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Two cpx and opx generation in the southern Patagonian lithospheric mantle

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The petrological study of mantle xenoliths brought up to the surface by basic magmas is the most effective way to know both the provenance and the nature of the fluids which percolate in the mantle and affect its chemical and mineral modifications. Mantle nodules are very rare in the subductive environment, which is also characterized by a great complexity of the material involved.
With these aims a new locality, Estancia Sol de Mayo, from Southern Volcanic Zone in Patagonia was studied. Hereafter a detailed petrographic and in situ geochemical (major and trace elements) study of these xenoliths is presented, together with a comparison with several Patagonia localities.
Xenoliths from Estancia Sol de Mayo are mainly represented by spinel-bearing protogranular harzburgites and dunites, with minor lherzolites and one wehrlite. They are avoid of metasomatic features, such as spongy cpx, reaction rims around spinel and/or orthopyroxene, glassy patches, as well as of any hydrous minerals. Olivine is the most abundant and largest mineral (0.5-0.6 mm in size) often with kink-banding. Orthopyroxene is present as both protogranular crystal (opx1), with size comparable to olivine, and smaller crystals arranged in a vein (opx2). The former has mg# (MgO/MgO+FeO, at%) between 88.02 and 92.76 and Al2O3 content varying between 1.37 and 2.97 wt%, most probably depending upon lithology. Opx in the vein presents a more restricted range of mg# values, overlapping the low range of protogranular opx (89.99-90.88) with a significantly higher Al2O3 content (3.02-3.52). Clinopyroxene, usually smaller than opx, appears also as both protogranular large crystals (cpx1) and smaller individuals growing around spinel (cpx2). These latter have mg# varying from 89.66 to 92.36 and Al2O3 from 2.65 to 4.45. Within the same sample, at comparable mg#, protogranular cpx has lower Al2O3 and Cr2O3 contents. In Primordial mantle normalized incompatible trace elements diagram the two type of cpx show very similar patterns with cpx2 often showing more enriched values. Spinel has the smallest dimension rounded or elongated in shape. They are characterized by variable Al2O3 and MgO enrichment, most of them plotting on the normal mantle array, with mg# and cr# (Cr2O3/ Cr2O3+Al2O3, at%) varying between 53.14 and 60.83 and 43.45 and 59.14 respectively. Isolated spinels (not surrounded by cpx) present the highest cr# (and lowest mg#), while spinels surrounded by clinopyroxenes present higher Al2O3 content.
The above reported textural and geochemical features indicate that i) opx2 was added to the system after the harzburgites was formed and ii) cpx growing around spinel is not an isochemical process, due to a simple deformation and recrystallization event, but, at least Al2O3 and REE, should have been added to the system. Time relationships between opx and cpx formation are not constrained, but assuming that the two phenomena are linked together, their formation point toward a SiO2-, Al2O3- and REE-rich metasomatizing agent affecting an already moderately to strongly depleted peridotite.