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Cenozoic Structural and Stratigraphic Evolution of the Ulukışla and Sivas Basins (Central and Eastern Turkey)

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Because subduction is a destructive process, the surface record of subduction-dominated systems is naturally incomplete. Sedimentary basins may hold the most complete record of processes related to subduction, accretion, collision, and ocean closure, and thus provide key information for understanding the kinematic evolution of orogens.
In central and eastern Anatolia, the Late Cretaceous-Paleogene stratigraphic record of the Ulukışla and Sivas basins supports the hypothesis that these once formed a contiguous basin. Importantly, their age and geographic positions relative to their very similar basement units and ahead of the Arabian indenter provide a critical record of pre-, syn- and post-collisional processes in the Anatolian Orogen.
The Ulukışla-Sivas basin was dissected and translated along the major left-lateral Ecemiş fault zone. Since then, the basins on either side of the fault evolved independently, with considerably more plate convergence accommodated to the east in the Sivas region (eastern Anatolia) than in the Ulukışla region (central Anatolia). This led to the deformation of marine sediments and underlying ophiolites and structural growth of the Sivas Fold-and-Thrust Belt (SSFTB) since latest Eocene time, which played a major role in marine basin isolation and disconnection, along with a regionally important transition to continental conditions with evaporite deposition starting in the early Oligocene.
We use geologic mapping, fault kinematic analysis, paleomagnetism, apatite fission track (AFT) thermochronology, and 40Ar/39Ar geochronology to characterize the architecture, deformation style, and structural evolution of the region. In the Ulukışla basin, dominantly ∼E-W trending normal faults became folded or inverted due to N-S contraction since the Lutetian (middle Eocene). This was accompanied by significant counter-clockwise rotations, and post-Lutetian burial of the Niğde Massif along the transpressional Ecemiş fault zone. Since Miocene time, the Ecemiş fault zone has been active as an extensional structure responsible for the re-exhumation of the Niğde Massif in its footwall. To the east and in front of the Arabian indenter, the Sivas Basin evolved during Paleogene collision of the Tauride micro-continent (Africa) with the Pontides (Eurasia), but prior to Arabia collision. The thin-skinned SSFTB is a >300 km-long by ∼30 km-wide ∼E-W-elongate, convex-north arcuate belt of compressional structures in Late Cretaceous to Miocene strata. It is characterized by NE- to E-trending upright folds with slight northward asymmetry, south-dipping thrust faults, and overturned folds in Paleogene strata indicating predominantly northward vergence. Several thrusts are south-vergent, typically displacing younger (Miocene) units. Structural relationships and AFT data reveal a sequence of initial crustal shortening and rapid exhumation in the late Eocene and Oligocene, an early-middle Miocene phase of relative tectonic quiescence and regional unconformity development, and a final episode of contraction during the late Miocene. Pliocene and younger units are only locally deformed by either halokinesis or transpression along diffuse and low-strain faults. Paleomagnetic data from the SSFTB reveal significant counter-clockwise rotations since Eocene time. Miocene strata north of the SSFTB consistently show moderate clockwise rotations. Our results indicate that collision-related growth of the orogen ended by the latest Miocene, coeval with or shortly after initiation of the North Anatolian fault zone.