

Mediterranean Marine Science

Vol 21, No 3 (2020)

Vol 21, n3



Benthic foraminifera and brachiopods from a marine cave in Spain: environmental significance

LUISA BERGAMIN, EMMA TADDEI RUGGIERO, GIANCARLO PIERFRANCESCHI, BELEN ANDRES, RICARDO CONSTANTINO, CINZIA CROVATO, ANDREA D'AMBROSI, ANDREA MARASSICH, ELENA ROMANO

doi: [10.12681/mms.23482](https://doi.org/10.12681/mms.23482)

To cite this article:

BERGAMIN, L., TADDEI RUGGIERO, E., PIERFRANCESCHI, G., ANDRES, B., CONSTANTINO, R., CROVATO, C., D'AMBROSI, A., MARASSICH, A., & ROMANO, E. (2020). Benthic foraminifera and brachiopods from a marine cave in Spain: environmental significance. *Mediterranean Marine Science*, 21(3), 506–518. <https://doi.org/10.12681/mms.23482>

Integrated environmental study in the CT12 marine cave (Eastern Spanish coast) through benthic fauna and sediment texture

Luisa BERGAMIN, Emma TADDEI RUGGIERO, Giancarlo PIERFRANCESCHI, Belen ANDRES, Ricardo CONSTANTINO, Cinzia CROVATO, Andrea D'AMBROSI, Andrea MARASSICH, and Elena ROMANO

Mediterranean Marine Science, 2020, 21 (3)

Fig. S1: Grainsize distribution curve; gravel (orange), sand (yellow), silt (green), clay (blue).

