

**Biogenic carbonate records environmental variation in sulfur isotopes**

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There has been growing interest in the use of sulphur isotopes ( $\delta^{34}\text{S}$ ) as biogeochemical markers to untangle food web dynamics, track animal movements, and determine dietary provenance across marine and freshwater systems. The hard, carbonate-based tissues of aquatic organisms are particularly useful for isotopic analyses as they retain a permanent and temporally-resolved chemical record over the life time of the organism. We sought to experimentally determine whether biogenic carbonate is a useful tool to track variation in  $\delta^{34}\text{S}$ , and whether such variation is influenced by the isotopic composition of the ambient water and/or diet. In an orthogonal design, we raised juvenile fish, for a month, in two water treatments with differing  $\delta^{34}\text{S}$  signatures, as well as three diet treatments with differing signatures. We subsequently analysed the calcium carbonate ear bones (otoliths) of the fish using secondary ion mass spectrometry, a technique that allowed the ‘experimental portion’ of the otolith to be targeted. We found that the ear bones recorded environmental variation in  $\delta^{34}\text{S}$ , which were influenced by both ambient water and diet. This study provides experimental evidence that biogenic carbonates record variation in  $\delta^{34}\text{S}$  and questions the assumption that diet is the sole source of  $\delta^{34}\text{S}$  variation in aquatic consumers.

**Keywords:** biogeochemical marker, sulfur isotopes, carbonate, diet, otolith

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