

Supplementary Material

Sr/Ca in shells of laboratory-grown bivalves (*Arctica islandica*) serves as a proxy for water temperature – Perspectives for (paleo)environmental research?

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1 Supplementary Figures

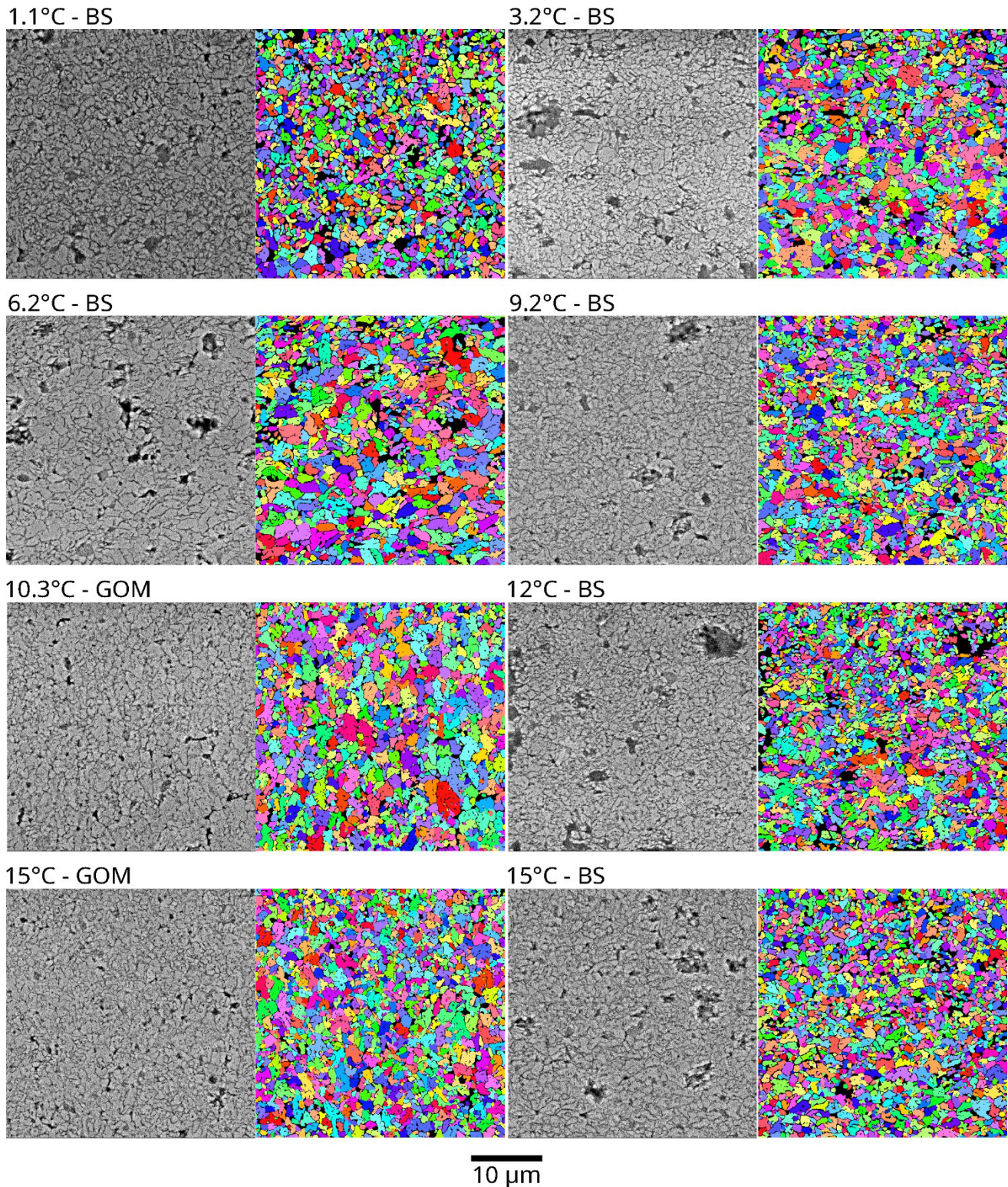


Figure S1. Example of SEM images taken at 7700 $\times$ magnification (grayscale) and their respective segmentation (colored) for discrimination of individual biomineral units (BMUs; various colors) of the homogeneous ultrastructure from the outer portion of the outer shell layer (oOSL) of *Arctica islandica* specimens cultured at 1.1, 3.2, 6.2, 9.2, 10.3, 12 and 15°C. For each image, the culturing

temperature of the laboratory tank is given (top left corner) as well as the origin of the specimen (BS = Baltic Sea experiment; GOM = Gulf of Maine). The scale applies to all images.

