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Lateral Strength Variations in Iberia and their Influence on Intra-plate Mountain Building: Inferences from Analogue Modelling

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Analogue modelling alludes to the presence of lithosphere scale folds in Iberia as a result of large-scale convergence during Oligocene-Miocene times between the Iberian and Europe Plates. Different tectono-thermal events affected the Microplate since late Paleozoic and resulted in lateral strength variations of the Iberian lithosphere. An old and cold lithosphere, Variscan in age, can be found in the western most part of Iberia whereas a relative weak and hot Mesozoic lithosphere affected by episodes of rifting and basin inversion during Mesozoic-Tertiary times covers the area of the Iberian Chain. Our study aims at deciphering whether deformation and topography evolution in Iberia are related to lateral strength variations and/or the inherited structural grain stemming from Variscan deformation. Interpretation of the modelling results has been aided through the analysis of gravity anomalies of the physical experiments and by particle tracing techniques (PIV). We also integrate the total strength of the lithosphere to gain insights into the effects of rheological variations related to local thrusting or initial strength variations along the Iberian lithosphere. The newly implemented tools also may help to provide useful information about the mechanism of folding affecting the lithospheres characterized by different strengths under horizontal compression. Our results emphasise the control of folding on the wavelengths of the Bouguer Gravity anomalies and crustal thickness variations. Thickening of the ductile layers occurred at the sites of broad synforms where topography developed and where gravity lows are predicted. Unlike the strong lithosphere, which responded to shortening by folding, the weak lithosphere is mainly deformed by thickening. These differences become evident from the PIV analysis and the obtained crustal thickness and strength maps from the models. The results are consistent with geological and geophysical observations in Iberia where lateral changes in strength of the lithosphere, are thought to have resulted in thickness variations during tectonic inversion affecting the eastern part of Iberia (Iberian Chain), while the western part remains more stable.