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Physical modelling of geodynamical processes proposed for the evolution of the Alboran Sea

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Two different geodynamic processes have been proposed to explain the presence of extension in the Alboran Sea within a regional context of compression: subduction and convective removal. In this second process, a thickened orogenic lithosphere brings about a Rayleigh-Taylor gravitational instability because the lithospheric root is colder and denser than the surrounding mantle. As a result, the lithospheric root sinks into the mantle and is progressively replaced by less dense asthenospheric material. This removal can happen either in a symmetric way, in a static position, or in an asymmetric way, with lateral migration of the slab (commonly called lithospheric mantle delamination). Both subduction and lithospheric mantle delamination processes could be supported by seismic tomography images and seismological data due to the similarities in the resulting geometry.

This work presents some algorithms of thermo-mechanical modelling, developed in MATLAB code, able to study the temporal evolution of subduction and symmetric and asymmetric convective removal. To do this, the motion equation formulated with the stream function and the coupled thermal equation are solved, under the extended Boussinesq approximation, applying finite difference techniques. The effects of the initial geometry and the stratification of density and viscosity are analysed.

The preliminary results we present here highlight the differences between the subduction and lithospheric mantle delamination processes, and allow a quantitative comparison of different conceptual models proposed for the evolution of the Alboran Sea and the surrounding Betic-Rif Mountain belt.