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Major and trace element whole rock and mineral chemistry of Southern Patagonian Mantle Xenoliths

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The Pali Aike Volcanic Field (PAVF) situated in the back-arc tectonic setting of southern Patagonia is one of the two Patagonian localities where garnet and spinel peridotites are brought to the surface by alkaline basalts. The other locality is Prahuaniyeu in northern Patagonia. The xenoliths from the PAVF were collected at Salsa, El Ruido and Potrok Aike mare and are spinel- and spinel-garnet-lherzolites, followed by spinel- and spinel-garnet harzburgites. Textures are protogranular to protogranular-equigranular with some samples slightly foliated. None of the studied xenoliths contain hydrous phases such as phlogopite and/or amphibole but few contain secondary interstitial clinopyroxenes and melt pockets. Inclusions of spinel in some garnets suggest transition from spinel to garnet peridotite stability field. Frequently, Opx show exsolution lamellae of Cpx (+/- Sp) and vice versa indicating subsolidus cooling. Occasionally, Cpx show spongy rims suggesting either decompression or reaction with infiltrating melt.

Whole rock $Al2O_3$ and CaO contents range from 0.63 to 3.54 wt% and 0.24 to 2.90 wt%, respectively. The variation diagrams of CaO and $Al2O_3$ versus MgO exhibit a linear correlation that could be interpreted as residuals after extraction of melts with different degrees of partial melting from a common mantle source. Modeled fractional melting degrees for Salsa, El Ruido and Potrok Aike Sp-peridotites are 6.5 – 12%, 4 – 17% and 5.5 – 9%, respectively.

Olivine compositions vary between Fo89.51 – Fo92.04. However, one El Ruido Sp-harzburgite and one Gt-harzburgite have lower Fo-contents (Fo88.88 -Fo89.11) indicating either a cumulate nature of the xenoliths or a change in chemical composition of the rocks due to reaction with infiltrating melts. Primary Cpx are Cr-diopsides with mean compositions En47-50Fs4-5Wo48-45 in lherzolites, En49-53Fs6-5Wo44-41 in harzburgites, and En47Fs3Wo50 in the El Ruido dunite. Cpx $Al2O_3$ and $Cr2O_3$ contents in all rock types vary from 2.06 to 6.11 wt% and 0.77 to 1.95 wt%, respectively. Opx compositions are in the range En88-91Fs10-7Wo1.5-1.2 with mg# varying between 0.89 and 0.92. Primary Sp shows variable cr# from 0.17 in lherzolites to 0.50 in dunite. Gt is a Cr-rich pyrope with $Cr2O_3$ between 1 and 1.5 wt%.

PAVF peridotites have Primitive Mantle normalized whole rock REE abundances enriched in LREE [(La/Yb)N=1.4-13.8]. LA-ICP-MS analyses of Cpx show that most of the PAVF Sp-peridotites experienced cryptic metasomatism [(La/Yb)N=8.4-9.1], only Cpx from 4 peridotites are depleted in LREE [(La/Yb)N=0.3-0.7]. Their enriched whole rock LREE abundances suggest host basalt infiltration.

Equilibrium P-T estimates yield temperatures in the range of 975 to 1140 °C for Salsa samples with pressures from 18 to 21 kbar. El Ruido peridotites equilibrated in the range of 950 to 1175°C and pressures of 18.7 to 19.7 kbar for Gt-peridotites. Two El Ruido samples show lower equilibration temperatures of $\sim$750°C indicating subsolidus cooling. Potrok Aike samples yield equilibration temperatures of 950 to 1000°C with pressures of $\sim$20 kbar. Sp inclusions in Gt indicate initial P-T conditions within the Sp-stability field and subsequent passing through the Gt-stability field.