A UNIQUE METASOMATISED PERIDOTITE XENOLITH FROM THE MIR KIMBERLITE, SIBERIAN PLATFORM

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Mantle xenoliths brought to the Earth's surface provide a window through which to view the upper mantle. These xenoliths likely have undergone numerous processes at varying P&T which are recorded in the mineral compositions and texture. Metasomatism is one of these processes and plays an extremely important role in the alteration and modification of the rocks and minerals.

A garnet peridotite, sample A-143, was collected from the Mir kimberlite pipe on the Siberian Platform. The Siberian Platform is located in northeastern Russia, represents a unique opportunity for studying mantle xenoliths.. Major- and trace-element chemistry of garnet, clinopyroxene, orthopyroxene, and olivine from this garnet peridotite have been determined by electron microprobe and ion microprobe.

A-143 is a garnet peridotite, consisting of a typical mineral assemblage of olivine, orthopyroxene, clinopyroxene, and garnet with small amounts of chrome spinel and phlogopite. The sample is equigranular and consists of mostly olivine and orthopyroxene with grain sizes ranging from 0.5 to 3 mm. Garnet, clinopyroxene and sometimes phlogopite occur as an intergrowths or "microxenoliths" (fingers, selvedges of clinopyroxene in garnet) 1-3 mm in size. Chromites are quite small (0.1-0.3 mm) and occur as inclusions in garnet-cpx intergrowths.

Olivine and orthopyroxene do not show significant compositional variation, and have typical garnet peridotite compositions; Mg# for olivine and enstatite component for orthopyroxene both equal ~92. Garnets in sample A-143 have significant core-to-rim chemical zonation (Fig. 1-3) and inter-grain compositional variation. The rims are highly enriched in Cr_2O_3 compared to the core, 8.10 and 4.90 wt. % respectively. Al_2O_3 contents decrease from 20.0 to 17.5 wt. % from core to rim. Cr_2O_3 contents between separate grains vary from 4.30 to 9.30 wt.%. Clinopyroxene exhibits intergrain compositional variation. Cr_2O_3 contents vary from 6.05 to 6.80 wt.% while Na_2O changes from 6.70 to 7.25 wt.% at the same time. Therefore, clinopyroxene is unique in composition, containing the highest Na_2O and Cr_2O_3 contents yet reported for peridotites, i.e. it is enriched in so-called *kosmochlor* component (i.e. $NaCrSi_2O_6$ up to 21%). Chrome spinels do not exhibit inter-grain compositional variation, having Cr_2O_3 contents 57.5-58.0 wt%, Al_2O_3 6.50-7.30 wt.% and MgO 10.0-10-4 wt.%. Phlogopite contains 9.60-9.80 wt.% K_2O, 25.5-25.7 wt.% MgO and 0.40-0.60 wt.% F.

Trace-elements in garnets show convex-upward patterns with both LREE-depleted and HREE-depleted signatures (Fig.4). Garnet rims (high Cr_2O_3) are slightly enriched in LREE and depleted in HREE compared to the core. Clinopyroxene REE patterns also are convex-upward and exhibit no significant intergrain variation. Clinopyroxenes are slightly depleted in LREE (20-

50xC1 chondrites), enriched in MREE (60-70xC1 chondrites) and depleted in HREE (5-20xC1 chondrites).

According to the classification scheme for peridotite garnets proposed by Sobolev et al. (1973), garnets from A-143 fall within the harzburgite-dunite field on a Cr_2O_3 - CaO plot. However, this sample consists of a typical lherzolite mineral assemblage (i.e. Gt + Opx + Ol + Cpx). Sobolev et al. (1973) stated that high Na contents in clinopyroxene lowers Ca contents in coexisting garnet and therefore "moves" garnet compositions from the lherzolite to the harzburgite field (Fig. 3). Figure 3 shows that lherzolite garnet compositions having slope parallel to lherzolite field borders and correlation coefficient r = 0.80 are shifted towards the harzburgite field. Line 1-1', Fig. 3 (Sobolev et al., 1973) limits garnet compositions in respect to Ca contents for lherzolites containing the most Na-rich clinopyroxenes.

