

Petrology, geochemistry and mineral chemistry of the Crystal Lake and Mount Mollie mafic intrusions, Northwestern Ontario

S.F. O'Brien¹, P. Hollings¹, J.D. Miller²

¹Department of Geology, Lakehead University, Thunder Bay, Ontario; ²Department of Geological Sciences, University of Minnesota Duluth, Duluth, Minnesota

The Midcontinent Rift (MCR) extends 2500 km through Canada and the United States, and comprises ~1,500,000 km³ of volcanic and intrusive rocks spanning four distinct stages of activity ranging from 1150-1087 Ma. Stage 2 (1115-1105 Ma) and Stage 3 (1100-1094 Ma) represent the formation and maturation of the rift system and are responsible for the majority of the igneous activity, producing mafic to ultramafic intrusions, basaltic sills, dikes and flows as well as alkaline rocks. The extent and volume of magmatic activity have led previous researchers to conclude that a plume was most likely the cause of the MCR. In this study, two mafic intrusions related to the MCR will be investigated using detailed petrography, geochemistry and mineral chemistry. The two intrusions, Crystal Lake and Mount Mollie, are located around 40 km south of Thunder Bay, Ontario and are located within a few km of each other. Both are compositionally mafic and consist mostly of gabbro and troctolite. Crystal Lake is a Y-shaped layered intrusion with a north limb striking W-NW for 5 km and a south limb striking E-NE for 2.75 km. Mount Mollie varies from 60 to 350 m wide and extends for ~35 km, and is located just east of the Crystal Lake intrusion. Both intrusions have been targets for exploration for the past few decades as they both contain disseminated sulphides and are hosts to Ni-Cu-PGE mineralization. The close spatial relationship led to the belief that the intrusions were related and possibly shared the same magma source, however, recent age dating has shown that the Mount Mollie has an age of 1109.3 ± 6.3 Ma whereas Crystal Lake has been dated at 1099.6 ± 1.2 Ma. Diamond drill core samples from each intrusion will be collected and studied for modal, compositional, and cryptic layering to understand the style of emplacement and what factors were responsible for the mineralization. Preliminary observations suggest that there may be at least two phases of magmatism in the Mount Mollie intrusion allowing for the possibility that there is a younger phase related to the Crystal Lake intrusion.