Seasonal moisture sources influence on desert paleowetland development during the late Pleistocene in the American Southwest

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Paleowetland development of the late Pleistocene

During the late Pleistocene, increased groundwater discharge in the SW US formed widespread paleowetlands (Quade, 1986). Paleowetlands formed during wet/cool cycles due to increased precipitation and collapsed during dry/warm cycles (Pigati *et al*., 2009). The origin of increased moisture is controversial. Asmerom *et al.* (2010) argued for a southward shift of the westerlies (SOW) that increased seasonal proportions of winter precipitation (stabilizing C_3 vegetation) sourced from the eastern Pacific. In contrast, Lyle *et al.* (2012) argued for enhanced summer precipitation (stabilizing C_4 grasses) originating out of the tropics (OOT). Isotopic data from mammalian tooth enamel can resolve which moisture source stablized paleowetlands in the southwestern US during the late Pleistocene.

Data Analysis and isotopic implications

Enamel samples of water-sensitive grazers (e.g. *Bison*, *Equus* and *Mammuthus*) and a browser *Camelops* from warm vs. cool cycles were analyzed for $\delta^{13}C$ and $\delta^{18}O$. In climates with increased summer precipitation, grazers would consume more C_4 vegetation and *Camelops* would consume C_3. In environments with enhaced winter precipitation (such as today) grazers would consume more C_3 vegetation, whereas *Camelops* might consume saltbush (C_4 halophyte).

Data suggest elevated $\delta^{13}C$ and $\delta^{18}O$ values ($\delta^{13}C > 8‰$) for grazers from cool/wet cycles and lower $\delta^{13}C$ and $\delta^{18}O$ values ($\delta^{13}C < 8‰$) from warm/dry cycles. Elevated $\delta^{13}C$ and $\delta^{18}O$ values during cool cycles indicate increased C_4 grass consumption and summer precipitation, supporting the OOT model. Decreased $\delta^{13}C$ and $\delta^{18}O$ values during warm cycles indicate increased C_3 consumption and winter precipitation, supporting the SOW model.

Climate models and recent observational trends predict higher temperatures and lower water runoff in the American Southwest. Modern desert ecosystems rely on wetlands, and given their potential delicacy, this study may provide insight into how modern wetlands and fauna and biota will transition to the next century's significantly warmer climate.