

FIGURE 26. A-G) *Rotalia trochidiformis*. A: uncentered axial section. B: centered axial sections. C-D: uncentered axial sections. E: section perpendicular to coiling axis. F-G: centered axial sections. Specimen A: sample I 4; B: sample SC 1; C: sample SC 32; D: sample I 51; E: sample G 48; F: sample I 54 and G: sample G 23. H-O) *Medocia blayensis*. H: section perpendicular to coiling axis. I: oblique axial section. J, K: oblique peripheral sections. L: sections perpendicular to coiling axis. M: oblique section. N, O: oblique sections perpendicular to coiling axis. Specimen H: sample G 58; I: sample G 60; J-L, N, O: sample I 50 and M: sample G 16. P-S) *Neorotalia lithoamnica*. P, R: oblique sections perpendicular to coiling axial. Q, S: oblique axial sections. Specimen P: sample I 12; Q: sample G 3; R: sample I 2 and S: sample G 19. Abbreviations: pr: proloculus; up: umbilical plate; ump: umbilical pile; fol: folia.

its biostratigraphic context (Figs. 3; 4). Summarizing, the biostratigraphic range of this species is early Lutetian to Priabonian (SBZ13-SBZ20).

Family: Chapmaninidae THALMANN, 1938

GENUS *Chapmanina* SILVESTRI, 1905

Type species: *Chapmanina gassinensis* SILVESTRI, 1905

Chapmanina gassinensis SILVESTRI, 1905 Fig. 25W

1973 *Chapmanina gassinensis* (Silvestri). Deloffre and Hamaoui, pl. 11, fig. 8.

1975 *Chapmanina gassinensis* (Silvestri). Colom, p. 239, pl. 27, fig. 2; text-figs. 85.5-7

1979 *Chapmanina gassinensis* (Silvestri). Drobne *et al.*, pl. 3, figs. 7 and 8

1994 *Chapmanina gassinensis* (Silvestri 1905). Pignatti, pl. 3, fig. 8

2000 *Chapmanina gassinensis* (Silvestri). Sirel, pl. 3, fig. 14

2001 *Chapmanina gassinensis* Silvestri 1905. Romero, p. 192-193; pl. 18, figs. 1-7; pl. 19, figs. 1-9

2003 *Chapmanina gassinensis* (Silvestri, 1931). Sirel, p. 305; pl. 8, fig. 17

Material. This species is present in the Sierra Caballera section (Fig. 5).

Remarks. Only a non centered longitudinal section was available. Test of conical morphology. The neanic stage displays a uniserial arrangement of the chambers which are connected by crosswise stolons.

Age. According to Romero (2001) and Sirel (2003) the biostratigraphic range of this species is Bartonian-Priabonian (SBZ17-SBZ20). This species belongs to sample SC 23 (Fig 5) which occurs below beds with *Nummulites crassus* (N. sordensis-N. crassus Zone), indicating middle Lutetian 2 or SBZ15. Thus, the biostratigraphic range of this species extends from middle Lutetian 2 (SBZ15) to Priabonian (SBZ20).

Taxa Excluded from the Family ROTALIIDAE by Hottinger (2014)

GENUS *Neorotalia* BERMÚDEZ, 1952

Type species: *Rotalia mexicanai* NUTTALL, 1928

Neorotalia lithamnica (UHLIG, 1886)

Fig. 26P-S

2014 *Neorotalia lithamnica* (Uhligh, 1886). Hottinger, pl. 8.2

Material. This species is present in the Gabardiella and Isuela sections (Figs. 3; 4).

Description. Test with trochospiral growth and lenticular morphology. The dorsal and ventral sides show large plugs

and piles distributed from the polar and umbilical zones to the periphery. The length for 15 chambers, measured in a section perpendicularly to the coiling axis, is 1.2mm.

Age. According to Hottinger (2014) the biostratigraphic range of this species is SBZ13-SBZ14 (early-middle Lutetian 1). In the material studied this species is associated with *Alveolina callosa*, *A. ospiensis* and *A. stipes* (samples G 3 and G 19; Fig 3), indicating early Lutetian (A. stipes Zone) or SBZ13. The presence of *N. lithamnica* in SBZ14 is justified by its occurrence between samples with *Nummulites aspermontis* and *N. beneharnensis* (Fig. 4), indicating middle Lutetian 1.

Family: Nummulitidae DE BLAINVILLE, 1825

Subfamily: Nummulitinae DE BLAINVILLE, 1825

GENUS *Assilina* D'ORBIGNY, 1839

Type species: *Assilina depressa* D'ORBIGNY, 1850

Assilina spira abrardi SCHAUB, 1981

Fig. 27A-L

1963 *Assilina spira* (De Roissy). Schaub, p. 294, fig. 5

1966 *Assilina spira*. Schaub, fig. 1

1981 *Assilina spira abrardi* n. ssp.. Schaub, p. 202; fig. 114; pl. 78, figs. 6, 11-20; pl. 79, figs. 1-16; pl. 80, figs. 1-13; tbl. 16, fig. i

2012a *Assilina spira abrardi* Schaub, 1981. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 1-3, pl. 2, figs. 30-31

Material. This species is present in the Gabardiella, Isuela and Sierra Caballera sections (Figs. 3-5).

Description. Micro- and megalospheric forms with planispiral and evolute growth, showing a lenticular flattened morphology and rounded periphery. Diameter is 18.5mm for 11 whorls. In both generations the ornamentation is formed of spiral and septal ridges and granules at the polar zones and over the septal ridges in the inner whorls. Slightly irregular spiral growth. Marginal cord thin, varying in thickness from 1/4 the chamber's height in the external whorls to 1/5 in the inner whorls. Chambers higher than long. The septa are straight and slightly curved backwards at the top of the chambers. The septa distribution is regular in the inner whorls and irregular in the outer ones. The diameter of the megalospheric forms is around 8.2-8.5mm for 5 whorls. The proloculus of the megalospheric forms is 420-680µm in diameter. Further measurements of the equatorial section of megalospheric forms in Table 1.

Age. This species is associated with *Alveolina stipes* (sample I 7; Fig. 4) and with *Nummulites lehneri* (samples G 4 and SC 16; Figs. 3; 5), indicating early Lutetian (A. stipes and N. laevigatus-N. obesus zones) or SBZ13.

GENUS *Nummulites* LAMARCK, 1801Type species: *Camerina laevigata* BRUGUIÈRE, 1792*Nummulites lehneri* SCHAUB, 1981

Fig. 28A-L

1981 *Nummulites lehneri* n. sp. Schaub, p. 97; fig. 81; pl. 11, figs. 13-27; tbl. 4, fig. a2012a *Nummulites lehneri* Schaub, 1981. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 10-15; pl. 2, figs. 1-5**Material.** This species is present in the Gabardiella and Sierra Caballera sections (Figs. 3; 5).**Description.** The microspheric forms show a lenticular morphology and an acute periphery. Diameter 5.7-6.2mm for 10 whorls, 10.7mm for 16 whorls with a thickness of 4.5mm. Spiral growth regular and divided in three zones, the first zone formed of 4-5 tightly coiled whorls, thesecond zone formed of 5-6 looser whorls and the third zone is poorly developed and formed only of 1-2 tight whorls. Chambers are isometric except in the external whorls, where they are slightly longer than high. Ornamentation composed of sinuous filaments bearing granules. Marginal cord thin. Septa inclined. The megalospheric forms show a lenticular morphology. The diameter of the test is 3.5-4.0mm and the thickness of the test is 2.5mm for 4-5 whorls. Ornamentation similar to the one in the microspheric forms. Chambers with rhomboidal outline mainly longer than high. Septa inclined, some slightly curved backwards at the top. Proloculus is 380-440 μ m in diameter. The equatorial section in megalospheric forms shows the values listed in Table 2.**Age.** This species is associated with *Assilina spira abrardi* (samples G 4 and SC 16; Figs. 3; 5), indicating early Lutetian (*A. spira abrardi* and *N. laevigatus*-*N. obesus* zones) or SBZ13.*Nummulites aspermontis* SCHAUB, 1981

Fig. 28M-U

1981 *Nummulites aspermontis* n. sp. 1981. Schaub, p. 104, fig. 85; pl. 13, figs. 24, 26-37; tbl. 4, fig. n2012a *Nummulites aspermontis* Schaub, 1981. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 4-6; pl. 2, figs. 6-10**Material.** This species is present in the Isuela section (Fig. 4).**Description.** Microspheric forms of middle size, lenticular morphology and acute periphery. Diameter around 10.2mm for 14-15 whorls. Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth divided in three zones, the first zone comprising 4-5 tightly coiled whorls, the second zone comprising 9-10 looser and regular whorls, and the third zone comprising 1-3 tight whorls. Marginal cord thick, approximately 1/2 of the height of the chambers. Megalospheric forms with a morphology and an ornamentation similar to that of the B-forms. Spiral growth is regular with diameters of 3.4-4.0mm for 4 whorls and 4.0-4.3mm for 5 whorls. The thickness of the marginal cord is 1/2-1/3 of the chamber height. Proloculus is 400-680 μ m in diameter. The equatorial section in megalospheric forms shows the values in Table 3.

In both generations the septa are inclined and curved. In the external whorls of the microspheric forms particular septa may be undulate. The chambers are rhomboidal in morphology, isometric in the inner whorls, longer than high in the other whorls.

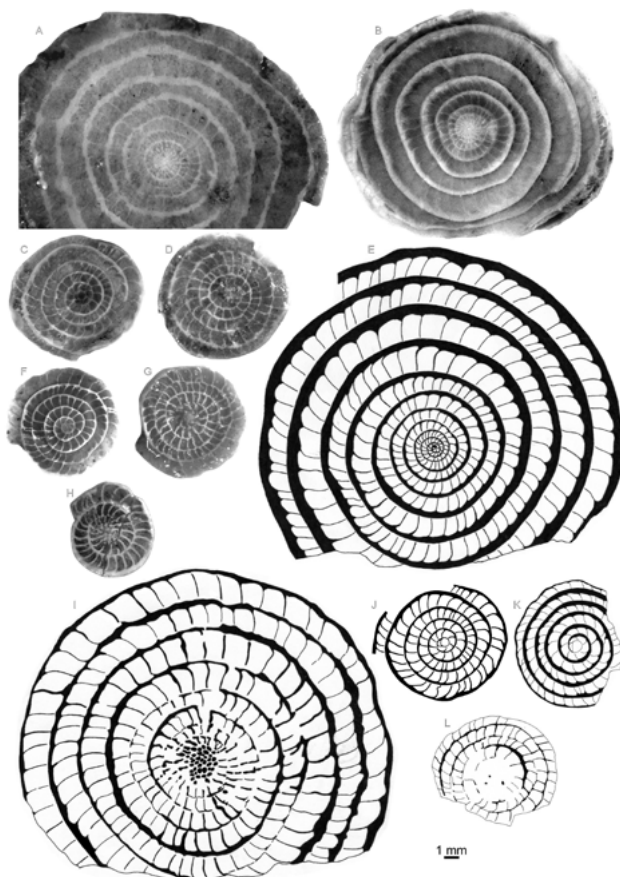
Remarks. *N. aspermontis* shows the marginal cord thicker, the distribution of chambers more regular, the

FIGURE 27. A-L) *Assilina spira abrardi*. A: external view, microspheric form. B: equatorial section, microspheric form. C-D: equatorial sections, megalospheric forms. E: drawings on photography, equatorial section, microspheric form. F: equatorial sections, megalospheric forms. G-H: external view, megalospheric forms. I-L: drawings on photography. I: external view, microspheric form. J-K: equatorial sections, megalospheric forms. L: external view, megalospheric form. All specimens from sample G 5.



FIGURE 28. A-L) *Nummulites lehneri*. A: equatorial section, microspheric form. B: external view, microspheric form. C-K: equatorial sections, megalospheric forms. L: external view, megalospheric form. All specimens from sample G 5. M-U) *Nummulites aspermontis*. M: equatorial section, microspheric form. N-S: equatorial sections, megalospheric forms. T, U: external view, megalospheric forms. All specimens from sample I 8. V-B') *Nummulites beneharnensis*. V-W: equatorial sections, megalospheric forms. X: equatorial section, microspheric form. Y-A') megalospheric forms. B': external view, megalospheric form. All specimens from sample I 18. C'-L') *Nummulites crassus*. C': equatorial section, microspheric form. D': external view, microspheric form. E'-J'): equatorial sections, megalospheric forms. K': external view and L': axial section, megalospheric form. All specimens from sample SM 4. M'-Q') *Nummulites taverdetensis*. M': equatorial section, microspheric form. N'-P'): equatorial sections, megalospheric forms. Q': external view, megalospheric form. All specimens from sample SM 4. R'-X') *Nummulites aturicus*. R'-S'): equatorial section, megalospheric forms. T': equatorial section, microspheric form. U'-V'): equatorial section, megalospheric forms. W', X': external views, megalospheric forms. Specimens R'-T', W: sample SC 39 and U', V', X': sample SC 50.

septum inclined and curved backwards at the top and the granules less dense on the surface than *N. beneharnensis*.

Age. This species is found associated with *N. beneharnensis* (sample I 8; Fig. 4), indicating middle Lutetian 1 (N. gratus-N. beneharnensis Zone) or SBZ14.

Nummulites beneharnensis DE LA HARPE, 1926

Fig. 28V-B'

1981 *Nummulites beneharnensis* De La Harpe, 1926. Schaub, p.86; fig. 76; pl. 12, figs. 33-44; pl. 13, figs. 1-22, 25; tbl. 2 fig. k

2012a *Nummulites beneharnensis* De La Harpe, 1926 Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 7-9, pl. 2, figs. 11-15

Material. This species is present in the Santa Marina and Isuela sections (Figs. 2; 4).

Description. Microspheric forms show an inflated lenticular morphology and rounded periphery. Diameter 13.3mm, thickness 4.8mm for 20 whorls. Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth divided in three zones. The first zone comprising 4-5 tightly coiled whorls, the second zone comprising 9 looser and irregular whorls, and the third zone comprising 1-2 tight whorls. Megalospheric forms of inflated lenticular morphology. Diameter 4.0-4.3mm and thickness 2.2mm for 5 whorls. Ornamentation formed of sinuous filaments and granules on and between the filaments. Proloculus is 400-460 μ m in diameter. Equatorial section in megalospheric forms shows values as in Table 4.

In both generations the septa are inclined and curved, in the external whorls of the microspheric forms some septa can be undulate. Chambers are rhomboidal, isometric in the inner whorls, and longer than high in the rest of the whorls. Irregular spiral growth. Thin marginal cord, representing 1/5 and 1/3 of the height of the chambers.

Remarks. *N. beneharnensis* differs from *N. aspermontis* in the tighter spiral growth, thinner marginal cord and denser granules on the surface.

Age. This species occurs along with *N. aspermontis* (sample I 8 and I 18; Fig. 4) and *N. boussaci* (sample SM 1; Fig. 2), indicating middle Lutetian 1 (N. gratus-N. beneharnensis Zone) or SBZ14.

Nummulites crassus BOUBÉE, 1831

Figs. 28C'-E

1963 *Nummulites crassus* Boubée. Schaub, p. 286-294; fig. 3

1972 *Nummulites crassus* Boubée. Blondeau, P 81, 161; pl.34, fig. 5

1981 *Nummulites crassus* Boubée, 1831. Schaub, p. 91; fig. 78; pl. 19, figs. 9-24; tbl. 3, fig. c

1984 *Nummulites crassus* Boubée. Serra-Kiel, p. 128-133; pl. 13, figs. 9-12; pl. 14, figs. 1-5; figs. 4.155-158, 4.160-162

Material. This species is present in the Santa Marina, Sierra Caballera, La Foz de Escalete and La Peña sections (Figs. 2; 5-7).