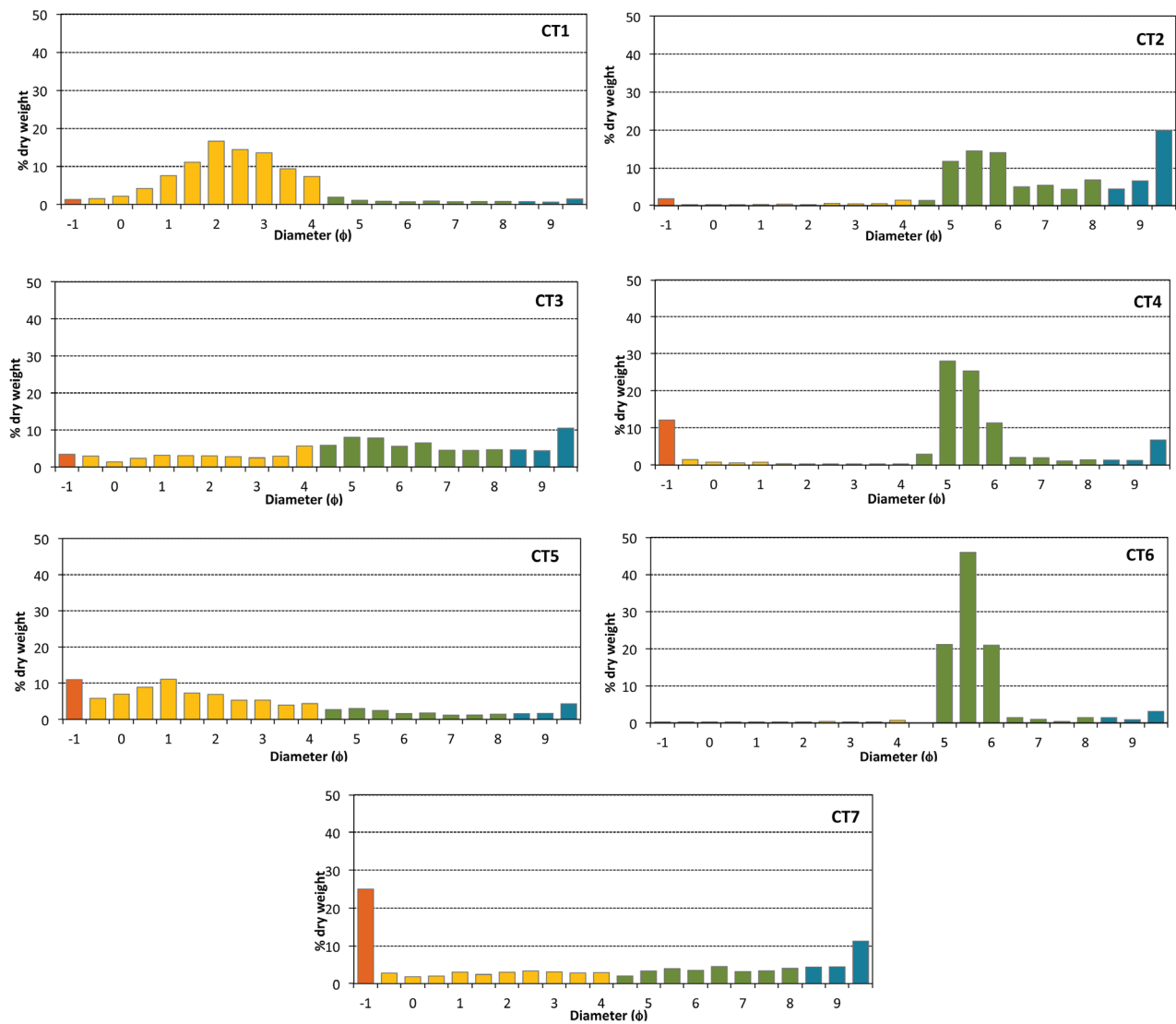


Table S1. Results of grain size analysis with sediment fractions at 0.5 ϕ interval.

f	CT1	CT2	CT3	CT4	CT5	CT6	CT7
-1.0	1.3	1.8	3.4	12.2	11.0	0.0	25.0
-0.5	1.5	0.2	2.9	1.5	5.9	0.1	2.8
0.0	2.2	0.1	1.4	0.7	7.0	0.1	1.8
0.5	4.2	0.2	2.4	0.5	8.9	0.1	2.0
1.0	7.6	0.3	3.2	0.7	11.1	0.1	3.0
1.5	11.1	0.4	3.1	0.3	7.3	0.2	2.4
2.0	16.6	0.3	3.0	0.1	6.9	0.2	3.0
2.5	14.4	0.6	2.8	0.1	5.3	0.4	3.3
3.0	13.5	0.5	2.5	0.1	5.3	0.2	3.1
3.5	9.4	0.5	2.9	0.1	4.0	0.3	2.8
4.0	7.4	1.5	5.7	0.1	4.4	0.7	2.9
4.5	1.9	1.4	5.9	2.9	2.7	0.0	2.0
5.0	1.1	11.7	8.0	28.1	3.0	21.1	3.4
5.5	0.9	14.4	7.8	25.4	2.5	45.9	3.9
6.0	0.7	14.0	5.6	11.4	1.6	20.9	3.5
6.5	0.9	5.0	6.5	2.0	1.8	1.5	4.5
7.0	0.7	5.3	4.5	1.9	1.2	1.0	3.2
7.5	0.8	4.3	4.5	1.1	1.2	0.4	3.4
8.0	0.8	6.8	4.7	1.4	1.4	1.5	4.0
8.5	0.8	4.4	4.6	1.3	1.6	1.5	4.4
9.0	0.6	6.6	4.4	1.3	1.7	0.9	4.4
11.0	1.4	19.9	10.5	6.8	4.3	3.1	11.2

Table S2. Foraminifera absolute abundance standardized at 1 g dry sediment. Faunal parameters are also given at the table bottom.

