

# Geophysical Data Processing, Compilation and Interpretation – Provincial Compilation Project

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## Overview

Between January and March 2026, the Geological Survey Division (GSD) of the Department of Natural Resources carried out a provincial-scale geophysical data processing, compilation, and interpretation program to modernize and integrate legacy airborne geophysical datasets across Nova Scotia. The project was undertaken to enhance regional geological understanding and improve exploration targeting for critical minerals through the development of standardized, interpretation-ready geophysical products.

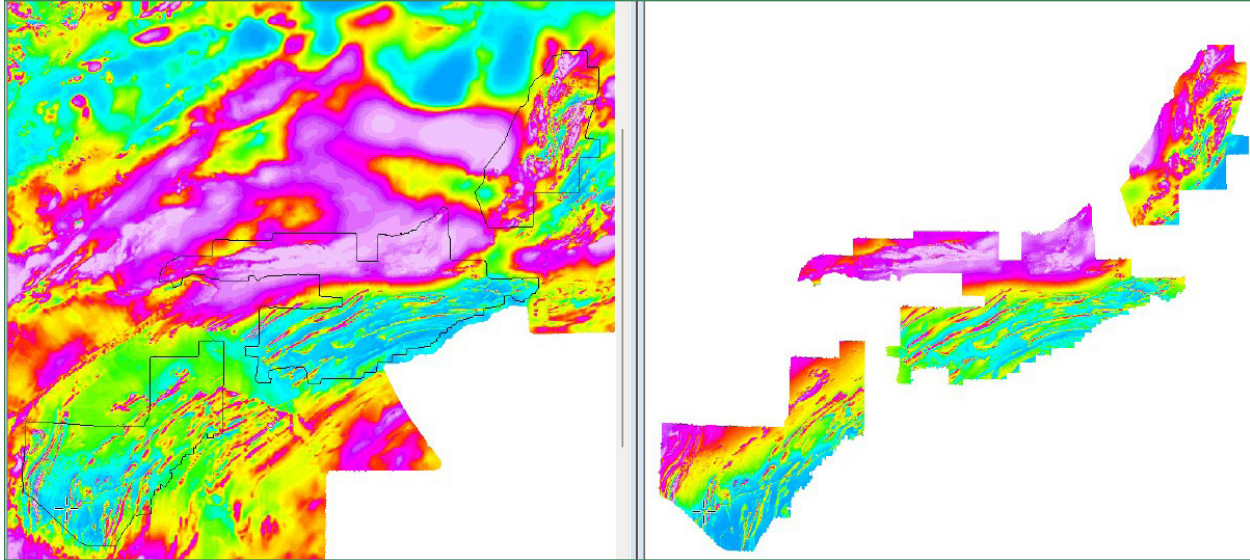
Compilation and interpretation work was contracted to DIP Geosciences of Cocagne, New Brunswick. The program evaluated aeromagnetic, radiometric, very low frequency (VLF), electromagnetic, and gravity datasets sourced from Natural Resources Canada (NRCan), the Nova Scotia Geoscience Maps and Publications Database (NovaScan), and previously released provincial surveys. Datasets were reviewed for coverage, acquisition parameters, and data quality prior to inclusion in compilation workflows.

## Data Processing and Compilation

Aeromagnetic data represented the primary component of the project. A provincial regional compilation based on NRCan's Total Magnetic Intensity (TMI) grid was standardized and delivered at 200 m cell size, while higher-resolution surveys were reprocessed and integrated into a 50 m grid compilation (Figure 17). A consistent suite of interpretation products, including reduction-to-pole, first vertical derivative, horizontal gradient, tilt derivative, and analytic signal amplitude, was generated to support geological interpretation.

Radiometric surveys were reprocessed and mosaicked to produce potassium, thorium, uranium, and total-count grids, along with element ratio and ternary products useful for lithological discrimination and alteration analysis.

VLF datasets were processed individually due to acquisition inconsistencies between surveys, while existing NRCan gravity datasets were retained and supplemented with derivative products to enhance interpretive value.



