Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24181

A New Interpretation of an Old Layered Mafic Intrusion - Oxygen Isotope Evidence for the Genesis of the Coldwell Complex in the North American Midcontinent Rift.

NEIL R. BANERJEE[1], DAVID GOOD[1], ELIZABETH WEBB[1], IMRAN MEGHJI[2], ROBERT L LINNEN[1] AND IAIN SAMSON[3]

[1]Western University
[2]RockMass Technologies
[3]University of Windsor

Presenting Author: neil.banerjee@uwo.ca

The Coldwell Complex is one of the largest composite intrusions in North America which extends north from Lake Superior in a roughly circular shape with a diameter of over 25 km. It is also one of the most significant geological features of the Midcontinent Rift System (MCRS), formed ~1.1 billion years ago. As the North American continent began to stretch and thin, magma from the mantle rose, leading to extensive volcanic activity and the emplacement of large gabbroic to syenitic intrusions. The Coldwell Complex is an important geological feature for studying the processes of continental rifting and provides insights into the dynamics of the Earth's crust including mechanisms of magma differentiation and mineralization. The Coldwell Complex comprises layered gabbro and syenite, with lesser amounts of granite, peridotite, and pyroxenite along with volcanic equivalents. The complex is of economic interest because it hosts deposits of platinum-group elements (PGEs) and copper associated with the mafic and ultramafic rocks.

The Geordie Lake gabbroic intrusion located near the centre of the Coldwell Complex contains some of the lowest $\delta^{18}O$ values reported for mafic rocks. Our results from an investigation of the Cu-PGE mineralization and localized intense albite alteration reveal very low $\delta^{18}O$ values (+1-2 ‰) in almost fresh gabbro that increase with increasing albite alteration ($\delta^{18}O$ = +3-4 ‰), opposite to what is expected during hydrothermal alteration. These results suggest that the unaltered gabbro was derived from a low $\delta^{18}O$ magma. These low $\delta^{18}O$ values together with recent advances in our geologic understanding of the intrusions have implications for unravelling the structure and history of the Coldwell Complex. In this study, we synthesize new geologic and geochemical results with a well-established understanding of igneous processes that lead to low oxygen isotope values in mafic rocks, as suggested ~50 years ago by Karlis Muehlenbachs. We propose that contamination by hydrothermally altered crustal rocks or their melts, possibly in a large caldera setting, played a significant role in the genesis of the Coldwell Complex.