

Triple oxygen isotopes in terrestrial carbonates

BENJAMIN H. PASSEY^{1*}, HUANTING HU¹, HAUYUAN JI¹,
SHAENA MONTANARI², SHUNING LI¹,
GREGORY A. HENKES¹ AND NAOMI E. LEVIN¹,

¹Department of Earth and Planetary Sciences, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, USA [*correspondence: bhpassey@jhu.edu]

²American Museum of Natural History, Sackler Institute for Comparative Genomics, New York, NY, 10024, USA

The ¹⁷O-anomaly ($\Delta^{17}\text{O}$) of natural waters has been shown to be sensitive to evaporation in a manner analogous deuterium excess [1, 2]. Specifically, evaporated bodies of water (e.g., soil waters, lake waters, animal body water) will tend to have lower $\Delta^{17}\text{O}$ than primary meteoric waters. Carbonates should record the triple oxygen isotope compositions of parent waters, providing a basis in the sedimentary record for identifying evaporated waters and perhaps for estimating primary (unevaporated) $\delta^{18}\text{O}$ values of ancient meteoric water.

The $\Delta^{17}\text{O}$ of animal body water relates to factors such as intake of evaporated waters (e.g., leaf water), evaporative water effluxes, and the triple oxygen isotope composition of atmospheric O₂, which itself relates to global carbon cycling, atmospheric CO₂ levels, and stratospheric photochemistry [3, 4].

Thus there is much potential for $\Delta^{17}\text{O}$ in studies of continental paleoenvironments, but progress has been hampered by a lack of high-precision analytical methods for carbonate. We optimized a reduction / fluorination approach [5] and present the first high-precision ($\pm 0.01\text{‰}$, 1σ) $\Delta^{17}\text{O}$ dataset for sedimentary and biogenic carbonates. The clearest pattern to emerge is a strong ¹⁷O-depletion in avian, dinosaurian, and mammalian body water (from analyses of eggshell and enamel) relative to meteoric waters, following expected influences of evaporated water and atmospheric O₂ on vertebrate body water. Parent waters of soil carbonates have similar or slightly lower $\Delta^{17}\text{O}$ than global precipitation, suggesting that they are mildly to moderately evaporated.

Our results suggest that $\Delta^{17}\text{O}$ will have useful application in continental environments where the effects of evaporation are important, and where animal body water may record an isotopic signal of evaporated water and atmospheric oxygen.

[1] Landais *et al* (2006) *GCA* **70**, 4105-4115. [2] Luz and Barkan (2010) *GCA* **74**, 6276-6286. [3] Pack *et al* (2013) *GCA* **102**, 306-317. [4] Bao *et al* (2008) *Nature* **453**, 504-506. [5] Brenninkmeijer and Röckmann (1998) *Rapid. Commun. Mass Spectrom.* **12**, 479-483.