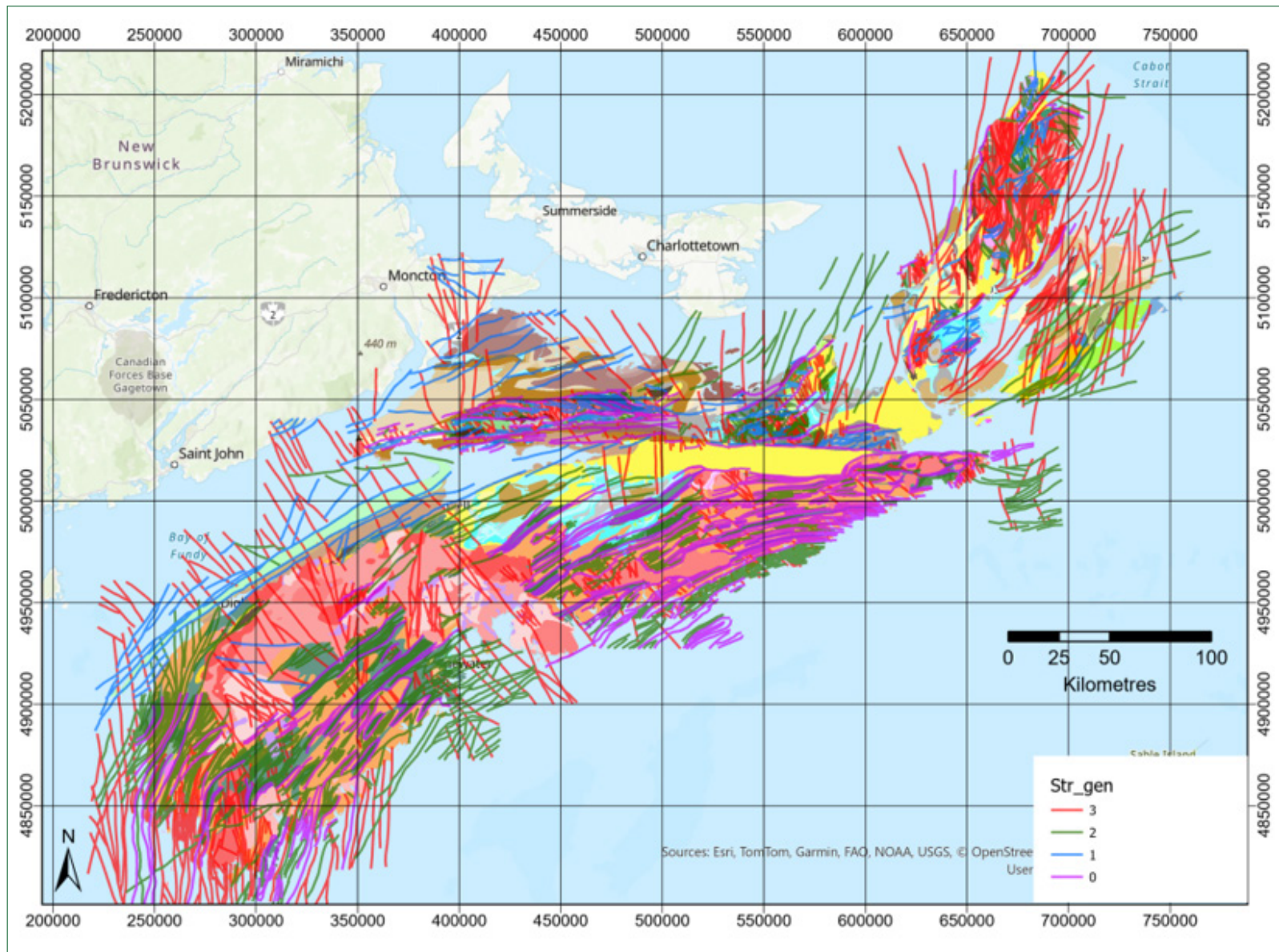
**Figure 17.** Compilation of high-resolution aeromagnetic Total Magnetic Intensity (TMI) data for Nova Scotia. The image shows merged 50 m–resolution aeromagnetic surveys, highlighting detailed magnetic fabric and structural trends across the province. The high-resolution compilation (right) is compared with the Geological Survey of Canada’s 200 m grid (left), demonstrating the improved definition of lithological boundaries and folded geological structures resolved in the newer dataset. (Ugalde, 2026).

