18. LATE CRETACEOUS SMALLER BENTHIC FORAMINIFERS FROM SITES 363 AND 364 DSDP LEG 40, SOUTHEAST ATLANTIC OCEAN

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INTRODUCTION

The present study is based on selected washed residues and picked slides, which were made available to the author through the courtesy of H.M. Bolli, Co-Chief Scientist of Leg 40 of the Deep Sea Drilling Project. Samples from two Leg 40 sites which penetrated a late Cretaceous section were studied (Figure 1). Site 363 is located on the Walvis Ridge (19°39'S, 9°03'E) at a water depth of 2248 meters. From this site, 20 samples were examined from Cores 18 to 25. Site 364 lies on the eastern margin of the Angola Basin (11°34'S, 11°58'E), at a depth of 2448 meters. From this site, 39 samples from Cores 11 to 23 were studied. The exact core intervals of the samples, their foraminiferal faunas, and their ages are listed on Tables 1 and 2. A total of 102 taxa were identified, of which 65 occur at Site 363, and 76 at Site 364. The larger number of species at Site 364 is mostly because of its thicker section, which contains a better developed Coniacian to Santonian portion.

The illustrated specimens (Plates 1 to 5) are deposited at the Natural History Museum, Basel, Switzerland (Catalog Numbers C 33370 to 33536).

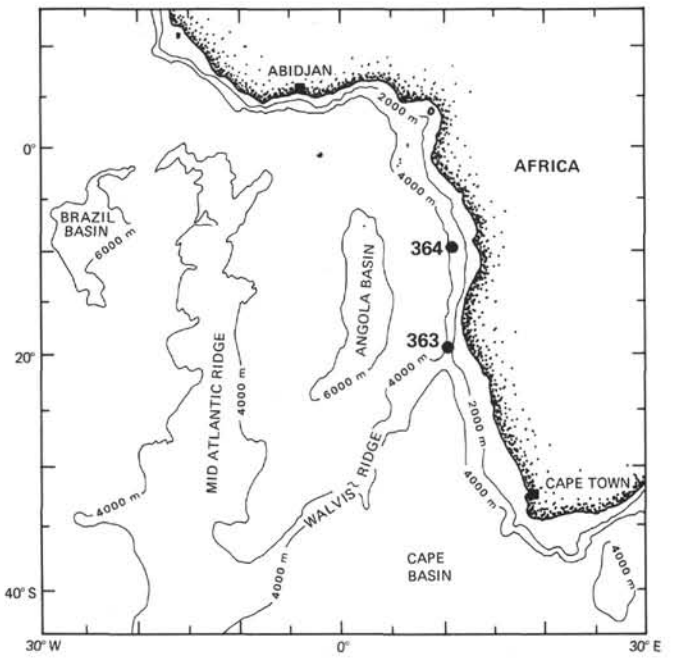


Figure 1. *Location map of Sites 363 and 364, DSDP Leg 40.*

SPECIES DISTRIBUTION

Sites 363 and 364 have a certain number of species in common, but their benthic foraminiferal faunas are by no means identical. This is not surprising, since Site 364 is about 900 km north of Site 363, and occupies a different paleogeographic setting.

