Geophysical Research Abstracts
Vol. 20, EGU2018-12902, 2018
EGU General Assembly 2018

Pervasive formation of secondary lherzolite during melting and thermal erosion of the Subcontinental Lithospheric Mantle: the record of the Beni Bousera peridotite

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Correlations between major and minor transition elements in tectonically-emplaced orogenic peridotites have been ascribed to variable degrees of melt extraction and melt-rock reaction processes, leading to depletion or refertilization. In order to elucidate how such processes are recorded in the subcontinental lithospheric mantle, we processed a large geochemical database of peridotites from the four tectono-metamorphic domains of the Beni Bousera orogenic massif (Rif Belt, N. Morocco). Our study reveals that variations in bulk rock major and minor elements, Mg-no. and modal proportions of lherzolites, as well as their clinopyroxene trace element compositions, are inconsistent with simple partial melting and mainly resulted from different reactions between melts and depleted peridotites. On the other hand, up to 30% melting at < 3 GPa and cryptic metasomatism can account for the geochemical variations of most harzburgites. In Grt-Sp mylonites, melting and melt-rock reactions are masked by tectonic mixing with garnet pyroxenites and subsolidus re-equilibration. In the rest of the massif, lherzolites are secondary and mostly produced by refertilization of a refractory protolith (Mg-no. ~ 91, Ol $\sim 70\%$, Cpx/Opx $= 0.4$) via two distinct near solidus, melt-rock reactions: (1) clinopyroxene and orthopyroxene precipitation and olivine consumption at melt/rock ratios < 0.75 and variable mass ratio between crystallized minerals and infiltrated melt (R), which are recorded quite homogeneously throughout the massif; and (2) dissolution of orthopyroxene and precipitation of clinopyroxene and olivine at melt/rock ratios ≤ 1 and R = 0.2 – 0.3, which affected mainly the Ariègite-Seiland and Seiland domains. The distribution of secondary lherzolites in the massif suggests that the first refertilization reaction occurred prior to the differentiation of the Beni Bousera mantle section into petro-structural zones, whereas the second reaction was associated to the development of the tectono-metamorphic domains. Our data support a secondary, refertilization-related, origin for most lherzolites in orogenic peridotite massifs.