	CT1	CT2	CT3	CT4	CT5	CT6	CT7
<i>Adelosina cliariensis</i> (Heron-Allen & Earland, 1930)	0	0	0	0	0	0	25
<i>Adelosina mediterraneensis</i> (Le Calvez & Le Calvez, 1958)	4	0	0	0	0	0	0
<i>Affinetrina planciana</i> (d'Orbigny, 1839)	0	33	0	0	0	0	0
<i>Articulina carinata</i> Wiesner, 1923	0	0	0	0	0	20	0
<i>Asterigerinata mamilla</i> (Williamson, 1858)	32	33	25	25	0	0	0
<i>Astrononion stelligerum</i> (d'Orbigny, 1839)	4	67	50	13	67	0	0
<i>Aubignyna perlucida</i> (Heron-Allen & Earland, 1913)	0	67	25	75	0	40	0
<i>Bolivina alata</i> (Seguenza, 1862)	0	0	0	0	0	20	0
<i>Bolivina catanensis</i> Seguenza, 1862	0	33	0	25	0	0	0
<i>Bolivina earlandi</i> Parr, 1950	0	33	0	13	17	20	50
<i>Bolivina pseudoplicata</i> Heron-Allen & Earland, 1930	0	67	0	13	0	0	0
<i>Bolivina striatula</i> Cushman, 1922	0	0	0	38	0	0	0
<i>Bolivina variabilis</i> (Williamson, 1858)	0	700	50	375	0	80	50
<i>Bulimina aculeata</i> d'Orbigny, 1826	0	0	0	0	0	0	25
<i>Bulimina elongata</i> d'Orbigny, 1846	4	0	0	13	0	0	0
<i>Bulimina marginata</i> d'Orbigny, 1826	0	33	0	0	0	0	75
<i>Buliminella elegantissima</i> (d'Orbigny, 1839)	0	33	0	0	0	0	0
<i>Carterina spiculotesta</i> (Carter, 1877)	0	33	0	0	0	0	0
<i>Cibicides refulgens</i> Montfort, 1808	68	33	125	88	100	20	25
<i>Cibicoides lobatulus</i> (Walker & Jacob, 1798)	112	433	125	125	100	60	50
<i>Cibicoides variabilis</i> (d'Orbigny, 1826)	64	0	0	0	0	0	0
<i>Conorbella erecta</i> (Sidebottom, 1908)	16	0	0	0	0	0	0
<i>Cornuspira involvens</i> (Reuss, 1850)	0	33	0	0	0	0	0
<i>Cribrostomoides jeffreysii</i> (Williamson, 1858)	0	0	25	0	0	20	0
<i>Cycloforina</i> sp.	4	0	0	0	0	0	0
<i>Cymbaloporetta</i> sp.	4	0	0	0	0	0	0
<i>Discamina compressa</i> (Goess, 1882)	0	0	0	0	0	0	25
<i>Discorbis torrei</i> (Bermudez, 1935)	0	0	0	0	0	40	0
<i>Elphidium aculeatum</i> (d'Orbigny, 1846)	48	0	0	0	0	0	0
<i>Elphidium advenum</i> (Cushman, 1922)	4	0	25	0	0	0	0
<i>Elphidium crispum</i> (Linnaeus, 1758)	4	0	0	0	0	0	0
<i>Elphidium fichtelianum</i> (d'Orbigny, 1846)	8	0	0	0	0	0	0
<i>Elphidium pulvereum</i> Todd, 1958	4	0	0	0	0	0	0
<i>Eponides repandus</i> (Fichtel & Moll, 1798)	0	267	50	13	0	20	0
<i>Fissurina orbignyana</i> Seguenza, 1862	0	33	0	38	0	20	0
<i>Fissurina</i> sp.	0	33	0	13	0	0	0
<i>Fursenkoina subacuta</i> (d'Orbigny, 1852)	0	0	0	0	0	20	0
<i>Gavelinopsis praegeri</i> (Heron-Allen & Earland, 1930)	168	233	25	75	17	80	25
<i>Globocassidulina crassa</i> (d'Orbigny, 1839)	0	33	0	63	0	40	0
<i>Globocassidulina subglobosa</i> (Brady, 1881)	0	233	0	175	0	80	0
<i>Gyroidina umbonata</i> (Silvestri, 1898)	0	0	0	13	0	40	0
<i>Haynesina depressula</i> (Walker & Jacob, 1798)	0	33	0	63	0	0	25
<i>Haynesina germanica</i> (Ehrenberg, 1840)	0	0	0	0	0	40	0
<i>Laevidentalina communis</i> (d'Orbigny, 1826)	0	33	0	0	0	0	0
<i>Lagena</i> sp.	0	0	0	13	0	0	0

