



## **Subdaily geochemical and microstructural study on the Chilean coastal gastropod *Concholepas concholepas*: towards a high resolution proxy calibration**

C. E. Lazareth (1), N. Guzmán (1, 2), F. Poitrasson (3), J.-P. Cuif (2), L. Ortlieb (1)

(1) UR Paléotopique, IRD, Bondy, France, (2) Paleontology Unit, Univ. Paris XI, Orsay, France, (3) LMTG-CNRS, Toulouse, France (Claire.Lazareth@bondy.ird.fr / Fax : 00 33 1 48 02 55 54 / Phone : 00 33 1 48 02 59 64)

### **Introduction**

Mollusc shell growth patterns and chemistry begin to be widely used to reconstruct recent and past environmental variations. Along the south-oriental coast of the Pacific, a region climatically dominated by the El Niño phenomenon, mollusc shells are probably the most suited carbonate material for paleo-environmental reconstruction. However, before working on fossil remnants, it is essential to properly understand how the environmental parameters are recorded in the shell, both from the microstructural and chemical standpoints. *Concholepas concholepas* lives close to the shore along the Peruvian-Chilean coasts and shells of this relatively large gastropod are abundantly found in Holocene archaeological sites. We chose this species to test it as a paleo-environmental recorder, and focused our study on the understanding of growth modalities and on establishing geochemical proxy calibration.

### **Results**

Shells submitted to periodical fluorochrome marking, grown in aquaculture tanks, showed that the biomineralization process of *Concholepas concholepas* takes place at about a hourly scale (MEB observations, layers of a few microns thickness) (Guzmán, 2004). In addition, it was established that a couplet of a thin layer and a broader translucent layer are formed every day (microscopic observations, between 30-200  $\mu\text{m}$  per day). Afterwards, a date, or even a subdaily time-period, was identified and assigned to each high-resolution geochemical data point using the subdaily pattern of

the shells. Since the water temperature was recorded every 30 min in the tank during the experiment, dated analytical results can be very precisely compared with the temperature record.

High-resolution geochemical profiles were realized following the maximum growth axis and along single growth lines. Mg and Sr were obtained using Laser-Ablation-ICP-MS and  $\delta^{18}\text{O}$  using Secondary Ion Mass Spectrometry (SIMS), both with a mean resolution of two points per day for two months of shell growth. When excluding the part of the growth line close to the shell border, Mg and Sr distributions are almost homogeneous (RSD  $\sim 4\%$ ). For the period of time analyzed, no environmental and/or physiological control on Sr incorporation is evidenced (RSD normal to growth axis compares with RSD along a single time-line). This is not the case for Mg which roughly mimics the temperature variations. Variations of  $\delta^{18}\text{O}$  values along single growth lines (3 parallel lines analyzed at different day/temperature of growth) are more important than for Mg and Sr, with a global decrease towards the shell border. Moreover, the slope of this trend increases with temperature. Thus, along the secreting layer at a given time, the  $\delta^{18}\text{O}$  fractionation seems to linearly change towards the shell border and is temperature influenced. As for Mg, the  $\delta^{18}\text{O}$  roughly follows the temperature and statistical analysis of the  $\delta^{18}\text{O}$  data seems to confirm a significant correlation between  $\delta^{18}\text{O}$  and T, even if weak. Calculated temperatures from our  $\delta^{18}\text{O}$  data, based on the Epstein *et al.* (1953) equation, are, on average, lower by  $5^\circ\text{C}$  compared to the measured temperatures. The amplitude of  $\delta^{18}\text{O}$  variations is generally much more important than the measured temperature fluctuations.

## Conclusion

High-resolution geochemical study on precisely dated *Concholepas concholepas* shells shows that Mg and Sr are homogeneously incorporated at a given time, except for the shell border, whereas  $\delta^{18}\text{O}$  fractionation seems to change linearly towards the exterior. Even if Mg seems to be temperature controlled, more data are needed to confirm this tendency. For  $\delta^{18}\text{O}$ , the relation with temperature seems better but probably is probably still obscured by the apparent change of  $\delta^{18}\text{O}$  fractionation at a given time, which is furthermore temperature controlled. Finally, a discrepancy between calculated temperatures, using our  $\delta^{18}\text{O}$  values and the empirical evenly used Epstein equation, and measured temperatures was observed. This highlights the species dependant  $\delta^{18}\text{O}$  fractionation and thus the work still to be done towards a better understanding of biomineralization processes and calibration of proxies.

Work supported by "CONCHAS" Project (PNEDC) and UR Paléotropique IRD.

## References

Epstein S., Buchsbaum R., Lowenstam H. A. & Urey H. C. (1953) Revised carbonate-water isotopic temperature scale. *Geol. Soc. Am. Bull.*, **64**, 1315-1326.

Guzman, N. (2004) Validation d'une approche scléroclimatologique sur la côte du Chili et du Pérou par l'analyse microstructurale et biogéochimique des coquilles du gastéropode *Concholepas concholepas* [Bruguière, 1989]. PhD thesis, Orsay, France, 219 p.