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Kinematic Evolution of the Middle Section of the Convex Arc of the North Anatolian Fault: Modelling a shear zone using GPS, INSAR and field data

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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 following 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 and microseismicity. Precise micromamal dating of the related basin stratigraphy indicate that branching off the NAF main strand initiated at Early Pliocene and evolved to the south. After the basin formation, E-W trending synthetic Y shear planes of Riedel system started to form at Middle Pleistocene, cross cutting and deforming the prior basins. This right-lateral Y shears together with NNE-SSW trending left-lateral antithetic X shears forms the boundaries of small tectonic blocks indicating progressive development of a broad dextral shear zone located within the Anatolian micro-plate.

In this complementary work after defining the improved GPS based strain field and focal mechanism based regional stress tensor of the study area (Erturac et al EGU-2008), we combined kinematic data from field measurements to achieve the change in the geometry of the stress tensor acting on forming and evolution of the splay faults. To understand the kinematics of the recent deformation within the splay zone we also performed INSAR modeling of a moderate size earthquake (1996, Mw=5.6) and focal mechanism solutions of more recent events (Ms=4.5) that occurred on the NNE-SSW trending left-lateral boundary of the micro-blocks.

A significant kinematic incompatibility (reverse extension directions) is observed at the junction areas of synthetic Y shears with antithetic X shears. This localized phenomenon started to act since Middle Pleistocene (which is constrained by micromammal and OSL dating of faulted sediments) and still active. The understanding of this interesting phenomenon would improve our knowledge on evolution of broad shear zones and as well as seismic hazard evaluation of the area..