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Geochronological Constraints on the Exhumation and Emplacement of Subcontinental Lithospheric Mantle Peridotites in the Westernmost Mediterranean

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Exhumation of subcontinental mantle peridotite in the Western Mediterranean has been attributed to different tectonic processes including pure extension, transpression, or alternating contractive and extensional processes related with continental subduction followed by extension, before final their contractive intracrustal emplacement. Any model trying to explain the exhumation and emplacement of subcontinental lithospheric mantle peridotites in the westernmost Mediterranean should take into account the available geochronological constraints, as well as the petrological and geochemical processes that lead to internal tectono-magmatic zoning so characteristic of the Betic and Rif orogenic peridotites.

Different studies have suggested a Hercynian, Cenozoic-Mesozoic or an Alpine age for the late tectono-magmatic evolution and intra-crustal emplacement of Betic-Rif peridotites. The pervasive presence of Mesozoic U-Pb zircon ages in Ronda UHP and HP garnet pyroxenites does not support a Hercynian age for the intracrustal emplacement of the peridotite. A hyper-extended margin setting for is in good agreement with the Jurassic extensional event that pervasively affected ALKAPECA terrains (i.e. the Alboran, Kabylides, Peloritani, and Calabria domains) in the western Mediterranean due to the opening of the Piemonte-Ligurian Ocean. However, a Jurassic age and a passive margin tectonic setting do not account, among other observations, for the late Miocene thermochronological ages recorded in zircons rims (U-Pb) and garnets (Lu-Hf) in garnet pyroxenites from the Betic-Rif peridotites, the pervasive Miocene resetting of U-Pb zircon and monazite ages in the overlying Jubrique crustal section, the supra-subduction radiogenic signature of late pyroxenite intrusive dikes in the Ronda peridotite, and the arc tholeiitic affinity of late mantle-derived, gabbroic dykes intruding in the Ronda and Ojen plagioclase lherzolites. These data are more consistent with a supra-subduction backarc setting for the Paleocene Alpine evolution of the Alboran peridotite massifs due to slab rollback in the westernmost Mediterranean.

Several geodynamic models have proposed initial south directed migration of the orogenic arc in a more easterly position (south of the Balearic Islands) during the Paleogene before the closure of the Paleo-Tethys Ocean and collision with the Algerian margin. This early emplacement for the Ronda Peridotite (approx. 25-23 Ma) in such an easterly position would provide a common origin for the peridotite bodies found in the Kabylies in Algeria, and in the Betics-Rif. We propose that after thinning and extension in a back-arc setting recorded in the Ronda spinel tectonite domain and the recrystallization front, the final Miocene exhumation of Ronda Peridotite is associated with early folding and later but probably synkinematic shearing of the SCLM in a contractive geodynamic setting. This process is recorded in the low-pressure plagioclase tectonite domain of the Ronda peridotite and the supra-subduction bonititic affinity of late intrusive pyroxenites.