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TRIPLE OXYGEN ISOTOPE PALEOHYDROLOGY OF EARLY EOCENE PALEOLAKE GOSIUTE (WYOMING, USA)

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The Green River Formation in southwestern Wyoming records the existence of paleolake Gosiute, a massive early Eocene lake that reached areal extents up to ~40,000 km^2. During its several million-year history, Lake Gosiute shifted from a largely freshwater lake (overfilled to balance-filled) to a largely saline lake (underfilled), and then back to a balance-filled and overfilled lake. The $\delta^{18}O$ values of lacustrine carbonates show pronounced, step-like shifts, with the saline stage ~ 6 to 8 ‰ higher in $\delta^{18}O$ than the preceding and ensuing freshwater stages. However, the significance of these shifts is unclear: what was the importance of changes in evaporation versus changes in the isotopic composition of catchment precipitation? What was the $\delta^{18}O$ of 'pristine' (unevaporated) catchment precipitation during different stages of the lake's history, and what can this tell us about catchment paleogeography?

The triple oxygen isotope composition ($\Delta'^{17}O$, $\delta^{18}O$) of lake water and lacustrine minerals is sensitive to evaporation, and can be used to estimate the $\delta^{18}O$ values of catchment waters prior to evaporation. We report triple oxygen isotope compositions of >30 lacustrine carbonates spanning the Green River formation and stratigraphically adjacent units. Our results show that (1) lake waters were strongly modified by evaporation (ca. + 10‰ in $\delta^{18}O$) during all major stages (overfilled, balance-filled, under-filled); (2) The previously observed 6 to 8 ‰ shift in $\delta^{18}O$ largely represents a shift in the $\delta^{18}O$ of catchment precipitation and not in the degree of evaporative enrichment; and (3) the $\delta^{18}O$ of unevaporated catchment precipitation was ~ –19‰ prior to and following the saline stage, and ~ –12‰ during the freshwater stage. Following previous interpretations, we hypothesize that the saline stage was bracketed by the abandonment and then recapture of a large paloeriver. Using the isotopic mass balance model of Doebbert et al. (2010), a captured river with $\delta^{18}O$ ~ –19‰ would shift lake water $\delta^{18}O$ by the observed ~ –7‰ if it had an annual discharge of ~ 25 x 10^9 m^3/year, comparable to the modern Missouri River at Bismarck, ND. By analogy with modern $\delta^{18}O$–elevation relationships, a value of –19‰ suggests high elevations (~ ≥ 2500 m) in this region during the early Eocene.

Reference: Doebbert A.C., et al. (2010), GSA Bulletin 122, 236-252.

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T68. Lacustrine Systems around the World I: In Honor of Michael Rosen
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