Geophysical Research Abstracts
Vol. 12, EGU2010-12550, 2010
EGU General Assembly 2010

Mantle metasomatism by melts of HIMU piclogite components: new insights from Fe-lherzolite xenoliths (Calatrava Volcanic District, Central Spain)

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Mantle xenoliths from the Calatrava Volcanic District (CLV), central Spain, are characterized by a wide compositional range, which includes lherzolites (prevalent) as well as minor amounts of wehrlite, ol-websterite and rare dunites. They generally have bulk-rock Mg#s <89, lower than any primordial mantle estimates. Intra-suite variations in modal proportions are inconsistent with those predicted by melting models irrespective of the starting composition; mineral and bulk-rock variation diagrams show inconsistencies between the CLV compositions (anomalously enriched in Fe-Ti) and those predicted from partial melting of primordial mantle material. Processes other than pure melt extraction are confirmed by the whole-rock REE budget, typically characterized by LREE enrichments, with LaN/YbN (up to 6.7), probably related to pervasive metasomatism. CLV mantle clinopyroxenes (cpx) generally display fractionated REE patterns with upward convex shapes, characterized by low HREE (Tm-Lu) concentrations (typically <6 x chondrite) and enrichments in Middle/Light REE (NdN/YbN up to 7, LaN/YbN up to 5). These "enriched" cpx compositions either result from re-equilibration of primary mantle cpx with an incoming melt, or represent cpx crystallization directly from the metasomatic agent. The latter was plausibly generated at greater depths in the presence of residual garnet (from peridotite or eclogite starting materials). Separated cpx have homogeneous 87Sr/86Sr compositions between 0.7031 and 0.7032; 143Nd/144Nd ranges from 0.51288 to 0.51295 and 176Hf/177Hf is in the range 0.28302-0.28265. Unlike mantle xenoliths and alpine-type peridotites from other Iberian occurrences, which range in composition from the Depleted Mantle (DM) to the Enriched Mantle (EM), the CLV mantle cpxs approach the composition of the HIMU mantle end-member, the genesis of which is generally interpreted as the result of long-term recycling of oceanic basalts/gabbros (or their eclogitic equivalent) via ancient subduction. A model is proposed for the mantle evolution under central Iberia, where sublithospheric convective instabilities - possibly triggered by the neighbouring subduction along the Betic collisional belt - could have remobilized deep domains from the mantle Transition Zone (410-660 km) which may include relicts of older subducted slabs. Within these remobilized domains, characterized by the coexistence of peridotite and eclogite and referred to as a "piclogite" association, the eclogites melt preferentially generating Fe-Ti rich melts characterized by a HIMU isotopic signature that infiltrates and metasomatizes the shallower lithospheric mantle.