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The Geology, Geochemistry, and Magmatic Evolution of the Legris Lake Mafic-Ultramafic Complex.

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The Archean Legris Lake mafic-ultramafic complex is the Eastern most extent of a ring-shaped array of mafic-ultramafic intrusions in northwestern Ontario, Canada, with an unambiguous spatial (~11 km Southeast) and temporal (~2.69 Ga) association with the world class Lac Des Iles (LDI) palladium deposit. We present an overview of the geology of the Legris complex and new whole rock geochemistry, mineral chemistry, and Sm-Nd isotope data from the major cumulate lithologies in the complex. The intrusive rocks in the Legris system range from dunnite to gabbrodiortie, with the majority of the complex being composed of varieties of leucogabbro. The bulk of the PGE mineralization in the system is hosted in a white leucogabbro (LGAB-M) which occurs along the outer margins of the complex either as homogenous masses of plagioclase-clinopyroxene or as a component of heterolithic breccias. Primitive mantle normalized whole rock trace element plots from LGAB-M show moderate to strongly fractionated light rare earth element patterns, strongly negative Ta, Nb, Zr, and Hf anomalies, positive Eu anomalies, and strong enrichment in the large ion lithophile elements and Pb. These features are consistent with low degrees of partial melting of metasomatized mantle in a subduction-related, continental arc setting. Moreover, the trace element patterns of the major intrusive units in the Legris complex mirror that of local metasedimentary country rock (MTSD), suggesting that assimilation of MTSD was a major control on the chemical evolution of this system. This is supported by mixing models between MTSD and primitive mantle melt which closely reproduce the observed trace element patterns of the cumulate rock in the Legris system. Furthermore, calculated parental magma compositions for the LGAB-M reflect/overlap the trace element pattern of the MTSD. In comparison with the northern portion of the LDI complex, and parental magmas of the Legris complex are more fractionated, likely as a consequence of MTSD assimilation. While it's unclear if MTSD assimilation drove S saturation in this system, high degrees of contamination are negatively correlated with sulfide content and PGE grades suggesting that the introduction of external S was not a major factor in driving sulfide melt formation.