Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22744

The Mackenzie LIP: tracking the crustal magma plumbing system and impacts of one of the largest preserved igneous events on Earth

JAMES S SCOATES[1] AND R.F. JON SCOATES[2]

[1]University of British Columbia
[2]Retired Geologist
Presenting Author: scoates@mail.ubc.ca

The 1.27 Ga Mackenzie large igneous province (LIP), including the the Coppermine River Group flood basalts, Mackenzie dike swarm, and Muskox layered intrusion, resulted from widepread tholeiitic magmatism across northern Canada covering an area of almost 3 million square kilometres. The Muskox intrusion, one of the world's largest mafic-ultramafic layered intrusions, formed as an open-system sub-volcanic magma reservoir that records repeated injections of magma (25 cyclic units grouped into 4 megacycles) early in the emplacement history of the Mackenzie LIP. Due to regional tilting, the entire 1.8 km-thick stratigraphic sequence of the Muskox layered series is exposed from its base (mostly dunites + minor olivine clinopyroxenites) to its top (granophyre-bearing gabbronorites overlain by a granophyric roof zone). Magma addition to the Muskox intrusion was incremental, with magma flowing laterally from a much larger connected reservoir to the north, and space was accommodated by progressive floor depression related to reactivated basement faults. Cumulates from the layered series of the Muskox intrusion correlate geochemically (whole rock, Nd isotopes, MELTS modeling) only with a distinctive suite of basaltic andesites from the lowermost 400 m of the 1000 m-thick September Creek member of the Copper Creek Formation, the stratigraphically lowest part of the regionally extensive >3 km-thick Coppermine River group flood basalts. Eruption of subsequent basalts utilized alternate conduit systems and shallow to mid-crustal magma reservoirs imaged geophysically to the north, underlying the apical graben around the plume centre, that have been interpreted to represent stacks of amalgamated and differentiated cumulates up to 10 km thick and an extensive lower crustal magma underplate. With an estimated total volume of at least 3 million cubic kilometres, including both intrusive and extrusive components, and a low-latitude, near-equatorial paleographic setting, volatile release (carbon dioxide, sulfur dioxide, halogens) during magmatic activity of the Mackenzie LIP likely lead to significant global environmental impacts. The Mackenzie LIP is an ideal natural laboratory to test hypotheses concerning the evolution of transcrustal to translithospheric magmatic systems and linkages to contemporaneous flood basalts, mafic dike swarms, and major climate changes resulting from relatively short-lived magmatism in the Mesoproterozoic.