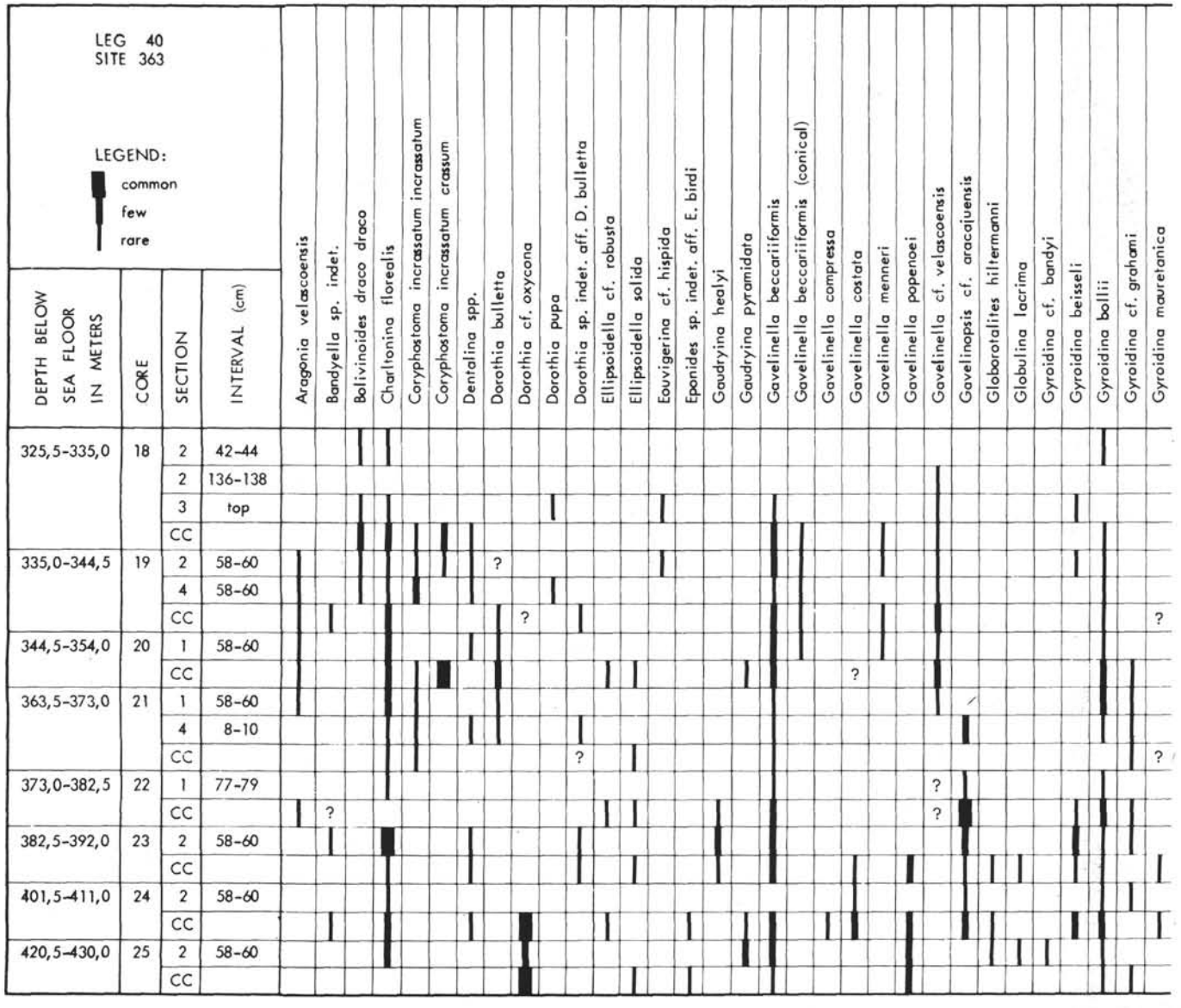
The significant species which occur in similar frequencies at both sites are:

Aragonia velascoensis
Charltonina florealis
Dorothia cf. *oxycona*
Eponides sp. aff. *E. birdi*
Gaudryina pyramidata
Gavelinella beccariiformis
Gavelinella popenoei
Gyroidina beisseli
Gyroidina bollii
Gyroidina cf. *grahami*
Gyroidinoides octocamerata
Lagena apiculata
Lenticulina muensteri
Nuttallides bronnimanni
Osangularia cf. *lens*
Praebulimina cf. *beaumonti*
Pullenia coryelli
Reussella szajnochae
Valvulineria allomorphinoides

The following species and subspecies were found at Site 363 (Walvis Ridge), but not at Site 364 (Angola Basin):

Bolivinoides draco draco
Coryphostoma incrassatum crassum
Coryphostoma incrassatum incrassatum
Coryphostoma cf. *limonense*
Dorothia bulletta
Dorothia sp. indet aff. *D. bulletta*
Dorothia pupa
Ellipsoidella cf. *robusta*
Gaudryina healyi
Gavelinella costata
Gavelinella menneri
Gavelinella cf. *velascoensis*
Gavelinopsis cf. *aracajuensis*
Globorotalites hiltermanni
Neoflabellina gibbera subsp. indet.
Neoflabellina sp. indet. aff. *N. numismalis*
Neoflabellina cf. *praereticulata*
Praebulimina cf. *navarroensis*
Praebulimina sp. indent. A