### Structural Interpretation

Integrated interpretation of aeromagnetic derivatives enabled province-wide structural analysis and development of a litho-structural framework (Figure 18). Continuous geophysical coverage allowed structural trends to be traced across areas of limited outcrop, extending mapped geological structures beneath sedimentary and surficial cover.

A deformation model was established for the major tectonic terranes based on cross-cutting and offset relationships observed in magnetic lineaments. Three generations of structural features were recognized within each tectonic zone, reflecting successive deformation events. Interpretation identified regional faults, splays, fold axes, and ductile deformation patterns, including multiple folding phases (F1 and F2) and later fault-related deformation, particularly within Meguma metasediments.

Structural interpretation significantly expanded the known fault and contact framework across the province, including recognition of faults beneath Carboniferous cover and improved definition of structural corridors associated with mineral occurrences.



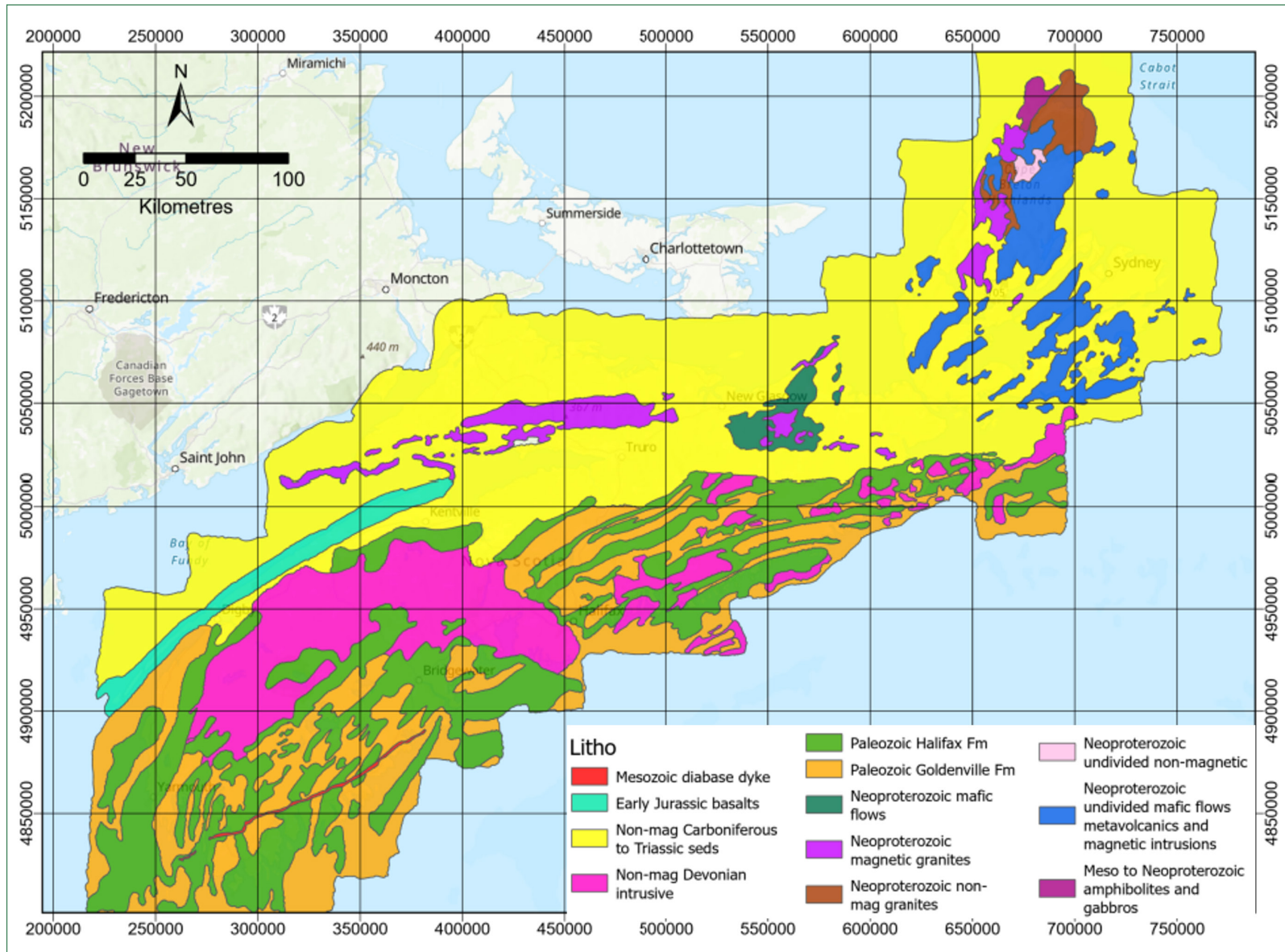
**Figure 18.** Province-scale structural interpretation of Nova Scotia based on integrated aeromagnetic derivatives (Ugalde, 2026).