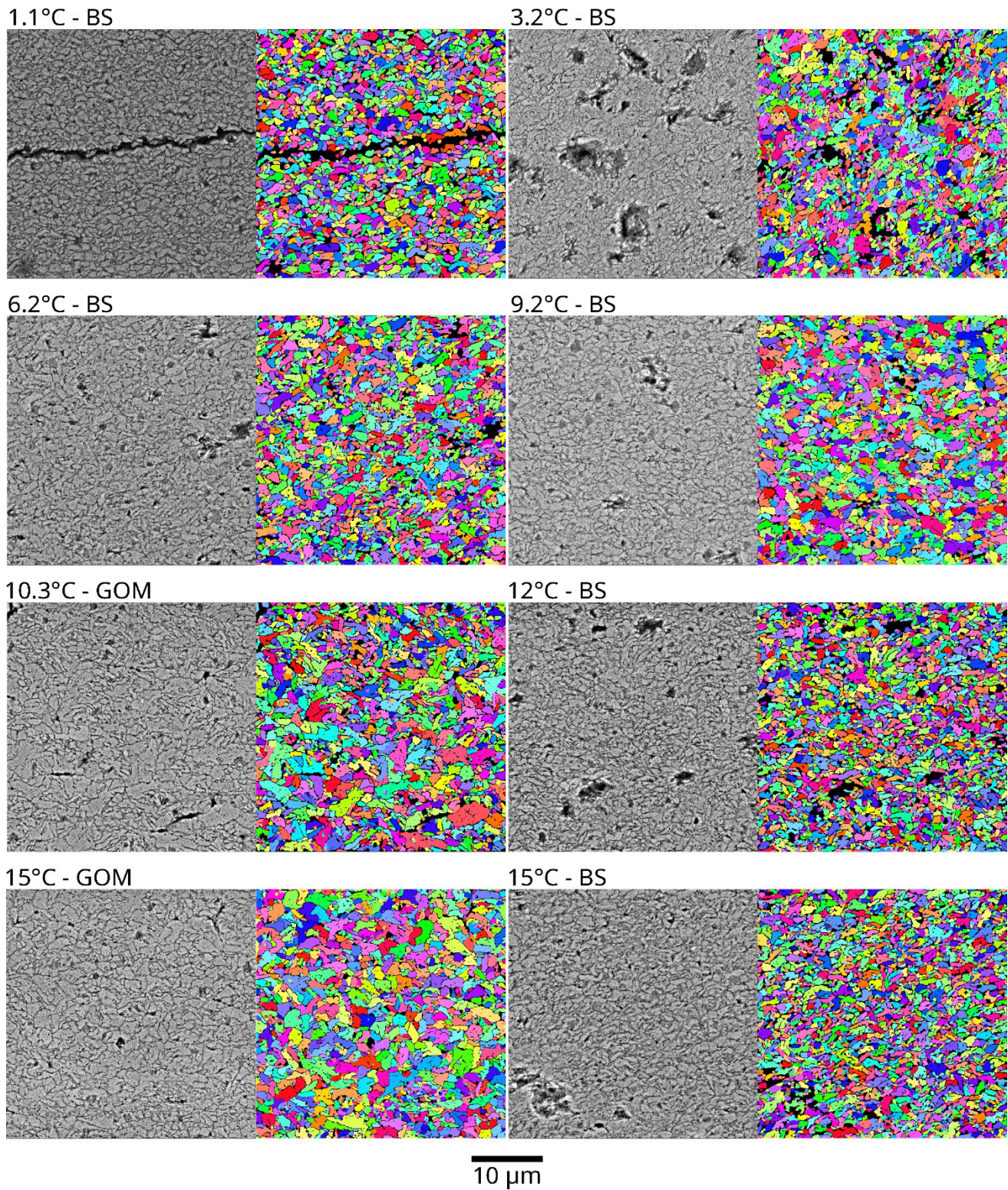


Figure S2. Example of SEM images taken at 7700 $\times$ magnification (grayscale) and their respective segmentation (colored) for discrimination of individual biomineral units (BMUs; various colors) of the crossed-acicular ultrastructure from the outer portion of the outer shell layer (iOSL) of *Arctica*

islandica specimens cultured at 1.1, 3.2, 6.2, 9.2, 10.3, 12 and 15°C. For each image, the culturing temperature of the laboratory tank is given (top left corner) as well as the origin of the specimen (BS = Baltic Sea experiment; GOM = Gulf of Maine). The scale applies to all images.

