Geophysical Research Abstracts,
Vol. 11, EGU2009-5848, 2009
EGU General Assembly 2009

Garnet - Spinel Peridotites from Potrok Aike: An insight into the Patagonian Lithospheric Mantle

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The mantle-xenolith bearing hyaloclastic tephra from Potrok Aike, located 68 km SW of Río Gallegos, Argentina, provide good opportunities for studying the lithospheric mantle beneath southern Patagonia. The Potrok Aike maar belongs to the Pliocene to Holocene Pali Aike volcanic field located east of the Andean volcanic arc. The studied samples are spinel-bearing and garnet + spinel-bearing lherzolites and harzburgites.

The entire suite of the studied mantle-xenoliths have protogranular to protogranular-equigranular textures. The most interesting textural features are the kelyphitic rims around both garnet and spinel, that clearly demonstrate break-down of garnet in spinel bearing xenoliths. Detailed petrographic investigations showed different degrees of kelyphitisation. Another feature is the intergranular growth of clinopyroxene, representing a late metasomatic event. No hydrous minerals were so far found in the studied xenoliths.

The Potrok Aike clinopyroxenes are Cr-diopsides with Al2O3 contents ranging from 3.2 to 7.1 wt %, whereas the garnets show pyrope composition (Alm16.3Py69.3Gros13.7 Spess0.7). The spinel shows broad range of compositional variation with Cr# varying between 0.1 and 0.5.

The bulk chemistry points out the fertile character of the lherzolithes (Al2O3 2.6 - 3.6 wt % and CaO 2.5 - 2.9 wt %), while the harzburgites indicate a depleted character (Al2O3 0.7 - 2.5 wt % and CaO 0.33 - 2.14 wt %). According to the REE patterns, the Protok Aike peridotites can be divided into three groups: group I, non-metasomatised peridotites with Lan/Smn from 0.76 to 0.91 and Tbn/Ybn from 0.70 to 0.71; group II, slightly metasomatised peridotites with Lan/Smn from 0.95 to 1.27 and Tbn/Ybn from 0.96 to 1.18; and group 3, metasomatised peridotites with Lan/Smn from 1.36 to 3.2 and Tbn/Ybn from 1.06 to 2.12.

LA-ICP-MS analyses on clinopyroxenes from spinel-peridotites have convex upward REE patterns resembling those from the spinel-garnet-bearing peridotites. Clinopyroxenes from both types of rocks have similar Lan/Smn and Tbn/Ybn ratios ranging from 0.21 to 0.63 and from 2.1 to 6.5 respectively, with LREE being lower and HREE higher in the spinel-peridotites, suggesting the former presence of garnet in spinel facies samples,. Clinopyroxenes from the spinel-peridotite facies in primitive mantle normalized trace elements diagrams show variable positive Zr anomalies relative to Nd and Sm, which are absent in the clinopyroxenes from the garnet-spinel peridotites but present in the garnets. Such features reflect a gradual transition from spinel-garnet peridotite field to the spinel-peridotite stability field. This transition took place whithin a narrow range of P-T conditions before total re-equilibration at lower depth was achieved. This is also supported by the growth of fine grained radial olivine- and clinopyroxene around spinels, which replace former garnet crystals.