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A hidden deformation zone withing the Cilician Taurus Mountains: Analysis of the GPS data using a novel approcah

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Tectonics within the Anatolian peninsula is shaped mainly by the northward motion of Arabia that collides with the East Anatolian High Plateau in the east and the extension in western Turkey and the Aegean Sea due to the roll-back of the Hellenic Trench in the west. The zone between these tectonically active regions is the central Anatolian block that rotates counterclockwise with respect to the stable Eurasia, hitherto thought to have been undergoing little internal deformation. However, the stalled subduction of the Cyprus Arc exerts compression on the overriding Anatolia, thereby creating compressive stresses all along the Turkish southern coast. The immediate consequence of this tectonic setting along with the east-west extension creates a strike-slip dominated central Anatolian block. Neverthless along the southern coast (southern margin of the Taurus mountains) there is scarse evidence of active faulting. Two exceptions are the Ecemis fault and its antithetic Tuzgolu fault, both strike-slip faults, the former bounding the Cilician Taurus from the west. Very little information exists on the ongoing deformation within the Cilician Taurus Mountains that form a quasi-elliptic structure with the major axis that is almost parallel to the Ecemis fault. Since Turkey is planning to build a nuclear power plant 15 km to the south the Ecemis fault, the hazard community has been giving the major attention to the Ecemis fault itself.

Recent studies by Dimitrova et al. (2012) revealed that the subsurface sources of the laterally widespread deformation fields can be located very efficiently if one works with the vertical derivatives of horizontal stress (VDoHS) rates. The alternative approach is to directly calculate the GPS strain rates using kinematic algorithms, but they are much less efficient than working with VDoHS in determining zones of deformation, especially along faults without slip rate information mapped from palaeo-seismicity or along completely hidden faults. We used GPS campaign data across central Anatolian block, gathered between 1998 and 2006. Our analysis shows significant contractional force area strain within Cilician Taurus. This is unlikely to be a post-seismic signature, as there were no large earthquakes documented in the region in the instrumental period. Our results show also large extensional force area strains to the south of the Orta fault, coinciding with the northern part of the Tuzgolu fault. Orta fault has recently produced a M6.0 earthquake with E-W extensional focal mechanism. The signature across the Cilician Taurus is very significant and might potentially indicate a hidden ongoing deformation field that possibly produces large earthquakes with long recurrence period (e.g. 2011 Christchurch earthquake). This possibly has far-reaching implications on the hazard mapping of the region and the nuclear safety for the entire eastern Mediterranean.