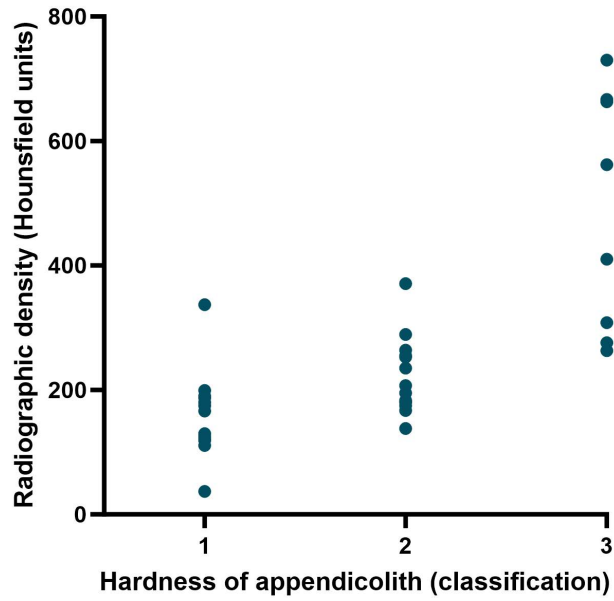


## Online supplemental material



**Supplementary Figure 1.** Correlation of Radiographic density to appendicolith hardness. Dot plot of Hounsfield units of appendicoliths in each appendicolith class.

**Supplementary Table 1.** Elemental compositions of representative appendicoliths from each class (1-3) in weight percentage measured by micro-XRF from the cross-section including mean values and standard deviation (SD) for each class.

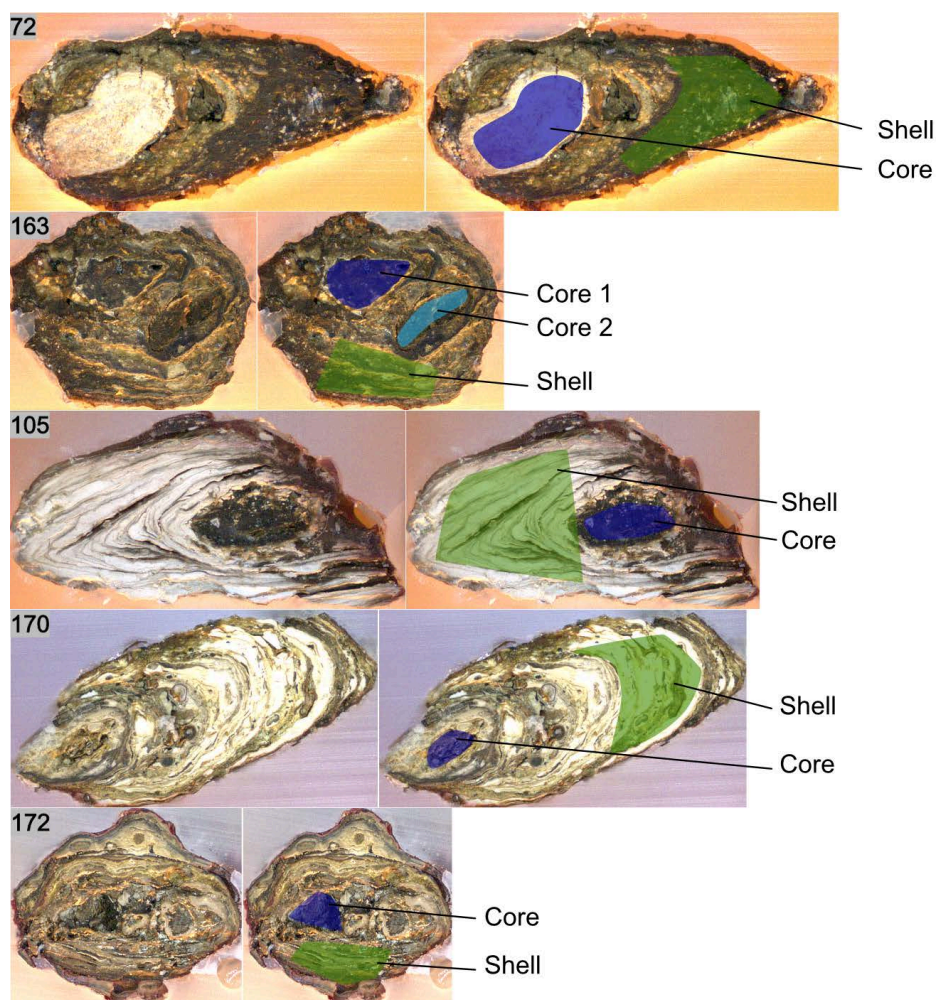
Sample	Ca	P	Mg	K	Cl	S	Zn
<b>Class 1</b>							
6	2.62	1.03	0.50	0.06	0.11	0.24	0.07
62	1.90	0.77	0.65	0.17	0.27	0.32	0.11
72	3.11	0.75	0.45	0.21	0.34	0.17	0.05
102	3.41	1.08	0.42	0.08	0.22	0.19	0.22
111	3.36	1.00	0.41	0.42	0.15	0.19	0.10
Mean	2.88	0.93	0.49	0.19	0.22	0.22	0.11
SD	0.63	0.15	0.10	0.14	0.09	0.06	0.07
<b>Class 2</b>							
84	4.55	1.61	0.80	1.38	0.27	0.18	0.07
120	3.66	1.04	0.41	0.10	0.33	0.13	0.07
163	7.27	1.92	0.52	0.21	0.22	0.16	0.06
207	6.48	1.90	0.41	0.09	0.37	0.17	0.07
213	4.89	1.89	1.01	0.15	0.52	0.14	0.03
Mean	5.37	1.67	0.63	0.38	0.34	0.16	0.06
SD	1.47	0.38	0.27	0.56	0.11	0.02	0.02
<b>Class 3</b>							
105	9.36	2.82	0.32	0.16	0.04	0.14	0.02
130	8.65	2.59	0.44	0.10	0.26	0.13	0.17
170	5.60	1.00	0.25	0.05	0.09	0.11	0.07
172	7.23	2.71	1.03	0.12	0.03	0.08	0.03
Mean	7.71	2.28	0.51	0.10	0.11	0.12	0.07
SD	1.66	0.86	0.35	0.05	0.11	0.03	0.07

Calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), chlorine (Cl), sulfur (S) and zinc (Zn).

**Supplementary Table 2.** Compositions (weight percentage) of trace elements titanium, iron, manganese and copper in the cross-section of representative appendicoliths measured by micro-XRF.

Sample	Titanium	Iron	Manganese	Copper
<b>Class 1</b>				
6	0.047	0.049	0.013	0.024
62	0.008	0.029	0.014	0.004
72	0.011	0.029	0.017	0.011
102	0.022	0.038	0.020	0.011
111	0.070	0.035	0.033	0.011
Mean	0.032	0.036	0.020	0.012
SD	0.026	0.008	0.008	0.007
<b>Class 2</b>				
84	0.017	0.056	0.029	0.017
120	0.029	0.053	0.018	0.015
163	0.036	0.022	0.021	0.008
207	0.045	0.036	0.020	0.020
213	0.072	0.037	0.016	0.006
Mean	0.040	0.041	0.021	0.013
SD	0.021	0.014	0.005	0.006
<b>Class 3</b>				
105	0.016	0.015	0.001	0.009
130	0.012	0.010	0.013	0.008
170	0.008	0.041	0.018	0.010
172	0.015	0.037	0.013	0.008
Mean	0.013	0.026	0.011	0.009
SD	0.004	0.016	0.007	0.001

**Supplementary Figure 2 and Table 3.** Photographs of representative appendicolith cross-sections showing core and shell areas. Elemental compositions in weight percentages (wt%) from the selected core and shell areas were quantified from elemental maps obtained by micro-XRF and are represented in the table. The elemental composition of the core and shell area are distinguishable. For example, a class 3 appendicolith (105) with a pigmented core had elevated levels of titanium, potassium and zinc while the calcium and phosphorus levels were decreased. Class 2 appendicolith (163), had two separate cores with differing elemental compositions. Further, a representative from class 1 (72) showed a core which was atypically white in color with elevated levels of chlorine and potassium.



Element	72		163			105		170		172	
	shell	core	shell	core 1	core 2	shell	core	shell	core	shell	core
Calcium	5.08	6.40	9.73	11.84	7.35	15.22	8.05	8.04	8.20	12.53	7.86
Phosphorus	1.56	2.63	2.48	4.78	1.94	5.07	1.26	0.80	1.73	3.82	2.09
Magnesium	0.65	1.41	0.60	1.41	0.75	0.54	0.14	0.19	0.40	0.52	0.31
Potassium	0.16	0.28	0.35	0.19	0.48	0.21	0.49	0.09	0.04	0.20	0.21
Chlorine	0.34	0.68	0.47	0.36	0.39	0.05	0.15	0.17	0.10	0.05	0.02
Sulfur	0.41	0.35	0.22	0.13	0.25	0.16	0.35	0.16	0.11	0.12	0.13
Zinc	0.09	0.09	0.08	0.05	0.08	0.01	0.15	0.13	0.06	0.04	0.03
Titanium	0.03	0.04	0.08	0.00	0.07	0.00	0.37	0.00	0.01	0.03	0.02
Iron	0.06	0.08	0.02	0.02	0.03	0.01	0.11	0.03	0.00	0.05	0.03
Manganese	0.03	0.04	0.03	0.02	0.03	0.00	0.01	0.02	0.01	0.02	0.01
Copper	0.02	0.03	0.01	0.00	0.01	0.01	0.03	0.02	0.01	0.01	0.01

**Supplementary Table 4.** Elemental composition (weight percentage) of carbon, hydrogen and nitrogen and the estimated organic proportion of representative appendicoliths from class 1-3 obtained by CHN-analysis.

Sample	Carbon (%)	Hydrogen (%)	Nitrogen (%)	Estimated organic (% <sub>no O</sub> )
<b>Class 1</b>				
6	29.0	5.1	2.4	36.5
62	34.2	6.1	4.6	44.9
72	46.0	8.2	2.4	56.6
102	30.8	5.1	2.1	38.0
111	36.9	6.1	2.8	45.8
<b>Class 2</b>				
84	33.6	5.6	2.4	41.6
120	20.7	3.5	1.8	26.0
<b>Class 3</b>				
105	25.2	4.0	1.5	30.7
105	29.3	4.7	1.9	35.8
130	19.4	3.5	1.4	24.3
170	51.4	8.3	1.5	61.1
172	25.0	4.2	1.0	30.1