Palaeogeography, Palaeoclimatology, Palaeoecology 484 (2017) 1–6

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Preface

New research on the development of high-resolution palaeoenvironmental proxies from geochemical properties of biogenic carbonates

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ARTICLE INFO

Available online 31 May 2017

Keywords:
Sclerochronology
High-resolution proxy records
Mollusc
Bivalve
Gastropod
Echinoderm
Otolith
Coral

ABSTRACT

Geochemical signatures from biogenic carbonates are being increasingly employed as palaeoenvironmental proxies. In turn, many of these proxy archives including mollusc shells, corals, and otoliths have periodic growth structures, which allow the reconstruction of chronologically constrained records of palaeoenvironmental variability at unparalleled high temporal resolution. Studying the growth and chemistry of these periodic growth structures is known as sclerochronology. Biogenic hard parts accumulate in geological or archaeological deposits, and can be directly dated using radiometric and racemisation methods. They therefore offer the opportunity for high-resolution palaeoenvironmental reconstructions across many time intervals, all over the globe. Such data are important for several reasons: (1) understanding past climate and environmental change provides a means of contextualising current and future climate change and ecological disturbance; (2) high-resolution palaeoenvironmental records are essential for constraining, testing and validating global and regional numerical climate models; (3) palaeoenvironmental records from biogenic carbonates can provide an environmental framework from which to understand the behavioural changes and interactions of peoples with their environment. However, inter and intra-species differences in growth rate, physiology, and environmental response can cause variations in the chemical profiles of biogenic carbonates. Before geochemical data is employed for palaeoenvironmental reconstructions, it is thus necessary to examine modern specimens of the target species, or related taxa, to understand how geochemical variations are influenced by local environmental conditions, kinetic and vital effects. This allows the generation of quantitative and more reliable proxy records of environmental change.

This special issue brings together the latest research on palaeoenvironmental proxy development and validation in biogenic carbonates. It includes studies on marine, freshwater and estuarine organisms (molluscs, corals and echinoderms), and on traditional as well as novel geochemical proxies. The papers presented here include in situ field calibration studies, laboratory growth experiments as well as methodological studies into the effects of sampling and pre-treatment. The geographical scope is broad, encompassing both the northern and southern hemispheres including South Africa, South America, Australia, Asia, the Mediterranean Sea and the North Atlantic.

1. Palaeoenvironmental records from biogenic carbonate archives

Climate and environmental change is an increasingly pressing issue in today's world, yet instrumental records of past climate are short, rarely stretching back beyond 1860 CE (Jones et al., 2001, 2009). The analysis of palaeoenvironmental proxies, preserved in various natural archives, enables the reconstruction of climate and environmental conditions prior to the instrumental record. The development of a broad range of proxy records of climatic and environmental change is crucially important for understanding patterns of past climate and environmental change at various spatial and temporal scales (IPCC, 2013). Robust, quantitative and high-resolution palaeoclimate and palaeoenvironmental data from varied regions of the globe are needed to provide a framework of past changes, to form baselines for environmental monitoring, and provide data for numerical simulations that will allow climate modellers to better predict anthropogenic impacts on the natural climate system (McCarroll, 2010; Schmidt et al., 2014; IPCC, 2013).

It is becoming increasingly evident that understanding past climate and environmental change at high-resolution timescales (annual to

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http://dx.doi.org/10.1016/j.palaeo.2017.05.032
0031-0182/