



Petrology and geochemistry of spinel and garnet peridotites from the Lethlakane Diamond Mine, Botswana

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The best samples from the subcontinental lithospheric mantle (SCLM) are usually recovered in kimberlitic and alkalibasaltic pipes and flows as no alteration or metamorphic overprint is found there. In Botswana the Lethlakane kimberlite is mined for diamonds but produces also a variety of xenoliths. More than 100 samples were taken which can be subdivided in: (I) spinel-lherzolite, (II) spinel-harzburgite, (III) garnet-harzburgite, (IV) porphyroclastic garnet-lherzolites, and (V) spinel-dunite. Most samples display interaction with a melt phase seen in max. 0.1 mm wide melt veinlets, which are typically associated with newly formed minerals such as calcite, phlogopite and clinopyroxene. Spinel-lherzolite contains spinel up to 1 mm in size within an equigranular matrix consisting of olivine, clinopyroxene and orthopyroxene. spinel-harzburgite is comparable in texture without clinopyroxene in the matrix but newly formed along the melt veinlets. Garnet lherzolite contains up to 8 mm sized garnet with up to 0,5 mm wide kelyphitic rims. The matrix consists of equigranular olivine, hypidimorphic clinopyroxene and orthopyroxene. Porphyroclastic peridotites display a fine grained olivine matrix with orthopyroxene, clinopyroxene and garnet clasts.

Temperatures obtained by the Cpx-Opx thermometer (BREY & KOEHLER, 1990) and the Al and Cr in Ol thermometer (DE HOOG et al., 2010) allowed to constrain the temperature for spinel peridotites from 790°C to 910°C and 970-1100°C for garnet peridotites. The highest temperatures were found in porphyroclastic garnet lherzolites with 1200 to 1250°C. The pressure for the spinel bearing mantle xenoliths is around 2.3 GPa, when plotting the calculated temperatures on the average geotherm for the Kapvaal craton (FULLEA et al., 2011). Pressures range from 3.0 GPa up to 4.6 GPa for garnet bearing xenoliths where the highest pressures occur in porphyroclastic samples.

Trace and rare earth element compositions in Ol, Cpx, and Grt were determined by LA-ICPMS. Clinopyroxene from garnet bearing samples displays typical chondrite normalized rare earth element (REE) pattern with 20 to 100 times enrichment for LREE and values <1-10 for HREE. In spinel-peridotites the HREE content is significantly higher due to the absence of garnet. In some samples metasomatic modification is observed by unusual flat REE pattern. Chondrite normalized REE pattern for garnet also follow mostly trends typical for the average SCLM with low LREE and high HREE contents. Some samples display a sinusoidal shape with elevated Nd and Sm. Eu values indicating melt metasomatism.

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