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Thermal structure of the South-Iberian margins: inference for crustal geodynamic processes and seismicity

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In the Westernmost Mediterranean, the Alboran Sea and surrounding mountain chains (the arcuate Gibraltar Arc, formed by Betics and Rif in southern Spain and northern Morocco, respectively) are the locus of concurrent mountain uplift and basin subsidence in a plate-convergence setting between Africa and Iberia. The lithosphere structure suggests differential thinning and mechanical decoupling at the base of the crust, because the crust thins from the high-mountain areas of the central and eastern Betics to the Alboran Sea (34 to 26 km) with a geometry that clearly mimic the present coastal line, while the lithosphere mantle shows an oblique thinning trend (toward the ESE, 70 to 50 km).

Based on the lithosphere structure of the South-Iberian margins, modelled previously by combining heat flow, gravity, and elevation, and defining the crustal geometry and composition, we have estimated the thermal regime under the assumptions of thermal steady state and local isostasy. The crustal geotherms have been constrained also by PT-estimates for metamorphic xenoliths from Cabo de Gata volcanics. The thermal regime has been used to estimate areas where the deep crust achieves temperature conditions of melting (through muscovite and biotite dehydration-melting reactions).

Important lateral variations in the thermal structure are inferred to occur in the deep crust at the eastern portion of the margin, where deep crustal melting is consistent with the existence of recent volcanic activity ($<$5 Ma) and determines a reduction

of the gravitational potential energy of the lithosphere, inducing uplift, and diminishes the lithosphere yield strength. The estimated thermal and rheological structure agrees with earthquake distribution, because anomalously high-temperature crust has scarce seismicity and the hypocenters release there less energy ($Ms < 3$). The thermal structure may then help to understand the seismic or aseismic character of the major fault-systems affecting the South-Iberian margins.