Geophysical Research Abstracts, Vol. 7, 10328, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10328

Interpreting the microstructure and geochemical variations within *Protothaca thaca* (Mollusca, Bivalvia) shells of Chile and Peru

Claire E. Lazareth (1), Florence LeCornec (1), Cécile Liétard (2), Gregory Lasne (1), Catherine Pierre (2), L. Ortlieb (1).

1. **UR PALEOTROPIQUE, IRD, 32 Avenue H. Varagnat, F-93143 Bondy Cedex, France**
2. **LODYC (LOCEAN), Univ. Pierre et Marie Curie, 5 place Jussieu, 75230 Paris cedex 05, France.**

Introduction

In the absence of coral along the coasts of Peru-Chile, bivalve shells might be used as climatic and oceanographic variability recorders, including ENSO impacts. The Veneridae *Protothaca thaca*, a fairly common, upper subtidal bivalve that lives along the south-eastern coasts of the Pacific Ocean (8˚-45˚S) has been chosen to evaluate its potential as paleo-environmental recorder as it is (1) resistant to temperature variations, and (2) abundant in Holocene archaeological deposits and Pleistocene marine terraces. Sclerochronological and geochemical studies on modern shells were combined to understand the relation between shell microstructure and chemistry with environmental parameters (SST in a first instance). This kind of study is viewed as essential before any data acquired on ancient/fossil shells can be properly interpreted in terms of environmental variations.

Protothaca thaca sclerochronology and geochemistry

The growth rhythms of *Protothaca thaca* were studied by combining microscope observations and comparisons between growth increment measurements and water temperature recorded on the sampling site. Within modern shells from 17˚S (Pocoma, southern Peru) and 25˚S (Antofagasta, northern Chile), it is observed that the width of daily growth increments is related to temperature, at least for temperatures be-

low $\sim$18˚C. When temperature exceeds this limit continuously during some time ($>$3 weeks), a clear "summer check" (SC) forms in the shell. The width of SC seems to be closely related to the length of the period of SST $>$18˚C. It is assumed that the presence of wide SC ($>$500 μm), as observed in *P. thaca* shells which survived the strong 1997-98 El Niño event may be an indicator of paleo-ENSO events.

Several year-long δ^{18}O and δ^{13}C profiles were obtained on micromilled samples from 4 modern shells collected in 2003 at 17˚S. The δ^{18}O profiles do not show a clear temperature dependency; this could depict either (or both) a non-equilibrium δ^{18}O fractionation, or (and) important local variations of the seawater composition. The variations of δ^{13}C profiles seem to be controlled by seasonal metabolic fluctuations. However it cannot be excluded that the presence of high organic matter content within the SCs may be partly responsible for the highly depleted peaks observed in summer.

Shells of each site were sampled (by Micromill), for Mg/Ca, Sr/Ca and Ba/Ca content determination (ICP-MS). Mg and Sr are quite well correlated, with a slope that seems to depend on the mean SST of each locality. No clear control by temperature is found for Mg/Ca and Sr/Ca incorporation. The variations of Sr/Ca ratio, which mimic the variations of width of the daily growth increments, may reflect kinetic effects. This positive correlation between growth rate and Sr/Ca was also observed for *Protothaca staminea* of the northern Hemisphere (Takesue & Van Geen, 2004). A Ba/Ca profile measured on a shell from Antofagasta shows several peaks every summer, when coastal upwelling events occur and drive phytoplankton blooms (Castilla et al., 2002).

Conclusion

The sclerochronological study done on *Protothaca thaca* shells leads to identify daily increment and growth anomalies related to summer temperatures, referred to as "summer checks". By comparison with recorded water temperature variations, growth increment width profiles can be dated. This chronological control provides the temporal framework for the interpretation of Oxygen and Carbon stable isotopes, Mg, Sr and Ba profiles. In southern Peru shells, no clear relation has been found between δ^{18}O, Mg, Sr on one hand and temperature on the other hand. Only δ^{13}C variations of these shells are inter-individually consistent and suggest a metabolic control. This suggests highly variable environmental conditions. The Sr/Ca is positively correlated with growth rate. Ba/Ca peaks are interpreted as markers of upwelling events. The uptake of Ba in *P. thaca* seems similar to that observed in other bivalves (Vander-Putten *et al.*, 2000; Lazareth *et al.*, 2002).

References

Castilla J. C., Lagos N. A., Guiñez R. & Largier J. L. (2002) Embayments and

nearshore retention of plankton: the Antofagasta Bay and other examples. In: *The oceanography and Ecology of the nearshore and bays in Chile*, J. C. Castilla and J. L. Largier, eds., Edition Universidad Católica de Chile, Santiago, 179-203.

Lazareth C.E., Liétard C., Lasne G., Pierre C. y Ortlieb L. (2004). Sclerochronological and geochemical study of *Protothaca thaca* (Veneridae, Bivalvae) shells of the Peru-Chile region: Environmental vs. physiological controls. *EOS trans., AGU,* **85** (47): Fall meeting suppl. Abstr. B21B-0878.

Lazareth C. E., Vander Putten E., André L. & Dehairs F. (2003) High-resolution trace element profiles in shells of the mangrove bivalve *Isognomon ephippium*: a record of environmental spatio-temporal variations? *Estuar. Coast. Shelf Sci.,* **57** (5-6), 1103-1114.

Takesue R.K. & Van Geen A. (2004). Mg/Ca, Sr/Ca and stable isotopes in modern and Holocene *Protothaca staminea* shells from an northern California coastal upwelling region. *Geochim. Cosmochim. Acta,* **68** (19): 3845-3861.

Vander Putten E., Dehairs F., Keppens E. & Baeyens W. (2000) High resolution distribution of trace elements in the calcite shell layer of modern *Mytilus edulis*: Environmental and biological controls. *Geochim. Cosmochim. Acta*, **64**, 997-1011.