Contrasting shell growth strategies in two Mediterranean bivalves revealed by oxygen-isotope ratio geochemistry: The case of *Pecten jacobaeus* and *Glycymeris pilosa*

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**A B S T R A C T**

High-resolution stable-isotope ratio data (δ¹⁸O, δ¹³C) were used to study growth strategies of two bivalve species, *Pecten jacobaeus* (calcitic shell) and *Glycymeris pilosa* (aragonitic shell) from the North Adriatic Sea. The principal objectives of this study were to identify the period of the year when the growth line is formed in the shell of two target species, to identify the major growing season of these two species, to identify the environmental drivers of shell growth, and to evaluate the potential applicability of δ¹⁸O and δ¹³C values for the reconstruction of environmental variability. Samples were collected from the North Adriatic Sea by commercial bean trawl (*P. jacobaeus*, December 2013 and January 2014, N = 4) and SCUBA diver (*G. pilosa*, March 2016, N = 3). Samples for the oxygen (δ¹⁸O) and carbon (δ¹³C) isotope composition of the calcium carbonate were collected by drilling the outer shell layer across several annual cycles. Temporal and spatial temperature and salinity values inside the investigated area were simulated using the 3D numerical ocean model - ROMS. The δ¹⁸O cycles corresponded to the number of seasonal growth marks observed on the external shell surface of both target species, thereby confirming the annual periodicity of these growth patterns. In February 2012, extreme cooling of the water column accompanied by dense water formation occurred in the Adriatic Sea - an event recorded by *P. jacobaeus* shells. This study indicates that *P. jacobaeus* and *G. pilosa* have contrasting shell growth strategies. *P. jacobaeus* grows during winter and slows shell growth during the warmest part of the year, and thereby may be an interesting archive for winter conditions. Due to its longevity and continuous growth during the warmest part of the year, *G. pilosa* is a promising archive for the reconstruction of summer seawater temperatures.

1. Introduction

Over the past decade, the field of sclerochronology has been rapidly developing by investigating structural elements, as well as the geochemical composition of bivalve shells, with the objective of obtaining information on environmental conditions archived during the lifetime of an organism (Schöne and Gillikin, 2013). Analysis of oxygen-isotope ratios (δ¹⁸O) of mollusk shell carbonates has become a key tool for paleoclimate reconstruction as this data can be used to estimate the temperature of the ambient water at the time of shell formation, when δ¹⁸O_{water} is known (Urey, 1947; Epstein et al., 1953; Grossman and Ku, 1986; Schöne and Surge, 2005; Gröcke and Gillikin, 2008; Oschmann, 2009; Wanamaker et al., 2011; Schöne and Gillikin, 2013; Butler and Schöne, 2017; Prendergast et al., 2017). Although the interpretation of δ¹³C data is often less straightforward because of species-specific metabolic effects (Chauvaud et al., 2011; Marchais et al., 2015), stable carbon-isotope ratio signatures of mollusk shells may provide data on salinity and δ¹³C_{DIC} values in estuarine environments (Gillikin et al., 2006; McConnaughey and Gillikin, 2008). These records can range from daily to sub-seasonal time-scales, depending on growth rate and longevity of the studied species, and can provide data for recent years and decades, as well as past centuries (e.g. Black et al., 2009; Butler...