Molluscan skeletal growth and reconstruction of environmental conditions at a high time-resolution: Reassessments of a methodological approach in the case of Peru-Chile coastal shells as recorders of ENSO events.

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Mollusc shells are beginning to be viewed as potential recorders of past environmental conditions. While scleractinian coral colonies, which can grow during decades (and centuries), have been considered as powerful, long-range, recorders of past sea surface temperature (SST) and salinity (SSS) of equatorial/tropical coastal regions, and benefited for many years of dedicated research, mollusc shell skeletons are not yet commonly regarded as reliable paleoceanographic archives. Recent research on a limited number of bivalve taxa, such as *Islandia arctica* (northern Atlantic O.), *Mercenaria mercenaria* (Eastern US), tridacnids (western Pacific) or pectinids (Europe) aimed to develop proxy data of varied kinds of environmental and climatic parameters. Current efforts, within the CENSOR project, are concentrated toward the development of scleroclimatological tools through high-resolution microstructural and geochemical studies on the shells of a series of coastal molluscan taxa from the Peruvian and Chilean coast which would allow the identification and characterization of anomalous conditions proper to El Niño-Southern Oscillation (ENSO) events, be they warm El Niño or cold La Niña episodes.

It can be expected that minor element, or stable isotope, variations of abundance within the biocarbonates that form the mollusc skeketon reflect the occurrence and the intensity of the departures from "normal" environmental nearshore conditions. However before this hypothesis is verified, this approach implies that several steps are reached. One of the prerequisites is that we understand how the organisms build their shell. Do they form their skeleton continuously or are there interruptions in the growth process? In the last case, are the growth interruptions linked to seasonal factors and/or to anomalous conditions (storms, ENSO events)? Can we easily detect growth anomalies through microscopic analysis of smear slides of the shells? How does evolve the growth rhythm during the ontogeny of the individuals? A second series of prerequisites, related to the former ones, concern the sclerochronological control on the studied species. When we study modern shell individuals, with known date of death, we should be able to "read backwards" the absolute date of a given increment. In fossil (dead) shell samples it is also highly desirable to be able to determine the date of a given portion of the shell relative to the birth and/or death of the organism. This may be done either through smear slides of shells, or in the case of pectinids through counting of daily increments observed on the outer surface. Fluorochrome marking of living shells, made with the relevant precautions to limit the effect of the chemical staining, proved to be particularly useful to assess the sclerochronology of ill-known species.

It should be stressed that it is only when a sufficient knowledge of the modalities of growth and of the parameters that control changes in growth rhythm is acquired that it makes sense to proceed with geochemical analyses of shell fragments. Unlike what is commonly done in paleoceanographic studies on coral sequences, geochemical studies on mollusc shells oriented toward the reconstruction of previous environmental conditions should not be performed, simply, in a serial (and blind) way along the axis of major growth. Common changes in the growth rates of mollusc shells preclude any interpretation based upon extrapolation of mean growth rates. Besides that, according the size of the shell samples, the sampled zone within the shell, and the specific growth pattern, and depending on the equipment used (Inductively-Coupled Plasma Spectrometry, with or without Laser-ablation technique, or Electronic Probe Microanalyser) the time resolution of the geochemical analysis may encompass a few hours, weeks or whole months of growth. The use and interpretation of the geochemical results, in terms of Mg or Sr abundance or in oxygen stable isotope composition, need to be accurately related to the lapse of time during which was formed the analyzed shell fragment. This is particularly crucial for the identification of short-lived episodes of anomalous conditions.

In the calibration phase of geochemical proxies on modern samples, the principal environmental factor currently monitored (through automatic recording devices) is the water temperature. This is also the easiest parameter to measure at a ~hourly resolution. Preliminary results on some mollusc species show the importance of (maximum and minimum) threshold temperatures in the growth process. However it is expected that temperature is only one of the many factors that play a role in the shell growth patterns. At this stage of the experiments and studies it cannot yet be determined whether the temperature rise (decrease) during warm (cold) ENSO events is actually the dominant environmental parameter, which affect the nearshore molluscs.

Within the CENSOR project, emphasis is thus given to the microstructural study of mollusc shells and particularly to the understanding of the factors driving the shell growth pattern of the different considered species. The favoured species are among those, which can resist and survive to the anomalous conditions, which disturb the nearshore environment during ENSO events.

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