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Origin and evolution of detachments in metamorphic core complexes

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The thermo-mechanical numerical code PAROVOZ is used to study, at lithosphere scale, shear zone patterns associated with the development of metamorphic core complexes (MCC). The development of a MCC requires that the middle-lower crust is weak enough to flow laterally, in order to feed an exhuming metamorphic dome and to maintain a flat Moho geometry. Two successive stages of MCC development are identified, called here "upper crust necking" and "dome amplification and widening". During the first stage, the deformation pattern is rather symmetrical and is dominated by the formation of a graben in the upper crust. The highest shear strains are located at the base of the graben and in horizontal shear zones within the ductile lower crust. The transition to the second stage occurs when the first layers, initially located below the brittle-ductile transition, reach the surface. In the same time, the horizontal shear zones propagate upward along the two dome limbs towards the base of the opening graben, giving an almost symmetrical deformation pattern with no obvious detachment. Then, the system becomes rapidly asymmetric with the localization of a detachment along one dome limb that further accommodates the widening of the dome. Thus, the detachment is a consequence of the exhumation process, and not the primary cause of MCC formation. Early stages of MCC development are always similar. In contrast, the evolution of detachment zones during dome widening may vary, especially according to thermal conditions. For an initial Moho temperature of 830°C, detachments are remarkably stable in time and space. On the other hand, for a rather high initial Moho temperature (1070°C), the detachments are not stable in time and space, and become versatile in terms of location and (or) vergency. For large amounts of dome widening, a detachment can migrate in space or can die out and be replaced by a new one with

an opposite vergency.