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Quantification of fluvial response to tectonic deformation in the Central Pontides, Turkey; inferences from OSL dating of fluvial terraces

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From Late Miocene to present, Anatolia's rapid counterclockwise movement, which increases in velocity towards the Hellenic Arc, has formed the North Anatolian Fault (NAF), a dextral transform fault along the Anatolia-Eurasia plate boundary and the northern margin of the Central Anatolian Plateau (CAP). A zone of transpression referred to as the Central Pontides exists between the broad restraining bend of the NAF and the Black Sea Basin, uplifting what is interpreted as a detached flower structure.

Dating of Quaternary landforms in the eastern flank of the Central Pontides has helped to understand its recent deformation. However, in the western flank of the Central Pontides there is an absence of Quaternary studies, relatively quiet modern seismicity, and difficulties locating or observing fault scarps. This led us to use optically stimulated luminescence dating (OSL-dating) of fluvial terrace sediments and the study of geomorphic features to gain insight into the influence of climate and tectonics on landscape evolution of this area. In this area, the Filyos River crosses the Karabük Fault (reverse fault) and deeply incises a gorge through the Karabük Range before flowing towards the Black Sea. In the gorge an abundance of indicators of tectonic deformation were mapped, such as hanging valleys, wind gaps, bedrock gorges, landslides, steep V-shaped channels, tilted basins, as well as fluvial strath terraces. In particular, strath terraces of at least 8 levels within just 1.5 km of horizontal distance were examined.

We used OSL-dating to estimate five deposition ages of fluvial strath terrace sediments, leading to an estimation of incision and uplift rates over time. Using three samples per terrace with strath elevations of 246 $\pm$ 0.2 m, 105.49 $\pm$ 0.2 m, 43.6 $\pm$ 0.2 m, 15.3 $\pm$ 0.2 m and 3.6 $\pm$ 0.2 m above the Filyos River, we determined corresponding ages of 841 $\pm$ 76 ka, 681 $\pm$ 49 ka, 386 $\pm$ 18 ka, 88 $\pm$ 5.1 ka and 50.9 $\pm$ 2.8 ka.

Incision rates over time (oldest terrace to youngest) suggest uplift of 0.29 $\pm$ 0.03 mm/y, 0.16 $\pm$ 0.01 mm/y, 0.10 $\pm$ 0.01 mm/y, 0.17 $\pm$ 0.01 mm/y and 0.07 $\pm$ 0.004 mm/y. Collectively, our ages infer decelerating fluvial incision and rock uplift rates in the Karabük Range of the Central Pontides. The highest rate that belongs to oldest terrace level (841 $\pm$ 76 ka) also implies long-term mean uplift, which is well correlated with long term ($\sim$350 ka) mean uplift rate obtained from fluvial terraces in the eastern flank of the (Gökırmak Basin) Central Pontides. These results indicate Quaternary activity of the Karabük Fault despite the fact that very low modern seismicity and partition of strain in the north of the North Anatolian Fault.

Keywords: Tectonics, Geomorphology, Fluvial Terrace, OSL Dating, Central Pontides, North Anatolian Fault, Filyos River, Turkey, Central Anatolian Plateau