No other peridotite xenoliths with such specific features of coexisting garnet and clinopyroxene have been documented to date. The densest parts of these xenoliths, i.e. "microxenoliths" of Gt + Cpx + Chr ± Phl occur sometimes in kimberlite "concentrates" (Sobolev, 1974) indicating that these peculiar peridotites are subjected to disaggregation. The compositional features of coexisting garnet and chromite are similar to those of graphite-bearing peridotites (Sobolev, 1974; Pokhilenko et al., 1993; Pearson et al., 1994).

REE abundances do not vary significantly from the core to the rim. In contrast with zoned garnets in harzburgites (Shimizu et al., 1994), an absence of REE variation from the core to the rim can be explained by equilibrium between coexisting garnet and clinopyroxene.

Significant garnet zonation, unusual garnet-clinopyroxene intergrowths (fingers, and/or selvedges of cpx and garnet) and unique clinopyroxene compositions point to involvement of metasomatic fluids. However, the nature of these fluids is not well understood. In fact, according to the REE patterns, this fluid could be kimberlitic, with $(La/Nd)_n$ =5-10, and Nd≈100xC1 chondrites. In any case, sample A-143 represents a mineral assemblage with unique chemical compositions and unusual textural features.

References

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Figure captions

Figure 1. X-ray map of A-143 garnet.

Figure 2. Cr_2O_3 zonation in sample A-143.

Figure 3. Cr_2O_3 vs. CaO in garnets from sample A-143

Figure 4. Chondrite-normalized REE diagram for A-143 zoned garnet.

Fig. 1

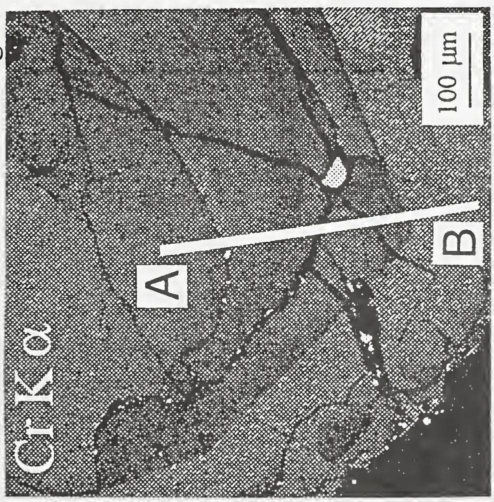

Fig. 2

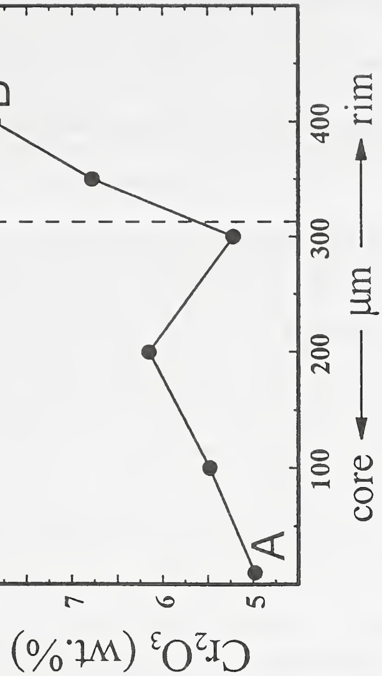

Fig. 3

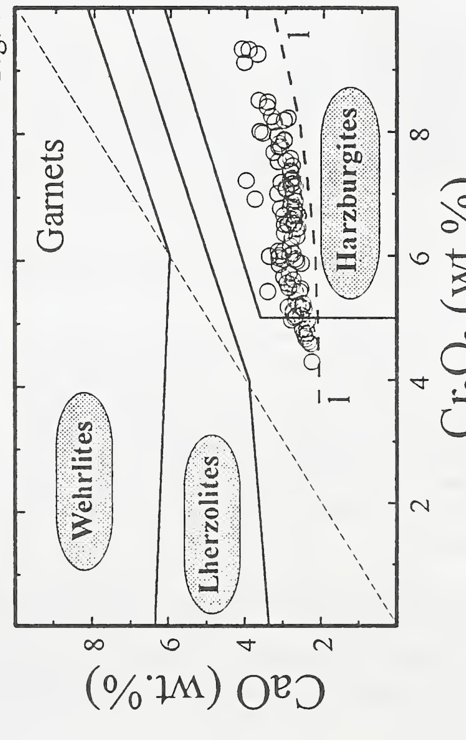

Fig. 4