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Stable isotopes, elemental distribution, and growth rings of belemnopsid belemnite rostra: Proxies for belemnite life habitat

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ABSTRACT

Stables isotopes and elemental composition of two well-preserved belemnite rostra (*Hibolithes beyrichi* and *H. hastatus*) from the Bathonian of central Poland were studied. Average temperatures calculated from the oxygen isotope ratios of *Hibolithes beyrichi* and *H. hastatus* are 10ºC and 6ºC, respectively. The absence of high-amplitude variations in high-resolution temperature profiles suggests these belemnites lived in deeper waters. This interpretation is compatible with a nektobenthic habitat of belemnopsid belemnites. Carbon isotope ratios of the rostra are assumed to be affected by vital fractionation with prominent fluctuations in the $\delta^{13}C$ records resulting from changes in the metabolic activity. Observed variations in Mg:Ca ratios of the rostra (from 5 mmol·mol^{-1} to 28 mmol·mol^{-1}) are predominantly a primary signal. Temperature dependence of the Mg:Ca ratio is inferred for *H. beyrichi* on the basis of a correlation with $\delta^{18}O$ values; however, no such correlation is observed for *H. hastatus*. No significant correlation is observed between Sr:Ca ratios and $\delta^{18}O$ values in either taxon. Sulphur contents in the rostra vary from 630 ppm to 4400 ppm and are interpreted to be largely coprecipitated with belemnite calcite. Extreme compositions of sulphur are interpreted to result from the incorporation of diagenetic sulphur during early marine diagenesis, which is also characterized in these rostra by high Mg:Ca and Sr:Ca ratios and low $\delta^{13}C$ values. A total number of growth rings in the rostrum of *H. beyrichi* is calculated at around 600, thus, an expected life span of *H. beyrichi* is considered to be ~1.5 years assuming daily precipitation of growth bands.