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Extensional emplacement of the Ronda peridotite as recorded in the Dorsale unit

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The Betic-Rif orogen forms the westernmost part of the Alpine orogenic system and results from the closure of the Tethys Ocean between Africa and the Iberian Peninsula. Subduction and crustal thickening leading to the formation of high-pressure and low-temperature (HP/LT) rocks were followed by a late-orogenic extensional stage in an overall still convergent setting. Indeed, plate-kinematic reconstructions reveal a continuous convergence from Late Cretaceous times to the present day and characterized by slow convergence rates. If this large-scale scenario is now broadly admitted, some first order questions remain opened. Among these questions, the timing and kinematics of the emplacement of the Ronda or Beni Bousera peridotite massifs remain particularly unclear. Due to the numerous published early Miocene ages, the emplacement of these massifs is classically considered as a very fast event that occurred just after a large-scale high-temperature metamorphic known in a large part of the Betics and part of the Rif. In most scenarios, the peridotite bodies are emplaced by overthrusting onto the continental crust within a compressional context but other models emphasize extensional context in the Alboran back-arc rift.

Based on detailed field observations along the contact between the Ronda peridotites and the high-temperature continental basement and the Dorsale Unit, as well as and Raman spectroscopy on carbonaceous material and Ar/Ar dating on phlogopite, we reconsider this discussion. Indeed, our results bring new constrains on the geometry and the thermal structure of the narrow metamorphic zone in the Dorsale unit. We are considering that the peridotite – dorsale – crustal unit contact and the formation of these marbles occurred during an hyper-extension event leading to the partial exhumation of the mantle body in the upper crust. In fact, we can observe in this area a strongly localized ductile deformation with stretching lineations parallel to the contact and peridotite in contact with the Dorsale carbonates in the NE and with the Paleozoic basement in the SW. Ar/Ar ages on phlogopites from the contact marbles show that the HT-LP metamorphism and thus the extension lasted until the Early Miocene, when the massif and a large part of the Alpujarride were already exhumed. Published evidence of reworked peridotites suggests that exhumation had started before, in the Mesozoic or even the Paleozoic. At least two extensional events are thus recorded, a first during Mesozoic or Paleozoic times, linked with the rifting of the Tethys Ocean, and second during back-arc extension during the late Oligocene until the Early Miocene, before final exhumation during the renewal of crustal thickening.

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