Metallogenic model of the main Ni-Cu±PGE showings of the Portneuf-Mauricie Domain

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Abstract

The Portneuf-Mauricie Domain, located about 100 km west of Quebec City and shown on NTS map sheets 31I and 31P, is composed of metasedimentary rocks and metatuffs of the Montauban Group (1.45 Ga), intruded by plutons of the La Bostonnais Complex (1.40 to 1.37 Ga). This assemblage formed in an island arc setting. Intrusive rocks of the La Bostonnais Complex and associated metasedimentary rocks were intruded by differentiated mafic-ultramafic plutons that host several Ni-Cu±PGE occurrences. The Ni-Cu potential of the area is confirmed by the presence of the former Lac Édouard mine, which was in operation in the 1970s (69,000 t at 1.5% Ni and 0.5% Cu), and by the presence of sulphide occurrences with higher Ni and Cu grades than most magmatic sulphide deposits in the Grenville Province.

World-class Ni-Cu±PGE deposits share several common characteristics that help to explain how they were emplaced and became enriched in metals. In the Portneuf-Mauricie Domain, study of the Lac Matte, Lac Kennedy, Rousseau and Lac Nadeau showings, along with the Lac Édouard mine, has resulted in a preliminary genetic model in which the Ni-Cu±PGE occurrences formed, atypically for this deposit type, in a magmatic arc setting. The deposits formed from primitive or slightly differentiated tholeiitic magmas associated with a subduction zone. The Portneuf-Mauricie Domain contains crustal rocks that are locally sulphide bearing. Interaction between the relatively hot magmas and the country rocks led to the felsification of the magmas, that is, the assimilation of felsic material by the magmas. In the northern part of the domain, this interaction allowed the magma to assimilate crustal sulphur. These mechanisms induced sulphide saturation of the magmas, causing sulphide to separate from the silicate melt. It appears that, in the Lac Matte, Lac Kennedy and Rousseau occurrences, as well as in the Lac Édouard mine, sulphides separated from the mafic magma as it rose towards the surface. Sulphide segregation may have caused a depletion of chalcophile elements and precious metals in the magma, thus affecting the composition of the sulphides that formed subsequently. In contrast, the magmas associated with the Lac Nadeau occurrence may have remained undersaturated in sulphides until the moment the deposit formed or they may have undergone early sulphide loss offset by a high *R* factor. In the Portneuf-Mauricie Domain deposits, sulphide formation was followed by magma-sulphide interactions which caused enrichment of the sulphides in Ni and Cu. In the southern part of the domain, the interactions were more intense, giving rise to sulphides rich in precious metals. When the magmas reached the sulphide saturation point, the sulphides were deposited. Subsequent trapping of sulphides in or near a magmatic conduit could not be established on the basis of the available information.

Some recent discoveries of Ni-Cu±PGE deposits elsewhere in the world, such as the Aguablanca deposit in Spain, have been interpreted to be associated with magmatic arc settings. Research on Ni-Cu±PGE occurrences in the Portneuf-Mauricie Domain will provide additional insight into this new deposit type; this is essential for the development of Ni, Cu and PGE exploration strategies.

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