

Evaluating Frontier Basins for Sediment-Hosted Stratiform Copper: A Mineral-Systems Assessment of the Sverdrup Basin in the Canadian Arctic Archipelago

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Increasing global demand for copper is driving exploration into frontier terranes to discover the next generation of mineral deposits. While terrane scale evaluations commonly generate new geological insights, results are rarely published unless a major discovery is made. Sharing the outcomes of these assessments provides practical context for future frontier basin evaluations.

This study presents a mineral-systems based assessment of the Sverdrup Basin, a Carboniferous to Paleogene rift basin in the Canadian Arctic Archipelago. The evaluation, undertaken over two years was completed to assess the basin's potential to host sediment-hosted stratiform copper deposits.

An initial concept evaluation phase integrated the extensive government and petroleum geoscientific datasets to generate basin scale prospectivity maps. These maps enabled quantification of the effectiveness and uncertainty of the mineral system critical processes and identified the key technical risks and focus areas for field-based assessment.

Field assessment and data collection focused on testing these risks through targeted geological mapping and a multidisciplinary analysis program including lithogeochemistry, petrology, biostratigraphy, geochronology, thermochronology and petrophysics. Field based work was coupled with remote sensing, basin modelling, structural restoration and fluid flow modelling for a multi-scale assessment of the targeted critical processes highlighted by the prospectivity mapping.

Results indicate that while oxidized saline brines were generated and circulated within the lowermost rift sequences containing the targeted source rocks and reductants, no significant sediment hosted stratiform copper deposits are likely to have formed. The quality of multiple mineral system elements such as the source, reductant, and ineffective fluid focusing mechanisms are the limiting factors restricting copper mobilization and precipitation at large scales.

Although the basin evaluation ultimately determined a low likelihood for a Top Tier basin, the study advanced the geological framework of the region and provides a workflow for evaluating sediment-hosted copper potential in frontier basins globally.