continued

Table S2 continued

	CT1	CT2	CT3	CT4	CT5	CT6	CT7
<i>Lagenammia fusiformis</i> (Williamson, 1858)	0	33	0	13	17	0	0
<i>Lamarckina scabra</i> (Brady, 1884)	8	33	0	0	0	0	0
<i>Lenticulina gibba</i> (d'Orbigny, 1839)	0	67	0	0	0	0	25
<i>Lepidodeuterammia ochracea</i> (Williamson, 1858)	0	0	0	0	0	20	0
<i>Leptohalysis scottii</i> (Chaster, 1892)	0	0	0	13	0	0	0
<i>Melonis barleeanus</i> (Williamson, 1858)	0	0	0	13	0	0	0
<i>Miliolinella semicostata</i> (Wiesner, 1923)	0	0	0	25	0	0	0
<i>Miliolinella subrotunda</i> (Montagu, 1803)	120	500	375	200	183	120	125
<i>Neoconorbina terquemi</i> (Rzehak, 1888)	4	0	0	0	0	0	0
<i>Patellina corrugata</i> Williamson, 1858	4	2,867	1,300	1,488	1,250	2,040	2,900
<i>Peneroplis pertusus</i> (Forsskal in Niebuhr, 1775)	16	0	0	0	0	0	0
<i>Peneroplis planatus</i> (Fichtel & Moll, 1798)	8	0	0	0	0	0	0
<i>Pileolina patelliformis</i> (Brady, 1884)	0	33	0	25	0	0	0
<i>Planorbulina mediterraneensis</i> d'Orbigny, 1826	36	0	25	0	0	0	50
<i>Pseudotriloculina cuneata</i> (Karrer, 1867)	0	0	0	0	0	100	0
<i>Pseudotriloculina lecalvezae</i> (Kaasschieter, 1961)	0	0	0	0	0	40	0
<i>Pseudotriloculina</i> sp.	8	0	150	0	0	0	0
<i>Pyrgo inornata</i> (d'Orbigny, 1846)	0	0	0	13	0	0	0
<i>Quinqueloculina auberiana</i> d'Orbigny, 1839	20	67	50	50	0	0	0
<i>Quinqueloculina berthelotiana</i> d'Orbigny, 1839	12	33	25	0	33	20	0
<i>Quinqueloculina bosciiana</i> d'Orbigny, 1839	0	167	0	13	0	40	0
<i>Quinqueloculina irregularis</i> d'Orbigny in Terquem, 1878	16	0	0	0	0	0	0
<i>Quinqueloculina laevigata</i> d'Orbigny, 1839	0	0	0	0	0	20	0
<i>Quinqueloculina lata</i> Terquem, 1876	8	0	50	25	17	20	0
<i>Quinqueloculina milletti</i> Wiesner, 1923	0	0	0	0	0	60	0
<i>Quinqueloculina parvula</i> Schlumberger, 1894	8	200	75	138	100	20	25
<i>Quinqueloculina pygmaea</i> Reuss, 1850	0	33	0	13	0	40	0
<i>Quinqueloculina seminulum</i> (Linnaeus, 1758)	0	0	175	125	183	20	25
<i>Quinqueloculina stelligera</i> (Terquem, 1882)	12	67	250	13	83	40	25
<i>Quinqueloculina ungeriana</i> d'Orbigny, 1846	44	0	0	0	0	0	0
<i>Quinqueloculina</i> cf <i>venusta</i> Karrer, 1868	0	0	225	0	17	0	25
<i>Rosalina bradyi</i> (Cushman, 1915)	56	100	225	88	133	40	75
<i>Rosalina floridana</i> (Cushman, 1922)	16	133	0	50	0	20	0
<i>Rosalina obtusa</i> d'Orbigny, 1846	0	33	0	0	17	0	0
<i>Rosalina posidonicola</i> (Colom, 1942)	0	0	0	25	0	0	0
<i>Sahulina conica</i> (d'Orbigny, 1839)	44	0	25	0	0	0	25
<i>Sejunctella</i> sp.	0	967	400	125	233	120	250
<i>Sigmoilina costata</i> Schlumberger, 1893	0	67	0	38	33	0	0
<i>Sigmoilina grata</i> (Terquem, 1878)	4	133	0	13	17	0	0
<i>Sigmoilopsis schlumbergeri</i> (Silvestri, 1904)	0	67	450	150	550	40	75
<i>Siphonina reticulata</i> (Czjžek, 1848)	0	133	25	38	150	20	100
<i>Spirillina vivipara</i> Ehrenberg, 1843	4	1,967	1,875	1,000	767	1,540	1,875
<i>Spiroloculina ornata</i> d'Orbigny, 1839	8	267	225	175	467	20	75
<i>Spirophthalmidium emaciatum</i> (Haynes, 1973)	0	1,133	250	225	17	420	400

