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3D shapes of metamorphic core complexes

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Metamorphic Core Complexes (MCCs) are dome shaped structures forming in extensional settings in which the middle to lower crust is exhumed under a detachment fault. They can either be elongated in the stretching direction (e.g. Kesebir-Kardamos, Bulgaria; Buckskin Rawhide, Harcuvar; Arizona, US; Naxos, Greece; Fig. 1a, orange structure) or normal to this direction (e.g. Bitterroot, Idaho; North Cyclades, Greece; Fig. 1a, blue structure). MCCs are known to accommodate extension when the lower crust is thick and/or weak[1]. Several processes leading to either, or both, of these conditions have been proposed and modelled: (1) thermal equilibration of a thickened crust to high Moho temperature[2 3], (2) partial melting of the lower crust[4 5] (3) adjunction of water[6] or (4) underthrusting of felsic units below more mafic ones prior to extension[7]. However, the numerical models published to date are all two-dimensional and therefore apply only to domes, which are elongated normal to the stretching direction. Here, for the first time, we explore by means of thermo-mechanical modelling, the impact of 3D kinematic extensional boundary conditions on the shape of MCCs. We show that a component of strike-slip motion triggers the formation of domes elongated in the direction of stretching. In the Cyclades (Aegean, Fig. 1a), domes elongated normal and parallel to stretching were formed during the same Miocene event[8]. Running 3D thermomechanical models with gale[9], we find that this coeval formation is possible at the tip of a propagating strike-slip fault (Fig. 1b) and propose that this kinematics could be the mark of a putative tear in the Aegean slab[10 11].

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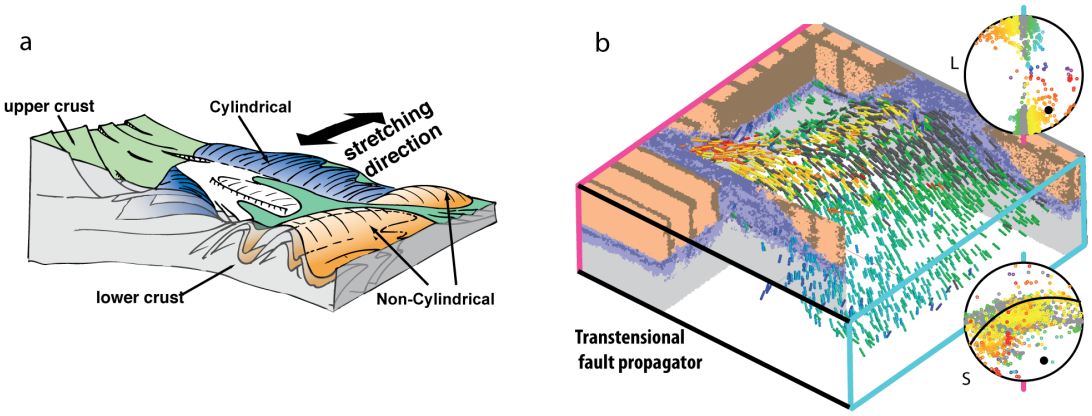

Figure 1: a) Sketch of the 3D shapes of Domes in the Aegean; b) results of 3D models with a 3D representation of the phase and the stretching lineation and the stereoplot projection of the lineation and schistosity