The Regional Geology of the South Turkey – North Cyprus Domain: New Perspectives and Consequences for Hydrocarbon Plays*

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General Comments

Research performed in the last 5 years during the TOPOEUROPE-VAMP project (coordinated by the European Science Foundation, with the substantial support of TUBITAK) has resulted in new data and interpretations on the Miocene to Present evolution of Central Anatolia and surrounding regions; these are of direct relevance for hydrocarbon exploration.

In the southern part of a N-S section through the Central Anatolia Plateau from the Black Sea to Cyprus, five main components can be identified (Figure 1):

i) Kilometers-thick Neogene to Present shallow-marine to continental succession of the Tüz Gölu Basin
ii) the Taurus Mountains, composed of a metamorphic core covered by slightly disturbed Miocene marine carbonates presently at elevations >2000m (e.g., Mut Basin)
iii) South Turkey monocline where Miocene rocks gently dip to the South in the Turkey offshore,
iv) Cilicia Basin formed by Miocene carbonates, Messinian evaporites and a post-Messinian siliciclastic succession
v) Kyrenia ridge.

In early Miocene, an area of continuous subsidence stretched from the Tüz Gölu Basin to the future Kyrenia ridge. Sedimentation was continental to transitional in the north, actually marine in the center (Mut Basin) and deeper marine farther to the South in the future Kyrenia belt.

The homogeneous development of the sedimentary basin ended in the Serravallian when relief developed in the hinterland of the Taurus Mountains shedding clastics in the Manavgat and Adana basins. In contrast, the area presently occupied by the Taurus Mountains and the adjacent Cilicia Basin were still subsiding. In the Late Tortonian subsidence in the Manavgat, Mut and Adana basins stopped and was replaced

by the uplift which led to the formation of the southern margin of the Central Anatolia plateau (Figure 2). Subsidence persisted in the Cilicia Basin.

The uplifting and subsiding domains are linked by the South Anatolia monocline which developed in an overall contractional regime documented by thrusting in the Tüz Gölu area, the Cilicia Basin, the Kyrenia ridge and elsewhere. Quantitative analysis show that extensional faulting accommodated only limited deformation. With the development of the uplifted margin of the Anatolia plateau, sediments originating from the East Taurus collision zone and transported Westward by large rivers were channelized along the Adana and Cilicia basins causing sediment thicknesses decreasing form East to West.

Current models interpret these events as the result of the delamination/detachment of the African lithosphere subducting towards the North underneath Anatolia. This line of interpretation, however, lacks quantitative modeling support, is in contradiction with the tomographic record of the area, and does not provide an explanation for the coexistence of subsidence and uplift in the area since the late Miocene.

We propose that the evolution of the South Anatolia margin is controlled by thermo-mechanical processes occurring at the Africa-Cyprus subduction zone. In this perspective, the South margin of Anatolia; i.e. the Taurus mountains, is the forearc high of the Cyprus subduction zone (Figure 3).

Numerical modeling studies show that the growth of the Taurus forearc high can be explained by thermal weakening and subsequent enhancement of viscous deformation at the lower Anatolian crust (e.g., Fuller et al., 2006). The model provides an elegant and quantitative explanation for the coexistence of subsidence in the Cilicia Basin and uplift in the Taurus Mountains, as well as the contractional tectonics dominating in the entire area of interest. Sedimentation rate exerts a key role in controlling the growth or demise of the forearc high. Sedimentation rates in the Cilicia Basin vary with time and space as a consequence of the westward progradation of sediments deposited in the Gulf of Adana by rivers such as the Seyhan en Ceyhan (e.g., Aksu et al., 2014).

References Cited

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Fuller, C.W., S.D. Willett, D. Fisher, and C.Y. Lu, 2006, A thermomechanical wedge model of Taiwan constrained by fission-track thermochronometry: Tectonophysics, v. 425/1-4, p. 1–24.

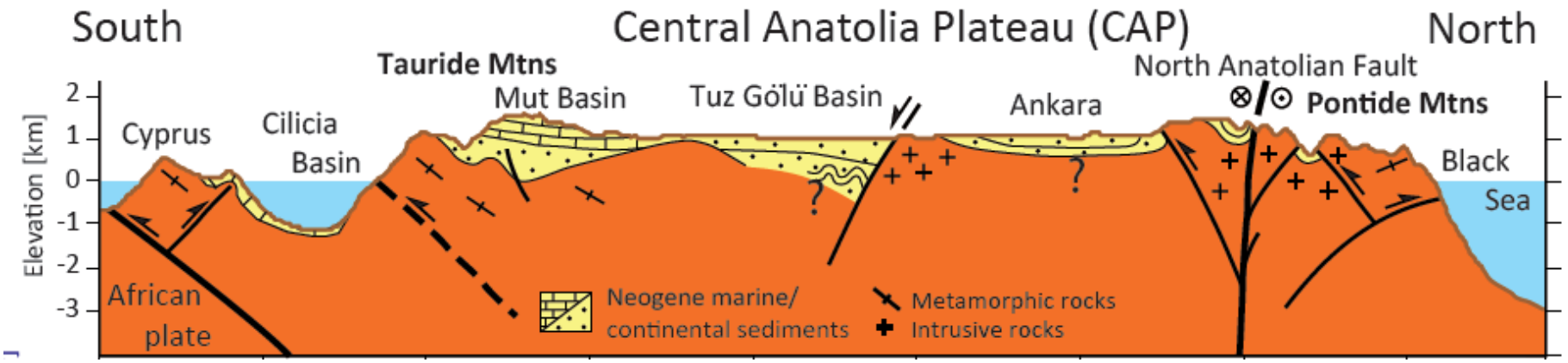

Figure 1. Schematic cross section across the Central Anatolia Plateau and surrounding regions (from the VAMP proposal).

