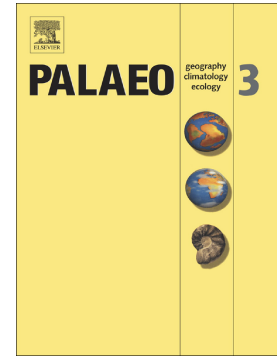


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Oxygen isotopes from limpet shells: implications for palaeothermometry and seasonal shellfish foraging studies in the Mediterranean

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Abstract

Limpet shells are common components of many archaeological sites in the Mediterranean. To test whether $\delta^{18}\text{O}$ values from archaeological *Patella caerulea* shells can serve as a reliable palaeothermometer for the Mediterranean and a reliable archive of season of collection information, we collected live *P. caerulea* from eight Mediterranean locations in Croatia, Israel, Libya, Malta, Tunisia, and Turkey. Shell growth patterns were studied in section, and samples for oxygen isotope analysis were milled from the shells and used to calculate sea surface temperature (SST). As with other species of limpet, SST reconstructed from *P. caerulea* $\delta^{18}\text{O}$ values were lower than expected from observational records. However, when a correction factor of -0.72‰ was applied, the shells recorded SST within the range of instrumental SST. SST calculated from $\delta^{18}\text{O}_{\text{shell}}$ values of the most recently formed shell portion of monthly-collected shells from one site in Libya were strongly and significantly correlated with instrumental SST in the region ($R^2 = 0.95$). Oxygen isotope curves from individual shells sampled at high resolution from each of the study sites across the Mediterranean exhibited sinusoidal patterns. Annual growth lines correlated with the lowest $\delta^{18}\text{O}_{\text{shell}}$ values and were thus formed in summer. However, shell growth rates varied markedly between the sites. Some sites with larger shells recorded less than a year of growth in broad, highly irregularly shaped increments. At other sites, medium sized shells recorded several years of growth with clear, regular growth increments. A sclerochronological approach can therefore be used to pre-screen limpet shell sections before geochemical sampling. The $\delta^{18}\text{O}_{\text{shell}}$ values from shells sampled at high-resolution recorded the full seasonal range of instrumental SST at each collection site. This reinforces the potential of this species as one of the few sub-seasonal resolution palaeoenvironmental archives in the region. Additionally, the pattern of $\delta^{18}\text{O}_{\text{shell}}$ variation from the last formed shell portion was studied to determine whether accurate season of collection information could be identified from *P. caerulea* shells. The correct season was interpreted $>80\%$ of the time indicating that this species is a good candidate for seasonal shellfish foraging studies using archaeological shells.

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