CCG23

Seasonality of thrombolite formation at Lake Clifton, Western Australia

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The timing of calcification in modern aragonitic thrombolite deposits in Lake Clifton, Western Australia was investigated using oxygen isotope ratios. The temperature and oxygen isotope composition of lake water, regional groundwater, and groundwater input to Lake Clifton were used to calculate equilibrium $\delta^{18}O$ values of aragonite. Measured $\delta^{18}O$ values (reported in ‰ VSMOW) of aragonite in thrombolite core samples are enriched in ^{18}O by 1.54‰, 8.45‰, and 4.58‰ as compared to calculated $\delta^{18}O$ values of aragonite in equilibrium with lake water, regional groundwater, and groundwater input, respectively. These equilibrium calculations indicate that aragonite likely precipitates from lake water, not groundwater.

Monthly lake water temperature and $\delta^{18}O$ data were used with aragonite core $\delta^{18}O$ data to determine that oxygen isotope equilibrium between aragonite and lake water occurs during both the Austral summer and winter. The duration of oxygen isotope equilibrium lasted approximately two months during the Austral summer as compared to approximately one week during the Austral winter. Monthly aragonite saturation indices and pH measurements indicate more favorable calcification conditions during the Austral summer. Precipitation of aragonite in Lake Clifton thrombolites may therefore occur primarily during the Austral summer. This suggests that ancient saline lake thrombolites may have exhibited seasonality in the timing of calcification and that paleo-reconstructions using $\delta^{18}O$ data from saline lake thrombolites are biased seasonally.

Keywords: Thrombolite, seasonality, oxygen isotope equilibrium, aragonite, calcification