TABLE 1
Distribution of Upper Cretaceous Benthic Foraminifers, Site 363

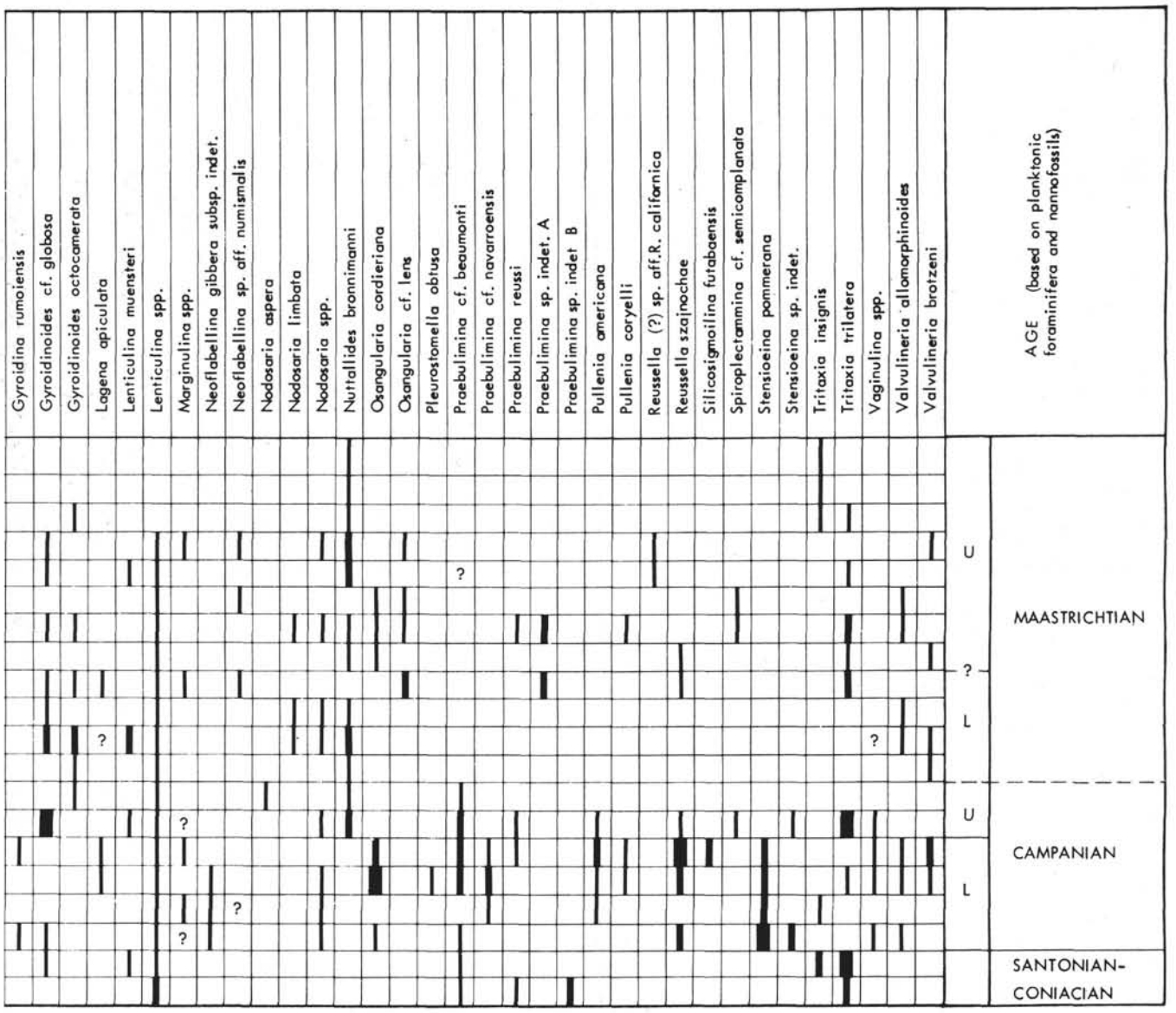


Praebulimina sp. indet. B
Silicosigmoilina futabaensis
Stensioeina pommerana
Tritaxia insignis
Tritaxia trilatera

A certain number of species were found at Site 364 but not at 363:

Aragonia ouezzanensis
**Bandyella greatvalleyensis*
"*Bathysiphon*" spp.
Clavulina gabonica
Conorbina cf. *marginata*
Dorothia trochoides
Dorothia cf. *trochoides*
Gavelinella brotzeni
Gavelinella sp. aff. *G. daini*
**Gavelinella eriksdalensis*
Gavelinella sp. indet.
Globorotalites conicus
Globorotalites spineus
Globulina lacrima horrida
**Gyroidina mauretanica* subsp. indet.
Gyroidina noda
**Gyroidina quadrata*
**Gyroidina* sp. indet.
**Gyroidinoides* sp. indet.
**Lenticulina subangulata*
Nuttallinella(?) cf. *monterelensis*
Nuttallinella sp. indet.
**Osangularia incisa*
Pleurostomella austinana
**Praebulimina* sp. indet. C
Pullenia puentepiedraensis
**Reussella* cf. *cushmani*
Spiroplectammina chicoana
Spiroplectammina dentata
Spiroplectammina regularis
Tritaxia capitosa

TABLE 1 – *Continued*



**Valvulineria camerata*

**Valvulineria* (?) cf. *gracillima*

(The species marked by an asterisk occur only in the Coniacian-Santonian section which is much better developed at Site 364 than at Site 363. The reason for their restricted distribution may therefore be at least partially stratigraphic rather than ecologic.)