Description. Microspheric forms of middle-large size, lenticular morphology and rounded periphery. Diameter 16.8mm and thickness 5.9mm for 20 whorls. Spiral growth divided in three zones; first zone comprising 5 tight whorls, second zone comprising 12-14 looser whorls and third zone formed of 2-3 very tightly closed whorls. Megalospheric forms of lenticular morphology. Diameters 4.4-5.3mm and thickness 2.4mm for 6 whorls. For 7 whorls the diameter can reach 5.5mm and the thickness 2.7mm. Proloculus is 500-720 μ m in diameter. Equatorial section in megalospheric forms shows values as in Table 5.

In both generations chambers changes from isometric in the inner whorls to longer than high in the other whorls. Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth regular. Thickness of the marginal cord is 1/2 or more of the height of the chambers. Septa inclined, slightly curved backwards at the top and sinuous in the external whorls.

Remarks. *N. crassus* differs from *N. aturicus* and *N. deshayesi* in the thicker marginal cord and in the spiral growth being more regular.

Age. This species is a biomarker of the middle Lutetian 2 according to Schaub (1981). In the material studied this species is associated with *N. aff. deshayesi* (samples SC 38 and E 28; Figs. 5; 6), indicating middle Lutetian 2 (N. sordensis-N. crassus) or SBZ15.

Nummulites tavertetensis REGUANT AND CLAVELL, 1967

Fig. 28M'-Q'

1967 *Nummulites tavertetensis* n. sp. Reguant and Clavell, p. 45, 46; pl. 1

1967 *Nummulites tavertetensis* Reguant and Clavell, 1967. Reguant, p. 269-270; pl. 36

1981 *Nummulites tavertetensis* Reguant and Clavell, 1967. Schaub, p. 104; pl. 22, figs. 29, 37-45; pl. 23, figs. 1-8, 10-19

1984 *Nummulites tavertetensis* Reguant and Clavell, 1967. Serra-Kiel, p. 94-100; pl. 11, figs. 1-9; figs. 4.94-97, 4.99-101.

Material. This species is present in the Santa Marina section (Fig. 2).

Description. Microspheric forms of middle-large size, inflated lenticular morphology with rounded periphery. Diameter 14.2mm for 20 whorls. Spiral divided in three zones; first zone comprising 5 tight whorls, second zone comprising 10-12 looser whorls and third zone formed of 4-5 very tightly closed whorls. Megalospheric forms of inflated lenticular morphology, with Diameter 3.8-4.2mm for 4-5 whorls. Proloculus is 520-620 μ m in diameter.

Equatorial section in megalospheric forms shows values as in [Table 6](#).

In both generations the chambers change from isometric in inner whorls to longer than high in the other whorls. Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth irregular. Thickness of the marginal cord is around 1/3

TABLE 1. Measurements of the ecuatorial section of *Assilina spira abardi*

Whorl (n°)	1	2	3	4	5
Radius (mm)	0.8-1.1	1.4-1.8	1.2-2.6	2.9-3.7	4.0-4.5
Septa (n°)	7-8	19-24	43-50	68-79	92-118

TABLE 2. Measurements of the ecuatorial section of *Nummulites leheneri*

Whorl (n°)	1	2	3	4	5
Radius (mm)	0.6-0.9	1.0-1.2	1.4-1.9	1.6-2.0	2.0
Septa (n°)	7-9	17-26	48-52	71-75	77

TABLE 3. Measurements of the ecuatorial section of *Nummulites aspermontis*

Whorl (n°)	1	2	3	4	5
Radius (mm)	0.7-0.9	1.2-1.5	1.5-1.9	1.8-2.1	2.1-2.3
Septa (n°)	6-9	16-23	33-43	55-72	85-88

TABLE 4. Measurements of the ecuatorial section of *Nummulites beneharnensis*

Whorl (n°)	1	2	3	4	5
Radius (mm)	0.7-0.8	1.1-1.2	1.3-1.5	1.7-1.9	1.9-2.2
Septa (n°)	6-9	19-27	39-41	57-83	84-94

TABLE 5. Measurements of the ecuatorial section of *Nummulites crassus*

Whorl (n°)	1	2	3	4	5	6
Radius (mm)	0.6-1.0	1.0-1.5	1.5-1.9	1.9-2.3	2.1-2.6	2.5-2.6
Septa (n°)	6-9	16-27	32-45	51-82	70-90	105-107

of the height of the chambers. Septa inclined and curved backwards at the top.

Age. This species occurs associated with *N. deshayesi* (sample SC 50; Fig. 5), indicating late Lutetian (N. herbi-N. aturicus Zone) or SBZ16.

Nummulites aff. *deshayesi* D'ARCHIAC AND HAIME, 1853
Fig. 29A-L

2012a *Nummulites* aff. *deshayei* d'Archiac and Haime, 1853. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 16-19; pl. 2, figs. 18-21

Material. This species is present in the Isuela, Sierra Caballera, La Foz de Escalete, La Peña, Murillo and Villalangua sections (Figs. 4-8).

Remarks. This species shows similarities to *N. deshayesi* described thereafter and is considered here to be its phylogenetic predecessor. It differs from *N. deshayesi* in the smaller parameters of the test.

Age. This species is associated with *N. crassus* (sample SC 38; Fig. 5), indicating middle Lutetian 2 (N. sordensis-N. crassus Zone) or SBZ15.

Nummulites deshayesi D'ARCHIAC AND HAIME, 1853
Fig. 29M-U

1981 *Nummulites deshayesi* D'Archiac and Haime, 1853. Schaub, p. 88; fig. 76; pl. 15, figs. 1-19; tbl. 2, fig. 1

2012a *Nummulites deshayesi* D'Archiac and Haime, 1853. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 1, figs. 20-23; pl. 2, figs. 26-29

Material. This species is present in the Santa Marina, Isuela, Sierra Caballera, La Foz de Escalete, La Peña and Villalangua sections (Figs. 2; 4-7; 9).

Description. Microspheric forms of large size, inflated lenticular morphology and rounded periphery. Diameter of the test 17.4mm for 32 whorls, 14.2mm for 22 whorls and 13.8mm for 17 whorls. The thickness is 1.75mm for 22 whorls. Spiral growth divided in three zones, with the first zone comprising 5-7 tight whorls, the second zone comprising 16-18 looser whorls and the third zone comprising 10 or more very tightly-closed whorls. Megalospheric forms of inflated lenticular morphology. For 6 whorls the diameter of the test is 4.62-5.20mm and the thickness 2.7-2.8mm, and for 7 whorls the diameter can reach 5.8mm. Proloculus is 550-720 μ m in diameter. Equatorial section in megalospheric forms shows values as in Table 8.

In both generations the chambers change from isometric in the inner whorls to longer than high in the other whorls.

Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth quite regular. Marginal cord thin. Septa inclined and curved backwards at the top.

Remarks. This species differs from *Nummulites* aff. *deshayesi* by having a larger size and by the higher morphological variability in the microspheric forms, from lenticular to spherical. The proloculus of the megalospheric forms is also larger in this species than in *N. aff. deshayesi*.

Age. This species is associated with *N. aturicus* (sample SC 50; Fig. 5), indicating late Lutetian (N. herbi-N. aturicus Zone) or SBZ16.

Nummulites perforatus (MONTFORT, 1808)

Fig. 29V-D'

1938 *Nummulites aturicus* Joly and Leymerie. Flandrin, p.64- 66; pl. 6, figs. 20-28

1938 *Nummulites rouaulti* D'Archiac and Haime. Flandrin, p. 66; pl. 7, figs. 35-46,

1962 *Nummulites perforates*, Schaub, p. 327: fig. 7

1963 *Nummulites perforates* (Montfort, 1808). Schaub, p. 286-294, 290: figs. 2 and 7

1963 *Nummulites perforatus* (Montfort). Bieda, p. 193; pl. 13; pl. 15, figs. 6-8

1964 *Nummulites perforatus* (Montfort). Kecskeméti, pl. 11, fig. 2

1967 *Nummulites perforatus* (Montfort). Nemkov, p. 181-185; pl. 21, figs. 6-8; pl. 22, figs. 1-7

1971 *Nummulites perforatus* (Montfort). Ferrer, p. 34; pl. 4, figs. 1-5

1972 *Nummulites perforatus* (Montfort). Kecskeméti and Vanová, p. 131-133; pl. 29, figs. 8-9; pl. 30, figs. 1, 6; pl. 31, figs. 1-2; pl. 32, figs. 1-2

1972 *Nummulites perforatus* (Montfort). Blondeau, p. 15, 23, 25, 27, 39, 54-56, 63, 82, 88, 90, 94, 102, 161; pl. 34, figs. 6-11

1973 *Nummulites perforatus* (Montfort). Kecskeméti, p. 38-39; pl. 2

1975 *Nummulites perforatus* (Montfort). Bombita, p. 165; pl. 34, figs. 6-11

1976 *Nummulites perforatus* (Montfort). Rahaghi and Schaub, p. 775; pl. 4, fig. 5; pl. 5, fig. 1

1977 *Nummulites perforatus perforatus* (Montfort, 1808), Nemkov and Vanová, pl. 24, figs. 5-7

1981 *Nummulites perforatus* (Montfort, 1808). Schaub, pp. 88-90; figs. 76, 77; pl. 17; pl. 18; pl. 19, figs. 1-8; tbl. 2, fig. m

1984 *Nummulites perforatus* (Montfort, 1808). Serra-Kiel, p. 124-128; figs. IV-148-IV-150; pl. 23, figs. 1-7; pl. 24, figs. 1-3.

2013 *Nummulites perforatus* (Montfort, 1808). Costa *et al.*, on-line Supplementary Material, Figs. A10 (6-10)

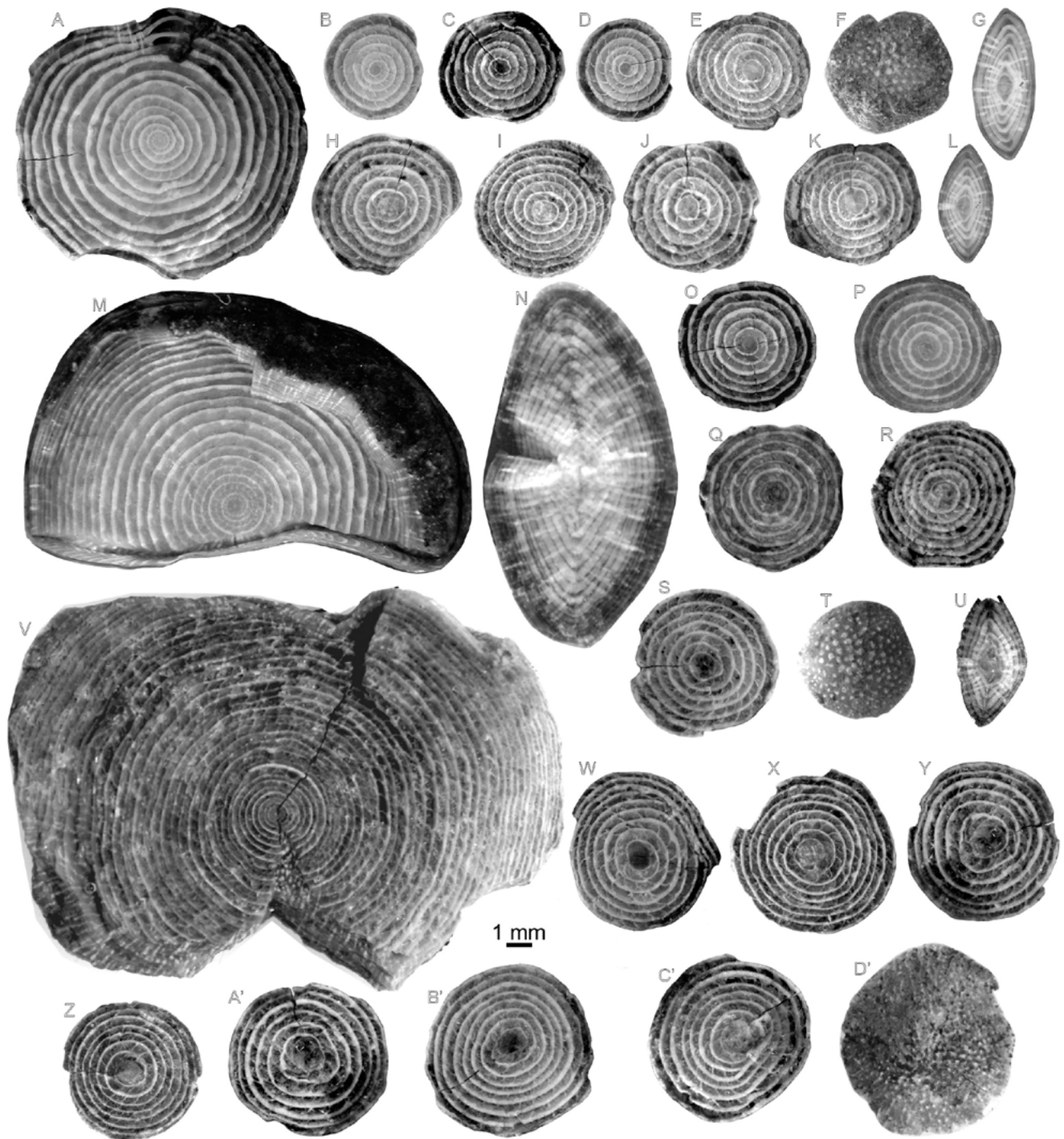


FIGURE 29. A-L) *Nummulites aff. deshayesi*. A: equatorial section, microspheric form. B-E: equatorial sections, megalospheric forms. F: external view, megalospheric form. G: axial sections, megalospheric forms. H-K: equatorial sections, megalospheric forms. L: axial sections, megalospheric forms. Specimens A-D: sample I 52; E-F, H-K: sample E 30 and G, L: from sample SC 38. M-U) *Nummulites deshayesi*. M: equatorial section, microspheric form. N: axial section, microspheric form. O-S: equatorial sections, megalospheric forms. T: external view, megalospheric form. U: axial section, megalospheric form. Specimens M, O, P: sample I 54; N, Q, R, T, U: sample SC 50 and S: sample SM 5. V-D') *Nummulites perforatus*. V: equatorial section, microspheric form. W-C': equatorial sections, megalospheric forms. D': external view, megalospheric form. All specimens from sample SM 6.

Material. This species is present in the Santa Marina section (Fig. 2).

Description. Microspheric forms of large size, inflated lenticular to spherical morphology and rounded periphery. Diameter of the test is 22mm for 42 whorls, 12.5mm for 22 whorls and 8.8mm for 17 whorls. Spiral growth divided in three zones; the first zone comprising 9-10 tight whorls, the second zone comprising 14-17 looser whorls and the third zone formed of at least 20 very tightly closed whorls. Megalospheric forms of inflated lenticular morphology. For 6-7 whorls the diameter of the test is 6.4-6.75mm and the thickness 3.2-3.4mm, and for 7 whorls the diameter can reach 6.85mm. Proloculus is 960-1.280 μ m in diameter.

In both generations the chambers change from isometric in the inner whorls to longer than high in the other whorls. Ornamentation formed of meandriform filaments and granules on and between the filaments. Spiral growth almost regular. Marginal cord thin. Septa inclined and curved backwards at the top.

Remarks. This species differs from *N. aturicus* in the thinner marginal cord, the more irregular spiral growth, the larger diameter of the proloculus and the higher morphological variability in the microspheric forms, which ranges from inflated lenticular to flattened lenticular.

Age. In the study area this species occurs in the Arguis Fm. (sample SM 6; Fig. 2). According to Schaub (1981) this species is a biomarker of the *N. brongniarti*-*N. perforatus* Zone, early Bartonian, or SBZ17.

Nummulites boussaci ROZLOZSNIK, 1924

Fig. 30A-C

1929 *Nummulites Boussaci* Rozlozsnik. Rozlozsnik, p. 161; pl. 4, figs. 7, 9; pl. 6, fig. 9

1981 *Nummulites boussaci* Rozlozsnik. Schaub, p. 111-112; pl. 32, figs 9, 20, 21, 23, 23-31, 35-39, 41-46, 49, 50; pl. 33, figs. 1-13, 15, 16; pl. 34, figs. 1-11; table 5, fig. g

Material. This species is present in the Santa Marina section (Fig. 2).

