



The dynamics of Eastern Mediterranean Meso-Cenozoic tectonics: insights from three-dimensional models of free-subduction

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The closure of the Tethys and the collision of Arabian continent in the Eastern Mediterranean are associated with large deformation in the Eurasian plate, as the Aegean Sea opening and the Anatolian extrusion. Tomographic imaging and reconstructions show that entrainment of heterogeneous lithosphere, from oceanic to continental, slab detachments and lithospheric tearing occurred during subduction. Modelling such processes by means of three-dimensional numerical methods allows testing the impact these regional features have on the force balance at convergent margins and their evolution. The models show that differential retreat along the trench is a consequence of along-trench slab buoyancy gradients, resulting from the entrainment of variably buoyant lithospheres. When slab buoyancy gradients increase, stresses are accommodated at shallow depth, within the deforming upper plate. The localisation of large stress in the upper plate, above the plastic limit, forms a new plate margin at large distance in the continent interiors. The bounding newly formed and the convergent margins allow the lateral extrusion of a large rigid block of lithosphere in between and strong velocity gradients. Internal deformation within the extruding block occurs when lithospheric tears disrupt the slab coherence, and the trench segments. This quantitative model presented illustrates a novel mechanism of plate margins formation and continental tectonics in time, and is here tested against the Eastern Mediterranean tectonics. The models reproduce the Meso-Cenozoic evolution of the margin, from the Aegean trench retreat to the formation of the North Anatolian Fault, and yields motions that are strikingly compatible with present-day geodetic observable. The models allow speculations on the present-day state of stress of the area and deformation within the Anatolian block. Albeit simplified, these models elucidate the controls of deep subduction processes on the tectonics of the Aegean Sea and Anatolia.