

## Carbon and oxygen isotopic compositions of modern brachiopod shells from a subtropical shelf off Amami-o-shima, southwestern Japan

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This study examines the fidelity of carbon and oxygen isotopic compositions of two modern brachiopod species (*Kikaithyris hanzawai* and *Basiliola lucida*) as paleoenvironmental proxies. Both species were collected at water depths of 180 to 200 m on a subtropical shelf environment off Japan. High-resolution, three-dimensional samplings through the shells (1) identify isotopic variation through a single shell, (2) determine which shell components are in isotopic equilibrium with ambient seawater (equilibrium calcite), and (3) define which shell components can be used for paleoenvironmental proxies.

The  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values of the secondary shell layer that constitutes the main body of the brachiopod shells may or may not be in isotopic equilibrium with ambient seawater. The extent of disequilibrium is different between the two species and between different portions of each shell. The isotopic compositions of the samples from the outermost part of the secondary shell layer are correlated well with growth rates. Positive correlations are recognized between the  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values of these samples, which can be ascribed to a kinetic fractionation effect.

Far from the umbro and along the shell growth axis, the  $\delta^{18}\text{O}$  values of the secondary shell layer of *K. hanzawai* mostly fall within the range of equilibrium calcite. The  $\delta^{13}\text{C}$  values from the inner surface of the secondary shell layer in both species are relatively constant and equivalent to or very close to equilibrium calcite. These portions of the shell, therefore, would be most suitable for collecting reliable environmental proxy data. Samples from elsewhere in the shells, and particularly near the umbro would yield bad proxy data.

This study clearly illustrates that the carbon and oxygen isotopic compositions of modern brachiopod shells are predominantly influenced by a kinetic fractionation effect. However, appropriate selection of species and shell portions that reflect the isotopic composition of ambient seawater can still enable the reconstruction of secular variations in oceanic  $\delta^{13}\text{C}$  or  $\delta^{18}\text{O}$  values.