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Evaluation and characterization of the nickel-copper-PGE potential of the Red Cross Lake intrusive suite, central Newfoundland

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The Red Cross Lake Intrusive Suite (RCLIS) is a small mafic to ultramafic intrusion within the Victoria Lake Group, central Newfoundland. Mapping identified well developed, subvertical, magmatic layering in dunite, troctolite, and olivine gabbro of the Lower Series (LS), and poorly layered, pyroxene amphibole gabbro in the Upper Series (US). Layering in the LS exhibits cumulate textures with gradational layering of olivine. A number of sheared, layer-parallel belts, containing 25 to 85% heterolithic xenoliths, were identified, which locally resemble hydrothermal or intrusion breccia. These belts are located parallel to the basal intrusive contact and parallel to the major boundary separating the LS and US. Sulfides are present throughout the most mafic basal units, up to a few percent, and comprise pyrrhotite, pyrite, chalcopyrite, and pentlandite.

Whole-rock lithogeochemical data indicate that the tholeiitic RCLIS was emplaced in a within-plate environment. Harker diagrams indicate fractional crystallization in the LS, and a relatively homogeneous, unfractionated evolved US. Calculated modal Ni-Cu-Fe sulfide abundances indicate that country rock samples contain greater amounts of Fe sulfides. Metal-silicate relationships suggest that the majority of Ni occurs in olivine rather than Ni-sulfides, that Cu is present primarily in Cu sulfides, and that Pt+Pd concentrations, which are quite low, correlate with MgO rather than sulfides.

Microprobe analyses indicate a primitive composition for the LS cumulates, averaging  $Fo=83$  ( $n=176$ ,  $SD=2$ ); the US is more variable averaging  $Fo=48$  ( $n=73$ ,  $SD=14$ ). The maximum Fo value is in a sample from the lower portion of the LS ( $Fo=87.4$ ), and the minimum is from a sample of ambiguous origin near the transition zone between the US and LS ( $Fo=10$ ). Though most samples have a positive correlation of MgO with Ni, some samples are clearly depleted in Ni, suggesting that a sulfide liquid interacted with olivine prior to crystallization of the LS. Most olivine grains exhibit little systematic internal zonation. Plagioclase compositions in the LS average  $An=73$  ( $n=45$ ,  $SD=5$ ), whereas in the US, plagioclase averages  $An=55$  ( $n=100$ ,  $SD = 10$ ). There is considerable rim-core zoning in US plagioclase, but the LS plagioclase is relatively homogeneous. Pyroxene, amphibole, and oxide microprobe data exhibit similar trends of being more Mg-rich in the Lower Series and more Fe-Ti rich in the Upper Series.

Taken together, field, lithogeochemical, and microprobe

data indicate that the RLCIS is a strongly differentiated layered intrusion that may have been emplaced through multiple magma injections. Intrusion-spanning xenoliths belts, parallel to the base, may define remnant basal contacts to later pulses of magma. The lack of mapped sulfide mineralization, in combination with low concentrations of precious or base metals, is not encouraging for exploration. However, a narrow zone over one kilometer north of the basal contact in the SW corner of the RCLIS exhibits strong Ni depletion in olivine from ultramafic rocks, suggesting that locally at least, Ni may have been stripped by a sulfide liquid during emplacement.