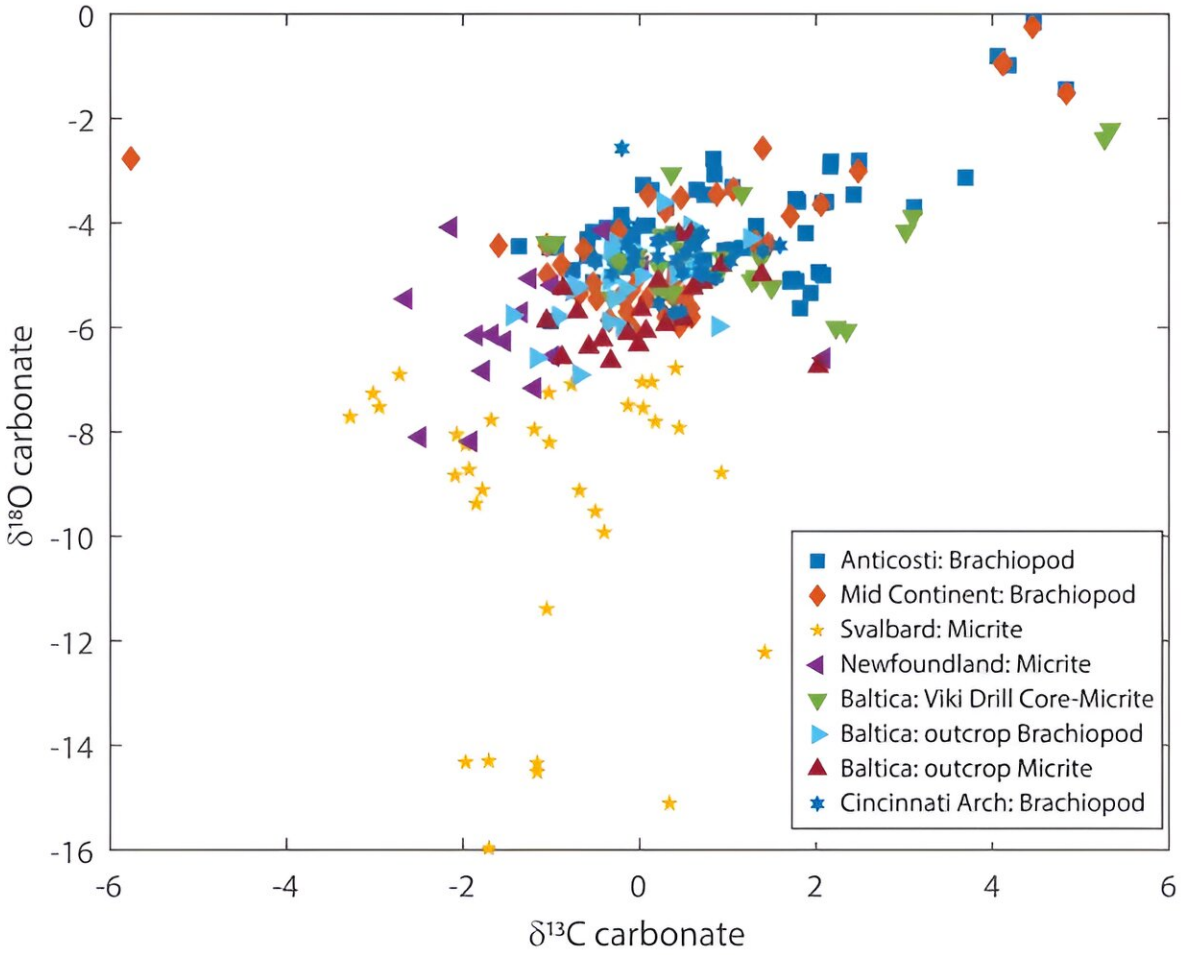
New evidence supports theory that oxygen isotope ratio in seawater slowly increased over last 540 million years

September 2 2024, by Bob Yirka



Cross plot of $\delta^{18}O$ carbonate vs $\delta^{13}C$ carbonate of Baltica and Laurentia records. Although Baltica has lower Δ_{47}-Temperatures than Laurentia, both have similar ranges in $\delta^{18}O$ carbonate. Credit: *Proceedings of the National Academy of*

Sciences (2024). DOI: 10.1073/pnas.2400434121

An international team of ocean, Earth and marine scientists has found evidence supporting a theory that a certain oxygen isotope ratio in seawater has changed slowly over the past 540 million years. In their study, published in the *Proceedings of the National Academy of Sciences,* the group analyzed rocks from the Ordovician period.

Over the past half-century, earth scientists have debated the possibility of changes in the ratio of ^{16}O to ^{18}O (written as $\delta^{18}O$) in seawater over the past 540 million years. Some have put forth arguments claiming no change has occurred, while others report evidence that it has increased.

The researchers in this study found new evidence supporting the latter theory. They note that settling the argument is important because the ratio impacts the prediction of ocean temperatures during certain times in the distant past.

Researchers believe that there are two factors that can force changes to the ratio—hydrothermal alteration due to hot water coming into contact with certain rock formations, and to a lesser extent, weathering of continental crust.

To learn more, the research team pulled drill cores from a location on Estonia's Baltic basin. Those, along with rock samples collected at above-ground sites in the region, were analyzed using clumped isotope thermometry—a technique that can measure the ^{13}C that has become bound to ^{18}O encased in carbonate minerals. It can be used to estimate ocean temperatures because the binding process is temperature dependent.

The measurements showed that during the Ordovician, the seawater in which the rocks had been covered had a lower $\delta^{18}O$ and was cooler than previous estimates had suggested, which shows that the ratio has been slowly changing over the past half-billion years.

The findings are not definitive proof of such a change, of course, which means that the ratio debate will continue until more concrete evidence can be found.

More information: Nivedita Thiagarajan et al, Reconstruction of Phanerozoic climate using carbonate clumped isotopes and implications for the oxygen isotopic composition of seawater, *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2400434121