The characteristics of the composition of the benthic foraminiferal faunas of Sites 363 and 364 can be summarized as follows:

1) Some groups of agglutinated foraminifers (Astrorhizidae, Hormosinidae, Lithuolidae, Trochamminidae) are remarkably scarce, whereas others (Textulariidae, Ataxophragmiidae) appear to be about normally represented.

2) The rotaloid group of foraminifers is very well represented, both in the number of species and of specimens.

3) There is an average development of buliminid and nodosariid foraminifers. The number of specimens among the Nodosariidae is relatively small.

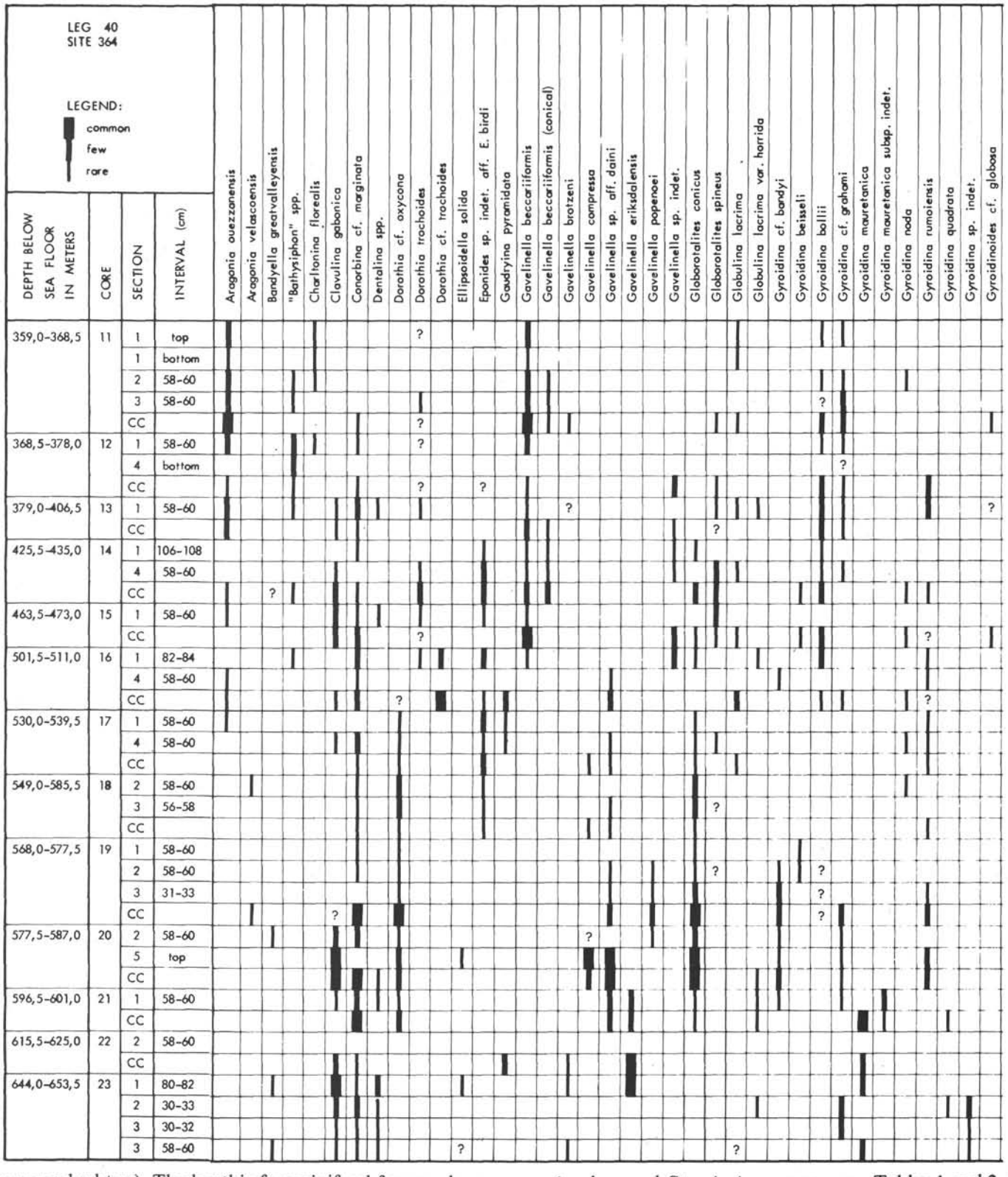
The following species are most numerous:

Aragonia ouezzanensis (Site 364), *Charltonina florealis*, *Clavulina gabonica* (Site 364), *Conorbina* cf. *marginata* (Site 364), *Coryphostoma incrassatum* (Site 363), *Gavelinella beccariiformis*, *Gavelinella* sp. aff. *G. daini* (Site 364), *Gavelinopsis* cf. *aracajuensis* (Site 363), *Globorotalites conicus* (Site 364), *Gyroidina bolli*, *Gyroidina mauretanica*, *Gyroidinoides* cf. *globosa*, *Nuttallinella* spp. (Site 364), *Reussella szajnochae*, and *Tritaxia trilatera* (Site 363).