Description. Microspheric forms of inflated lenticular morphology. Diameter 12.7mm for 15 whorls. Spiral growth regular. Marginal cord thick. Septa inclined, slightly flexuous and curved backwards at the top. Megalospheric forms of lenticular morphology with a diameter around 2.8mm for 3 whorls. Ornamentation consisting of large granules in spiral distribution. Chambers are first isometric and change to longer than high in later growth stages.

Age. This species is associated with *N. beneharnensis* (samples SM 1 and SM 2; Fig. 2), indicating middle

Lutetian 1 (*N. gratus*-*N. beneharnensis* Zone) or SBZ14.

Nummulites aff. *bullatus* AZZAROLI, 1952

Fig. 30D-F

1981 *Nummulites* aff. *bullatus* Azzaroli, 1952. Schaub, p. 125; pl. 49, figs 25a-b

2012a *Nummulites bullatus* Azzaroli, 1952. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 2, figs. 22, 23

Material. This species is present in the Isuela section (Fig. 4).

Description. Microspheric forms not found. Megalospheric forms of flattened lenticular morphology and sharp periphery. Test small with a diameter of 2.3-2.7mm for 3 whorls. Ornamentation formed of granules in spiral distribution on filaments, that form an irregular network more pronounced in the polar zone. Spiral growth regular. Proloculus is 200-250 μ m in diameter. Chambers isometric in early growth stages and longer than high in later growth stages. Septa straight and curved backward on the chamber roof. Equatorial section shows values as in Table 9.

Remarks. A similar species was described by Schaub (1981) from middle Lutetian rocks from the South Pyrenean Basin (p. 125, *op. cit.*). This species differs from *N. bullatus* in the larger size of the proloculus and in the thicker marginal cord.

Age. This species occurs associated with *N. aff. deshayesi* (sample I 52; Fig. 4), indicating middle Lutetian 2 (*N. sordensis*-*N. crassus* Zone) or SBZ15.

Nummulites migiurtinus AZZAROLI, 1952

Fig. 30G-H

1952 *Nummulites migiurtinus* n. sp., Azzaroli, p. 120; pl. 10, figs. 1-4

1981 *Nummulites migiurtinus* Azzaroli, 1952. Schaub, p. 135; pl. 53, figs. 7-16, 20, 21; tbl. 14, fig. o

2012a *Nummulites migiurtinus* Azzaroli, 1952. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 2, figs. 24 and 25

Material. This species is present in the Santa Marina, Isuela, Sierra Caballera, La Foz de Escalete, La Peña and Murillo de Gállego sections (Figs. 2; 4; 5).

Description. Microspheric forms not found. Megalospheric forms of small size, biconical in morphology and sharp periphery. Diameter 2.5mm and thickness 1.3mm for 5-6 whorls. Ornamentation formed of one large granule at the polar zone and radial slightly

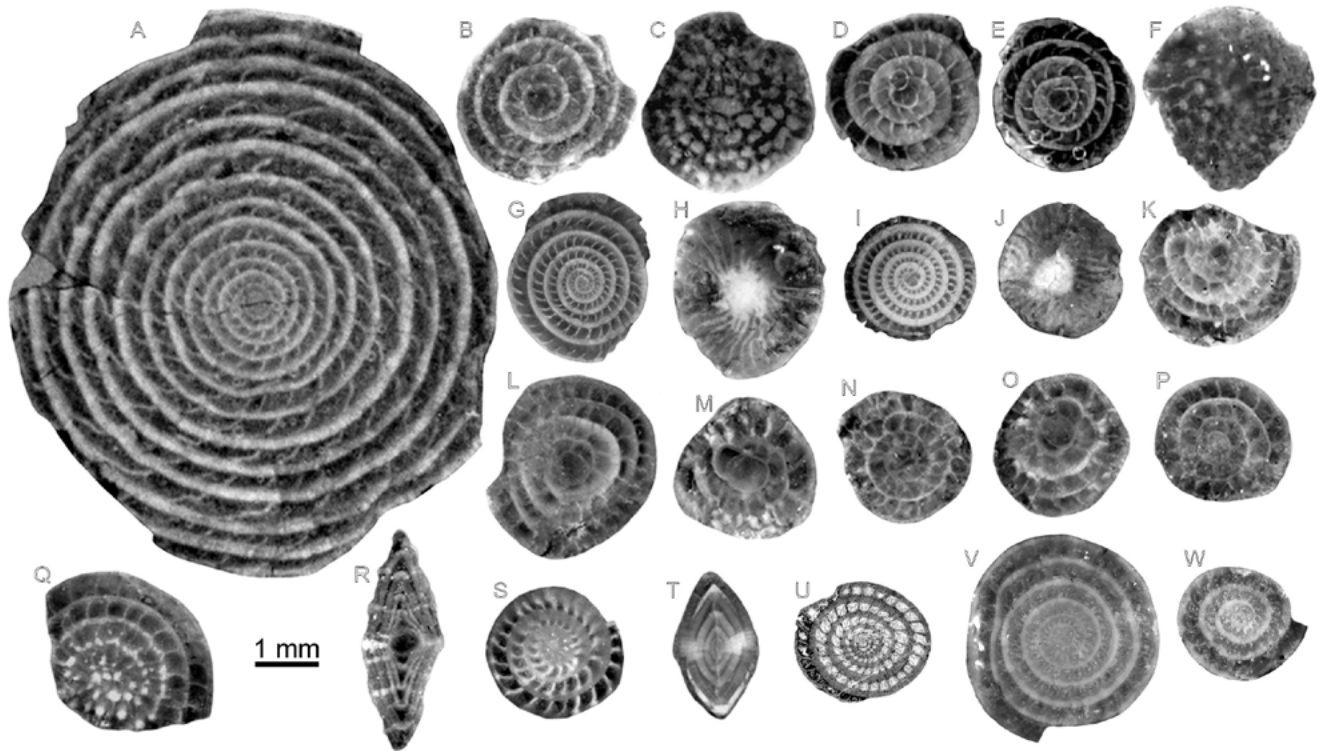


FIGURE 30. A-C) *Nummulites boussaci*. A: equatorial section, microspheric form. B: equatorial section, megalospheric form. C: external view, megalospheric form. All specimens from sample SM 2. D-F) *Nummulites aff. bullatus*. D, E: equatorial sections, megalospheric forms. F: external view, megalospheric form. All specimens from sample I 52. G-H) *Nummulites migiurtinus*. G: equatorial section, megalospheric form. H: external view, megalospheric form. Specimens from sample I 18. I-J) *Nummulites praediscorbinus*. I: equatorial section, megalospheric form. J: external view. Specimen from sample I 7. K-R) *Nummulites praepuschi*. K-O: centered slightly oblique equatorial sections, megalospheric forms. P-Q: subequatorial section. R: centered axial section, megalospheric form. All specimens from sample M 24. S-U) *Nummulites beaumonti*. S: equatorial section. T: axial section. U: equatorial section. All specimens megalospheric forms. Specimen S: sample E 40, T: sample P 29 and U: sample I 50. V-W) *Nummulites biarritzensis*. V: equatorial section, microspheric form. W: equatorial section, megalospheric form. Specimens from sample CF 5.

sinuous filaments. Spiral growth regular. Proloculus is 90–140 μm in diameter. Chambers begin being isometric and change to higher than long. Straight and backward curved septa on chamber roof.

Age. The biostratigraphic range of this species extends from SBZ13 to SBZ14. In SBZ13 this species occurs intercalated with samples of *Alveolina callosa* (sample SC 8; Fig. 5), indicating early Lutetian (A. stipes Zone). The SBZ14 is characterized by the association of *N. migiurtinus* with *N. aspermontis* and *N. beneharnensis* (samples I 18 and SM 3; Figs. 2; 4), indicating middle Lutetian 1 (N. gratus-N. beneharnensis Zone).

***Nummulites praediscorbinus* SCHAUB, 1981**

Fig. 30I-J

1981 *Nummulites praediscorbinus* n. sp. Schaub, 1981, p. 165; pl. 61, figs. 1-5; tbl. 8, fig. e

2012a *Nummulites praediscorbinus* Schaub, 1981. Rodríguez-Pintó *et al.*, on-line Supplementary Material, pl. 2, figs. 16 and 17

Material. This species is present in the Isuela section (Fig. 4).

Description. Microspheric forms not found. Megalospheric forms of biconical morphology and sharp periphery. Diameter 1.9mm and thickness 2mm for 4-5 whorls. Ornamentation composed of one large granule at the polar zone and radial filaments. The diameter of the proloculus is around 150 μm . Spiral growth tight and regular. The thickness of the marginal cord equals the height of the chambers. Chambers isometric or slightly higher than long.

Age. This species occurs associated with *N. aspermontis* and *N. beneharnensis* (sample I 8; Fig. 4), indicating early Lutetian (A. stipes and A. spira abrardi zones) or SBZ13.

***Nummulites praepuschi* SCHAUB, 1981**

Fig. 30K-R

1981 *Nummulites praepuschi* n. sp. Schaub, p. 165; fig. 100; pl. 61, figs. 1-5; tbl. 8, fig. e

Material. This species is present in the Murillo de Gállego section (Fig. 8).

Description. Although megalospheric forms have only been studied in non-oriented sections, the following

features were observed. Regular spiral growth. Isometric chambers with curved septa. Diameter of the proloculus between 540-600 μ m. Ornamentation formed of granules in spiral distribution on the marginal cord and filaments forming a subreticular network.

Age. This species occurs in the Murillo de Gállego section (sample M 24; Fig. 8). According to Schaub (1981) it characterizes the late Lutetian (N. herbi-N. aturicus Zone) or SBZ16.

Nummulites beaumonti D'ARCHIAC AND HAIME, 1853
Fig. 30S-U

1952 *Nummulites Beaumonti* d'Archiac and Haime. Azzaroli, P 121; PL. 9, FIG. 3, 6, 12 AND 13.

1981 *Nummulites beaumonti* d'Archiac and Haime, 1853. Schaub, p. 135; pl. 53, figs. 17-19, 22-25; tbl. 14 p

1995 *Nummulites beaumonti* d'Archiac and Haime, 1853. Racey, p. 34; pl. 5, figs. 15-17, and 19.

2013 *Nummulites beaumonti* d'Archiac and Haime, 1853. Serra-Kiel in Costa *et al.*, on-line Supplementary Material, Figs. A2 1-4 and A9 1-8.

Material. This species is present in the Isuela, Sierra Caballera, La Foz de Escalate and Campo Fenereo sections (Figs. 4; 6; 12).

Description. Microspheric forms not found. The megalospheric forms show an inflated biconical morphology and rounded periphery. The test diameter for 6 whorls is around 2.8mm. Ornamentation composed of a large granule at the polar zone and sinuous filaments. Diameter of the proloculus around 100 μ m. Chambers higher than long in the inner whorls, and isometrical and higher than long in the outer whorls. Septa inclined.

Age. According to Serra-Kiel *et al.* (1998) this species occurs in SBZ15-SBZ17. Here this species occurs overlying beds with *N. crassus* and *N. aff. deshayesi* and underlying beds with *N. deshayesi* (Fig. 6), indicating middle Lutetian 2 (SBZ15), or associated with *N. biarrizensis* (sample CF 5; Fig. 12), indicating early Bartonian or SBZ 17. Thus, the biostratigraphic range of this species extends from middle Lutetian 2 (SBZ15) to early Bartonian (SBZ17).

Nummulites biarrizensis D'ARCHIAC AND HAIME, 1853
Fig. 30V-W

1981 *Nummulites biarrizensis* d'Archiac and Haime, 1853. Schaub, p. 123; pl. 51, figs. 30-46, tbl. 15, figs. c, d

2013 *Nummulites biarrizensis* d'Archiac and Haime, 1853. Serra-Kiel in Costa *et al.*, on-line Supplementary Material, Fig. 2A 5-8; Fig. A9 (9-13)

Material. This species is present in the Campo Fenereo section (Fig. 12).

Description. Microspheric forms not found. The megalospheric forms show a lenticular shape and rounded periphery. Diameter of the proloculus around 270 μ m. The test diameter for 6 whorls is around 2.2mm. Ornamentation formed of filaments radiating S-shaped and a large granule at the polar zone. Septa inclined.

Age. This species occurs associated with *N. beaumonti* (sample CF 5; Fig. 12). According to Schaub (1981) and Serra-Kiel (in Costa *et al.*, 2013) this species indicates SBZ17 (early Bartonian).

DISCUSSION

Magnetostratigraphic calibration

The biostratigraphic distribution of larger foraminiferal index species in the studied sections has been based on the the alveolinid zones of Hottinger (1960) and Hottinger and Drobné (1988), the nummulitid zones of Schaub (1981) and the Shallow Benthic Zones (SBZ) of Serra Kiel *et al.* (1998). The biostratigraphy of *Alveolina*, *Nummulites* and *Assilina* species in the Boltaña, Guara and Arguis formations in the study area is synthesized in Table 10.

The stratigraphic distribution of the taxa described above allowed recognition and calibration of late Ypresian (SBZ 11) to early Bartonian (SBZ 17) shallow benthic zones. SBZ11 was identified by the presence of *Alveolina decastrói* and *A. cremae*. No taxa were found in the studied material representing SBZ 12, and thus the upper and lower boundaries of this zone could not be established precisely. SBZ 13 is well identified by the concurrence of *Assilina spira abrardi*, *Nummulites lehneri*, *Alveolina stipes*, *A. callosa* and *A. obtuse*. The lower boundary of SBZ 13 was not determined in the studied sections, but the lowermost biostratigraphic markers associated to this zone correlate with the upper part of Chron C21r. The boundary between SBZ 13 and SBZ 14 was pinpointed at 145m from the base of the Isuela section (Fig. 4), in the lower half of Chron C20r. According to this calibration, the age of this boundary is *ca.* 45 Ma. SBZ 14 is also well represented by the occurrence of *A. munieri*, *N. boussaci*, *N. aspermontis* and *N. beneharnensis*. SBZ14 is correlated with Chron C20r and the lowermost part of C20n (Fig. 4). SBZ 15 was determined by the occurrence of *N. crassus*, *N. aff. deshayesi* and *N. taverdetensis*. The boundary between SBZ 14 and SBZ 15 was not accurately defined, but the transition interval was constrained by Rodríguez-Pintó *et al.* (2012a) thanks to the identification of *N. crassus* in the lower part of Chron C19r in La Foz de Escalate section (Fig. 6). Thus, SBZ 15 embraces the lower half of the C19r magnetozone, and the time span not covered by any characteristic taxa assemblage

