# Intra-cyclothem conodont $\delta^{18}O$: Insights into climatic forcing of seawater chemistry during the Late Paleozoic Ice Age

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We present intra-cyclothem, high-spatial (dm) resolution oxygen isotope ($\delta^{18}O$) records for further investigation of climatic controls of the $\delta^{18}O$ proxy during the Late Paleozoic. Conodonts from Pennyslvanian cyclothems of Arrow Canyon, NV and the USA Midcontinent basin provided the phosphate source used to construct the $\delta^{18}O$ records. Conodont yield (conodonts/kg of limestone) was maximized by using 7% acetic acid buffered to pH 3.6 for dissolution, thus enabling the high-spatial resolution records. Sample sizes of < 1 mg of bioapaite produced values with a precision as low as 0.1 ‰ (1σ), achieved by use of a refined conversion technique (buffered silver amine) and new pyrolysis system (Elementar's Pyrocube). The records reveal shifts in conodont $\delta^{18}O$ at a higher-frequency than sea-level changes inferred from facies stacking patterns. These results contradict recent interpretations of intra-cyclothem conodont $\delta^{18}O$ records, which attribute the full range of values, minus a few tenths of a per-mil for temperature change, to variability in seawater $\delta^{18}O$ due to the waxing and waning of ice sheets. The high-frequency variability in conodont $\delta^{18}O$, which can be as much as 1.5‰ over ~10 cm with no distinct facies change, are distinct in temporal scale from eccentricity-paced ($10^5$ yr) changes in glacioeustasy. Recent climate models of the late Paleozoic indicate precessional-scale ($10^4$ yr) variability in hydrologic cycling across tropical Pangea that could have significantly altered the $\delta^{18}O$ of seawater. These systematic changes in epicontintal seawater composition should be recorded in conodont $\delta^{18}O$ and are hypothesized here to be responsible for the high-frequency shifts revealed in these Pennsylvanian $\delta^{18}O$ records from paleo-equatorial marine deposits.