DISCUSSION: BIOSTRATIGRAPHY, PALEOECOLOGY, AND PALEOGEOGRAPHY

The biostratigraphy of the Sites 363 and 364 is based on planktonic microfossils (mostly foraminifers and

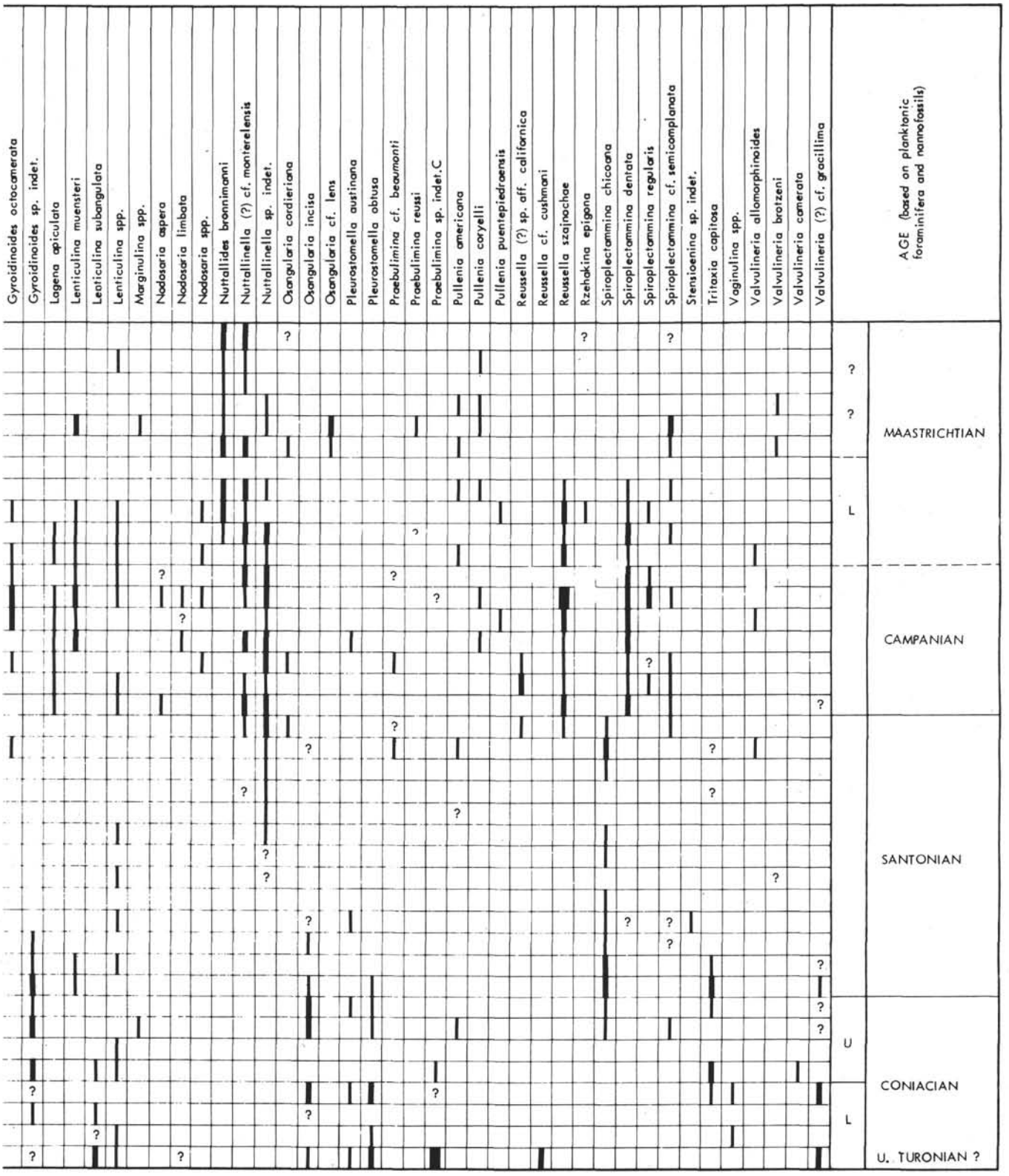
TABLE 2
Distribution of Upper Cretaceous Benthic Foraminifers, Site 364