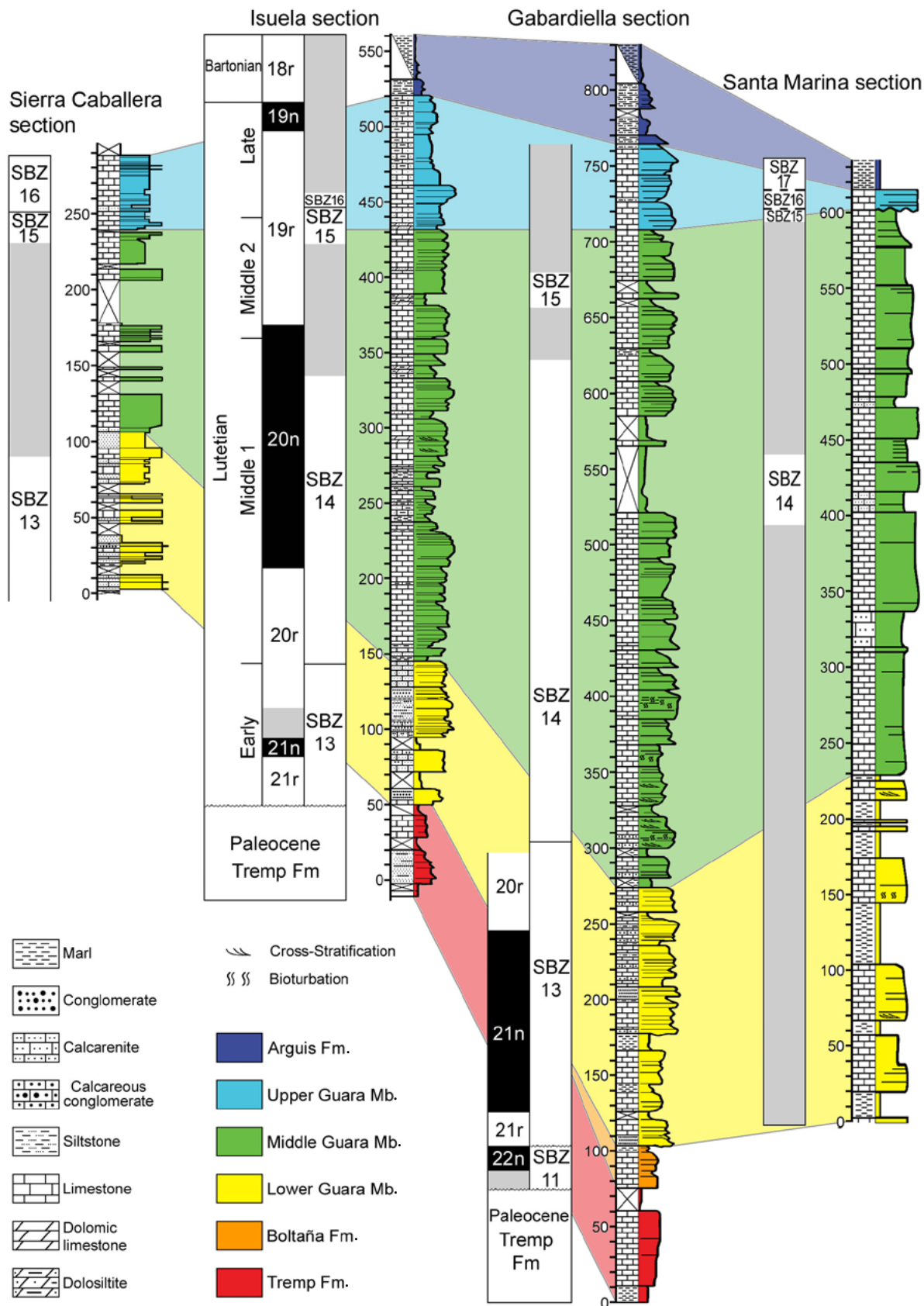


FIGURE 31. Correlation between lithostratigraphic units, magnetostratigraphy and SBZ of stratigraphic sections from the central part of Sierras Exteriores (Santa Marina, Gabardiella, Isuela and Sierra Caballera sections, Figs. 2-5).

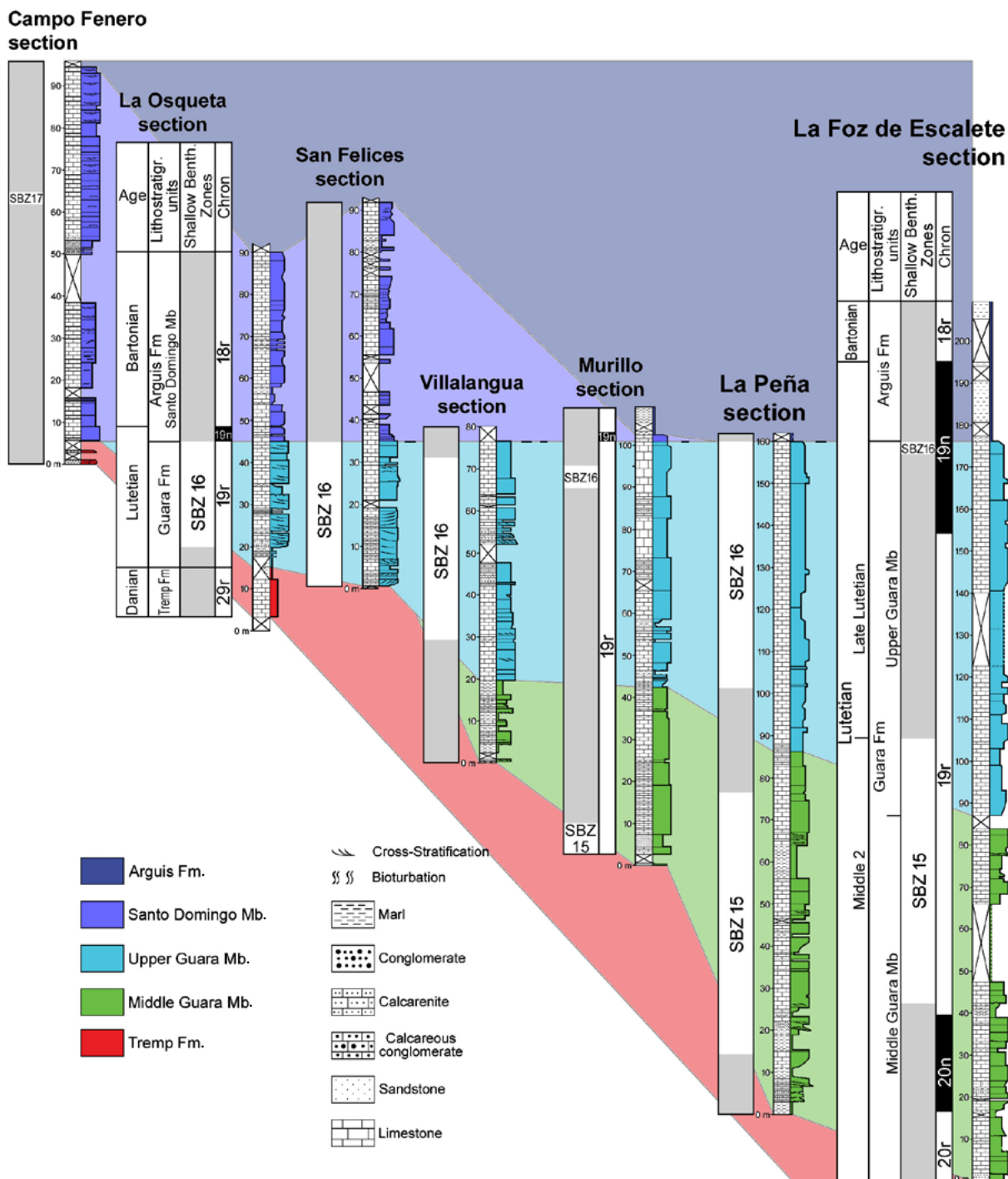


FIGURE 32. Correlation between lithostratigraphic units, magnetostratigraphy and SBZ of stratigraphic sections from the western part of Sierras Exteriores (La Foz de Escalete, La Peña, Murillo de Gállego, Villalangua, San Felices, La Osqueta and Campo Fenero sections Figs. 6-12).

extends/extended from 43.1 to 42.3 Ma. SBZ 16 is well characterized by the presence of *N. deshaysi*, *N. aturicus* and *N. praepuschi*. This zone correlates with the upper half of Chron C19r and C19n. The lower boundary of this SBZ was pinpointed in the Sierra Caballera section at 255m (Fig. 5). This boundary was identified in the Isuela section around 450m and calibrated with

magnetostratigraphy, obtaining an age of about 41.7Ma (Fig. 4). The upper boundary of SBZ 16 was not well constrained. SBZ 17 is represented in the Campo Fenero section (*N. biarritzensis*, Fig. 12) and Santa Marina section (*N. perforatus*, Fig. 2). The boundary between SBZ 16 and SBZ 17 was determined in this section, but precise magnetostratigraphic calibration was not possible.

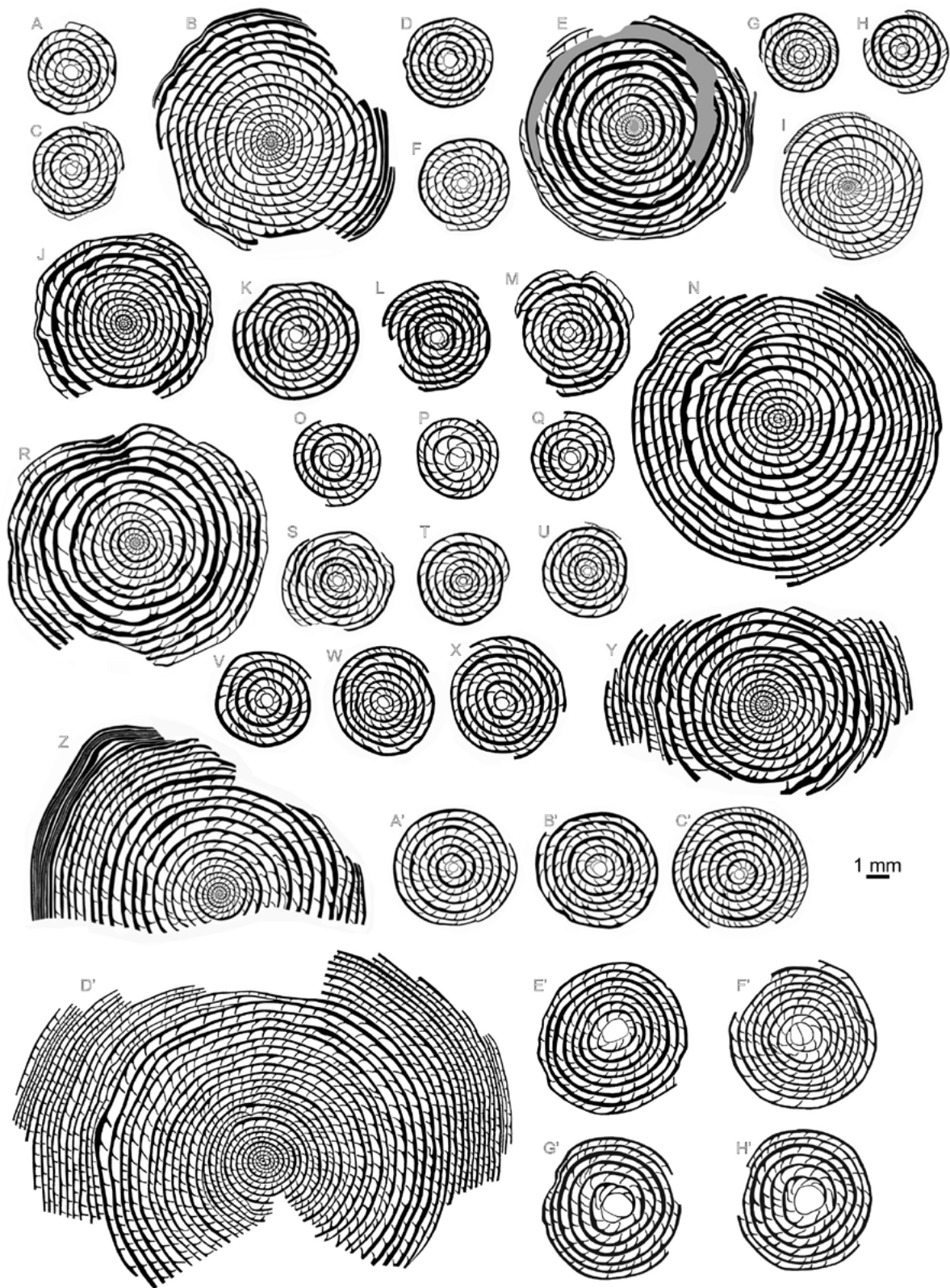


FIGURE 32. Correlation between lithostratigraphic units, magnetostratigraphy and SBZ of stratigraphic sections from the western part of Sierras Exteriores (La Foz de Escalete, La Peña, Murillo de Gállego, Villalangua, San Felices, La Osqueta and Campo Fenero sections [Figs. 6-12](#)).

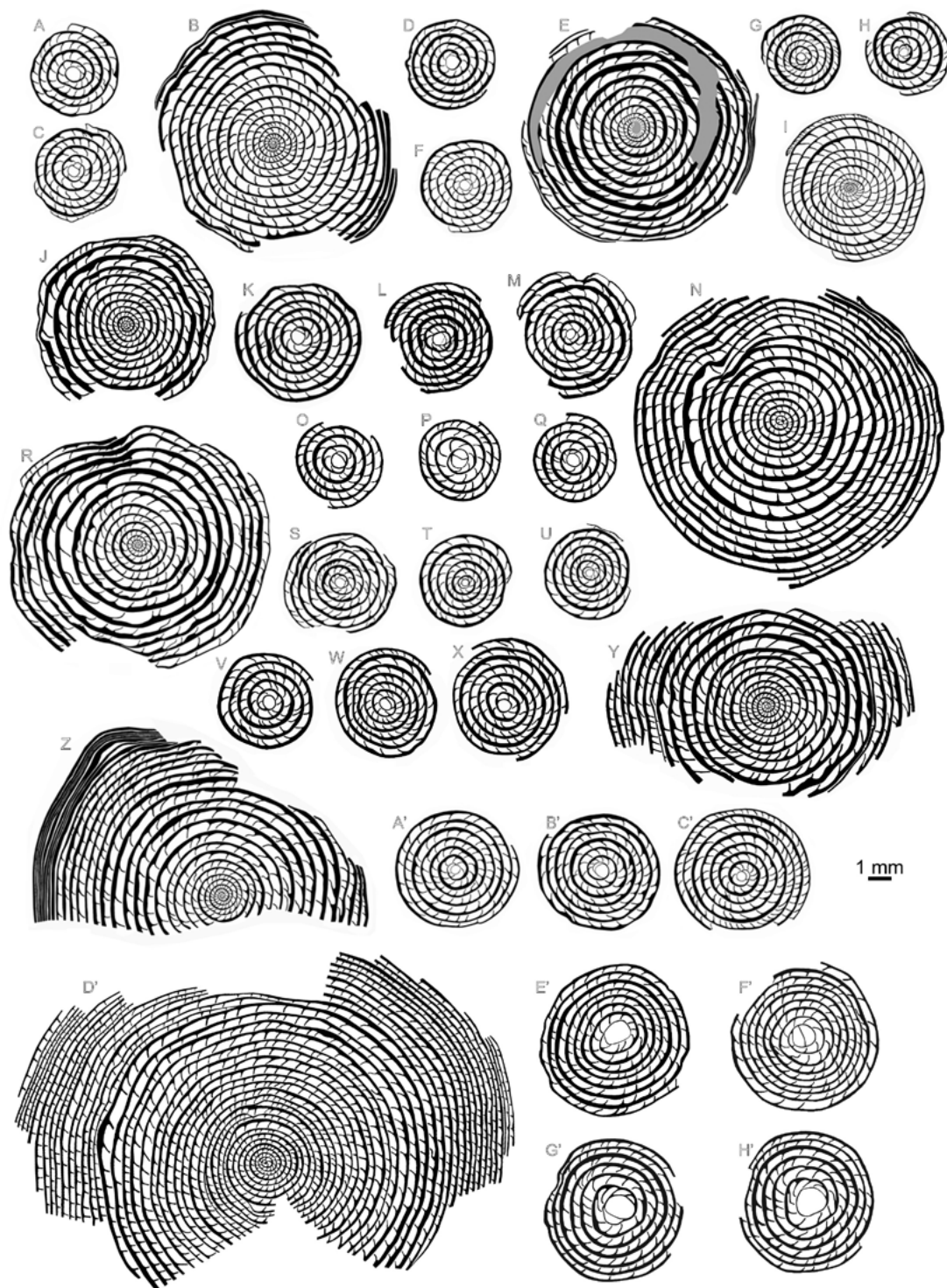


FIGURE 33. Nummulites of the Group *N. burdigalensis* used as biostratigraphic markers. A-C) *N. benehamensis*. A, C: specimens from sample I 18. B: drawing from Figure 28X. D-F) *N. aspermontis*. D: drawing from Figure 28R. E: drawing from Figure 28M. F: specimens from sample I 8. G-I) *N. lehneri*. All specimens from sample G 5. J-M) *N. crassus*. J: specimen from sample SM 4. K: drawing from Figure 28F'. L: drawing from Figure 28H'. M: drawing from Figure 28L'. N-Q) *N. tavertetensis*. N: drawing from Figure 28M'. O: drawing from Figure 28Q'. P: specimen from sample SM 4. Q: drawing from Figure 28O'. R-U) *N. aff. deshayesi*. R: drawing from Figure 29A. S: drawing from Figure 29C. T: specimen from sample I 52. U: drawing from Figure 29D. V-Y) *N. aturicus*. V-X: specimens from sample SC 39. Y: drawing from Figure 28T'. Z-C') *N. deshayesi*. Z: drawing from Figure 29M. A': drawing from Figure 29P. B': drawing from Figure 29O. C': specimen from sample I 54. D'-H') *N. perforatus*. D': drawing from Figure 29V. E': drawing from Figure 29B'. F': drawing from Figure 29X. G': drawing from Figure 29A'. H': drawing from Figure 29Y.

