Late Triassic kimberlitic magmatism, western Churchill Structural Province, Canada

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Recently identified kimberlite dykes hosted in greenschist-grade Archean supracrustal rocks in the Rankin Inlet area represent the first discovery of kimberlite magmatism in the western Churchill Province. The western Churchill Province is comprised of Meso- and NeoArchean rocks with scattered remnants of deformed and metamorphosed Paleoproterozoic rocks. Paleoproterozoic reworking of the Churchill Archean crust, and the formation, in part, of its prominent and distinctive regional northeastern structural grain, is in marked contrast with the adjacent Slave and Superior cratons which record comparatively minor Paleoproterzoic thermal resetting and deformation.

The kimberlite in the Rankin area occur as dykes whose orientation is controlled by preexisting Archean and Paleoproterozoic regional east-southeast and northwest fracture patterns. The kimberlite dykes are tabular, subvertical, and vary from 1-3 metres wide in width. They are heterogeneous due to flow differentiation, bifurcate into subparallel anastomosing veins and veinlets, and lack significant thermal effects on wallrocks and wallrock xenoliths. These features suggests that the dykes represent lower hypabyssal facies kimberlite (Mitchell, 1986). Petrological studies indicate that the distinctive inequigranular texture is the product of two generations of olivine and phlogopite, with primary and secondary serpentine, primary calcite, perovskite, spinel, magnesioilmenite, apatite, pyrite, chalcopyrite, galena, uraninite. The only macro- and microscopic xenoliths identified are derived from the adjacent greenschist facies, Archean metasedimentary host rocks.

Mineral chemistry of the spinels indicate they belong to the ulvöspinel series and lie within the magmatic trend T1 kimberlite domain in a Ti/(Ti+Cr+Al) vs $Fe^{+2}/(Fe^{+2}+Mg)$ plot. Both groundmass and phenocrystic phlogopite are compositionally similiar and electron microprobe analyses indicates that some of the zoned phlogopite phenocrysts exhibit high FeO & TiO_2 cores with increasing MgO and Al_2O_3 towards the rims. This trend corresponds to kimberlite trend 3 (increasing Al_2O_3) in an Al_2O_3 vs TiO_2 variation diagram. Whole rock geochemistry indicates that the kimberlite magma was highly evolved, and calcite-rich with CO_2(T) contents of 27.6 and 29.5 wt % and H_2 O(T) of 4.4 and 4.0 wt %. Contamination by digestion and reaction with wallrock xenoliths is minimal as indicated by contamination indices of 1.06 and 1.02 (Mitchell, 1986). The volatile-rich character of this kimberlite is expressed by an enriched incompatible (Sr 1237 - 1265 ppm; Zr 210 - 144 ppm; Hf 5.2 - 4.2 ppm; Nb 192 - 162 ppm) and compatible (Ni 610 - 600 ppm; Cr 240 ppm; Co 60 - 54 ppm) element signature similiar to some Late Cretaceous Somerset Island kimberlites.

A Late Triassic age of 214.3 ± 1 Ma was determined for one dyke using the Rb-Sr method on four, acid-leached phlogopite fractions. The Late Triassic age does not correlate with any of the three distinct emplacement periods of Phanerozoic kimberlites in North America (Kjarsgaard and Heaman, 1995). Known kimberlite occurrences in Canada cluster primarily in five areas bordering the western Churchill Structural Province. Three clusters are hosted either in stable Archean cratons or in Phanerozoic platformal sedimentary sequences that overlie Archean cratons: (1) the Lac de Gras field (Slave Province) of middle Jurassic, Late Cretaceous and Early Eocene age; (2) the Attawapiskat field in the James Bay lowlands (Superior Province) of Late Jurassic-Early Cretaceous age; and (3) the Kirkland Lake kimberlites (Superior Province) of Late Jurassic age (Brummer et al., 1992),. Two clusters are hosted in Phanerozoic strata that overlie terranes comprised of juvenile Paleoproterozoic rocks that are interlayered with reworked Archean basement gneisses (Frisch and Hunt, 1993; Lucas et al., 1993): (4) the Sommerset Island field (Arctic Platform) of Late Cretaceous age, and (5) the Prairie kimberlites (Interior Platform) of Early Cretaceous age (Kjarsgaard, 1995).

Insights into the Phanerozoic structural history of the western Churchill Province can be inferred through analysis of the stratigraphy and sedimentology in the Hudson Bay platform to the east-southeast, and Arctic Islands to the north. In the Moose River Basin, in the southern part of the Hudson Bay platform, Jurassics unconformities associated with initiation of block faulting, continental sedimentation and kimberlitic magmatism are correlated with widespread igneous activity in eastern Canada, all of which are associated with extension and opening of the Atlantic Ocean (Norris, 1993). Similiarly, in the Arctic Islands, a late Triassic regression in the Sverdrup Basin marks the first of several rift initiated unconformities during the Jurassic-Cretaceous that are related to the formation of the Amerasian Basin (Embry, 1991). It is proposed that the emplacement of the Rankin kimberlite dykes are related to late Triassic extension in the Churchill Structural Province.

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