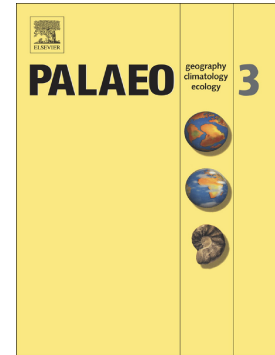


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Sequential $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ analyses of early Holocene bovid tooth enamel: resolving vertical transhumance in Neolithic domesticated sheep and goats

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Abstract

Vertical transhumance is an important animal husbandry strategy that provides livestock with consistent access to pasture throughout the year and contributed to the intensification of sheep and goat husbandry in the Near East over ten thousand years ago. Sequential carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) isotope analyses of teeth from domesticated sheep and goats dating to the early Neolithic (9200 to 8700 cal yr B.P.) from a region of strong local topographic relief in southern Jordan exhibit inverse cyclical isotopic variation characterized by the coincidence of high $\delta^{18}\text{O}$ values with low $\delta^{13}\text{C}$ values indicating ingestion of ^{13}C -depleted plants during the summer season. This pattern is consistent with vertical transhumance of caprines moving from low-elevation C_3/C_4 Irano-Turanian pastures to higher-elevation Mediterranean C_3 pastures during the summer, but other seasonally directed animal husbandry strategies involving amendment of livestock diets generate a similar isotopic outcome. Caprine $\delta^{18}\text{O}$ values referenced against the oxygen isotope ratios of contemporaneous obligate-drinking cattle and non-obligate-drinking mountain gazelle, species with limited home ranges, distinguish the influence of meteoric water, ^{18}O -enriched leaf water, and movement on the oxygen isotopic composition of sheep and goat. This approach assists in independent validation of vertical transhumance hypothesized for cyclical variation in sequential $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$

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