

Ore controls on Ni-Cu-PGE mineralization of the ca. 1882 Ma Circum-Superior large igneous province

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The ca.1.9 Ga Circum-Superior belt has long been recognized as one of Canada's major metallogenic belts, principally because of its world-class Ni-Cu-PGE deposits at Thompson and Raglan, as well as a number of other significant prospects elsewhere along the belt (e.g., Labrador Trough). Discontinuous outcrop along the margin of the Superior craton, remoteness, and the great extent of the belt has hampered detailed correlations between different segments. Although first-order correlations were perhaps suspected, U-Pb geochronology has only recently advanced to a point where we can demonstrate that peak mafic-ultramafic magmatism was coeval between localities such as Thompson and Raglan, with large volumes of Mg-rich ultramafic rock being emplaced at 1882 Ma, both as flows, sills, and feeder dykes. Similar age mafic-ultramafic magmatism is now known from around the Superior craton, from northern Quebec to Minnesota, while ca. 1882 Ma dyke swarms intrude far into the cratonic hinterland. Carbonatites and kimberlites, within age uncertainty, are coeval with the mafic-ultramafic magmatism or precede peak magmatism by a few million years, an age distribution also seen in other large igneous provinces (e.g., Bushveld Complex and slightly earlier carbonatites, Phalaborwa). A model that most easily explains the present observations is that of a mantle plume impinging on the base of thick cratonic lithosphere of supercraton Superia, with hot, low-viscosity plume mantle then flowing laterally into multiple thin spots and incipient rifts, localized along the present margins of the Superior cratonic fragment, where large-scale melting occurred under a thin lid. Where high-T and high volume melts interacted in a dynamic setting with sulphidic country rocks, often sediments, Ni-Cu-PGE sulphide deposits formed. A sharpened picture for the structural-stratigraphic framework of the Raglan belt has revealed less thrusts and essentially intact stratigraphy along the "Raglan horizon", with most of the Ni-Cu-PGE endowment occurring along a primary stratigraphic contact where channelized komatiite lavas flowed over relatively deep water sulphidic sediments. A profusion of major ultramafic sills and dykes below this key stratigraphic contact shows that the setting is relatively proximal, an observation that is repeated at Thompson. High-precision U-Pb geochronology now allows details to be resolved in the overall magmatic event, with some sills (e.g., Montagnais sills, 1878 Ma) being late and perhaps less prospective. Accurate and exact U-Pb age matches with other 1882 Ma events around the world may help identify the prospective conjugate margins that have since rifted away and been dispersed around the globe.