

## Revisiting the magmatic Ni-Cu-PGE prospectivity of the High Arctic LIP, Nunavut, Canada

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### Summary

The Canadian portion of the High Arctic Large Igneous Province (HALIP) ranges in age from ~130 to 80 Ma, and is exposed on Canada's Queen Elizabeth archipelago, mostly on Axel Heiberg and Ellesmere Islands. A recent mapping initiative under the federal Geo-mapping for Energy & Minerals Program (GEM-2) focused on the regional-scale Ni-Cu-PGE potential of the HALIP, integrating the structure and architecture of the province with the geochemistry of diabases, gabbros and basalts from intrusive-volcanic complexes. Previous work on the prospectivity of the HALIP concluded that subalkaline mafic units located on Axel Heiberg were more prospective than younger, mildly alkaline igneous rocks exposed on northern Ellesmere. Further sampling of the province indicates that subalkaline rocks occur on western Ellesmere Island, representing the along-strike continuation of a stratigraphic sequence along eastern Axel Heiberg Island containing abundant sills, herein known as the Schei Sills (ca. 120 Ma).

Orthomagmatic Ni-Cu-PGE deposits associated with mafic magmas tend to be located within subvolcanic intrusive settings. Also, one expects geochemical evidence, at the local intrusive complex scale, for chalcophile metal enrichment in some magma pulses while others should show evidence for sulfide saturation and chalcophile element removal, consistent with the formation of a metal-enriched sulfide liquid somewhere in that system. A ~20 km<sup>2</sup> intrusive complex at Middle Fiord (western Axel Heiberg), shows a bimodal distribution of Cu/Zr above and below unity, consistent with sulfide enrichment and removal, respectively. A similar observation is made at various localities within the Schei Sills. The spatial association of the Schei Sills with the Eocene Stolz thrust zone is noteworthy, since this post-HALIP thrusting uplifted and exposed subvolcanic roots. Absolute IPGE contents are low throughout the HALIP, but Pt and Pd contents vary among analysed subalkaline rocks; Pt+Pd ranging between 10-30 ppb detected at both Middle Fiord and the Schei Sills are consistent with heightened prospectivity. In contrast, thick voluminous flood basalts of the 95 Ma Strand Fiord Formation exposed in western Axel Heiberg, although they are subalkaline, exhibit Cu/Zr below 1 and low PPGE contents. Furthermore, olivine phenocrysts exhibit very low Ni contents (<250 ppm) for moderate Fo compositions (Fo<sub>50-30</sub>), suggesting that there was very little metal extracted from the mantle source associated with the Strand Fiord Formation. It thus appears that the ca. 120 Ma magmatic event that produced the Schei Sills generated magmas that are more slightly prospective than those of the ca. 95 Ma event.