nannoplankton). The benthic foraminiferal faunas also include species which are known to have limited stratigraphic ranges, such as *Bandyella greatvalleyensis*, *Bolivinoides draco draco*, *Coryphostoma incrassatum crassum*, *C. incrassatum incrassatum*, *Gavelinella costata*, *Gavelinella eriksdalensis*, *Gavelinella popenoei*, *Neoflabellina* spp., *Osangularia incisa*, *Reussella szajnochae*, and *Stensioeina pommerana*. Tables 1 and 2 show clearly that the occurrences of the benthic foraminifers are in good agreement with their generally accepted stratigraphic ranges.

Before discussing the paleoecological implications, it should be stressed that the available samples (washed residues or picked slides only) are not suitable for

TABLE 2 –*Continued*



reaching more than very tentative conclusions. Studies of this kind, in order to be conclusive, require an evaluation and some quantitative assessment of the entire microfauna and microflora.

The unmistakable differences between the benthic microfaunas of Sites 363 and 364 suggest certain differences in depositional environment—either depth, temperature, water chemistry, or paleogeographical setting. Various attempts have recently been made to use late Cretaceous benthic foraminifers as depth indicators. The papers by Sliter and Baker (1972) and by Schnitker (1972) were particularly useful for evaluating the present microfaunas. These authors have reached rather similar conclusions in two different

areas, California and southern France. By comparison with their findings, the Leg 40 faunas probably ranged between the shelf edge and the deeper parts of the continental slope, tentatively between about 200 meters and 2000 meters depth.

The benthic fauna of Site 363 does not change significantly from the bottom to the top of the upper Cretaceous section, except that in the uppermost cores (19 and especially 18) it gets diluted by an increasing number of planktonic foraminifers. Its composition, particularly the presence of *Coryphostoma incrassatum* and large specimens of *Gaudryina* and *Dorothia*, points to an upper slope or shelf edge environment. It is not easy to reconcile this depth interpretation with the distribution of the planktonic foraminifers, particularly with their absence in Cores 22 to 25. One possible explanation might be a rather shallow calcite compensation depth. However, support for this interpretation is found in the article by Scheibnerova (this volume), where the lower Cretaceous section of Site 363 is regarded as a shallow water deposit, and also in a paper by Todd (1970), in which she describes a Late Cretaceous fauna from the Walvis Ridge and concludes that it was deposited at a water depth shallower than that of today.

The fauna at Site 364, which is rich in representatives of the genera *Gyroidina*, *Osangularia*, and *Nuttallinella*, and which contains some specimens of "*Bathysiphon*," may indicate rather deeper water, corresponding to the middle, or possibly lower slope. The relative scarcity of "primitive" agglutinated foraminfers and Lituolidae would most easily be explained by a water depth of not more than about 2000 meters. Some caution is indicated, however, since the paleoecological implications drawn by Sliter and Baker (1972) admit the possibility that some high-latitude faunas in the Cretaceous could contain less agglutinated species than low-latitude faunas. The changes in the composition of the benthic foraminiferal fauna at Site 364 do not show a very clear trend from the bottom to the top of the section, except for the appearance of (rather scarce) individuals of "*Bathysiphon*" in the upper half.

It is unwise to make depth estimates of fossil benthic faunas without considering paleotemperatures, which in turn depend on paleoclimatology, currents, and bottom configuration. If we assume, based on the depth estimates above, that in late Cretaceous time the water depth, particularly around the present Walvis Ridge, was somewhat less than today, and that Africa was closer to South America and in a more southerly position than now, we would conclude that the exchange of water masses in a north-south direction was somewhat more restricted than now. Surface water temperatures might have been slightly cooler than today, but not necessarily the bottom waters. Speculations of this kind are admittedly highly hypothetical, but a certain degree of verification may be possible through a comparison of the Leg 40 faunas with those of other areas. A review of the literature reveals certain faunas that are very similar to the present material from Sites 363 and 364. Some of these are known from the Atlantic Ocean itself (Todd, 1970; Scheibnerova, 1973; Smali, 1973), others are from more distant places such as California (La Jolla area, see Sliter 1968), Europe (Brotzen, 1936), and Australia (Belford, 1960; Webb, 1973). The scattered records from Argentina either deal with different depositional facies (Camacho, 1954) or with small or incomplete faunas (Herm, 1966; Malumian, 1968; Malumian, Masiuk and Riggi, 1971; Bertels, 1972), with only few species (*Bolivinoides draco*, *Coryphostoma incrassatum*) in common with Site 363. Most of the coastal basins of Brazil (Lange, 1975) lack comparable assemblages of benthic foraminifers, with the exception of the Sergipe Basin far to the North (Petri, 1962), where the fauna is rather rich in agglutinated and nodosariid species. Other faunas from the Americas (Frizzell, 1943; Cushman and Jarvis, 1932; Cushman and Renz, 1947; Trujillo, 1960; Graham and Church, 1963; Martin, 1964), Europe (Hanzlikova, 1972), and New Zealand (Webb, 1971) contain a larger number of agglutinated species, especially lituolids, but are otherwise similar to those described here, particularly from Site 363. The faunas of Gabon (DeKlasz, 1965) include rich, predominantly calcareous assemblages comparable to those of Site 364, but with different types of buliminid species (see also Castelain et al., 1962). Assemblages of a distinct, usually restricted, boreal type (Macfadyen, 1933, fide Scheibnerova, 1973; Tappan, 1962; Wall, 1967) bear little resemblance to the faunas of Leg 40.

