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GPS-Based Strain-Rate Inversions and the Behavior of the Middle Section of the Convex Arc of the North Anatolian Fault: Remarks on Splay Faulting

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In this work we interpret the splay faulting in the eastern side of the middle section of the North Anatolian Fault.We use two embedded sets of GPS observations to calculate the strain rate field at two different scales and we relate the results to the development of young basins and other geological observables in the area.The North Anatolian fault (NAF) system forms the northern boundary of the Anatolian plate and is characterized by a right-lateral strike slip motion. The system starts approximately at 40˚ east and ends at 26˚ west forming a broad arc roughly parallel to the coast of the black sea fallowing a former suture zone. On the large-scale, one observes a 24±1 mm/yr slip on the NAF and a very comfortable, nearly rigid counterclockwise rotation of the Central Anatolian Block with respect to the stable Eurasia that fits very well the GPS data obtained by McClusky *et al* (2000). The only visible perturbations to the smooth geometry of the NAF are, at around 34-37˚E longitude, two main splay faults with several related minor fault segments that bifurcate from the main fault line, possibly due to the convexity of the NAF geometry. These secondary fault structures, show remarkable morphological expressions accompanied with elongated basin formations with ages ranging from Upper Pliocene to Recent, compatible with the fault geometry (trending EW at east and tend to bend SW at west). These also are known to be capable of generating several moderate (Mw 5-6) earthquakes that were observed during the instrumental period including a very recent event (ML:5.6) to the south of Ankara on a fault whose strike aligns with the southern splay. GPS-station collection of McClusky *et al.* includes points around the middle section of the NAF (both to the

north and to the south of NAF) but they are very sparse. On the large scale, these GPS observations enable us to calculate a “minimum strain rate” field that fits the geodetic observations and compatibility conditions. In this larger-scale strain rate distribution we do not see any significant signature in the zone covered by the splay faults. Within the convex zone we obtain shear strain rates whose both extensional and compressional components increase towards the west. Yet, a new GPS dataset composed of 16 locations concentrated in the splay zone and some stations to the west of it gives us a new handle to interpret the small-scale variations of the strain rates in this area, especially small pockets of confined extensions. We did focal mechanism modeling for around 20 local earthquakes within the wedge zone, they have mostly strike-slip styles with substantial extensional components.