in 2019 and 2020, covering 6976km² (Figure 1). These high-resolution 3D surveys provided a more detailed understanding of the basin's fault systems, structural traps, and reservoir characteristics.

Additional geoscientific studies, including seabed coring, geochemistry, satellite seep surveys, and rock physics modeling, have been incorporated to better understand the maturity of potential source rocks and provide insights into possible migration pathways and hydrocarbon accumulations.

Two independent resource assessments have been conducted by Becip Franlab in the Chidley Basin (2021) and in the Hawke Basin (2025) have provided critical insights into the maturation of source rocks and the timing and volume of hydrocarbon generation in both basins.

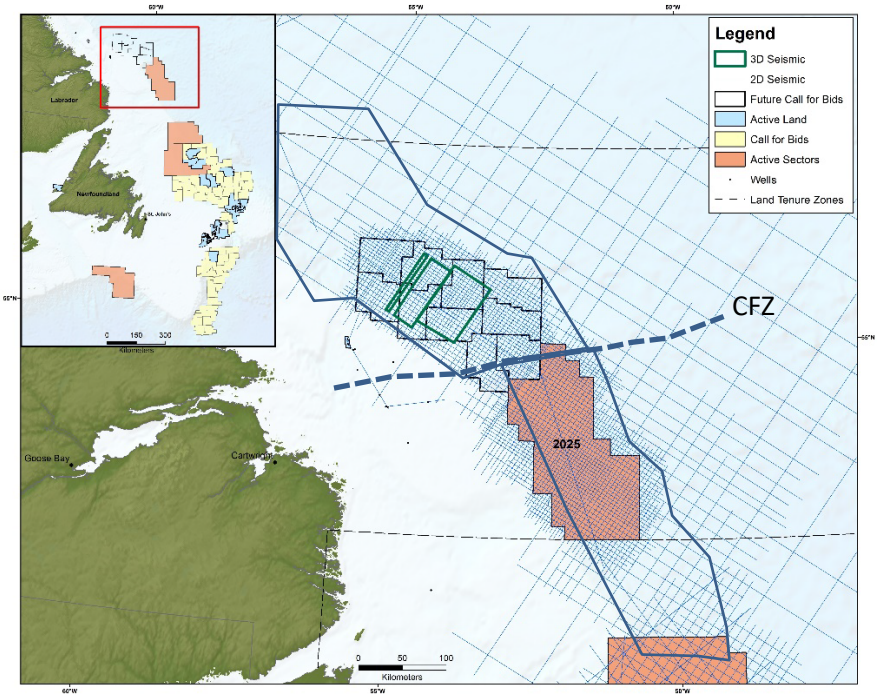

Figure 1: Map showing the location of the 2025 Call for Bids offshore Newfoundland and Labrador with outlines for the Chidley Basin and the Hawke Basin separated by the Cartwright Fracture Zone (CFZ)

Results

While the Hawke and Chidley basins share the same source rocks, Aptian/Albian, Cenomanian/Turonian and Paleocene, they have two very different petroleum systems. The play type in the Hawke Basin is primarily Cretaceous syn-rift to post-rift structural/stratigraphic trapping within localized half grabens (Figure 2). The reservoir is interpreted to be early rift Bjarni (fluvial/shoreface) to late rift Freydis (turbidites) equivalent.