continued

Table S2 continued

	CT1	CT2	CT3	CT4	CT5	CT6	CT7
<i>Spiroplectinella earlandi</i> (Parker, 1952)	0	100	75	0	67	0	50
<i>Spiroplectinella wrighti</i> (Silvestri, 1903)	16	0	0	0	17	0	0
<i>Spirosigmoilina tenuis</i> (Czjzek, 1848)	0	0	0	50	0	0	25
<i>Textularia agglutinans</i> d'Orbigny, 1839	16	0	0	0	0	0	0
<i>Textularia bocki</i> Höglund, 1947	100	0	0	13	33	0	0
<i>Tretomphaloides concinnus</i> (Brady, 1884)	4	0	0	0	0	0	0
<i>Triloculina plicata</i> Terquem, 1878	4	33	0	0	0	0	25
<i>Triloculina schreiberiana</i> d'Orbigny, 1839	24	0	0	0	0	0	0
<i>Tubinella inornata</i> (Brady, 1884)	0	2,533	1,225	350	433	620	975
<i>Vertebralina striata</i> d'Orbigny, 1826	12	0	0	0	0	0	0
Unknown specimen	0	0	0	0	0	20	0
Taxa_S	44	48	31	49	28	41	30
Dominance_D	0.06	0.11	0.12	0.11	0.12	0.19	0.23
Shannon_H	3.14	2.75	2.59	2.85	2.55	2.31	1.99
FN	1,180	14,300	8,000	5,763	5,117	6,120	7,525

Table S3. Relative abundance of commonly occurring foraminiferal species.

	CT1	CT2	CT3	CT4	CT5	CT6	CT7
<i>Bolivina variabilis</i>	0.0	4.9	0.6	6.5	0.0	1.3	0.7
<i>Cibicides refulgens</i> *	5.8	0.2	1.6	1.5	2.0	0.3	0.3
<i>Cibicidoides lobatulus</i> *	9.5	3.0	1.6	2.2	2.0	1.0	0.7
<i>Gavelinopsis praegeri</i> *	14.2	1.6	0.3	1.3	0.3	1.3	0.3
<i>Miliolinella subrotunda</i> *	10.2	3.5	4.7	3.5	3.6	2.0	1.7
<i>Patellina corrugata</i> *	0.3	20.0	16.3	25.8	24.4	33.3	38.5
<i>Rosalina</i> spp. *	6.1	1.9	2.8	2.4	2.9	1.0	1.0
<i>Sejunctella</i> sp. *	0.0	6.8	5.0	2.2	4.6	2.0	3.3
<i>Sigmoilopsis schlumbergeri</i>	0.0	0.5	5.6	2.6	10.7	0.7	1.0
<i>Spirillina vivipara</i> *	0.3	13.8	23.4	17.4	15.0	25.2	24.9
<i>Spirophthalmidium emaciatum</i>	0.0	7.9	3.1	3.9	0.3	6.9	5.3
<i>Textularia bocki</i>	8.5	0.0	0.0	0.2	0.7	0.0	0.0
<i>Tubinella inornata</i> *	0.0	17.7	15.3	6.1	8.5	10.1	13.0

* epifaunal clinging-attached taxa according to Murray (2006).

Table S4. Absolute abundance of Brachiopoda.

	CT1	CT2	CT3	CT4	CT5	CT6	CT7
<i>Argyrotheca cistellula</i> (Searles-Wood, 1841)	14	15	51	20	19	32	22
<i>Argyrotheca cuneata</i> (Risso, 1826)	45	7	22	21	41	9	5
<i>Gwynia capsula</i> (Jeffreys, 1859)	0	0	0	0	0	7	0
<i>Joania cordata</i> (Risso, 1826)	29	0	0	0	0	0	0
<i>Megathiris detruncata</i> (Gmelin, 1791)	1	0	0	1	11	0	0
<i>Novocrania anomala</i> (Mueller, 1776)	22	5	10	4	78	0	0
<i>Tethyrynchia mediterranea</i> (Logan, 1994)	2	12	42	5	32	16	29
Total # individuals	113	39	125	51	181	64	56
Number of species	6	4	4	5	5	4	3