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Core complex formation in a crustal wedge. Thermomechanical models and applications

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Metamorphic Core Complexes (MCCs) form in the continental lithosphere when a thickened domain with a low-strength lower crust is submitted to extension. These structures are characteristic of post-orogenic extension. Field observations in the Cyclades (Aegean domain), in alpine Corsica (Tyrrhenian sea) and in d'Entrecasteaux islands (Papua-New Guinea) suggest that several MCCs rework a crustal nappe-stack emplaced before extension begins. These MCCs therefore develop within heterogeneous crusts that present dipping heterogeneities such as thrust faults and dipping nappes.

Although very common, this first order structural inheritance has never been considered in modelling studies of MCCs. Our contribution therefore investigates the effect of an inherited crustal wedge structure on the dynamics and kinematics of formation of MCCs with the help of fully coupled thermomechanical modelling. The wealth of petrological, structural and time informations available in the Cycladic MCCs (Aegean domain) allows for setting up more realistic initial conditions for the experiments than the usual flat lying setups.

The experiments with dipping heterogeneities are characterised by a much more complex evolution and final structure than their flat lying layers equivalents. Dipping heterogeneities drive lateral strength contrasts and generate several re-localisations of the deformation on successive detachments. The dip of the inherited wedge structures imposes kinematic constraints on the crustal flow, leading to regional scale asymmetry of the MCCs.

Comparison between synthetic and natural data also allows validating the results of the numerical computation with final geometries, P-T paths and exhumation rates of the Cycades. The P-T paths, the exhumation rates and the final crustal structure that come out of an initial shallow-dipping wedge model recover better their natural datas than their counterparts from flat lying models. The model of formation of MCCs within inherited crustal wedges is then likely to apply to other areas where the MCCs form in a nappe stack involving continental basement.