## Lithological Interpretation

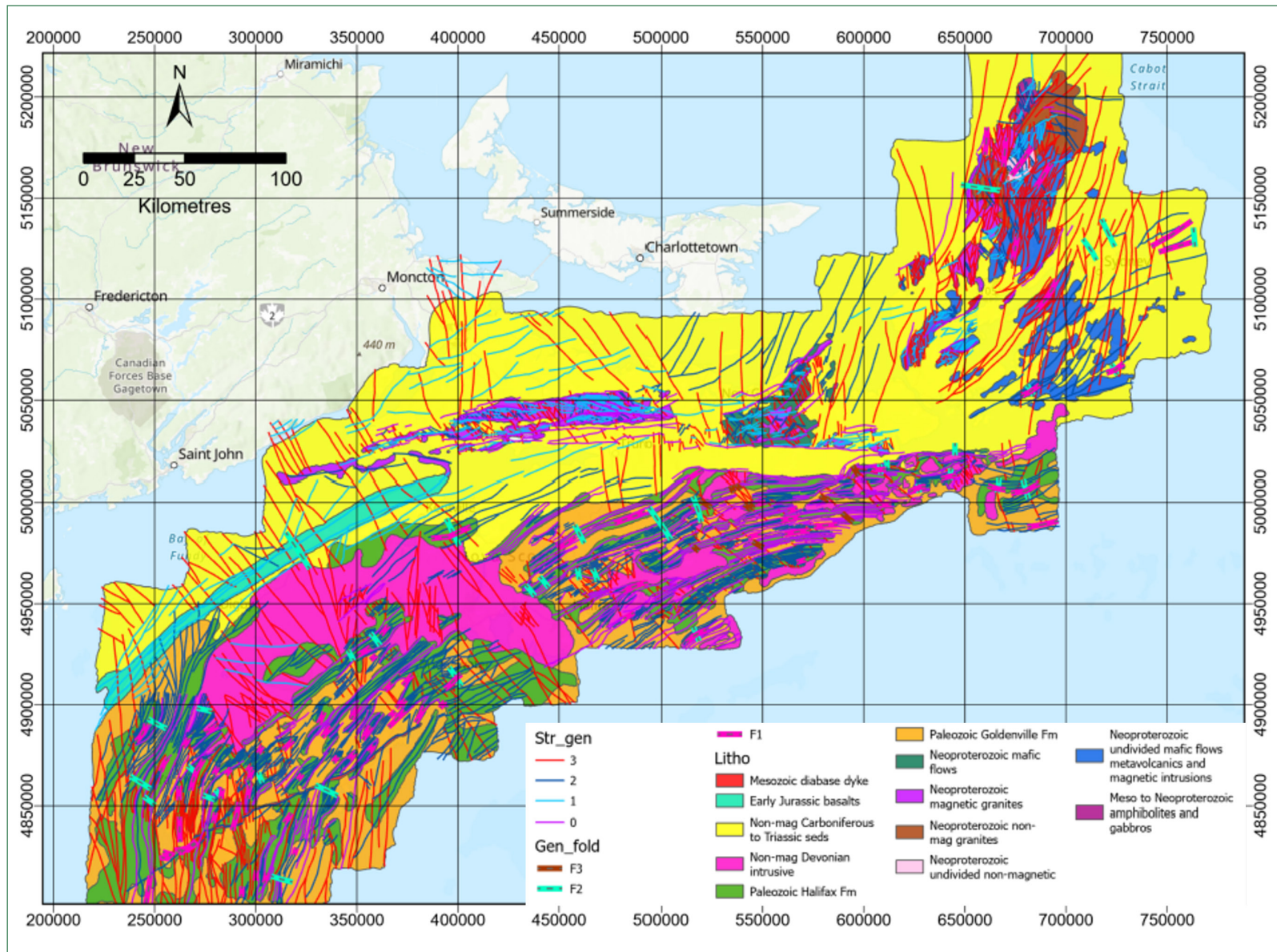
Lithological interpretation was derived primarily from analytic signal amplitude responses of aeromagnetic data, which highlight contrasts in magnetic susceptibility between rock units (Figure 19). Magnetic domains were classified according to magnetic character (high, moderate, and non-magnetic) and spatial association with mapped geology to refine lithological boundaries and identify previously unrecognized extensions of intrusive and stratigraphic units. In some regions, particularly Cape Breton, highly magnetic units could not be uniquely separated into metavolcanic, basaltic, or intrusive lithologies at regional scale. This work highlights the potential future need for supporting petrophysical data, including density, chargeability and magnetic susceptibility, to better integrate geological and geophysical datasets and to facilitate more robust calibration of geophysical interpretations.