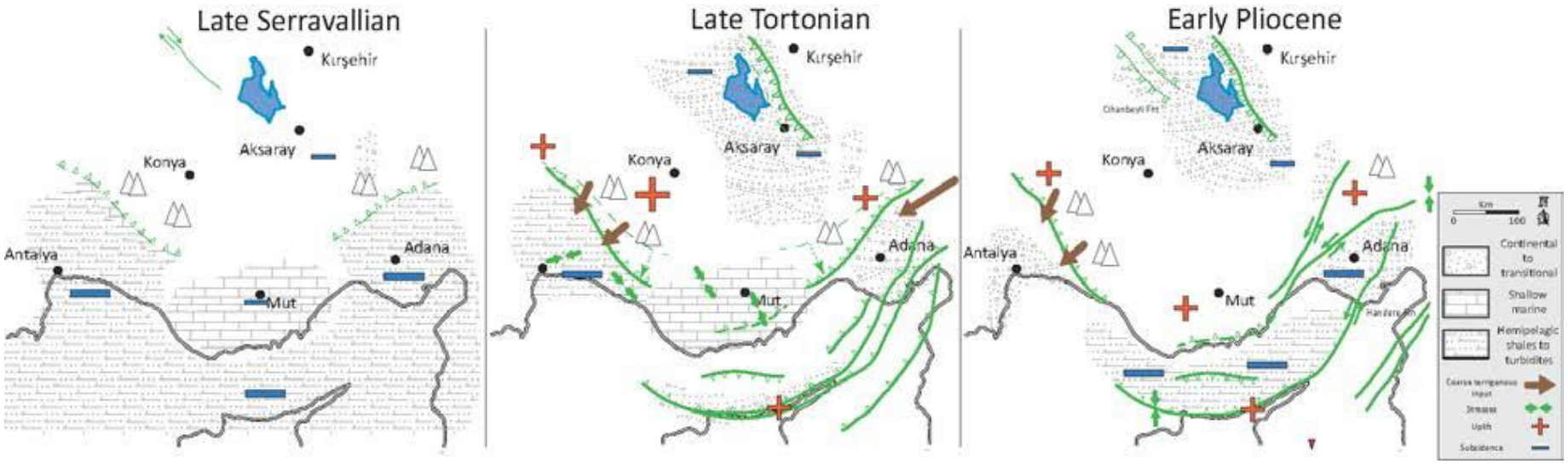

Figure 2. Regional, source-to-sink evolution of the South Anatolia plateau and surrounding regions during Neogene times (from Fernandez-Blanco, in preparation).

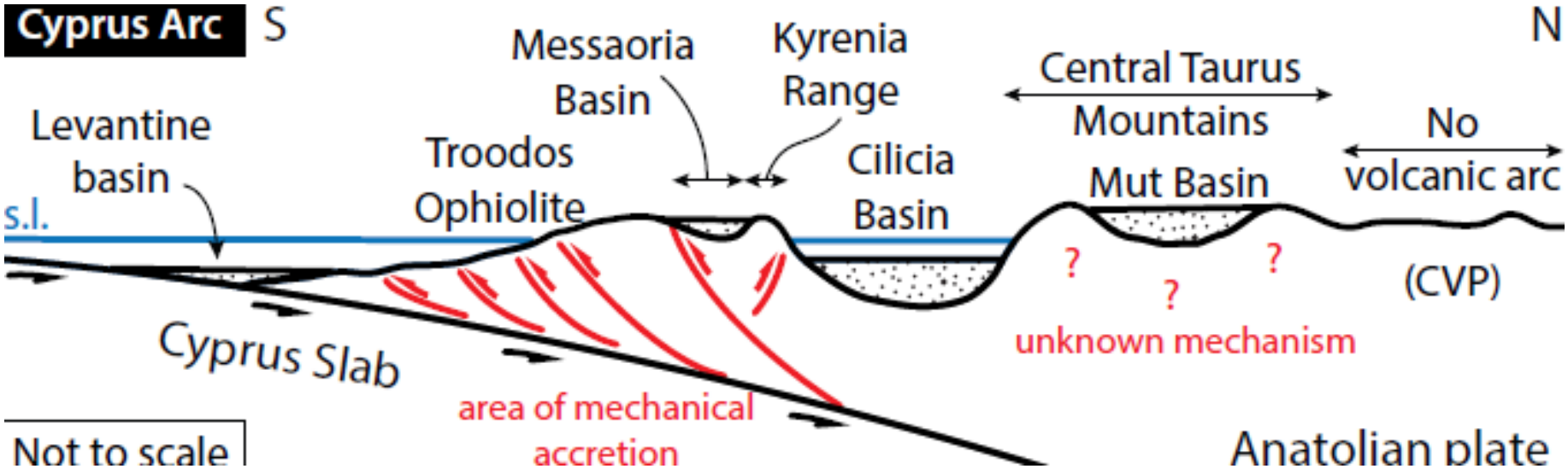

Figure 3. Schematic representation of the Cyprus – South Anatolia system inspiring the numerical model used to explain the development of the investigated area (from Fernàndez-Blanco, in preparation.