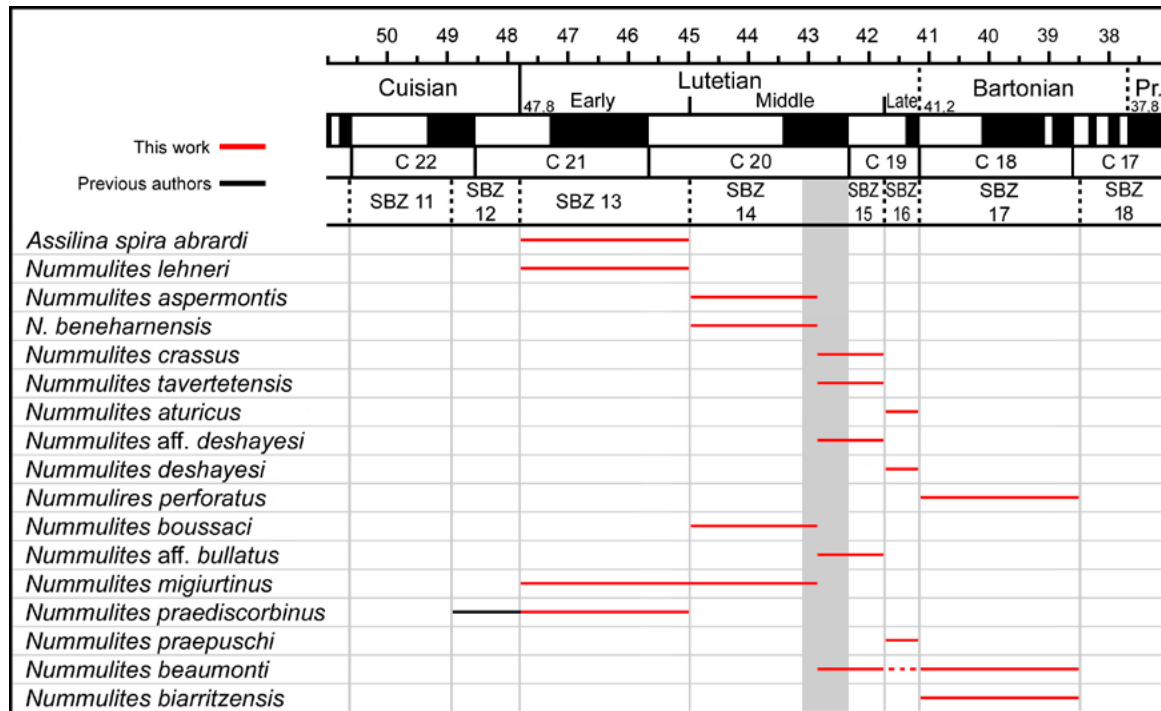


FIGURE 34. Biostratigraphic range of the *Nummulites* and *Assilina* species. The ranges shown with red lines are according to this study, whereas those in black lines are according to [Serra-Kiel et al. \(1998\)](#). Chronostratigraphy in accordance with Shallow Benthic Zones of [Serra-Kiel et al. \(1998\)](#), recalibrated according to [Rodríguez-Pintó et al. \(2012a\)](#) and [Costa et al. \(2013\)](#). Magnetostratigraphic data from [Rodríguez-Pintó et al. \(2012a\)](#) recalibrated to the GPTS 2012 according to [Ogg \(2012\)](#). The grey band represents the transition interval (no accurate boundary) between SBZ 14 and SBZ 15.

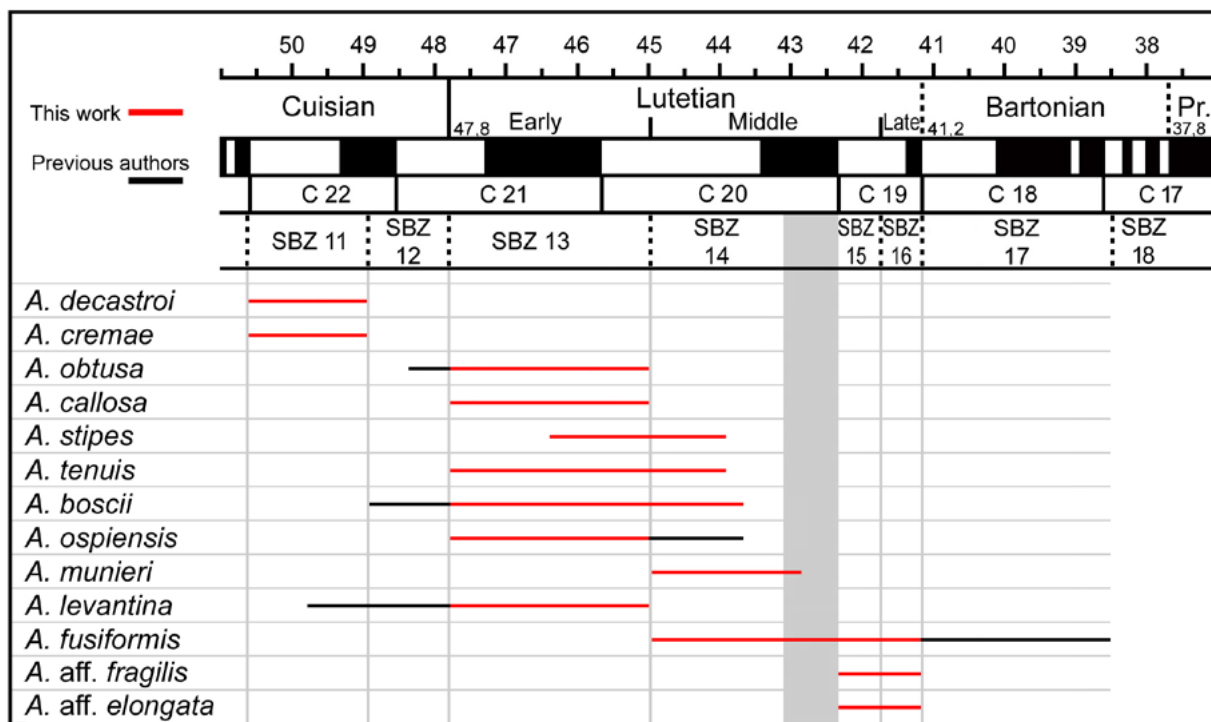


FIGURE 35. Biostratigraphic range of the *Alveolina* species studied in this work. The ranges shown with red lines are according to this study, whereas those in black lines are according to [Serra-Kiel et al. \(1998\)](#). Chronostratigraphy is in accordance with Shallow Benthic Zones of [Serra-Kiel et al. \(1998\)](#), recalibrated according to [Rodríguez-Pintó et al. \(2012a\)](#) and [Costa et al. \(2013\)](#). The boundaries of the SBZs in [Rodríguez-Pintó et al. \(2012a, Fig. 8\)](#) are recalibrated to GPTS 2012 according to [Ogg \(2012\)](#). The grey band represents the transition interval (no accurate boundary) between SBZ 14 and SBZ 15.

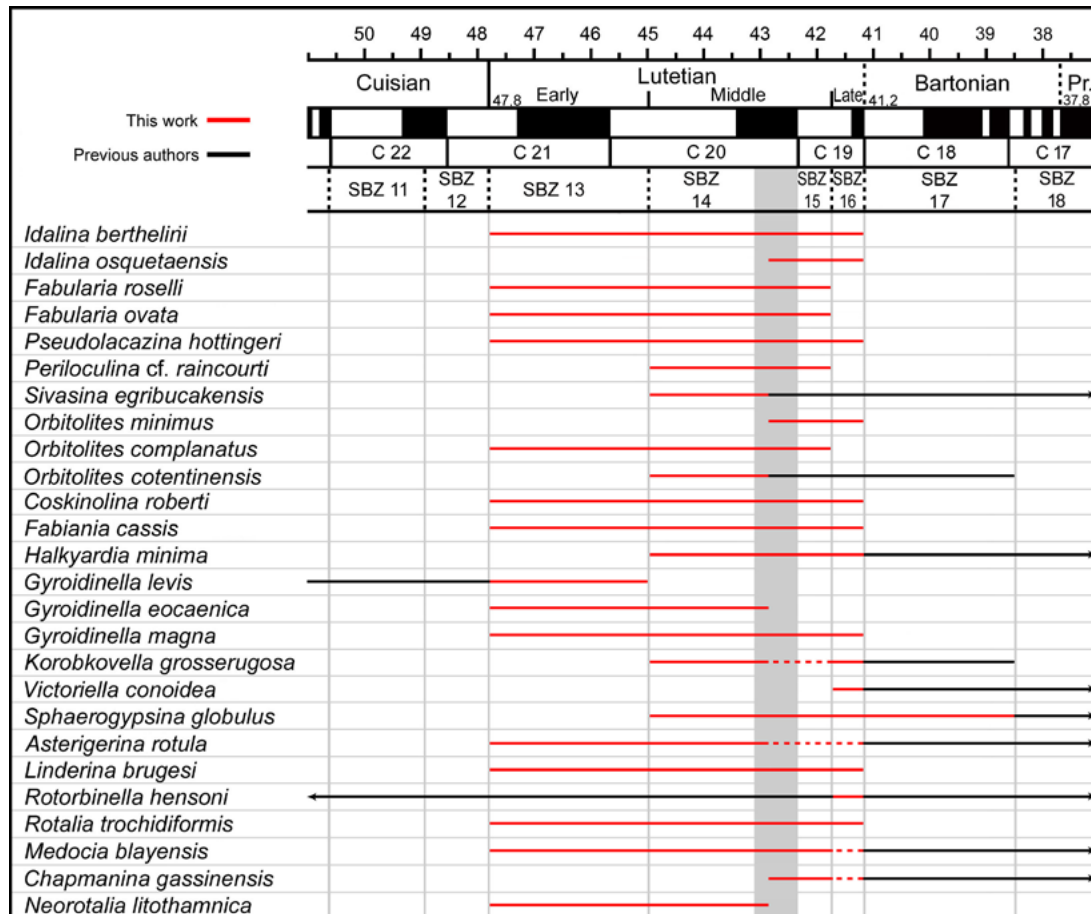


FIGURE 36. Biostratigraphic range of several taxa studied in this work. The ranges shown with red lines are according to this study, whereas those in black lines are according to [Serra-Kiel *et al.* \(1998\)](#). Chronostratigraphy in accordance with Shallow Benthic Zones of [Serra-Kiel *et al.* \(1998\)](#), recalibrated according to data by [Rodríguez-Pintó *et al.* \(2012a\)](#) and [Costa *et al.* \(2013\)](#). The boundaries of the SBZs in [Rodríguez-Pintó *et al.* \(2012a, Fig. 8\)](#) are recalibrated to the GPTS 2012 according to [Ogg \(2012\)](#). The grey band represents the transition interval (no accurate boundary) between SBZ 14 and SBZ 15.

The calibration of the biostratigraphic data of this study with magnetostratigraphic data ([Rodríguez-Pintó *et al.*, 2012a, b](#); [Rodríguez-Pintó *et al.*, 2017](#); [Silva-Casal *et al.*, 2019](#)) allowed the correlation of the late Ypresian–lower Bartonian shallow marine successions (*i.e.* Boltaña, Guara and Arguis formations) throughout the central ([Fig. 31](#)) and western parts ([Fig. 32](#)) of the Sierras Exteriores.

Contributions to the biostratigraphy of Larger Foraminifera

Most of the biostratigraphic markers used in this study belong to genera *Nummulites* and *Alveolina*. Genus *Nummulites*, widely studied by [Schaub \(1981\)](#), is represented in this study by several phyletic lines, some included in the Group of *Nummulites burdigalensis*, with five evolutionary branches. This group, diversified from the base of the Lutetian, includes most of the biostratigraphic markers used here, *i.e.* *N. tavertetensis*, *N. lehneri*, *N. aspermontis*, *N. crassus*, *N. aturicus*, *N. beneharnensis*, *N. aff. deshayesi*, *N. deshayesi*,

N. perforatus ([Fig. 33](#)). The Group of *N. laevigatus* (*N. praepuschi*), and the lineages of *N. leupoldi* (*N. biarrizensis*), *N. fabianii* (*N. aff. bullatus*), *N. partschi* (*N. boussaci*) and *N. beaumonti* (*N. migiurtinus*, *N. beaumonti*) are also present. The nummulitid *Assilina spira abrardi* is another important biostratigraphic marker used in this study. The biostratigraphic range and magnetostratigraphic calibration of the studied *Nummulites* and *Assilina* species are represented in [Figure 34](#).

Nummulites facies are not abundant in the studied sections, and the *Nummulites* specimens were collected from discrete levels. *Nummulites* data was complemented with species of *Alveolina* of biostratigraphic interest, which are abundant in facies rich in porcellaneous foraminifera in the Boltaña and Guara formations. The specific diversity of the genus *Alveolina* in the Sierras Exteriores is represented by six lineages that include elongated and fusiform morphotypes ([Hottinger and Drobne, 1988](#)). The best represented lineages are from the Group of *Alveolina callosa* (*A. obtusa*, *A. callosa*, *A. ospiensis*) and the Group

Age	Polarity	Chron	Biozones	Lithostratigraphic units	Biostratigraphic markers
39				Arguis FM	<i>N. perforatus</i> <i>N. biarritzensis</i>
40		C-18	SBZ 17		
41				Santo Domingo Member	<i>N. aturicus</i> <i>N. deshayesi</i> <i>N. praepuschi</i>
42		C-19	SBZ 15, 16	Upper Guara Mb.	<i>N. crassus</i> <i>N. taverdetensis</i> <i>N. aff. deshayesi</i>
43				Middle Guara Mb.	<i>A. munieri</i> <i>N. boussaci</i> <i>N. aspermontis</i> <i>N. beneharnensis</i>
44		C-20	SBZ 14		
45				Lower Guara Mb.	<i>A. stipes</i> <i>A. callosa</i> <i>N. lehneri</i> <i>A. spira abrardi</i>
46		C-21	SBZ 13		
47				Hiatus	Hiatus
48			SBZ 12		
49		C-22	SBZ 11	Boltaña Fm.	<i>A. decastroi</i> <i>A. cremae</i>
50					

FIGURE 37. Correlation between the standard Time Scale, magnetostratigraphy, Shallow Benthic Zones, lithostratigraphic units of the Sierras Exteriores and biomarker taxa used in this study, in accordance with the International Chronostratigraphic Chart 2017 (Vandenberghe *et al.*, 2012; Cohen *et al.*, 2013).

of *Alveolina munieri* (*A. stipes*, *A. tenuis*, *A. munieri* and *A. aff. fragilis*). However, *Alveolina prorrecta* was not found. Interestingly, *A. aff. fragilis*, which is the predecessor of the Bartonian species *A. fragilis*, fills in the gap in SBZ 16 for this lineage, with a biostratigraphic distribution ranging from upper middle Lutetian (SBZ15) to late Lutetian (SBZ16). Similarly, *A. aff. elongata* complements the significant gap existing in the Group of *Alveolina gigantea*, as a predecessor of the Bartonian *A. elongata*. Other groups represented are the group of *A. minuta* (*A. decastroi*, *A. boscii* and *A. frumentiformis*) and the group of *A. levantina* (*A. levantina* and *A. fusiformis*). According to the revision of *A. fusiformis* presented here, the biostratigraphic range of this species expands from middle-late Lutetian (SBZ14-16) to early Bartonian (SBZ17). The biostratigraphic distribution of the studied *Alveolina* species and their calibration to the GPTS is represented in Figure 35.