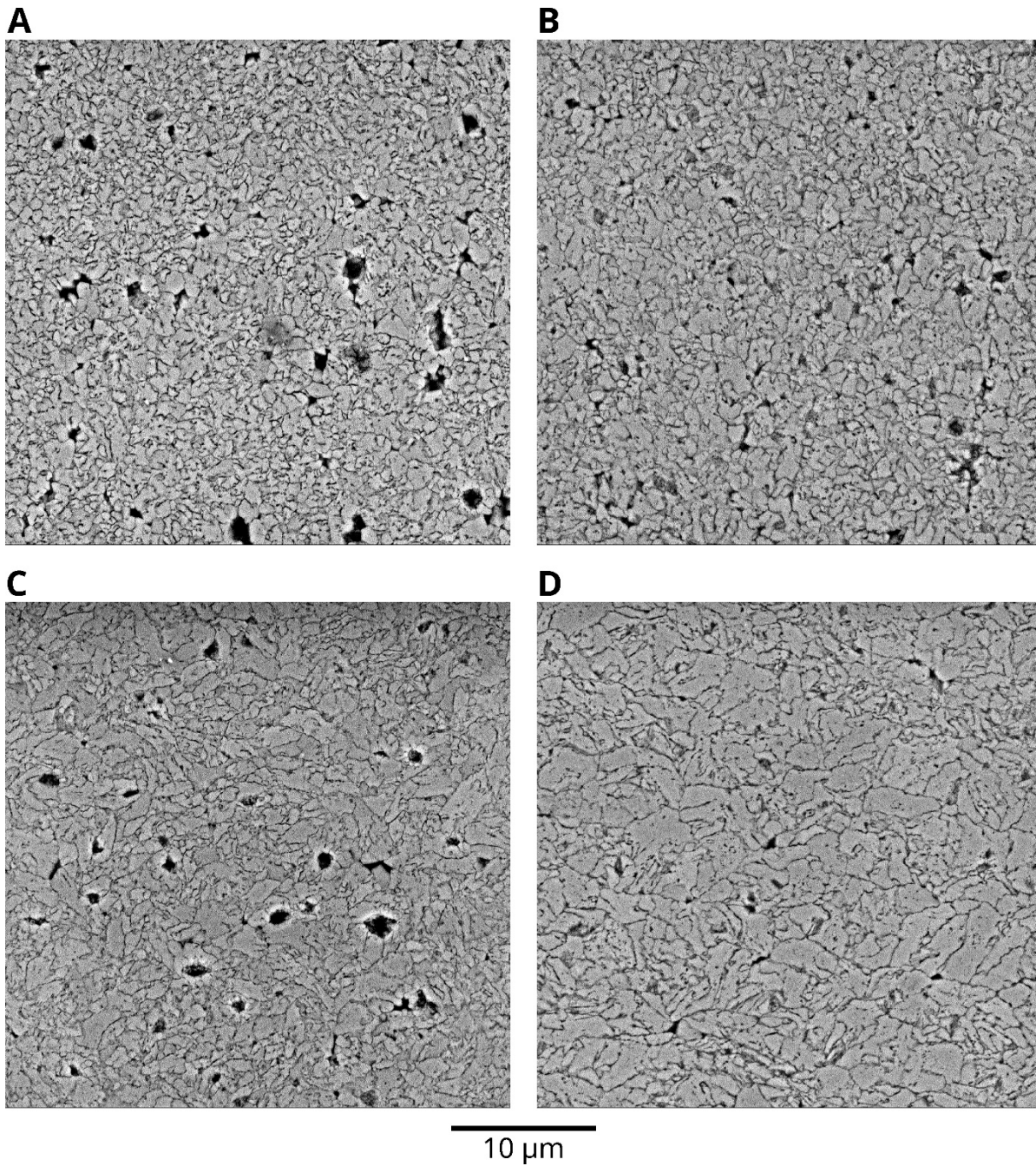


Figure S3. Example of SEM images taken at 7700 $\times$ magnification from the outer shell layer (OSL) of field-grown (NE Iceland) and laboratory-grown specimens of *Arctica islandica*. Laboratory specimens were kept at stable ambient temperature (Baltic Sea and Gulf of Maine experiments). (A-B) SEM images of the homogeneous ultrastructure of the outer portion of the OSL (oOSL). (C-D) SEM images of the crossed-acicular ultrastructure of the inner portion of the OSL (iOSL). SEM images of the shell of field-grown specimens are depicted in A and C, while B and D illustrate the shell of specimens grown in laboratory tanks. The scale applies to all images.

