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Ostracod δ^{18}O as a potential proxy for the pH and salinity of aquatic environments

Laurent S. Devriendt (1), Helen V. McGregor (2), Allan R. Chivas (2,3)

(1) NIOZ, OCS, Netherlands (laurent.devriendt@nioz.nl), (2) School of Earth and Environmental Sciences, University of Wollongong, Australia, (3) Department of Earth Sciences, University of Adelaide, Australia

This study presents a new understanding of the causes of ostracod δ^{18}O variations based on a global database of published ostracod δ^{18}O values in lake, marine and coastal environments, and from culture experiments. We demonstrate that the δ^{18}O of ostracod valves is not solely a function of the water δ^{18}O and temperature but also depends on the water pH and salinity. More specifically, the data show that: (1) the δ^{18}O of marine and non-marine ostracods reflects the ^{18}O/^{16}O of the sum of host water CO_3^{2-} and HCO_3^- ions. For example, at a given temperature, the δ^{18}O of non-marine ostracods decreases by 4‰ to 6‰ as $[CO_3^{2-}]$/[DIC] reaches 70%, depending on the ostracod species. In low $[CO_3^{2-}]$/[DIC] settings, ostracod ^{18}O/^{16}O is close to the 18O/16O of HCO_3^- ions, which explains why on average ostracod δ^{18}O is higher than the δ^{18}O of inorganic calcite precipitated slowly under the same conditions. (2) The sensitivity of ostracod δ^{18}O to $[CO_3^{2-}]$/[DIC] varies from –0.1‰ to –0.06‰ per % of $[CO_3^{2-}]$/[DIC] and strongly depends on taxonomy. This suggests that the δ^{18}O-offsets between ostracod taxa calcifying in the same environment vary with the water $[CO_3^{2-}]$/[DIC]. Because the water $[CO_3^{2-}]$/[DIC] mainly depends on the water pH and salinity, the δ^{18}O-offsets between contemporaneous ostracod taxa from the same environment may serve as a proxy for both the pH and salinity of aquatic environments. Our study reconciles contradictory observations of controls on ostracod δ^{18}O and paves the way for improved paleoenvironmental interpretations and reconstructions of past water pH and salinity.