Petrology and geochemistry of the Crystal Lake Gabbro and Mount Mollie Dyke, Northwestern Ontario

SF O'Brien[1], P Hollings[1], JD Miller[2]

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

The ~1.1 Ga Midcontinent Rift (MCR) is a well-preserved failed rift comprised of a series of volcanic and intrusive rocks exposed around Lake Superior. Ongoing exploration and mining interest over the past few decades, has led to the recent discoveries of the Tamarack and Eagle deposits. In this study two mineralized intrusions, Crystal Lake gabbro (CLG) and Mount Mollie dyke (MMD), related to the MCR have been investigated using petrography and geochemistry. The CLG is a "Y" shaped intrusion with a 5 km long north arm and a 3.75 km long southern arm. Historically the northern arm has received more attention as it hosts the Great Lake Nickel deposit. The ~ 35 km long MMD extends east from the CLG. The spatial relationship, similar trend and rock types led to the belief that the two were co-genetic and/or or contemporaneous, however recent age dating has revealed that the CLG formed at 1099.6 ± 1.2 Ma and the MMD formed at 1109 ± 6.3 Ma. There are still unresolved issues with this age gap, most notably that both have the same paleomagnetic N-polarity, where one would expect a R-polarity for MCR related rocks that are > 1105 Ma. In an attempt to resolve the conflicting evidence regarding the relationship between the CLG and MMD, 44 MMD and 50 CLG thin sections have been prepared as well as 101 MMD and 323 CLG whole rock analyses. All samples of the CLG were collected from an 828 m diamond drill core whereas 24 field samples and 77 diamond drill core samples were taken from the MMD. Petrographic study has revealed that the CLG and MMD are mineralogically and texturally similar, with troctolite and sub-ophitic to ophitic olivine gabbro being the most abundant rock types for both. In general, the CLG is coarser grained than MMD and has two units separated by ~75 m plagioclase-phyric diabase with both units containing a basal Cr-spinel rich layer. Downhole geochemistry displays fairly consistent fractionation trends of decreasing Al_2O_3, CaO, MgO and Ni, increasing Fe_2O_3, SiO_2, Na_2O, TiO_2, Ba and V, but consistent incompatible trace element ratios uphole. On plots of TiO_2 vs. Mg# and Gd/Yb_n vs La/Sm_n MMD and CLG overlap and show similar trends, on the Gd/Yb_n vs La/Sm_n plot, they plot in the Nipigon sills field and on the TiO_2 vs. Mg# they plot in a previously unrecognized intermediate-TiO_2 field.