2 Supplementary Tables

Table S1. Quality control data for ^{88}Sr LA-ICP-MS measurements conducted on cultured shells of *Arctica islandica*. NIST SRM 610 and NIST SRM 612 were used for calibration of the ^{88}Sr concentrations of the shells. The strontium-specific relative standard deviation (RSD%) was calculated for each quality control material (QCM) from their respective preferred literature value (Longerich et al., 1996; Jochum et al., 2011, 2015). conc. = concentration.

Average calibrated ⁸⁸ Sr conc. (µg/g)	Average detection limit ⁸⁸ Sr (µg/g)	QCM	Average ⁸⁸ Sr conc. (µg/g)	Literature ⁸⁸ Sr conc. (µg/g)	RSD%
NIST SRM 610 515.5 ± 1	0.11 ± 0.01	BCR-2G	333.04 ± 4.87	342 ± 4	0.72
		MACS3-3	6703.12 ± 109.27	6640 ± 170	0.76
NIST SRM 612 78.4 ± 0.2		JCp-1	7150.00 ± 109.29	6890 ± 330	0.76
JCt-1		1387.17 ± 66.39	1410 ± 50	0.76	

Table S2. Results of Dunn tests using generalized Bonferroni-adjustment for multiple comparisons of shell properties measured in laboratory-grown *Arctica islandica* specimens. Shell Sr/Ca, the area (AR) of the biomineral units (BMUs) and the elongation of the BMUs were compared between pairs of culturing temperatures (1.1, 3.2, 6.2, 9.2, 10.3, 12 and 15 °C) and separately for the outer and inner portions of the outer shell layer (oOSL in blue and iOSL in orange, respectively). For all comparisons: ns = non-significant at $p > 0.025$, * = significant at $p < 0.025$.

Temperature regime		1.1°C	3.2°C	6.2°C	9.2°C	10.3°C	12°C	15°C
Sr/Ca								
	1.1°C		ns	ns	ns	*	ns	*
	3.2°C	ns		ns	*	*	ns	*
	6.2°C	ns	*		*	*	ns	*
	9.2°C	ns	*	ns		*	ns	ns
	10.3°C	*	*	*	*		*	*
	12°C	ns	ns	ns	ns	*		*
	15°C	*	*	*	*	*	*	
AR								
	1.1°C		ns	*	ns	ns	ns	ns
	3.2°C	ns		*	ns	ns	ns	ns
	6.2°C	*	*		*	*	*	*
	9.2°C	ns	ns	*		ns	ns	ns
	10.3°C	*	*	*	*		ns	ns
	12°C	ns	ns	*	*	*		ns
	15°C	*	*	ns	ns	*	*	
EL								
	1.1°C		ns	*	ns	ns	ns	ns
	3.2°C	ns		*	*	ns	ns	ns
	6.2°C	*	*		*	*	ns	*
	9.2°C	*	*	ns		*	ns	ns
	10.3°C	*	ns	ns	*		*	*
	12°C	*	*	ns	ns	ns		ns
	15°C	*	*	ns	ns	ns	ns	

Table S3. Ultrastructure of the outer shell layer (OSL) of field-grown (NE Iceland) and laboratory-grown (Baltic Sea and Gulf of Maine experiments) *Arctica islandica* specimens. The average area (AR; μm^2) and elongation (EL) of the biomineral units and the relative variance (%) of these ultrastructural properties are given separately for the outer portion of the OSL (oOSL), dominated by homogeneous ultrastructure, and the inner portion of the OSL (iOSL), primarily composed of crossed-acicular ultrastructure.

Growth environment	Temperature	AR (μm^2)	AR relative variance (%)	EL	EL relative variance (%)
oOSL					
Field	2 – 10°C	0.85 ± 0.18	21.09	1.78 ± 0.06	3.09
Laboratory tank	3.2- 9.2°C	1.47 ± 0.26	17.52	1.85 ± 0.07	3.52
iOSL					
Field	2 – 10°C	0.97 ± 0.19	20.18	1.77 ± 0.05	2.72
Laboratory tank	3.2- 9.2°C	1.54 ± 0.27	17.72	1.96 ± 0.08	4.03