



Deformation and Exhumation of the sub-Continental Mantle: Insight from the Ronda Peridotite (Spain)

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We document detailed structural observations in the Ronda peridotite that provide new constraints on the deformation and exhumation of the sub-continental mantle. In the upper peridotite, the structural data and olivine Lattice Preferred Orientations (LPOs) are consistent with a large-scale strain gradient increasing upward beneath the overlying crustal rocks. The presence of B-type olivine LPOs in the highly strained, uppermost peridotite indicates that this strain gradient results from strain localization in the colder/stiffer peridotites. Structural data show also that the partial melting of the lower massif occurred coevally with this strain localization. Then, before the thrust-related emplacement of the peridotite lens, a second ductile deformation affected its lowermost part during decompression in the plagioclase stability field.

We attribute the occurrence of strain localization in the upper peridotite to sub-crustal mantle deformation during the intense thinning/rifting of a continental lithosphere. In this context, the partially melted lower peridotite represents the thinned basal lithosphere, which was “asthenospherized” during the syn-rifting uplift of the lithosphere-asthenosphere boundary. Subsequently, before the tectonic inversion of the former continental rift and emplacement of the peridotite, the deformation of the lowermost peridotite results from syn-rifting thermal relaxation. We relate this tectonic history to the rollback-related dynamics of the African slab during the Oligocene-Miocene. This dynamics implies back-arc rifting and then rift inversion during the accretion of the Alboran terrane onto the Iberian passive margin. We emphasize that the tectonic inversion of the continental rift probably plays a major role in the exhumation process of the Ronda sub-continental peridotite.