The occurrence of *A. fusiformis*, *A. aff. fragilis* and *A. aff. elongata* in SBZ 15 and SBZ 16 increases the diversity

of *Alveolina* species for this time span. The number of species increases from two to five in the middle Lutetian 2, and from one to four in the late Lutetian (Hottinger and Drobne, 1988; Serra-Kiel *et al.*, 1998).

In addition, two new taxa have been described in the evolutionary lineage of *Idalina berthelini* (Fig. 15). A late Ypresian (middle Cuisian SBZ 11) species, *Idalina* sp., has been considered the predecessor of *I. berthelini*. Unfortunately, it could not formally be defined as a species because of the scarce material available. On the other hand, *I. osquetaensis*, new species, represents a diversification of the *Idalina* genus in the middle Lutetian 2 (SBZ 15), showing an evolutionary trend in this genus towards an increase of the test size and the thickening of the basal layer over time (Fig. 15).

This study highlights the high diversity of larger foraminifera in the Sierras Exteriores, with 17 families, 26 genera and 61 species (see also Appendix II). The biostratigraphic distribution of species belonging to other genera than *Nummulites*, *Assilina* and *Alveolina*, is shown in Figure 36. A summary of the chronostratigraphic data is given in Figure 37.

CONCLUSIONS

A detailed systematic description of larger foraminifera recorded in the mid-Eocene successions exposed in the Sierras Exteriores (South Pyrenean Basin) has shown a high taxonomic diversity, with 17 families, 26 genera and 61 species. Furthermore, a new species, *Idalina osquetaensis*, has been described in this study. The biostratigraphic analysis of 11 sections widely distributed across the Sierras Exteriores and their correlation with magnetostratigraphic data has led to an accurate calibration of the Lutetian SBZs. The biostratigraphic markers identified in this study permitted the characterization of the following SBZs:

- SBZ 11 (middle Cuisian) characterized by *A. decastroi* and *A. cremae*.
- SBZ 13 (early Lutetian) characterized by *A. callosa*, *A. stipes*, *N. lehneri* and *A. spira abrardi*.
- SBZ 14 (middle Lutetian 1) characterized by *A. munieri*, *N. boussaci*, *N. beneharnensis* and *N. aspermontis*.
- SBZ 15 (middle Lutetian 2) characterized by *N. crassus*, *N. taverdetensis* and *N. aff. deshayesi*.
- SBZ 16 (late Lutetian) characterized by *N. deshayesi*, *N. aturicus* and *N. praepuschi*.
- SBZ 17 (early Bartonian) characterized by *N. perforatus* and *N. biarritzensis*.

The regional scope of this study allows for a correlation between *Alveolina* and *Nummulites* biostratigraphic

TABLE 6. Measurements of the ecuatorial section of *Nummulites tavertetensis*.

Whorl (n°)	1	2	3	4
Radius (mm)	0.7-0.9	1.2-1.3	1.5-1.6	1.8-2.0
Septa (n°)	1.8-2.0	17-20	32-35	56-57

TABLE 7. Measurements of the ecuatorial section of *Nummulites aturicus*.

Whorl (n°)	1	2	3	4	5	6
Radius (mm)	0.7-1.0	1.0-1.5	1.4-1.9	1.6-2.4	2.2-2.6	2.5-2.8
Septa (n°)	7-8	20-23	48-52	61-65	81-83	102-104

TABLE 8. Measurements of the ecuatorial section of *Nummulites deshayesi*.

Whorl (n°)	1	2	3	4	5	6	7
Radius (mm)	0.8-1.2	1.22-1.68	1.52-2.08	1.8-2.4	2.14-2.70	2.42-2.70	2.7-3.04
Septa (n°)	5-9	15-24	32-47	52-73	83-111	118-144	152-184

TABLE 9. Measurements of the ecuatorial section of *Nummulites* aff. *bullatus*.**Table 9.** Measurements of the ecuatorial section of *Nummulites* aff. *bullatus*

Whorl (n°)	1	2	3
Radius (mm)	0.5-0.6	0.8-1.0	1.2-1.7
Septa (n°)	7-8	21-22	39-42

markers. An improved definition of the SBZ boundaries and their magnetostratigraphic calibration, led to a revision of the stratigraphic distribution of several larger foraminifera species. This contributed to filling in a former gap of the biostratigraphy of the *Alveolina* biozonation in the middle Lutetian 2 and late Lutetian (SBZ 15 and SBZ 16) intervals. The material found in this work allowed the definition of *A. aff. elongata* and *A. aff. fragilis* as the ancestral representatives of the evolutionary lineages of the Bartonian *A. elongata* and *A. fragilis* respectively.

Alveolina aff. *fragilis* and *A. aff. elongata*, together with other biostratigraphic markers of the SBZ 15 (*N. crassus*, *N. aff. deshayesi*) and SBZ 16 (*N. praepuschi*, *N. aturicus* and *N. deshayesi*), sheds light on a previously poorly known middle to late Lutetian alveolinid biostratigraphy. Moreover,

the revision of the systematics and the stratigraphic range of *A. fusiformis* has shown that it can no longer be considered a biostratigraphic marker of the early Bartonian (SBZ 17). This species is common in materials belonging to SBZ 15 and SBZ 16 (along with *A. aff. fragilis* and *A. aff. elongata*), and its association to *A. munieri* confirms the occurrence of *A. fusiformis* at least in the upper part of SBZ 14.

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APPENDIX I

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 13A/Fig. 14A	<i>Idalina</i> sp.	G 1	L 20	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13B/Fig. 14B	<i>Idalina</i> sp.	G 2	L 23	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13C/Fig. 14C	<i>Idalina</i> sp.	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13D	<i>Idalina</i> sp.	G 2	L 23	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13E	<i>Idalina</i> sp.	G 1	L 20	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13F/Fig. 14N	<i>Idalina berthelini</i>	G 28	L 91	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13G/Fig. 14D	<i>Idalina berthelini</i>	I 45	A 78	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13H/Fig. 14M	<i>Idalina berthelini</i>	I 47	A 81	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13I	<i>Idalina berthelini</i>	I 45	A 78	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13J/Fig. 14G	<i>Idalina berthelini</i>	I 42	A 74	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13K	<i>Idalina berthelini</i>	I 38	A 70	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13L/Fig. 14J	<i>Idalina berthelini</i>	G 60	L 141	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13M/Fig. 14L	<i>Idalina berthelini</i>	I 22	A 46	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13N/Fig. 14K	<i>Idalina berthelini</i>	G 13	L 52	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13O	<i>Idalina berthelini</i>	I 44	A 77	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13P	<i>Idalina berthelini</i>	G 35	L 104	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13Q	<i>Idalina berthelini</i>	I 39	A 71	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13R	<i>Idalina berthelini</i>	I 37	A 69	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13S/Fig. 14F	<i>Idalina berthelini</i>	G 36	L 105	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13T	<i>Idalina berthelini</i>	I 40	A 72	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 13U/Fig. 14E	<i>Idalina berthelini</i>	G 27	L 88	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 13V	<i>Idalina berthelini</i>	I 17	A 40	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 14H	<i>Idalina berthelini</i>	I 38	A 70	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 14I	<i>Idalina berthelini</i>	I 9	A 18	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 14O	<i>Idalina osquetaensis</i>	O 12	Os-13	Natural Science Museum of the University of Zaragoza	MPZ 2020/506	La Osqueta
Fig. 14W	<i>Idalina osquetaensis</i>	O 5	Os-6	Natural Science Museum of the University of Zaragoza	MPZ 2020/511	La Osqueta
Fig. 15A/Fig. 14P	<i>Idalina osquetaensis</i>	O 3	Os-4	Natural Science Museum of the University of Zaragoza	Holotype, MPZ 2019/1681	La Osqueta
Fig. 15B/Fig. 14V	<i>Idalina osquetaensis</i>	P 21	P-10	Natural Science Museum of the University of Zaragoza	MPZ 2020/515	La Peña
Fig. 15C/Fig. 14A'	<i>Idalina osquetaensis</i>	V 9	Vi-10	Natural Science Museum of the University of Zaragoza	MPZ 2020/554	Villalangua
Fig. 15D/Fig. 14Q	<i>Idalina osquetaensis</i>	O 2	Os-3	Natural Science Museum of the University of Zaragoza	MPZ 2020/508	La Osqueta
Fig. 15E/Fig. 14R	<i>Idalina osquetaensis</i>	O 3	Os-4	Natural Science Museum of the University of Zaragoza	Paratype, MPZ 2019/1683	La Osqueta

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 15F/ Fig. 14S	<i>Idalina osquetaensis</i>	O 3	Os-4	Natural Science Museum of the University of Zaragoza	Paratype, MPZ 2019/1682	La Osqueta
Fig. 15G/ Fig. 14U	<i>Idalina osquetaensis</i>	E 33	Es-30	Natural Science Museum of the University of Zaragoza	MPZ 2020/488	La Foz de Escalete
Fig. 15H/ Fig. 14Z	<i>Idalina osquetaensis</i>	M 16	Mu-15	Natural Science Museum of the University of Zaragoza	MPZ 2020/495	Murillo de Gállego
Fig. 15I/ Fig. 14T	<i>Idalina osquetaensis</i>	SC 52	Sc-39	Natural Science Museum of the University of Zaragoza	MPZ 2020/538	Sierra Caballera
Fig. 15J/ Fig. 14Y	<i>Idalina osquetaensis</i>	V 15	Vi-17	Natural Science Museum of the University of Zaragoza	MPZ 2020/548	Villalangua
Fig. 15K	<i>Idalina osquetaensis</i>	M 16	Mu-15	Natural Science Museum of the University of Zaragoza	MPZ 2020/494	Murillo de Gállego
Fig. 15L	<i>Idalina osquetaensis</i>	O 17	Os-18	Natural Science Museum of the University of Zaragoza	MPZ 2020/507	La Osqueta
Fig. 15M	<i>Idalina osquetaensis</i>	E 40	Es-38	Natural Science Museum of the University of Zaragoza	MPZ 2020/490	La Foz de Escalete
Fig. 15N	<i>Idalina osquetaensis</i>	P 33	P-34	Natural Science Museum of the University of Zaragoza	MPZ 2020/520	La Peña
Fig. 15O	<i>Idalina osquetaensis</i>	SC 52	Sc-39	Natural Science Museum of the University of Zaragoza	MPZ 2020/537	Sierra Caballera
Fig. 15P	<i>Idalina osquetaensis</i>	M 8	Mu-24	Natural Science Museum of the University of Zaragoza	MPZ 2020/505	Murillo de Gállego
Fig. 15Q	<i>Idalina osquetaensis</i>	V 14	Vi-16	Natural Science Museum of the University of Zaragoza	MPZ 2020/547	Villalangua
Fig. 15R	<i>Idalina osquetaensis</i>	V 7	Vi-8	Natural Science Museum of the University of Zaragoza	MPZ 2020/549	Villalangua
Fig. 15S	<i>Idalina osquetaensis</i>	M 15	Mu-16	Natural Science Museum of the University of Zaragoza	MPZ 2020/493	Murillo de Gállego
Fig. 16A	<i>Fabularia roselli</i>	G 21	L 73	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16B	<i>Fabularia roselli</i>	G 20	L 71	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16C	<i>Fabularia roselli</i>	I 1	A 1	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 16D	<i>Fabularia roselli</i>	G 21	L 73	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16E	<i>Fabularia roselli</i>	G 12	L 51	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16F	<i>Fabularia roselli</i>	G 18	L 66	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16G	<i>Fabularia roselli</i>	G 16	L 60	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16H	<i>Fabularia roselli</i>	G 19	L 69	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16I	<i>Fabularia roselli</i>	G 21	L 72	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16J	<i>Fabularia roselli</i>	I 2	A 2	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 16K	<i>Fabularia roselli</i>	G 21	L 72	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16L	<i>Fabularia roselli</i>	G 21	L 72	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16M	<i>Fabularia roselli</i>	G 21	L 72	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16N	<i>Fabularia roselli</i>	G 18	L 66	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16O	<i>Fabularia roselli</i>	G 19	L 69	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16P	<i>Fabularia ovata</i>	G 18	L 66	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16Q	<i>Fabularia ovata</i>	G 9	L 47	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 16R	<i>Fabularia ovata</i>	G 9	L 47	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 16S	<i>Fabularia ovata</i>	V 9	Vf-10	Natural Science Museum of the University of Zaragoza	MPZ 2020/553	Villalangua
Fig. 16T	<i>Fabularia ovata</i>	E 16	Es2-17	Natural Science Museum of the University of Zaragoza	MPZ 2020/486	La Foz de Escalote
Fig. 16U	<i>Fabularia ovata</i>	V 9	Vf-10	Natural Science Museum of the University of Zaragoza	MPZ 2020/552	Villalangua
Fig. 16V	<i>Fabularia ovata</i>	P 22	P-12	Natural Science Museum of the University of Zaragoza	MPZ 2020/516	La Peña
Fig. 16W	<i>Fabularia ovata</i>	V 9	Vf-10	Natural Science Museum of the University of Zaragoza	MPZ 2020/551	Villalangua
Fig. 16X	<i>Fabularia ovata</i>	I 32	A 56	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 16Y	<i>Fabularia ovata</i>	G 9	L 47	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17A	<i>Pseudolacazina hottigeri</i>	G 18	L 67	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17B	<i>Pseudolacazina hottigeri</i>	G 14	L 55	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17C	<i>Pseudolacazina hottigeri</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17D	<i>Pseudolacazina hottigeri</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17E	<i>Pseudolacazina hottigeri</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17F	<i>Pseudolacazina hottigeri</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17G	<i>Pseudolacazina hottigeri</i>	I 34	A 59	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17H	<i>Pseudolacazina hottigeri</i>	M 2	Mu-30	Natural Science Museum of the University of Zaragoza	MPZ 2020/496	Murillo de Gállego
Fig. 17I	<i>Pseudolacazina hottigeri</i>	I 28	A 52	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17J	<i>Pseudolacazina hottigeri</i>	I 31	A 55	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17K	<i>Pseudolacazina hottigeri</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17L	<i>Pseudolacazina hottigeri</i>	I 28	A 52	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17M	<i>Pseudolacazina hottigeri</i>	G 14	L 55	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17N	<i>Pseudolacazina hottigeri</i>	G 13	L 52	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17O	<i>Pseudolacazina hottigeri</i>	G 10	L 49	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17P	<i>Pseudolacazina hottigeri</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17Q	<i>Pseudolacazina hottigeri</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17R	<i>Pseudolacazina hottigeri</i>	I 30	A 54	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17S	<i>Perilloculina cf. raincourtii</i>	I 28	A 52	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17T	<i>Perilloculina cf. raincourtii</i>	G 24	L 82	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 17U	<i>Perilloculina cf. raincourtii</i>	I 30	A 54	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17V	<i>Perilloculina cf. raincourtii</i>	I 28	A 52	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 17W	<i>Perilloculina cf. raincourtii</i>	SC 22	Sc-3	Natural Science Museum of the University of Zaragoza	MPZ 2020/530	Sierra Caballera

