

Triple oxygen isotopes of carbonates: Calibration of the θ -T relationship

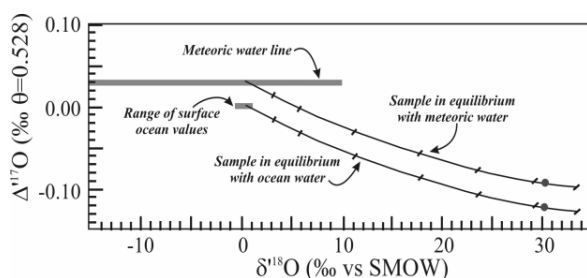
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High precision $\delta^{17}\text{O}$ - $\delta^{18}\text{O}$ measurements of minerals are used in combination to better constrain the water oxygen isotope values in $\Delta^{17}\text{O}$ - $\delta^{18}\text{O}$ space. The equilibrium fractionation factor, θ (where $\theta = \ln^{17}\alpha / \ln^{18}\alpha$) varies with temperature [1]. In order to apply paired $\delta^{17}\text{O}$ - $\delta^{18}\text{O}$ values to carbonates, complete fluorination of carbonates is required. We have adapted a method to make paired $\delta^{17}\text{O}$ - $\delta^{18}\text{O}$ measurements of carbonates using Ni-bomb fluorination [2] and present triple oxygen isotope values of the commonly used standards NBS-18, NBS-19, and PDB. We present a carbonate-water θ -T calibration curve based on modern brachiopod (0°C), PDB (15°C), and Palau shells (30°C). Preliminary data show a $\Delta^{17}\text{O}$ difference of 0.052‰ between the 0°C and 30°C sample. A preliminary θ -T relationship exists at ~ 0.00003 per °C where the θ value at 30°C is equal to 0.5256 and the θ value at 0°C is equal to 0.5245.

The figure below is a conceptual model of how $\Delta^{17}\text{O}$ varies with temperature in $\Delta^{17}\text{O}$ - $\delta^{18}\text{O}$ space, where the tick marks represent increasing temperature with lower $\delta^{18}\text{O}$ values. A carbonate oxygen isotope value has a unique solution to be in equilibrium with the formation water. If the carbonate value does not plot on the equilibrium fractionation line, then the sample is either in disequilibrium or equilibrated with non-ocean water. The fractionation curve can be applied to ancient carbonates to answer the question of whether they preserve ocean temperatures.



[1] Cao and Liu (2011) *GCA*, 7, 7435; [2] Kim and O'Neil (1997) *GCA*, 61, 16, 3461-3475