

The Gastropod Statolith Elemental Composition by EMPA

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Gastropods statoliths are biogenic structures of CaCO_3 , analogous to fish otoliths [1]. Their application in sclerochronology is recent and may be advantageous comparing to the most traditional organisms used hitherto. Moreover, since elements bind within calcified structures [2], statoliths theoretically incorporate chemical information from the surrounding environment over time. So, besides being used for age estimation and growth studies [1], statoliths elemental fingerprinting is recognized as natural tag to track larval dispersal [2] and may also be considered as a potential marker of environmental change and/or pollution. However there is a lack of information on the elemental composition of adult gastropod statoliths. Here we characterize *Nassarius reticulatus* (Gastropoda: Caenogastropoda) statoliths elemental composition by electron microprobe analysis (EMPA).

One statolith from each of 3 adults was prepared for EMPA (Figure 1) and showed the same structural pattern: a nucleus circled by a metamorphic ring and, in addition to this core, 4 other rings delineating 5 increments (Figure 1F). General composition was assessed by Energy and Wavelength Dispersive Spectroscopy revealing C, Ca, O, Sr, Na, S and Mg as the most representative elements. These were then quantified in 3 points per increment. Carbon was not determined since surfaces were C-coated and the amount of oxides of Ca, Sr, Na, S and Mg was estimated from the valence. In addition, Ba – trace element in statoliths of some gastropods larvae [2] – and Al, Cu, Hg, Sn – known as environmental pollutants – were also sought in one of the statoliths. For such, mean values for Ca, Sr, Na, S, Mg and O were set as the sample matrix. Standards and mean detection limits by element and statolith are indicated in Table 1.

Concentrations of Ca, O, Na, Sr and S varied between 3.7×10^5 - 4.2×10^5 , 1.5×10^5 - 1.7×10^5 , 2.5×10^3 - 6.1×10^3 , 1.3×10^3 - 8.9×10^3 and 4.7×10^2 - 1.3×10^3 ppm, respectively; Mg, which was not always detected, ranged from 2.0×10^2 - 8.6×10^2 ppm. No significant differences in these elements mean concentrations were found between increments, except Na in one statolith between increments 1 and 5 (higher at the edge; Dunn's test $s=2.014$, $p<0.05$). Thus the general elemental composition is nearly constant throughout lifespan (i.e. along statoliths radiuses). Regarding trace elements: Sn was never detected; Al and Hg were at 22.2% of the punctual analyses conducted while Cu was at 66.7% and Ba at 88.9%. Concentrations of Al, Hg, Cu and Ba varied between 55-71, 176-180, 183-302 and 647-969 ppm, respectively.

EMPA proved to be a useful technique in sclerochronology, allowing the characterization of the overall composition of gastropods statoliths and the quantification of elements in specific locations with high resolution.

References

1. Barroso C.M. *et al.*, Mar. Biol., 146:1139, 2005
2. Lloyd D.C. *et al.*, Mar Ecol. Prog. Ser., 353:115, 2008