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Growth Incremental analysis of thin sections from marine molluscs V.2

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ABSTRACT

Annual growth patterns in marine mollusc shells are valuable indicators of the condition of marine ecologies through time. In archaeological contexts, the mollusc's time of death (i.e. the last season of growth) is an indicator of human exploitation patterns throughout the year, enabling the reconstruction of when and how often gathering occurred as well as when sites were occupied. Both pieces of information, growth rate and season of death, are vital for understanding exploitation pressure in the past, and building baselines for modern environmental policies that secure sustainable marine resources. Previously, these parameters have been determined by incremental growth-line or isotopic analyses, which are time consuming and often expensive techniques, thus restricting sample size and the overall robustness of palaeoecological interpretations.

Here, we apply Laser Induced Breakdown Spectroscopy (LIBS) to produce elemental maps (Mg/Ca) with the potential to trace and display growth patterns quickly, and at a reduced cost. We further compare the elemental maps with the results obtained from incremental growth-line analysis to provide a structural context for the geochemical data, and demonstrate the utility of an integrated methodological approach.

Our pilot study was undertaken on 12 European oysters (Ostrea edulis, Linnaeus, 1758) from the Late Mesolithic shell midden at Conors Island, Co. Sligo in the Republic of Ireland. Our LIBS analysis enabled us to accurately and quickly determine repeating growth patterns, which were in agreement with the annual growth increments visible through the microscopic analysis. Based on this comparative dataset, including structural and geochemical patterns, the Late Mesolithic site of Conors Island had been occupied throughout the year. Moreover, our analyses highlight the applicability of LIBS to determine prehistoric seasonality practices as well as biological age and growth at an improved rate and reduced cost than was previously achievable.

STEPS MATERIALS

NAME	CATALOG #	VENDOR
Ethanol		
Release Agent	20-8185-016	Buehler
Epoxy Resin	No 20-8140-12B	Buehler
Epoxy Hardener	20-8142-016	Buehler
Polycrystalline suspension	40-6016	Buehler
Adhesive	n/a	

Producing thin sections

1

Section oysters following Milner (2001) and using a precision saw with a diamond blade. First section is at the hinge and in direction of growth, the second (optional) section is done to remove unnecessarily long portions of the shell section.

ISOMET 1000 Precision Saw
Saw
Buehler 11-2180
Using a Buehler Diamond Wafering Blade (Series 15LC Diamond No. 11-4276)

Milner, N., 2001. At the Cutting Edge: Using Thin Sectioning to Determine Season of Death of the European Oyster, Ostrea edulis. Journal of archaeological science, 28(8), pp.861–873.

2 Clean cylindric plastic moulds with

Ethanol

leave to dry for **00:05:00** . Then coat the inside with

Release Agent
by Buehler
Catalog #: 20-8185-016

and dry again for **00:30:00**

3

Place sectioned shells face down in 1- and 2-inch plastic moulds depending on the size of the cut hinge.
Then add resin (2 parts by volume of Epoxy Resin mixed with 1 part by volume Epoxy Hardener.

Epoxy Resin
by Buehler
Catalog #: No 20-8140-12B

Leave to cure in an environment of constant humidity and temperature overnight (or **12:00:00**)

Epoxy Hardener
by Buehler
Catalog #: 20-8142-016

4

Remove resin block from plastic moulds once hardened, and grind hinge-surface using successively finer metallographic grit papers (P600, P1200 and P2500 grades respectively) on a Buehler Motorpol 2000.

Motorpol 2000
Polisher
Buehler 49-7268

Clean the surfaces of the resin blocks with water and polish further using a polishing cloth and polycrystalline suspension of 3µm.

Polycrystalline suspension
by Buehler
Catalog #: 40-6016

Leave to dry overnight (or **12:00:00**)

5

Attach the polished facets of the resin blocks to a glass slide using Loctite 322 Adhesive, exposed to an ultraviolet light source and leave to harden for **24:00:00** .

Adhesive
Catalog #: n/a

6

Once the sample had bonded to the slide, cut the the bodies of the resin blocks from the slide using a Buehler ISOMET 1000 Precision Saw and leave a slice of the embedded hinge of approximately 200 to 500 µm in thickness on the glass slide.

ISOMET 1000 Precision Saw
Saw
Buehler 11-2180
Using a Buehler Diamond Wafering Blade (Series 15LC Diamond No. 11-4276)

7 Repeat Step 4, iIn order to lightly ground the shell and the resin to produce the final thin section of ~50 µm.