TRACE ELEMENT CHARACTERISTICS OF PERIDOTITIC XENOLITHS FROM THE JERICHO KIMBERLITE PIPE, NORTHCENTRAL SLAVE CRATON, CANADA

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ABSTRACT

Since the discovery of the first diamondiferous kimberlite in the Lac de Gras area, numerous kimberlite pipes have been located in the Slave craton and petrological characters of the underlying lithospheric mantle have been increasingly better known (e.g., Boyd and Canil, 1997; Kopylova et al., 1999; Russell and Kopylova, 1999; Schmidberger and Francis, 1999; MacKenzie and Canil, 1999). Majority of the Slave craton peridotites are orthopyroxene poor and plot on an extension of the “oceanic trend” of Boyd (1989), significantly different from those of the Kaapvaal and Siberian craton roots, perhaps reflecting different evolutionary pathways.

Trace element characteristics of minerals in the Slave craton peridotites have never been discussed in detail and this study is a step toward establishing a comprehensive dataset for the Slave craton, so that inter-craton comparisons can be made to advance understanding of processes by which cratonic lithosphere has evolved.

A Cameca IMS 3f ion microprobe at Woods Hole Oceanographic Institution was used for determining concentrations of La, Ce, Nd, Sm, Eu, Dy, Er, Yb, Ti, V, Cr, Sr, Y and Zr using an energy filtering-based working curve approach with a spatial resolution of approximately 20 µm. Analytical uncertainties range from 10~15% for REE and 5~10% for the rest of the elements for clinopyroxene and garnet. Orthopyroxene data involves uncertainties up to 40% for all elements.

Trace element abundance patterns in garnets and clinopyroxenes in Jericho peridotites show similarities and significant differences relative to their counterparts from the Kaapvaal and Siberian cratons. For high-temperature garnet peridotites, trace element abundances, patterns, and ranges of mineral zoning observed here are similar to those of the other cratonic roots. Exceptions are unusually high Cr and V contents: Cr_2O_3 in garnet as high as 13 wt% (as reported also by Kopylova et al., 1999) and >600 ppm V.

Garnets and clinopyroxenes in low-temperature garnet peridotites and spinel-garnet peridotites show trace element patterns that are very different from Kaapvaal and Siberia. For instance, clinopyroxenes are characterized by extreme LREE enrichment (>100 times chondrite), high Sr (up to 1400 ppm), high LREE/HREE ratios (100~400), and depletion in HFSE (e.g., 40 ppm Ti). Coexisting garnets have accentuated sinusoidal REE patterns with low La (as low as 0.2 times chondrite), high MREE (Eu up to 30 times) and Yb as low as 1.8 times chondrite. Orthopyroxenes are inhomogeneous in trace element abundances, varying more than a factor of 10 for LREE and Sr.

Trace element distribution between garnet and clinopyroxene appears to be highly disequilibrium in majority of rocks, consistent with the observation by Kopylova et al. (1999) for the major elements.

It appears that lithospheric peridotites beneath the Slave craton has interacted with melt/fluid shortly before eruption (Jurassic) and that trace element patterns of the melt/fluid are characterized by extreme LREE (and Sr) enrichment, high LREE/HREE ratios and HFSE depletion, and are very different from melt/fluid for the Kaapvaal and Siberian cratons. These differences may be related to the different fluid compositions observed in diamonds between Canada and Africa (Johnson et al., 1998).

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