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Building topography in Cyprus and south Turkey: geological constraints and geodynamic models

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We present a regional synthesis of the geometries and Neogene vertical motions and horizontal deformations of the central sector of the Cyprus arc-trench system, which are used to constrain 2D thermo-mechanical numerical models. We used depth-converted seismic reflection lines, basin analysis techniques and fieldwork observations, combined with available literature. From the Cyprus arc trench to the Central Anatolia Plateau, three independent vertical motion domains are identified: the Cyprus structural high; the Cilicia Basin and the Tauride Range. Early Miocene regional subsidence that still continues in the Cilicia Basin was disrupted by surface uplift in the north and south domains during Late Miocene or younger times. Coevally, N-S shortening developed regional contractional structures along the margin. The large-wavelength Miocene monocline fold that formed in S Turkey reveals relative vertical displacement rates of 0.5 mm/y and horizontal shortening values of <1%, along our studied sections. Shortening led to S-dipping thrusts in the center of the Cilicia Basin, and further developed the S-verging Kyrenia thrust system in N Cyprus. The observed deformation patterns and associated vertical motions suggest that the Anatolian upper-plate topography, including the uplifted south Turkey, results from wedge deformation in relation to the Cyprus arc. We use numerical finite element models to test this hypothesis. Models show that the mechanical growth of both the Anatolian accretionary complex and its forearc basin system caused sedimentary thickening and overburden, which led to the development of a sedimentary blanket that started to control the thermal distribution in the margin; relative temperatures decreased within the blanket and increased underneath it. This resulted in thermally weakened viscous deformation of the lower crust, which eventually forced the surface uplift of the landward side of the forearc basin and created a forearc-high, the modern Taurides. We also analyzed the influence of factors such as viscous properties of the crust and sedimentary accumulation rates. These parameters have a strong impact in the overall evolution of the margin as well as in when and whether surface uplift in the forearc-high occurs. Higher values in the viscous parameters drive older, more pronounced uplift, than lower viscosity values. Decreasing values change the shape and time-evolution of uplift, from older rounded-shaped uplift to mid-aged box-shaped uplift to absence of uplift. Large accumulation rates develop thicker basins that stabilize the margin and shift deformation towards their margins. This also induces surface uplift to take place at younger times and can lead to avoid its happening, i.e, if sediment accumulation rates are large, the subduction system needs longer times to develop the forearc-high. We conclude that the Cyprian subduction system drives mechanical accretion in Cyprus and deep-seated deformation in S Turkey, which in turn control vertical tectonic motions and topography development in the margin.