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Developing an integrated geological model for siting a deep geological repository: An example from the Revell Batholith in Northwestern Ontario

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Summary

The Nuclear Waste Management Organization is responsible for implementing Canada's plan for the long-term management of its used nuclear fuel - Adaptive Phased Management (APM). APM has as its endpoint centralized containment and isolation of Canada's used fuel in a deep geological repository (DGR) in an area with suitable geology and an informed and willing host community in partnership with Indigenous and municipal neighbours.

Key to the demonstration of the geological suitability of any site is the development of a Descriptive Geosphere Site Model (DGSM), which combines a multi-disciplinary interpretation of geology, geomechanics, thermal properties, hydrogeology, hydrogeochemistry and transport properties of the studied rock mass. The DGSM is underpinned by the integration of primary data collected during geological characterization activities and presented in a geological framework model. The development of the geological model is an iterative process that aims to reduce uncertainty with the addition of new information as it becomes available. This contribution presents an overview of the characterization activities undertaken to date to develop the geological model for a site located within the northern portion of the Revell batholith, a granitoid body of Archean age situated between the municipality of Ignace and Wabigoon Lake Ojibway First Nation in northwestern Ontario.

Geological characterization of the Revell site includes activities completed at both regional and local scales. At the regional-scale high-resolution airborne geophysical and LiDAR datasets have been acquired, and a structural lineament interpretation has been developed based on analysis and integration of airborne magnetic data and the high-resolution ground surface Digital Elevation Model (DEM) derived from the LiDAR dataset. The lineament interpretation is used to develop a regional fracture network model. In addition, an updated bedrock geology map has been compiled by integrating recent and historic bedrock geology maps for the area, which also used the airborne magnetic dataset to help constrain the location of geological contacts. At the local scale, a campaign to drill six deep boreholes, each with a target length of 1000 m, is underway. The workflow for the boreholes includes geological and geotechnical logging and sampling for additional laboratory analysis. Future field studies will include vertical and 2D seismic profiling, and additional geological mapping to target features interpreted in the lineament analysis and/or intersected in the boreholes. Integrated together, the information gathered during these characterization activities will support the development of a geological model for the Revell site.