When reviewing the literature mentioned above, we get the impression that both Sites 363 and 364 contain faunal elements known in the present tropical or subtropical Americas (*Tritaxia* and certain *Gavelinella/Gavelinopsis* spp. of Site 363; *Globorotalites* spp., *Gyroidina quadrata*, *Pullenia puentepiedraensis* at Site 364). Some components of the Site 363 fauna (*Bolivinoides draco*, *Coryphostoma incrassatum*) are in common with the late Cretaceous of Argentina. Site 364 (Angola Basin) contains some species which are more typically African (*Aragonia ouezzanensis*, *Clavulina gabonica*, *Gyroidina mauretanica*). Elements with a possible European affinity (*Conorbina* cf. *marginata*, *Gavelinella eriksdalensis*, *Lenticulina subangulata*, *Stensioeina pommerana*), or described from the Austral-Pacific province (*Gaudryina healyi*, *Gyroidina noda*, *Silicosigmoilina futabaensis*) are present at both sites.

We may therefore conclude that the late Cretaceous benthic microfaunas of Leg 40 show influences of the tropical subtropical, the temperate, and also the austral provinces (V. Scheibnerova, verbal communication). Bergquist (1971) places most of the South Atlantic into the cool temperate zone during the Cretaceous. This may be correct for the greater part of the Cretaceous period. However, in the Maestrichtian of Site 363, and even more in the late Senonian and Maestrichtian of Site 364, there is evidence of a warmer climate, particularly when we consider the rather well diversified *Globotruncana* faunas (Caron, this volume).

ANNOTATED SPECIES LIST

Aragonia ouezzanensis (Rey)
(Plate 3, Figure 25)

Bolivinoides ouezzanensis Rey, 1955, Soc. Géol. France Bull., 6, v. 4 (1954), p. 210, pl. 12, fig. 2.
Fairly common at Site 364 (late Santonian to Maestrichtian).

Aragonia velascoensis (Cushman)
(Plate 3, Figure 26)

Textularia velascoensis Cushman, 1925, Contrib. Cushman Lab. Foram. Res., v. 1, p. 18, pl. 3, fig. 1.
Rather scarce at both sites (Santonian to Maestrichtian).

Bandyella greatvalleyensis (Trujillo)
(Plate 3, Figure 16)

Pleurostomella greatvalleyensis, Trujillo, 1960, J. Paleontol., v. 34, p. 345, pl. 50, fig. 5, 6.
Rare at Site 364 (Coniacian-early Santonian, ?Campanian).

Bandyella (?) sp. indet.
(Plate 3, Figure 17)

Longer than *B. greatvalleyensis*. Last chamber more typically *Pleurostomella*-like. Rare at Site 363, probably also at Site 364 (Campanian-Maestrichtian).

"Bathysiphon" spp.

This term includes several types of tubular agglutinated foraminifers. Rather scarce at Site 364 (Campanian-Maestrichtian).

Bolivinoides draco draco (Marsson)
(Plate 2, Figures 12, 18, 19)

Bolivina draco Marsson, 1878, Mitt. Naturw. Ver. Vor-Pommern und Rügen (Greifswald), Jg. 10, p. 157, pl. 3, fig. 25.
Rather scarce at Site 363 (late Maestrichtian).

Charltonina florealis (White)
(Plate 4, Figure 24)

Gyroidina florealis White, 1928, J. Paleontol., v. 2, p. 293, pl. 40, fig. 3.
Fairly common at both sites (Santonian-Maestrichtian).

