Oxygen and carbon stable isotopes of *Mytilus galloprovincialis* Lamarck, 1819 shells as environmental and provenance proxies

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**Abstract**

Mollusc shell stable isotopes are commonly used to reconstruct past environmental conditions. However, despite being abundant components of natural and anthropogenic fossil accumulations, the geochemical composition of mussel shells (*Mytilus* spp.) has rarely received attention in palaeoenvironmental studies. This study tests the suitability of oxygen isotopes (δ18O) of *Mytilus galloprovincialis* as palaeothermometer. For 1 year, mussels and water samples were collected twice a month from Berria Beach, in Northern Spain. The geochemical data of the shells indicate that water temperatures can be reconstructed with an average offset of 1.2 ± 0.7°C with respect to the measured values. Furthermore, no prolonged shell growth cessations are observed. These results validate *M. galloprovincialis* as reliable recorders of seasonal water temperature fluctuations, supporting their use in palaeoenvironmental studies. In addition, further shell and water collections were carried out in the upper and lower areas of a nearby estuary. The geochemical analyses of these shells were aimed to test whether oxygen and carbon stable isotopes (δ13C) may be used as novel proxies to identify the shell provenance at local scale. The results show that the δ18O versus δ13C correlation direction varies along the coast–upper estuary geographical gradient, suggesting it to be a potential new proxy to distinguish between marine and estuarine mussel specimens.

**Keywords**

geochemistry, Mediterranean mussel, Northern Spain, palaeoenvironmental reconstructions, provenance, proxy calibration

**Introduction**

Molluscs deposit the shell throughout their life. By using a high-resolution sampling approach on individual shells, it is possible to reconstruct the water temperature fluctuation at annual, seasonal and even weekly resolution (Gutiérrez-Zugasti et al., 2015; Hallmann et al., 2009; Schöne et al., 2004). Furthermore, the temperature reconstruction of the last shell portion formed just before death can give important information in archaeological contexts as it can be used to determine the season of shellfish collection and therefore human dietary habits (Burchell et al., 2013; Mannino et al., 2007; Prendergast et al., 2016). Although *Mytilus* spp. are abundant in the archaeological record, there is a lack of specific modern calibration studies testing the suitability of representatives of this genus for palaeoenvironmental reconstructions. The current study is based on modern...