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PALAEO

Palaeogeography, Palaeoclimatology, Palaeoecology 184 (2002) 131–146

www.elsevier.com/locate/palaeo

Reconstructing daily temperatures from growth rates of the intertidal bivalve mollusk *Chione cortezi* (northern Gulf of California, Mexico)

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Received 25 October 2001; accepted 11 February 2002

Abstract

We establish a model for the reconstruction of average daily sea surface temperatures from calcification rates of an intertidal bivalve mollusk. The rate of shell production in *Chione cortezi* (Carpenter, 1864, ex Sloat MS) is mainly controlled by water temperature, ontogenetic age and the effect of tidal cycles. Statistical methods developed by dendrochronologists can successfully extract the water temperature signal from daily growth increment chronologies. After removal of noise, the growth rates are expressed as scaled daily growth indices. Average daily water temperatures during the first half of the year are highly correlated with the scaled daily growth index values of recent and subrecent specimens, using the multi-valued function presented here. Increment width analysis can reconstruct daily average water temperatures with a mean error of less than 3%. This technique provides an independent method for reconstructing temperatures in fossil specimens of species with living representatives and can supplement high-resolution temperature reconstructions based on geochemical analysis.

Keywords: growth rate; $\delta^{18}O$; growth index; sclerochronology; paleoecology

1. Introduction

Detailed reconstructions of seasonal temperature changes can be vital in developing and testing models of ancient climate variation (e.g., Kutzbach and Guetter, 1986; Kutzbach et al., 1993). Although tree-ring analysis has provided extraordinarily precise climatic reconstructions in the terrestrial realm for the last 1500 yr of climate history (e.g., Briffa et al., 1996), many of the statistical methods of dendrochronology (for a review see Cook and Kairiukstis, 1990) have not been extensively applied to the analysis of growth increments in the hard parts of marine organisms. This is despite the well-known role of temperature in calcification rates of bivalve mollusks (e.g., Davenport, 1938; Gunter, 1957; Berry and Barker, 1968). Typically, growth rate increases

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0031-0182/02/$ – see front matter
PII: S0031-0182(02)00252-3