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Anatolia-Aegea at the junction of ocean subduction and continental collision

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Since ∼15 Ma, the active tectonics of Anatolia-Aegea (AN-AG) has resulted from the interaction between subduction of the African (AF) oceanic lithosphere along the Hellenic-Cyprus trench system, and continental collision between the Arabian (AR) and Eurasian (EUR) plates across the 600 km-wide, Turkish-Iranian deformation zone. Geologic, seismologic, and plate tectonic observations have provided important constraints on the evolution of AN-AG including the decoupling of AN-AG from EUR and AR with the development of the North and East Anatolian faults, and back-arc extension, and southward motion of western AN-AG. Furthermore, plate tectonic reconstructions, and geologic investigations of paleo-fault slip rates suggest relatively steady rates of motions for the AR and AF plates with respect to EUR, providing a roughly uniform temporal context in which to investigate relationships between plate interactions and lithospheric tectonics.

Beginning in the late 1980s, geodetic observations, most notably GPS, have allowed highly precise quantification of the spatial and temporal behavior of presently active deformation within the zone of interaction of the AR-AF-EUR plate system. Quantification of motions provides a means to more precisely investigate the relationships between plate interactions and processes within the inter-plate deforming zone (in this case, AN-AG). Results immediately relevant to AN-AG kinematics and dynamics include: 1- AN-AG motion involves counterclockwise rotation with respect to EUR and AF, accommodating the NNW motion of AR, and SSW motion of the Hellenic Arc/Aegean Sea. Critically, the GPS observations demonstrate that rates of motion internal to Anatolia increase from east to west; an observation that provides evidence for Trench retreat being a driver of both SW translation of the Aegean micro plate, and N-S extension in western Anatolia; 2- known, active faults internal to AN-AG can account for > 70% of observed internal strains; 3- rates of strain accumulation on virtually all major faults are now known to 1-2 mm/yr providing important constraints on earthquake repeat times and hence seismic hazards; 4- geodetic motions agree within uncertainties with longer term geologic and plate tectonic rates in almost all cases (e.g., AR and Nubia motion with respect to Eurasia for > 10 Ma, Owens Fracture Zone, Dead Sea Fault, North and East Anatolian faults, Red Sea opening); 5- observations of pre-, co-, and 19 years post-seismic deformation for the 1999 M7.6 Izmit Earthquake continue to provide unique constraints on fault behavior through the full earthquake cycle.

We will present a broad view of plate motions and deformations derived from 900 survey sites and 370 continuous GPS sites, including 600 sites in AN-AG, across the AR-AF-EUR plate system as “context” for understanding the transition from late stages of subduction to early continental collision, and how these interactions are accommodate by deformation of the AN-AG inter-plate zone.