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 17X	<i>Periloculina cf. raincourtii</i>	SC 23	Sc-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/533	Sierra Caballera
Fig. 18A	<i>Alveolina ospiensis</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 18B	<i>Alveolina ospiensis</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 18C	<i>Alveolina ospiensis</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 18D	<i>Alveolina ospiensis</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 18E	<i>Alveolina ospiensis</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19A	<i>Alveolina decastrai</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19A'	<i>Alveolina munieri</i>	I 17	A 40	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19B	<i>Alveolina decastrai</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19B'	<i>Alveolina munieri</i>	I 20	A 43	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19C	<i>Alveolina decastrai</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19C'	<i>Alveolina munieri</i>	I 16	A 39	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19D	<i>Alveolina decastrai</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19D'	<i>Alveolina munieri</i>	I 20	A 43	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19E	<i>Alveolina cremae</i>	G 1	L 20	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19F	<i>Alveolina cremae</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19G	<i>Alveolina obtusa</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19H	<i>Alveolina levantina</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19I	<i>Alveolina levantina</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19J	<i>Alveolina obtusa</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19K	<i>Alveolina tenuis</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19L	<i>Alveolina boscii</i>	G 15	L 58	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19M	<i>Alveolina boscii</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19N	<i>Alveolina tenuis</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19O	<i>Alveolina tenuis</i>	G 21	L 73	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19P	<i>Alveolina tenuis</i>	G 17	L 63	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19Q	<i>Alveolina boscii</i>	G 18	L 65	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19R	<i>Alveolina boscii</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19S	<i>Alveolina boscii</i>	G 14	L 57	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19T	<i>Alveolina boscii</i>	G 34	L 103	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19U	<i>Alveolina boscii</i>	G 16	L 61	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 19V	<i>Alveolina callosa</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19W	<i>Alveolina stipes</i>	G 4	L 37	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19X	<i>Alveolina tenuis</i>	I 13	A 27	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 19Y	<i>Alveolina callosa</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 19Z	<i>Alveolina callosa</i>	SC 12	SC2-17	Natural Science Museum of the University of Zaragoza	MPZ 2020/525	Sierra Caballera
Fig. 20A	<i>Alveolina fusiformis</i>	I 20	A 43	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 20B	<i>Alveolina fusiformis</i>	O 7	O5-8	Natural Science Museum of the University of Zaragoza	MPZ 2020/512	La Osqueta
Fig. 20C	<i>Alveolina fusiformis</i>	I 22	A 46	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 20D	<i>Alveolina fusiformis</i>	O 3	O5-4	Natural Science Museum of the University of Zaragoza	MPZ 2020/510	La Osqueta
Fig. 20E	<i>Alveolina fusiformis</i>	I 20	A 43	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 20F	<i>Alveolina fusiformis</i>	I 22	A 46	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 20G	<i>Alveolina fusiformis</i>	P 12	Pe-19	Natural Science Museum of the University of Zaragoza	MPZ 2020/514	La Peña
Fig. 20H	<i>Alveolina fusiformis</i>	Lassere, Bastennes (Hottinger, 1974)	Plate 52.5			
Fig. 20I	<i>Alveolina fusiformis</i>	Brassempouy, Bastennes	Plate 52.2			
Fig. 20J	<i>Alveolina fusiformis</i>	Brassempouy, Bastennes	Plate 52.3			
Fig. 20K	<i>Alveolina fusiformis</i>	Lassere, Bastennes (Hottinger, 1974)	Plate 52.4			
Fig. 20L	<i>Alveolina fusiformis</i>	Lassere, Bastennes (Hottinger, 1974)	Plate 52.6			
Fig. 20M	<i>Alveolina aff. fragilis</i>	E 52	Es-52	Natural Science Museum of the University of Zaragoza	MPZ 2020/492	La Foz de Escatele
Fig. 20N	<i>Alveolina aff. fragilis</i>	P 32	P-33	Natural Science Museum of the University of Zaragoza	MPZ 2020/519	La Peña
Fig. 20O	<i>Alveolina aff. fragilis</i>	SF 6	SF-8	Natural Science Museum of the University of Zaragoza	MPZ 2020/544	San Felices
Fig. 20P	<i>Alveolina aff. fragilis</i>	E 15	Es2-16	Natural Science Museum of the University of Zaragoza	MPZ 2020/485	La Foz de Escatele
Fig. 20Q	<i>Alveolina aff. elongata</i>	SC 53	Sc-40	Natural Science Museum of the University of Zaragoza	MPZ 2020/542	Sierra Caballera
Fig. 20R	<i>Alveolina aff. elongata</i>	SF 6	SF-8	Natural Science Museum of the University of Zaragoza	MPZ 2020/543	San Felices
Fig. 20S	<i>Alveolina aff. elongata</i>	V 10	Vi-11	Natural Science Museum of the University of Zaragoza	MPZ 2020/546	Villalangua
Fig. 20T	<i>Alveolina aff. elongata</i>	O 3	O5-4	Natural Science Museum of the University of Zaragoza	MPZ 2020/509	La Osqueta
Fig. 21A	<i>Spiralina austriaca</i>	I 23	A 47	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 21B	<i>Spiralina austriaca</i>	G 50	L 126	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21C	<i>Sivasina egribucakensis</i>	G 27	L 88	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 21D	<i>Penarchaias</i> sp.	G 28	L 91	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21E	<i>Penarchaias</i> sp.	G 37	L 107	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21F	<i>Penarchaias</i> sp.	G 42	L 117	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21G	<i>Penarchaias</i> sp.	G 43	L 118	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21H	<i>Orbitalites complanatus</i>	G 25	L 83	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21I	<i>Orbitalites complanatus</i>	I 50	A 87	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 21J	<i>Orbitalites minimus</i>	P 5	Pe-10b	Natural Science Museum of the University of Zaragoza	MPZ 2020/521	La Peña
Fig. 21K	<i>Orbitalites minimus</i>	E 21	Es-16	Natural Science Museum of the University of Zaragoza	MPZ 2020/487	La Foz de Escalate
Fig. 21L	<i>Orbitalites complanatus</i>	SC 23	Sc-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/532	Sierra Caballera
Fig. 21M	<i>Orbitalites complanatus</i>	G 30	L 96	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 21N	<i>Orbitalites catentinensis</i>	SC 30	Sc-13	Natural Science Museum of the University of Zaragoza	MPZ 2020/534	Sierra Caballera
Fig. 22A	<i>Haddonia heissigi</i>	I 37	A 69	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22B	<i>Haddonia heissigi</i>	I 37	A 69	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22C	<i>Haddonia heissigi</i>	G 6	L 41	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 22D	<i>Coskinalina cf. perpera</i>	G 2	L 23	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 22E	<i>Coskinalina cf. perpera</i>	G 1	L 21	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 22F	<i>Coskinalina roberti</i>	I 28	A 52	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22G	<i>Coskinalina roberti</i>	I 31	A 55	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22H	<i>Coskinalina roberti</i>	I 31	A 55	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22I	<i>Coskinalina roberti</i>	I 24	A 48	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22J	<i>Coskinalina roberti</i>	I 33	A 58	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22K	<i>Coskinalina roberti</i>	I 50	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22L	<i>Coskinalina roberti</i>	I 41	A 73	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22M	<i>Coskinalina roberti</i>	I 38	A 70	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22N	<i>Coskinalina roberti</i>	I 48	A 82	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22O	<i>Coskinalina roberti</i>	I 42	A 74	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22P	<i>Coskinalina roberti</i>	I 45	A 78	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22Q	<i>Coskinalina roberti</i>	P 10	Pe-17	Natural Science Museum of the University of Zaragoza	MPZ 2020/513	La Peña
Fig. 22R	<i>Coskinalina roberti</i>	I 50	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22S	<i>Coskinalina roberti</i>	I 45	A 78	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 22T	<i>Coskinalina roberti</i>	I 42	A 74	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 23A	Gavelinellidae indet.	G 40	L 112	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23B	Gavelinellidae indet.	G 39	L 111	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23C	Gavelinellidae indet.	G 40	L 112	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23D	Gavelinellidae indet.	G 40	L 112	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23E	Gavelinellidae indet.	G 38	L 110	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23F	Gavelinellidae indet.	G 39	L 111	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23G	<i>Fabiania cassis</i>	E 41	Es-39	Natural Science Museum of the University of Zaragoza	MPZ 2020/491	La Foz de Escalete
Fig. 23H	<i>Fabiania cassis</i>	I 33	A 58	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 23I	<i>Fabiania cassis</i>	G 33	L 102	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23J	<i>Fabiania cassis</i>	G 36	L 105	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23K	<i>Halkyardia minima</i>	G 67	L 152	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23L	<i>Halkyardia minima</i>	G 62	L 147	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 23M	<i>Halkyardia minima</i>	SC 19	SC2-26	Natural Science Museum of the University of Zaragoza	MPZ 2020/529	Sierra Caballera
Fig. 23N	<i>Halkyardia minima</i>	G 48	L 123	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24A	<i>Gyroidinella levis</i>	SC 1	SC2-2b	Natural Science Museum of the University of Zaragoza	MPZ 2020/524	Sierra Caballera
Fig. 24B	<i>Gyroidinella levis</i>	G 7	L 44	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24C	<i>Gyroidinella levis</i>	I 4	A 5	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 24D	<i>Gyroidinella eoacaenica</i>	G 36	L 105	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24E	<i>Gyroidinella eoacaenica</i>	G 36	L 105	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24F	<i>Gyroidinella eoacaenica</i>	G 33	L 102	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24G	<i>Gyroidinella magna</i>	G 45	L 120	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24H	<i>Gyroidinella magna</i>	G 23	L 81	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24I	<i>Gyroidinella magna</i>	G 58	L 139	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24J	<i>Gyroidinella magna</i>	V 8	Vi-9	Natural Science Museum of the University of Zaragoza	MPZ 2020/550	Villalangua
Fig. 24K	<i>Gyroidinella magna</i>	G 23	L 81	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24L	<i>Gyroidinella magna</i>	G 26	L 85	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24M	<i>Gyroidinella magna</i>	G 24	L 82	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24N	<i>Karobkovella grosserugosa</i>	SC 53	SC-40	Natural Science Museum of the University of Zaragoza	MPZ 2020/541	Sierra Caballera
Fig. 24O	<i>Karobkovella grosserugosa</i>	G 71	L 156	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24P	<i>Karobkovella grosserugosa</i>	SC 53	SC-40	Natural Science Museum of the University of Zaragoza	MPZ 2020/540	Sierra Caballera
Fig. 24Q	<i>Victoriella conoidea</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 24R	<i>Korabkovella grosserugosa</i>	G 39	L 111	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 24S	<i>Korabkovella grosserugosa</i>	SC 53	Sc-40	Natural Science Museum of the University of Zaragoza	MPZ 2020/539	Sierra Caballera
Fig. 25A	<i>Solenomeris cf. agormani</i>	G 50	L 126	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25B	<i>Solenomeris cf. agormani</i>	I 33	A 58	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 25C	<i>Solenomeris cf. agormani</i>	V 10	Vi-11	Natural Science Museum of the University of Zaragoza	MPZ 2020/545	Villalangua
Fig. 25D	<i>"Gypsina" moussaviani</i>	G 38	L 110	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25E	<i>"Gypsina" moussaviani</i>	I 47	A 81	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 25F	<i>"Gypsina" moussaviani</i>	G 50	L 126	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25G	<i>"Gypsina" moussaviani</i>	G 30	L 96	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25H	<i>Sphaerogypsina globulus</i>	P 25	P-19	Instituto Geológico y Minero de España (IGME)		La Peña
Fig. 25I	<i>Sphaerogypsina globulus</i>	G 59	L 140	Natural Science Museum of the University of Zaragoza	MPZ 2020/517	Gabardiella / Lusera*
Fig. 25J	<i>Asterigerina ratula</i>	SC 19	Sc2-26	Natural Science Museum of the University of Zaragoza	MPZ 2020/528	Sierra Caballera
Fig. 25K	<i>Asterigerina ratula</i>	SC 19	Sc2-26	Natural Science Museum of the University of Zaragoza	MPZ 2020/527	Sierra Caballera
Fig. 25L	<i>Asterigerina ratula</i>	SC 1	Sc2-2b	Natural Science Museum of the University of Zaragoza	MPZ 2020/523	Sierra Caballera
Fig. 25M	<i>Asterigerina ratula</i>	SC 16	Sc2-22c (lámina delgada)	Natural Science Museum of the University of Zaragoza	MPZ 2020/526	Sierra Caballera
Fig. 25N	<i>Asterigerina ratula</i>	G 41	L 116	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25O	<i>Asterigerina ratula</i>	G 41	L 116	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25P	<i>Planolindrina ?</i>	G 69	L 154	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25Q	<i>Linderina cf. brugesi</i>	SC 40	Sc-23	Natural Science Museum of the University of Zaragoza	MPZ 2020/536	Sierra Caballera
Fig. 25R	<i>Linderina cf. brugesi</i>	G 48	L 123	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25S	<i>Linderina cf. brugesi</i>	G 64	L 149	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25T	<i>Planolindrina ?</i>	G 62	L 147	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25U	<i>Planolindrina ?</i>	I 38	A 70	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 25V	<i>Rotarbinella hersoni</i>	G 71	L 156	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 25W	<i>Chapmanina gassinensis</i>	SC 23	Sc-5 (lámina delgada)	Natural Science Museum of the University of Zaragoza	MPZ 2020/531	Sierra Caballera
Fig. 26A	<i>Rotalia trochialiformis</i>	I 4	A 5	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26B	<i>Rotalia trochialiformis</i>	SC 1	Sc2-2b	Natural Science Museum of the University of Zaragoza	MPZ 2020/522	Sierra Caballera
Fig. 26C	<i>Rotalia trochialiformis</i>	SC 32	Sc-15	Natural Science Museum of the University of Zaragoza	MPZ 2020/535	Sierra Caballera
Fig. 26D	<i>Rotalia trochialiformis</i>	I 51	A 88	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26E	<i>Rotalia trochialiformis</i>	G 48	L 123	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26F	<i>Rotalia trochialiformis</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 26G	<i>Rotalia trochiformis</i>	G 23	L 81	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26H	<i>Medocia blayensis</i>	G 58	L 139	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26I	<i>Medocia blayensis</i>	G 60	L 141	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26J	<i>Medocia blayensis</i>	150	A 88	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26K	<i>Medocia blayensis</i>	150	A 87	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26L	<i>Medocia blayensis</i>	150	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26M	<i>Medocia blayensis</i>	G 16	L 60	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26N	<i>Medocia blayensis</i>	150	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26O	<i>Medocia blayensis</i>	150	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26P	<i>Medocia blayensis</i>	112	A 26	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26Q	<i>Neorotalia lithamnica</i>	G 3	L 36	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 26R	<i>Neorotalia lithamnica</i>	12	A 2	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 26S	<i>Neorotalia lithamnica</i>	G 19	L 68	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 27A	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27B	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27C	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27D	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27E	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27F	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27G	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27H	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27I	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27J	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27K	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 27L	<i>Assilina spira abarardi</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 28A	<i>Nummulites lehnerei</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 28A'	<i>Nummulites beneharnensis</i>	118	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28B	<i>Nummulites lehnerei</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 28B'	<i>Nummulites beneharnensis</i>	118	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28C	<i>Nummulites lehnerei</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 28C'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 28D	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28D'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28E	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28E'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28F	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28F'/Fig. 33K	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28G	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28G'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28H	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28H'/Fig. 33L	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28I	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28I'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28J	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardella / Lusera*
Fig. 28J'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28K	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Santa Marina
Fig. 28K'	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Gabardella / Lusera*
Fig. 28L	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Santa Marina
Fig. 28L'/Fig. 33M	<i>Nummulites crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Gabardella / Lusera*
Fig. 28M/ Fig. 33E	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28M'/ Fig. 33N	<i>Nummulites taverdetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28N	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28N'	<i>Nummulites taverdetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28O	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28O'/ Fig. 33Q	<i>Nummulites taverdetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28P	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28P'	<i>Nummulites taverdetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28Q	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28Q'/ Fig. 33O	<i>Nummulites taverdetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 28R'	<i>Nummulites aturicus</i>	SC 39	Sc-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28R'/ Fig. 33D	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28S	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 285'	<i>Nummulites aturicus</i>	SC 39	Sc-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28T	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28T'/Fig. 33Y	<i>Nummulites aturicus</i>	SC 39	Sc-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28U	<i>Nummulites aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28U'	<i>Nummulites aturicus</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28V	<i>Nummulites benehamensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28V'	<i>Nummulites aturicus</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28W	<i>Nummulites benehamensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28W'	<i>Nummulites aturicus</i>	SC 39	Sc-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28X	<i>Nummulites benehamensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28X'	<i>Nummulites aturicus</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 28Y	<i>Nummulites benehamensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28Z	<i>Nummulites benehamensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 28Z'	<i>Nummulites aturicus</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29A/ Fig. 33G'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29A/ Fig. 33R	<i>Nummulites aff. deshayesi</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29B	<i>Nummulites aff. deshayesi</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29B/ Fig. 33E'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29C'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29C/ Fig. 33S	<i>Nummulites aff. deshayesi</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29D'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29D/ Fig. 33U	<i>Nummulites aff. deshayesi</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29E	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29F	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29G	<i>Nummulites aff. deshayesi</i>	SC 38	Sc-21	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29H	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29I	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29J	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29K	<i>Nummulites aff. deshayesi</i>	E 30	Es-27	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		La Foz de Escalate
Fig. 29L	<i>Nummulites aff. deshayesi</i>	SC 38	Sc-21	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29M/ Fig. 33Z	<i>Nummulites deshayesi</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29N	<i>Nummulites deshayesi</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 290/Fig. 33B'	<i>Nummulites deshayesi</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29P/Fig. 33A'	<i>Nummulites deshayesi</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 29Q	<i>Nummulites deshayesi</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29R	<i>Nummulites deshayesi</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29S	<i>Nummulites deshayesi</i>	SM 5	SM-5	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29T	<i>Nummulites deshayesi</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29U	<i>Nummulites deshayesi</i>	SC 50	Sc-36	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 29V/Fig. 33D'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29W	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29X/Fig. 33F'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29Y/Fig. 33H'	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 29Z	<i>Nummulites perforatus</i>	SM 6	SM-7	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 30A	<i>Nummulites bousiaci</i>	SM 2	SM-3	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 30B	<i>Nummulites bousiaci</i>	SM 2	SM-3	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 30C	<i>Nummulites bousiaci</i>	SM 2	SM-3	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 30D	<i>Nummulites aff. bullatus</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Santa Marina
Fig. 30E	<i>Nummulites aff. bullatus</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30F	<i>Nummulites aff. bullatus</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30G	<i>Nummulites migliurinus</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30H	<i>Nummulites migliurinus</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30I	<i>Nummulites praediscorbinus</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30J	<i>Nummulites praediscorbinus</i>	I 7	A 10	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30K	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/504	Murillo de Gállego
Fig. 30L	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/503	Murillo de Gállego
Fig. 30M	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/502	Murillo de Gállego
Fig. 30N	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/501	Murillo de Gállego
Fig. 30O	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/500	Murillo de Gállego
Fig. 30P	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/499	Murillo de Gállego
Fig. 30Q	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/498	Murillo de Gállego
Fig. 30R	<i>Nummulites praepuschi</i>	M 24	Mu-5	Natural Science Museum of the University of Zaragoza	MPZ 2020/497	Murillo de Gállego
Fig. 30S	<i>Nummulites beaumonti</i>	E 40	Es-38	Natural Science Museum of the University of Zaragoza	MPZ 2020/489	La Foz de Escalate

