Tectonics–Earth surface processes interactions of the Central Anatolian Plateau during the late Miocene to Pliocene revealed by ecosystem and paleotemperature reconstructions

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The Central Anatolian Plateau (CAP, Turkey, elevation ca. 1-1.5 km) was established during the late Miocene. Prior to Pleistocene surface uplift of its southern margin (Tauride Mountains), a southern margin orographic barrier with similar-to-present elevations (ca. 2 km) existed between 8 and 5 Ma.

To unravel the interactions between tectonics and Earth surface processes, we quantify biotic and abiotic parameters for the late Miocene to Pliocene. As the CAP exposes presently incised fluvio-lacustrine sedimentary rocks of well-dated Miocene to Pliocene age, the region provides an excellent archive for reconstructing past landscape dynamics, such as surface uplift, lake hydrology, and drainage integration. Within this established framework, we now reconstruct the late Miocene to Pliocene ecosystem by measuring clumped isotope (Δ47) temperatures of carbonate formation and δ13C and δ18O values of paleosol carbonate and fossil mammal tooth enamel. Collectively, our data allow for the reconstruction of paleoclimate, vegetation types (C3 vs. C4), mammalian diet, landscape heterogeneity, and seasonality.

The first clumped isotope-derived paleotemperatures indicate a large (8 °C) temperature difference at ca. 5.5 Ma between lacustrine carbonate from the Mediterranean coastal region (Adana Basin; ca. 26 ± 1.8 °C) and paleosol carbonate from the central Anatolian interior (ca. 18 ± 1.7 °C), which likely reflects the higher elevation of the CAP. Soil carbonate δ13C values from the plateau interior (13 sites, N= 344, ca. 10 to 2 Ma) are much higher between ca. 8 and 5 Ma (ca. –3 to 0 ‰) than earlier or later in time (ca. –8 to –5 ‰), which indicates the presence of a significant
component of $C_4$ vegetation, characterized by wooded grasslands and grasslands, during the latest Miocene. In contrast, $C_3$-dominated vegetation reflecting more wooded environments were dominant at ca. 10 Ma and from 4 to 2 Ma. The increase in $C_4$ vegetation during the late Miocene is coeval with surface uplift of the southern CAP margin, whereas an increase of $C_3$ vegetation by the Pliocene could coincide with a phase of subsidence of the southern CAP margin prior to its final phase of Pleistocene surface uplift. Furthermore, we collected mammal tooth enamel samples (equid, bovid, rhinocerotid, suid) from 11 individuals at one ca. 9 Ma-old and one latest Miocene-Pliocene fossil site. $\delta^{13}C$ and $\delta^{18}O$ values indicate the mammals at the two nearby fossil sites had varying diets and therefore access to different vegetation and water supplies. We are currently improving the stratigraphic framework and dating of these fossil sites, as well as obtaining tooth enamel $\delta^{13}C$ and $\delta^{18}O$ values of 44 more individuals to further constrain paleoenvironmental conditions and eventually the causality between tectonics and Earth surface processes in central Anatolia.