Formation of Garnet Orthopyroxenites and Mobility of Siderophile and Chalcophile Elements in the Subcontinental Lithospheric Mantle during Metasomatism by Asthenospheric Mantle-derived melt below the Southern South America

Introduction
The occurrence of secondary orthopyroxene has been reported in subarc mantle and it has been interpreted as SI enrichment by aqueous fluids and melt derived from slabs. High modal abundance of orthopyroxene in ancient SCLM is also explained by infiltration of SI-rich melt. An alkali-rich melt has a low activity of SiO₂ and is not expected to cause Si enrichment. However, a recent study of xenoliths in western Japan by Arai et al. (2006) suggests that evolved alkali-rich melt is capable of producing SI enrichment in such peridotites. Voluminous alkali basalts of Quaternary age in the northern South America contain abundant mantle xenoliths including garnet-bearing orthopyroxenites. They are distinct in color and texture from other mantle peridotites. This paper reports the mineralogy and petrology and origin of garnet orthopyroxenites.

The map shows the distribution of the Quaternary alkaline basalt fields (apple green) including the study area and other subarc mantle. The evidence suggests that the metasomatizing agent is most likely evolved (low Mg) high Ti melt because Ti is usually not mobile in fluids.

The secondary Opx contains high Ti and low MgO compared with Opx in peridotites in the study area and other subarc mantle. The evidence suggests that Ni is depleted and Mg are depleted during the metasomatism.

Conclusions
1. Grt orthopyroxenite xenoliths contain Ti-rich Amphibole and plagioclase, and abundant relict Ol in Opx. They are metasomatic products of Grt peridotites.
2. The Opx contains high TiO₂ (0.28-0.59 wt%), moderate Al₂O₃ (3.27-5.10 wt%) and Cr₂O₃ (0.15-0.48 wt%), and low MgO (Mg# 0.85-0.88) compared to Grt-harzburgites show no good correlation, suggesting Opx and Ol were not equilibrated.
3. The metasomatizing agent is likely an evolved alkali melt that was derived from the underlying asthenospheric mantle.
4. Cr, Ni, and PGE were essentially immobile during the metasomatism.

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