$\delta^{13}C$

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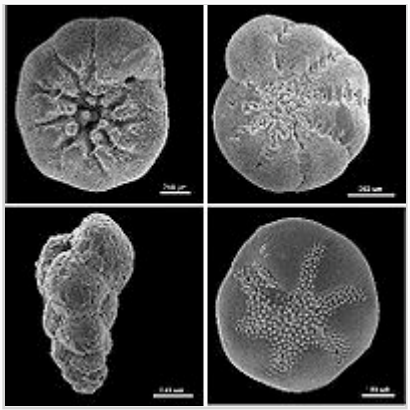
(Redirected from Δ13C)


Foraminifera samples.

In geochemistry, paleoclimatology and paleoceanography **$\delta^{13}C$** is a measure of the ratio of stable isotopes **^{13}C:^{12}C**, reported in parts per thousand (per mil, ‰).

The definition is $\delta^{13}C$ (in per mil) = $10^3[(R_{sample}/R_{standard})-1]$, where $R_x = (^{13}C)/(^{12}C)$ is the ratio of isotopic composition of a sample compared to that of an established standard, such as ocean water.

$\delta^{13}C$ varies in time as a function of productivity, organic carbon burial and vegetation type.

What affects $\delta^{13}C$?

Methane has a very light $\delta^{13}C$ signature: biogenic methane of –60‰ thermogenic methane –40‰. The release of large amounts of clathrate can impact on global $\delta^{13}C$ values, as at the PETM.[1]

More commonly, the ratio is affected by variations in primary productivity and organic burial. Organisms preferentially take down light ^{12}C, and have a $\delta^{13}C$ signature of about –25‰, depending on their metabolic pathway.

An increase in primary productivity causes a corresponding rise in $\delta^{13}C$ values as more ^{12}C is locked up in plants. This signal is also a function of the amount of carbon burial; when organic carbon is buried, more ^{12}C is locked out of the system in sediments than the background ratio (because organic carbon is lighter).

Geologically significant $\delta^{13}C$ excursions

C_3 and C_4 plants have different signatures, allowing the importance of C_4 grasses to be detected through time in the $\delta^{13}C$ record.[2]

Mass extinctions are often marked by a negative $\delta^{13}C$ anomaly thought to represent a decrease in primary productivity.

The evolution of large land plants in the late Devonian also led to increased organic carbon burial and consequently a drop in $\delta^{13}C$.

References

1. **^** Panchuk, K.; Ridgwell, A.; Kump, L.R. (2008). "Sedimentary response to Paleocene-Eocene Thermal Maximum carbon release: A model-data comparison". *Geology* **36** (4): 315-318. doi:10.1130/G24474A.1.
2. **^** Retallack 2001, see Evolutionary history of plants