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Dynamics of metamorphic core complex development

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The mechanical development of metamorphic core complexes (MCCs) is a key target in the understanding of the evolution of hot orogenic belts in extension. Two main features in MCCs structure constitute the matter of a vigorous debate concerning their origin and mechanics; the low-angle detachment observed at the surface of the dome and the flat Moho geometry at depth. A parametric study on continental extension at lithosphere-scale has been done using the fully coupled thermo-mechanical numerical code PARAVOZ, accounting for elastic-brittle-ductile properties of constituent rocks. Two main types of processes are observed, the formation of MCCs and the upper crustal necking leading to oceanization. The crucial result of this study is the role of the strength of the lithospheric mantle. The development of MCCs requires that both middle-lower crust and lithospheric mantle have to be weak enough to flow laterally, so as to feed the exhuming dome and enable to keep a flat geometry. In our study, this is obtained for initial Moho temperatures of 800˚C or higher and for crustal thicknesses of 45 km or greater. Those conditions correspond to initial effective viscosities lower than 10^{20} Pa.s and 10^{22} Pa.s in the lower crust and the underlying mantle, respectively. The deformation history of an MCC can be divided into two successive stages, here called “upper crust necking” and “dome amplification and widening”. During a first stage the deformation pattern is relatively symmetrical and dominated by the formation of a graben in the upper crust. Then, when the first ductile layers reach the surface, the dome amplification is accommodated by horizontal flow in the

ductile crust. The system rapidly becomes asymmetric, with the localization of a detachment zone along one dome limb, further accommodating dome widening. Thus, the exhumation process of a metamorphic dome results in the progressive development of a detachment zone. Depending on initial Moho temperature, the detachment zone can migrate in space or die out and be replaced by a new one with an opposite dip.