APPENDIX I. Continued.

Specimen	Species	Sample name in this work	Sample name in the repository	Repository	Catalogue numbers	Stratigraphic Section
Fig. 30T	<i>Nummulites beaumonti</i>	P 29	P-25	Natural Science Museum of the University of Zaragoza	MPZ 2020/518	La Peña
Fig. 30U	<i>Nummulites beaumonti</i>	I 50	A 86	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 30V	<i>Nummulites biarrizensis</i>	CF 5	CF-20	Natural Science Museum of the University of Zaragoza	MPZ 2020/484	Campo Fenero
Fig. 30W	<i>Nummulites biarrizensis</i>	CF 5	CF-20	Natural Science Museum of the University of Zaragoza	MPZ 2020/483	Campo Fenero
Fig. 33A	<i>N. beneharnensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33B	<i>N. beneharnensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33C	<i>N. beneharnensis</i>	I 18	A 41	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33C'	<i>N. deshayesi</i>	I 54	A 95	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33F	<i>N. aspermontis</i>	I 8	A 11	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33G	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 33H	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 33I	<i>Nummulites lehneri</i>	G 5	L 38	Instituto Geológico y Minero de España (IGME)		Gabardiella / Lusera*
Fig. 33J	<i>N. crassus</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 33P	<i>N. tovertetensis</i>	SM 4	SM-6	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Santa Marina
Fig. 33T	<i>N. aff. deshayesi</i>	I 52	A 91	Instituto Geológico y Minero de España (IGME)		Isuela / Arguis*
Fig. 33V	<i>Nummulites aturicus</i>	SC 39	SC-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 33W	<i>Nummulites aturicus</i>	SC 39	SC-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera
Fig. 33X	<i>Nummulites aturicus</i>	SC 39	SC-N1	Serra-Kiel collection. Department of Earth and Ocean Dynamics, University of Barcelona (UB)		Sierra Caballera

* Stratigraphic section names employed on the IGME repositories.

APPENDIX II

SYSTEMATICS OF LARGER BENTHIC FORAMINIFERA

Phylum Foraminifera EICHWALD, 1830

Class Tubothalamea PAWLOWSKI, HOLZMANN, JAROSLAW & TYSZKA, 2013

Order Miliolida DELAGE & HÉROUARD, 1896

Superfamily Milioloidea Ehrenberg, 1839

Family Hauerinidae Schwager, 1876

Subfamily Miliolinellinae Vella, 1957

GENUS *Idalina* SCHLUMBERGER & MUNIER-CHALMAS, 1884

Type species *Idalina antiqua* SCHLUMBERGER & MUNIER-CHALMAS, 1884

Idalina berthelini SCHLUMBERGER, 1905

Idalina osquetaensis n. sp. SERRA-KIEL & SILVA-CASAL

Superfamily Alveolinoidea EHRENBERG, 1839

Family Fabulariidae EHRENBERG, 1839

GENUS *Fabularia* DEFRANCE, 1820

Type species: *Fabularia discolites* DEFRANCE in BRONN, 1825

Fabularia roselli CAUS, 1979

Fabularia ovata de Roissy, 1805

GENUS *Pseudolacazina* CAUS, 1979

Type species: *Pseudolacazina hottingeri* CAUS, 1979

Pseudolacazina hottingeri CAUS, 1979

GENUS *Periloculina* MUNIER-CHALMAS & SCHLUMBERGER, 1885

Type species: *Periloculina zitteli* MUNIER-CHALMAS & SCHLUMBERGER, 1885

Periloculina cf. *raincourti* SCHLUMBERGER, 1905

Family Alveolinidae EHRENBERG, 1839

GENUS *Alveolina* D'ORBIGNY, 1826

Type species: *Oryzaria boscii* DeFrance in Bronn, 1825

Alveolina ospiensis DROBNE, 1977

Alveolina decastroii DI SCOTTO, 1966

Alveolina cremae CHECCHIA-RISPOLI, 1905

Alveolina obtusa MONTANARI, 1964

Alveolina boscii DEFRANCE, 1825

Alveolina levantina HOTTINGER, 1960

Alveolina tenuis HOTTINGER, 1960

Alveolina callosa HOTTINGER, 1960

Alveolina stipes HOTTINGER, 1960

Alveolina munieri HOTTINGER, 1960

Alveolina fusiformis SOWERBY, 1850

Alveolina aff. *fragilis* HOTTINGER, 1960

Alveolina aff. *elongata* D'ORBIGNY, 1828

Family Peneroplidae SCHULTZE, 1854

GENUS *Spirolina* LAMARCK, 1804

Type species: *Spirolina cylindracea* LAMARCK, 1804
Spirolina austriaca D'ORBIGNY, 1834

GENUS *Sivasina* SIREL & ÖZGEN-ERDEM, 2013

Type species: *Sivasina egribucakensis* SIREL & ÖZGEN-ERDEM, 2013
Sivasina egribucakensis SIREL & ÖZGEN-ERDEM, 2013

GENUS *Penarchaias* HOTTINGER, 2007

Type species: *Peneroplis glynnjonesi* HENSON, 1950
Penarchaias sp.

Family: Soritidae EHRENBERG, 1839
Subfamily: Soritinae EHRENBERG, 1839

GENUS *Orbitolites* LAMARCK, 1801

Type species: *Orbitolites complanatus* LAMARCK, 1801
Orbitolites minimus HENSON, 1950
Orbitolites complanatus LAMARCK, 1801
Orbitolites cotentinensis LEHMANN, 1961

Class Globothalamea PAWLOWSKI *et al.*, 2013

Order "Textulariida" DELAGE & HÉROUARD, 1896 *partim*

Superfamily Coscinophragmatacea THALMANN, 1951

Family Haddonidae CHAPMAN, 1898

GENUS *Haddonia* CHAPMAN, 1898

Type species: *Haddonia torresiensis* CHAPMAN, 1898
Haddonia heissigi HAGN, 1968

Superfamily ATAXOPHRAGMIOIDEA SCHWAGER, 1877

Family COSKINOLINIDAE MOULLADE, 1965

GENUS *Coskinolina* Stache, 1875

Type species: *Coskinolina liburnica* Stache, 1875
Coskinolina cf. *perpera* HOTTINGER & DROBNE, 1980
Coskinolina roberti SCHLUMBERGER, 1905

Order ROTALIIDA DELAGE AND HÉROUARD, 1896

Superfamily CHILOSTOMELLACEA BRADY, 1881

Family GAVELINELLIDAE HOFKER, 1956

Gavelinellidae indet.

Superfamily Planorbuloidea SCHWAGER, 1877

Family Cymbaloporidae CUSHMAN, 1927

Subfamily Fabianinae DELOFFRE AND HAMAOU, 1973

GENUS *Fabiania* SILVESTRI, 1924

Type species: *Patella (Cymbolia) cassis* Oppenheim, 1896
Fabiania cassis Oppenheim, 1896

Subfamily Halkyardiinae KUDO, 1931

GENUS *Halkyardia* HERON-ALLEN AND EARLAND, 1918

Type species: *Cymbalopora radiata* VON HAGENOW VAR. MINIMA LIEBUS, 1911
Halkyardia minima LIEBUS, 1911

Family Victoriellinae CHAPMAN AND CRESPIN, 1939

GENUS *Gyroidinella* LE CALVEZ, 1949

Type species: *Gyroidinella magna* LE CALVEZ, 1949

Gyroidinella levis GRIMSDALE, 1952

Gyroidinella eocaenica SACAL AND DEBOURLE, 1957

Gyroidinella magna LE CALVEZ, 1949

GENUS: *Korobkovella* HAGN AND OHMERT, 1971

Type species: *Truncatulina grosserugosa* GÜMBEL, 1870

Korobkovella grosserugosa GÜMBEL, 1870

GENUS: *Victoriella* CHAPMAN AND CRESPIN, 1971

Type species: *Victoriella conoidea* RUTTEN, 1914

Victoriella conoidea RUTTEN, 1914

Superfamily Acervulinoidea SCHULTZE, 1854

Family Acervulinidae SCHULTZE, 1854

GENUS *Solenomeris* DOUVILLÉ, 1924

Type species: *Solenomeris ogormani* DOUVILLÉ, 1924

Solenomeris cf. *ogormani* DOUVILLÉ, 1924

GENUS *Gypsina* CARTER, 1877

Type species: *Polytrema planum* CARTER, 1877

"*Gypsina*" *moussaviani* BRUGNATTI & UNGARO, 1987

GENUS *Sphaerogypsina* GALLOWAY, 1933

Type species: *Cerriopora globulus* REUSS, 1848

Sphaerogypsina globulus REUSS, 1848

Superfamily Asterigerinacea D'ORBIGNY, 1839

Family Asterigerinidae D'ORBIGNY, 1839

GENUS *Asterigerina* D'ORBIGNY, 1839

Type species: *Asterigerina carinata* D'ORBIGNY, 1839

Asterigerina rotula KAUFFMAN, 1867

Superfamily Orbitoideoidea SCHWAGER, 1876

Family Linderinidae LOEBLICH & TAPPAN, 1986

GENUS *Linderina* SCHLUMBERGER, 1893

Type species: *Linderina brugesi* SCHLUMBERGER, 1893

Linderina brugesi SCHLUMBERGER, 1893

Superfamily Planorbulinacea SCHWAGER, 1877

Family Planorbulinidae SCHWAGER, 1877

GENUS *Planolinderina* FREUDENTHAL, 1969

Type species: *Planolinderina escornebovensi* FREUDENTHAL, 1969

Planolinderina? FREUDENTHAL, 1969

Superfamily Rotalioidea EHRENBERG, 1839

Family Rotaliidae EHRENBERG, 1839**Subfamily Rotaliinae EHRENBERG, 1839**GENUS *Rotorbinella* BANDY, 1944

Type species: *Rotorbinella colliculus* Bandy, 1944
Rotorbinella hensoni SMOUT, 1954

GENUS *Rotalia* LAMARCK, 1804

Type species: *Rotalites trochidiformis* LAMARCK, 1804
Rotalia trochidiformis (LAMARCK, 1804)

GENUS *Medocia* PARVATI, 1971

Type species: *Medocia blayensis* PARVATI, 1971
Medocia blayensis PARVATI, 1971

Family Chapmaninidae THALMANN, 1938GENUS *Chapmanina* SILVESTRI, 1905

Type species: *Chapmanina gassinensis* SILVESTRI, 1905
Chapmanina gassinensis SILVESTRI, 1905

Taxa Excluded from the Family Rotaliidae by HOTTINGER (2014)

GENUS *Neorotalia* Bermúdez, 1952

Type species: *Rotalia mexicanai* NUTALL, 1928
Neorotalia lithamnica (UHLIG, 1886)

Family Nummulitidae DE BLAINVILLE, 1825**Subfamily Nummulitinae DE BLAINVILLE, 1825**GENUS *Assilina* D'ORBIGNY, 1839

Type species: *Assilina depressa* D'ORBIGNY, 1850
Assilina spira abrardi SCHAUB, 1981

GENUS *Nummulites* LAMARCK, 1801

Type species: *Camerina laevigata* BRUGUIÈRE, 1792
Nummulites lehneri SCHAUB, 1981
Nummulites aspermontis SCHAUB, 1981
Nummulites beneharnensis DE LA HARPE, 1926
Nummulites crassus BOUBÉE, 1831
Nummulites taverdetensis REGUANT & CLAVELL, 1967
Nummulites aturicus JOLY & LEYMERIE, 1848
Nummulites aff. *deshayesi* D'ARCHIAC & HAIME, 1853
Nummulites deshayesi D'ARCHIAC & HAIME, 1853
Nummulites perforatus (MONTFORT, 1808)
Nummulites boussaci ROZLOZNIK, 1924
Nummulites aff. *bullatus* AZZAROLI, 1952
Nummulites migiurtinus AZZAROLI, 1952
Nummulites praediscorbinus SCHAUB, 1981
Nummulites praepuschi SCHAUB, 1981
Nummulites beaumonti D'ARCHIAC & HAIME, 1853
Nummulites biarritzensis D'ARCHIAC & HAIME, 1853