Genesis of ultra-high pressure garnet pyroxenites in orogenic peridotites and its bearing on the compositional heterogeneity of the mantle

MARÍA ISABEL VARAS-REUS[1,2], CARLOS J. GARRIDO[2], CLAUDIO MARCHESI[2,3], DELPHINE BOSCH[4], KÁROLY HIDAS[2]

[1] University of Tübingen, Tübingen, Germany. mvarasreus@gmail.com

[2] Instituto Andaluz de Ciencias de la Tierra (IACT), CSIC-UGR, Armilla, Granada, Spain. carlos.garrido@csic.es; claudio@ugr.es; karoly.hidas@csic.es

[3] Departamento de Mineralogía y Petrología, Universidad de Granada, Granada, Spain. claudio@ugr.es

[4] Géosciences Montpellier, UMR 5243, CNRS-Université de Montpellier, Montpellier, France. Delphine.Bosch@gm.univ-montp2.fr

We present an integrated geochemical study of ultra-high pressure (UHP) garnet pyroxenites from the Ronda and Beni Bousera peridotite massifs (Betic-Rif Belt). We classify UHP garnet pyroxenites into three groups: Group A pyroxenites (Al_2O_3: 15 – 17.5 wt. %) have low initial $^{87}Sr/^{86}Sr$, relatively high $^{143}Nd/^{144}Nd$, $^{206}Pb/^{204}Pb$ and $^{176}Hf/^{177}Hf$ ratios, and highly variable $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios. Group B pyroxenites (Al_2O_3 < 14 wt. %) are characterized by high initial $^{87}Sr/^{86}Sr$ and low $^{143}Nd/^{144}Nd$, $^{206}Pb/^{204}Pb$ and $^{176}Hf/^{177}Hf$ ratios. Group C pyroxenites (Al_2O_3 ~ 15 wt. %) have low initial $^{87}Sr/^{86}Sr$ and $^{206}Pb/^{204}Pb$, high $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$, and $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios similar to Group B pyroxenites.

The major and trace element, and isotopic compositions of UHP garnet pyroxenites support they derived from ancient (1.5 – 3.5 Ga) oceanic crust recycled into the mantle and intimately mixed with peridotites by convection. Moreover, the genesis of these pyroxenites requires a component of recycled lower continental crust with an isotopic composition akin to the lower crustal section of the lithosphere where these UHP garnet pyroxenites now reside in. These crustal components were mixed in different proportions in the mantle originating pyroxenites with a more evident geochemical imprint of oceanic (Group A) or continental (Group B) crust, or hybrid compositions (Group C). The pyroxenite protoliths melted probably during the emplacement of the Ronda and Beni Bousera mantle sections into the lithosphere, generating the restitic UHP garnet pyroxenites now preserved in these orogenic peridotites. Positive Eu anomalies in bulk rocks, indicative of their origin from cumulitic crustal gabbros, are preserved only in high Mg-*no* pyroxenites due to their higher melting temperatures.