Geochemistry of Eclogite Xenoliths from the Victor Kimberlite, Superior Craton

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The Victor Mine, the first diamond mine in the Archaean Superior craton in Ontario, provides the unique opportunity to study the association of a diamond deposit with a post-Archaean rift system (the 1.1 Ga Keweenawan Midcontinent Rift). Victor forms part of the Attawapiskat kimberlite cluster, which was emplaced at ~170–180 Ma (Kong et al., 1999; Heaman and Kjarsgaard, 2000), subsequent to the Midcontinent Rift. Relatively little is known about the details of the history and composition of the lithospheric mantle below the Superior craton, due to the scarcity of large suites of mantle xenoliths. In particular, the impact of the 1.1 Ga Keweenawan Midcontinent Rift on diamond-bearing lithospheric mantle beneath the Superior Craton is poorly constrained. Preliminary results from garnet xenocrysts from the Kyle Lake (~1.1 Ga) and Victor kimberlites (Armstrong et al., 2004; Scully et al., 2004) indicate that the local lithospheric mantle was modified to lherzolitic compositions after emplacement of the Kyle Lake kimberlites, likely through melt infiltration associated with the Midcontinent Rift. Here we study eclogite xenoliths from the Victor kimberlite in order to assess their temporal relationship to and possible overprint by the Midcontinent Rift.

Preliminary major and trace element results from the eclogites will be presented. According to CaO and Cr_2O_3 contents, garnets in six eclogites analysed so far are classified as G3 and G4 (as defined by Grütter et al., 2004). Garnets from VIC1303 and VIC0201 both have low-Ca (G4) compositions, the G3 garnets range from intermediate (~7 - 10 wt%; VIC0607, VIC1106 and VIC1305) to high Ca contents (~15.7 wt%; VIC0608). The eclogites classify as Group II eclogites with Na_2O concentrations in garnets below 0.09 wt% and K_2O concentrations in pyroxenes below 0.08 wt % (McCandless and Gurney, 1989).

Based on the Na_2O and MgO contents of pyroxenes, the six eclogites studied plot in three groups, which broadly correlate to the Group A-B-C eclogite classification proposed by Coleman et al. (1965). "*Group C*": VIC0608 has the most Na-rich pyroxene composition (~8 wt% Na_2O) and, in addition to being kyanite-bearing, also has the most grossular-rich garnet composition (15 - 16 wt% CaO). "*Group B*": VIC0607 and VIC1305 have intermediate Na_2O and MgO contents in pyroxene (4.5 – 6.0 wt % and 9.6 – 12.0 wt %, respectively) and almandine-rich garnet compositions (17 – 18 wt % FeO). "*Group A*": VIC1303 has the most pyrope-rich garnet composition (19.5 – 20 wt % MgO) and along with VIC1106 and VIC0201, has the lowest jadeite component in pyroxene (2 – 3.3 wt % Na_2O).

Temperatures of last equilibration were calculated using Mg-Fe exchange between garnet and clinopyroxene (calibration of Krogh Ravna, 2000), assuming a pressure of 5 GPa. Temperatures for these six eclogites range between 830 and 1040 °C. The high-Ca, high-Na sample (VIC0608) yields higher average temperatures (950 ± 30 °C) than the low-Ca, high-Mg sample (VIC1303, 830 ± 30 °C), with the intermediate-Ca samples covering the entire range of temperatures. Preliminary stable oxygen isotope results have been obtained for garnet from two of these Victor eclogites, namely VIC0607 and VIC1106. These samples have $\delta^{18}O$ close to the

accepted value for the upper mantle ($\delta^{18}O = 5.5 \pm 0.2$ ‰ $_{SMOW}$), with VIC0607 giving 5.5 ± 0.3 ‰ and VIC1106 giving 5.9 ± 0.1 ‰.

Major element mineral chemistry of further Victor eclogite samples will be presented, in addition to trace element analyses of garnet and clinopyroxene in these eclogites. Constructed whole-rock trace element compositions for these eclogites will be interpreted alongside the major element compositions in order to better understand their origin and to constrain to what extent their composition may have been affected after emplacement in the sub-continental lithospheric mantle due to fluids/melts, possibly related to the Midcontinent Rift.

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