



Experimental and natural constraints on the spinel-plagioclase subsolidus transition in mantle peridotites.

G. Borghini (1), P. Fumagalli (2) and E. Rampone (1)

(1) Dipartimento per lo Studio del Territorio e delle sue Risorse, University of Genova, Genova, Italy (giulio.borghini@unige.it / Fax: +39 10 352169 / Phone: +39 10 3538137)

(2) Dipartimento di Scienze della Terra "Ardito Desio", University of Milano, Milano, Italy

Plagioclase-bearing peridotites are diffuse at extensional settings and can be related either to i) impregnation of melts or ii) metamorphic recrystallization via subsolidus tectonic exhumation of the lithospheric mantle from spinel- to plagioclase-facies conditions. Impregnation by melts is widely documented in most of these peridotites whereas few studies have recognized the spinel-plagioclase transition in mantle peridotites from both on-land and oceanic settings. Also, experimental data are available only on simplified chemical system, for pyrolite composition. The aim of this study is to constrain the spinel to plagioclase transition as a function of the compositional variability of mantle peridotites, thus providing insights on the subsolidus exhumation of the lithospheric mantle at slow-spreading oceanic settings. The research is based on a combined methodological approach including studies on Northern Apennines ophiolitic peridotites (Suvero, External Ligurides, Italy), coupled to experimental investigations. In the Suvero lherzolites ($cpx \approx 14\%$), the subsolidus plagioclase-facies recrystallization is recorded by i) fine-grained granoblastic aggregates of plagioclase + olivine + pyroxenes, and ii) plagioclase + olivine rims around brown Al-rich spinels. The study of ophiolitic peridotites provided major and trace element compositional variations related to facies transition and bulk-rock compositional end-members suitable for experimental investigations. Experiments were performed on peridotite compositions modelled in complex systems (e.g. CMAS + Na_2O + FeO + Cr_2O_3 + TiO_2) at P from 0.25 to 1.0 GPa and T from 900 to 1200°C, using both piston cylinder and autoclave (Internally Heated Pressure Vessel). Synthetic gels reproducing bulk com-

positions of natural peridotites from the Ligurian ophiolitic massifs were used as starting materials: selected compositions range from fertile lherzolite to depleted lherzolite to harzburgite in order to cover the compositional variability recorded by abyssal and ophiolitic peridotites. Experimental results at $T=1100^{\circ}\text{C}$ on a fertile lherzolite ($\text{CaO}=3.41\text{ wt\%}$; $\text{Al}_2\text{O}_3=3.79\text{ wt\%}$), representative of the Suvero peridotite composition, show that spinel-bearing assemblage is stable at pressure above 0.9 GPa whereas plagioclase-bearing assemblage is stable below 0.8 GPa. In this latter, plagioclase occurs as thin rim around partially reequilibrated (Cr-rich) spinel seeds or as small anhedral crystals associated with olivine and pyroxenes. This texture is consistent with natural occurrence and indicates that Cr-rich spinel is stable in the plagioclase-bearing assemblage. Reasonable grain size (up to 50-70 μm), and coherent element partitioning (e.g. X_{Mg} in olivine and pyroxenes), strongly support approach to equilibrium and the experiments reliability. Systematic compositional variations in minerals at different P-T conditions are consistent with those documented in the Suvero peridotites; in particular, both clino- and ortho-pyroxene record a significant decrease of the Al_2O_3 content from spinel to plagioclase stability field. Moreover, the Al_2O_3 decrease in plagioclase-bearing pyroxenes become more pronounced at decreasing pressure. Preliminary phase abundance results provided by mass balance calculations indicate that at decreasing P, the increase in plagioclase modal amount (6.5 to 8.5, from 0.5 to 0.8 GPa) is coupled to increase in modal olivine and overall decrease in modal pyroxenes: such modal variations, within the plagioclase-stability field, are likely consequence of progressive Al decrease in stable pyroxenes, and reflect the continuous reaction Al-rich sp + Al-rich px₁ = plag + ol + Al-poor px₂ + Cr-rich sp. The spinel to plagioclase transition is expected to shift towards lower pressure at increasing bulk peridotite depletion. Further experiments on variably depleted peridotites will be aimed to i) locate the spinel to plagioclase reaction in the P-T subsolidus space as a function of peridotite composition, and ii) define the reaction progress as a function of pressure through the determination of reaction coefficients.