

Triple oxygen isotope signatures of Eocene topographic development

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Isotopic signatures of ancient meteoric water ($\delta^{18}O$) preserved in lacustrine sediments are modified by evaporative enrichment and the temperature of mineral formation. The triple oxygen isotope system, defined by the deviation ($\Delta^{17}O$) from a mass-dependent reference line ($\lambda_{RL}=0.528$), is a powerful tool for constraining temperature and evaporation effects in order to extract information about past rainfall. Here, we present new $\Delta^{17}O$ measurements of late Eocene lacustrine cherts from northern Nevada, USA (Cherty Limestone Formation [1, 2]). Using these data, we estimate paleo-precipitation $\delta^{18}O$ and formation conditions, and discuss implications for the topographic evolution of western North America.

Our $\Delta^{17}O$ measurements range from -0.133‰ to -0.088‰ and are negatively correlated with $\delta^{18}O$ (ranging from 16.9‰ to 23.4‰). Together, the $\delta^{18}O$ and $\delta^{17}O$ data fall on a slope of $\lambda_{\text{chert}}=0.524$, within the range of equilibrium (~ 0.528) and kinetic (~ 0.519) fractionation end-members [3, 4]. Using an isotope mass balance model (modified from [5]), we perform a Monte Carlo routine to estimate probability density functions for model parameters. We calculate a mineral formation temperature of $36 \pm 6^\circ\text{C}$ in a flow-through lake. Additionally, we estimate a low $\delta^{18}O$ of meteoric source water ($-18 \pm 2\text{‰}$) consistent with regional high elevation topography ($> 2\text{km}$) in the late Eocene. Comparison to new Green River Formation $\Delta^{17}O$ data [6]—a time-equivalent, endorheic end-member—yields a similar result, suggesting that our analysis reflects regional conditions. Our contribution highlights the utility of the $\Delta^{17}O$ system in paleo reconstructions and places new constraints on the temporal evolution of North American topography.

[1] Horton et al. (2004) *AJS*, **304**, 862-888. [2] Abruzzese et al. (2005) *Geochim. Cosmochim. Acta*, **69**, 1377-1390. [3] Sharp et al. (2016) *Geochim. Cosmochim. Acta*, **189**, 105-119. [4] Barkan & Luz (2007) *Rapid Commun. Mass. Sp.*, **21**, 2999-3005. [5] Gázquez et al. (2018) *Earth Planet. Sci. Lett.*, **481**, 177-188. [6] Ibarra et al. (2019) *Goldschmidt Abstracts*.