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We investigate the stress regimes acting during serpentinization and faulting of the largest known subcontinental lithospheric peridotite body, namely the Ronda peridotites (Betic Cordillera, S Spain). Petrological and structural analyses on serpentinites grown along fault planes crosscutting the peridotite slab, reveal that they were developed during three superposed stress tensors: the oldest one (E1) is characterized by NW-SE sub-horizontal compression; the intermediate one consists in NE-SW to ENE-WSW extension with orthogonal compression (E2); the youngest one (E3) shows a sub-vertical maximum stress axis and NW-SE sub-horizontal extension. During serpentinization, maximum and minimum stress axes flip between a NW-SE horizontal position and a vertical one in the whole peridotite body (E1 and E3), while E2 represents an intermediate stress stage. Field relationships and previous petrological and geochronological data indicate that serpentinization and associated stress tensors are coeval with intrusive leucogranite dikes crosscutting the peridotites, thus constraining these processes to 19-22 Ma and occurring at upper continental crust depths ($P < 4$ kbar). Gravity data reveal that the average density of the Ronda mantle slab (~2.7-2.8 g/cm$^3$) shows a negligible contrast with the surrounding crustal rocks, thus suggesting that the peridotite body is serpentinized in a great proportion. Our preferred tectonic model to account for the evolution of the Ronda peridotites in the upper crust considers that E1 compression was linked to the collision of the Alborán continental domain with the Iberian passive margin during the Gibraltar Arc formation. Subsequently, the sudden onset of extension recorded within the peridotite slab (E2 and E3) was favored by serpentinization-driven buoyancy.

**Keywords:** Paleo-stress inversion; serpentinization; peridotite exhumation; collisional orogen; Gibraltar Arc.