ROCK-MELT REACTION AND SMALL SCALE HETEROGENEITIES IN THE LITHOSPHERIC MANTLE UNERNEATH N. PATAGONIA, ARGENTINA

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The Patagonian Lithosphere represents the southernmost part of the South American Plate. It has been shaped by the ongoing subduction of the Nazca and Antarctic oceanic plates responsible for the formation of the Andean continental arc and the back arc region. The back-arc region is characterized by voluminous, late Miocene “main plateau” tholeiitic basalts and less-voluminous Pliocene “post plateau” alkali basalts. The latter frequently carry mantle xenoliths up to 30 cm in diameter.

The xenoliths in the “post plateau” alkali basalts closest to the Andean arc SE of the village Comallo in N. Patagonia are mainly foliated spinel harzburgites frequently with disseminate amphiboles and/or cm thick veins. One xenolith, a fine-grained amphibole-free spinel harzburgite, shows unique features. In a 2.5 cm long profile along the foliation the Fo content of the individual olivine grains decreases from 91.5 to 79.5, whereas NiO remains constant at ~ 0.40 wt.%. The opx and cpx follow the same trend with Mg# ranging from 92.2 to 83.0 and 93.5 to 86.2 respectively. Furthermore, the Cr# of spinel ranges from 63.4 to 32.5 following the same trend as the pyroxenes. The cpx have concave downward LREE patterns indicating intergranular melt percolation and fractionation with increasing (La/Sm)N along the foliation from 1.5 in the grains with low Mg# to 4.1 in the high Mg# grains.

Based on the assumption of local equilibrium, the Fe-Mg partitioning between opx and cpx (opx-cpx geothermometer) would yield a dramatic temperature increase from 760°C in the high Mg# pairs to 1000°C in the low Mg# pairs over a distance of 2.5 cm. Such a temperature gradient is unfeasible and the observed Fe-Mg partitioning rather indicates grain-scale disequilibrium due to different rates of Fe-Mg exchange of opx and cpx during the metasomatic event.

The extreme compositional gradient in a mantle xenolith, which otherwise exhibits a well equilibrated microstructure, indicates interaction with a metasomatic agent not related to the host basalt. The most likely metasomatic agent is a melt e.g. from an upwelling vein. Emanating from the vein, the melt percolated into the wall rock preferably along the foliation leading to the most intense metasomatism closest to the melt source (low Mg#). The unusual constant Ni concentration in the olivine, independent of the Mg#, could be attributed to very low oxygen fugacity of the interacting melt. The metasomatic front is well defined by the highest Mg#, whereas the contact to the melt source is not preserved. This gives us a handle on the life-time of this geochemical perturbation via inverse diffusion modelling.