Geophysical Research Abstracts, Vol. 8, 04351, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04351

Constraining the dynamics of plate interactions in the E Mediterranean

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Since 1988, the Greater Mediterranean GPS Consortium has generated a comprehensive map of crustal motions using GPS survey sites and continuously recording stations throughout the zone of interaction of the African (Nubian and Somalian), Arabian, and Eurasian plates. The network extends N-S from the stable Eurasian platform to the East African Rift system in Ethiopia, and E-W from Morocco to the Iran-Afghanistan border, thus encompassing the entire zone of plate interaction. The resulting GPS velocity field indicates counterclockwise rotation of a broad area of the Earth's surface that includes the Arabian plate, adjacent parts of the Zagros and central Iran, Turkey, and the Aegean/Peloponnesus with motion rates in the range of 20 to 30 mm/yr. This relatively rapid motion occurs within the framework of the slow-moving ($\sim$ 5 mm/yr relative motions) Eurasian, Nubian, and Somalian plates. The circulatory pattern of motion increases in rate towards the Hellenic trench system, suggesting that subduction in the eastern Mediterranean is the dominant process responsible for regional deformation. We develop an elastic block model and use the GPS velocity field to constrain present-day motions of the Nubian, Somalian, Arabian, and Eurasian plates (relative Euler vectors), regional deformation within the inter-plate zone, and slip rates for major faults. We find that the convergence of Arabia with Eurasia is accommodated in large part by lateral transport within the interior part of the collision zone. We further find that the area of lithosphere "consumed" at trenches is roughly equal ($\pm$ 10%) to the area "created" by rifting in the Red Sea and Gulf of Aden. Unexpectedly, we also identify extension in the direction of plate convergence between Arabia and Anatolia (East Anatolian fault) and between Arabia and Eurasia within the broad boundary zone separating these plates (Lesser Caucasus). Based on these new observations, we hypothesize that deformation in the Africa-Arabia-Eurasia collision zone is driven in large part, if not entirely, by rollback of the subducting African litho-

sphere beneath the Hellenic and Cyprus trenches aided by slab pull on the southeastern side of the subducting Arabian plate along the Makran subduction zone. We further suggest that rifting in the Red Sea and Gulf of Aden is a response to plate motions induced by active subduction.