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Back-arc extension in the Aegean Sea

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Subduction roll-back is considered to be responsible for the extension and opening of back-arc basins in the Mediterranean region, in particular in the Aegean Sea. In such tectonic environments, extension of thickened and hot overriding lithosphere induces the exhumation of metamorphic core complexes (MCCs) as in the Cyclades in Oligo-Miocene times. These domes usually display HT parageneses overgrowing HP/LT parageneses, and P-T paths show a temperature overprint during decompression that causes frequent partial melting of metamorphic rocks. To investigate the dynamics of crust-mantle interactions a parametric study at different scales is carried out. Emphasis is on testing the initial and boundary conditions suitable for MCC exhumation in a back-arc extension setting using a fully coupled thermo-mechanical numerical code (PARAVOZ), which accounts for elastic-brittle-ductile properties of constituent rocks. Extensional processes occurring in the lithospheric and asthenospheric mantle give rise to a decrease in the effective viscosity at the Moho interface. Therefore, the strength reduction of the lithospheric column in the lower crust and lithospheric mantle leads to the localization of the extensional deformation and triggers formation of MCCs. Their development is characterized by two main stages. During a first stage of “upper crust necking”, the deformation pattern is relatively symmetrical and dominated by graben formation in the upper crust. During a second stage of “amplification and widening”, the metamorphic dome is accommodated by major middle-lower crustal flow at a regional scale to simultaneously feed an exhuming dome and to maintain a flat Moho geometry. This is obtained for initial effective viscosities lower than 10^{20} Pa.s and 10^{22} Pa.s for the lower crust and the underlying mantle, respectively.

The modelled dynamics of extensional processes within the overriding plate is consistent with geological observations regarding the development of MCCs in the Aegean.