## Litho-Structural Integration and Exploration Implications

Integration of structural and lithological interpretations produced a province-wide litho-structural model combining interpreted magnetic lithologies, structural lineaments, and deformation history (Figure 20). The results emphasize that mineral occurrences are commonly associated with intrusive contacts, regional faults, and structurally controlled zones such as fold hinges and fault splays. The interpretation also extended several intrusive bodies beneath sedimentary cover and identified structural pathways potentially favourable for fluid flow and mineralization, improving the regional framework for critical mineral exploration.



**Figure 19.** Lithological interpretation of Nova Scotia derived from aeromagnetic data. Where lithological attribution was uncertain, undivided units were assigned to represent mixed or ambiguous magnetic responses (Ugalde, 2026).



**Figure 20.** Integrated structural–lithological model of Nova Scotia combining aeromagnetic interpretations with geological constraints (Ugalde, 2026).

## Conclusion

The program successfully merged and interpreted legacy geophysical datasets into a modern provincial geoscience framework. The resulting litho-structural interpretation enhances understanding of Nova Scotia's tectonic evolution and provides a robust foundation for future critical mineral exploration, detailed follow-up interpretation, and geophysical survey planning. The project delivered a modern, internally consistent suite of provincial geophysical datasets and interpretation products. These results substantially improve geological continuity mapping, refine lithological and structural frameworks, and strengthen exploration targeting capability across Nova Scotia.

Work is currently underway to prepare the datasets and interpretation products for release on the Branch's website.

## Acknowledgments

The author would like to extend a special thank you to Hernan Ugalde, of DIP Geosciences, whose work forms the basis of this project. Despite a compressed timeline, their diligence and collaboration enabled the successful completion of the project.

## References

Ugalde, H. 2026. Geophysical Data Processing and Interpretation; Nova Scotia Department of Natural Resources, Open File Report 2026-002, 2 .zip files.