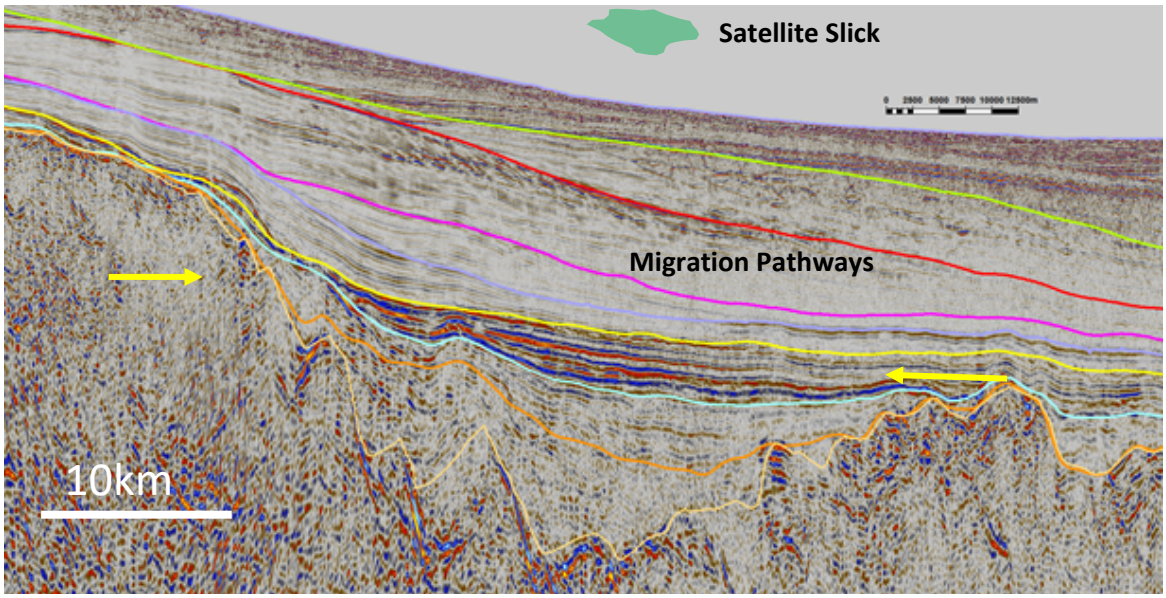

Figure 2: Far angle seismic line (courtesy of TGS) showing post rift prospect in the Hawke Basin

To the north of the Cartwright Fracture Zone, the prospectivity within the Chidley Basin is primarily located within the gravity driven listric fault system in the Cenozoic (Mitchell et al, 2017). This system was initiated by the rapid deposition of thick sediments (Figure 3). Numerous Class III and Class II AVO anomalies are observed within the fault blocks and appear to have structurally conforming amplitudes.

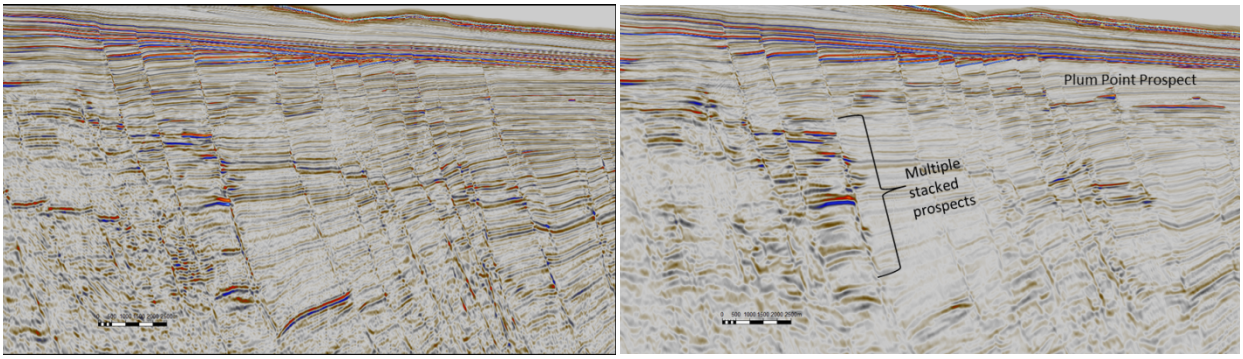

Figure 3: Near angle (left) and far angle (right) 3D seismic images (Courtesy of TGS) in Chidley Basin showing listric fault system and Class III and Class II AVO response

Conclusions

Though these basins are untested, the presence of source rocks that can be correlated to nearby wells, positive results from seabed coring and seismic evidence of Bottom Simulating Reflectors (BSRs), shallow bright anomalies and gas chimneys support the presence of active petroleum systems in the Hawke and Chidley Basins.

Both basins, through the application of modern seismic imaging, basin modeling, and geochemical analysis, provide a clearer picture of the offshore Labrador region's petroleum potential. Future exploration in the Hawke and Chidley Basins is likely to uncover substantial oil and gas reserves, particularly with the added insights from 3D seismic surveys and the ongoing integration of new data. These regions, while still in the early stages of exploration, represent some of the most promising areas for future hydrocarbon discoveries on the Labrador margin.

References

Carter, J., Cameron, D, Wright, R., Gillis, E., 2013. New insights on the slope and deepwater region of the Labrador Sea, Canada: Extended Abstract, EAGE Conference and Exhibition, June 2013

Gillis, E., Wright, R., Mitchell, V., Montevecchi, N., 2020. Definition of the Churchill River delta and its petroleum potential, offshore Labrador, Canada. SEG Interpretation. Vol 8, Issue2

Mitchell, V., Gillis, E., Montevecchi, N., Carter, J., 2017. Structural and Stratigraphic Interpretation of a Frontier Exploration Region, Offshore Labrador Canada. Extended Abstract, EAGE Conference and Exhibition 2017.

Beicip Franlab, 2021. Offshore Newfoundland and Labrador Resource Assessment Labrador South NL16-CFB03. https://oilconl.com/wp-content/uploads/2021/10/2021-Resource-Assessment-Labrador-South-Region-Public-Final.pdf