Clavulina gabonica Le Calvez, de Klasz, and Brun
(Plate 1, Figure 23)

Clavulina gabonica Le Calvez, de Klasz, and Brun, 1971, Rev. Espan. Micropal., v. 3, p. 308, pl. 1, fig. 7, 9.
Rather variable in the size of the triserial part and in the degree of inflation of the uniserial chambers. Common at Site 364 (Coniacian to early Maestrichtian).

Conorbina cf. marginata Brotzen
(Plate 2, Figures 20-22)

Conorbina marginata Brotzen, 1936, Sver. Geol. Und., C, 396, p. 142, pl. 10, fig. 5; text-fig. 50.
Mostly larger than Brotzen's types, and with 6 (rarely 7) instead of 4 to 5 chambers in the last whorl. The shape is variable, but the periphery is generally less angular and flaring than in the types. Fairly common at Site 364 (Coniacian to Maestrichtian).

Coryphostoma incrassatum crassum (Vasilenko and Mjatliuk)
(Plate 3, Figure 19)

Bolivina incrassata Reuss var. *crassa* Vasilenko and Mjatliuk, 1947, Mikrofauna Oilfields Caucasus etc., VNIGRI, p. 203, pl. 2, fig. 3-5.
Rather scarce at Site 363 (Maestrichtian).

Coryphostoma incrassatum incrassatum (Reuss)
(Plate 3, Figure 18)

Bolivina incrassata Reuss, 1851, Haid. Naturw. Abh., Stuttgart, v. 4, pt. 1, p. 45, pl. 4, fig. 13.
Fairly common at Site 363 (Maestrichtian).

Coryphostoma cf. limonense (Cushman)
(Plate 3, Figure 20)

Bolivina incrassata Reuss var. *limonensis* Cushman, 1926, Contrib. Cushman Lab. Foram. Res., v. 2, p. 19, pl. 2, fig. 2.
Less than 1 mm in length and therefore smaller than the type specimen. Very rare at Site 363 (Core 19, Section 4, late Maestrichtian).

Dentalina spp.

Rare specimens representing several species are found at both sites.

Dorothia bulletta (Carsey)
(Plate 1, Figure 18)

Gaudryina bulletta Carsey, 1926, Univ. Texas Bull., 2612, p. 28, pl. 4, fig. 4.
Rather scarce at Site 363 (Maestrichtian).

Dorothia sp. indet. aff. D. bulletta (Carsey)
(Plate 1, Figure 19)

Rather small; chambers not inflated. Scarce at Site 363 (Campanian-Maestrichtian).

Dorothia cf. oxycona (Reuss)
(Plate 1, Figures 14, 15)

Gaudryina oxycona Reuss, 1860, Sitz. Akad. Wiss Wien, v. 40, p. 229, pl. 12, fig. 3.
Initial part rather broadly rounded. Fairly common at both sites (Coniacian to early Campanian).

Dorothia pupa (Reuss)
(Plate 1, Figure 21)

Textularia pupa Reuss, 1860, Sitz. Akad. Wiss. Wien., v. 40, p. 232, pl. 13, fig. 4 (not fig. 5).
Rare at Site 363 (late Maestrichtian).

Dorothia trochoides (Marsson)
(Plate 1, Figure 22)

Gaudryina crassa Marsson var. *trochoides* Marsson, 1878, Mitt. Naturf. Ver. Neu-Vorpommern und Rügen, v. 10, p. 158, pl. 3, fig. 27.
Rather scarce at Site 364 (Campanian-Maestrichtian).

Dorothia cf. trochoides (Marsson)
(Plate 1, Figure 16)

Much smaller than the typical form, possibly an ancestor. Fairly common at Site 364 (early Campanian).

Ellipsoidella cf. robusta (Cushman)
(Plate 3, Figure 14)

Nodosarella robusta Cushman, 1943, Contrib. Cushman Lab. Foram. Res., v. 19, p. 92, pl. 16, fig. 8.
Smaller and thinner than the types from the Tertiary. Rare at Site 363 (Campanian-Maestrichtian).

Ellipsoidella solida (Brotzen)
(Plate 3, Figure 15)

Nodosarella solida Brotzen, 1936, Sver. Geol. Unders., C, 396, p. 140, pl. 9, fig. 11.
Rare at both Sites (Coniacian to Maestrichtian).

Eouvigerina cf. hispida Cushman
(Plate 2, Figure 13)

Eouvigerina hispida Cushman, 1931, Tennessee Rept. Ed., Div. Geol., Bull., 41, p. 45, pl. 7, fig. 12, 13.
Larger and particularly longer than the types. Scarce at Site 363 (late Maestrichtian).

Eponides sp. indet. aff. E. birdi Trujillo
(Plate 3, Figures 9-11)

Eponides birdi Trujillo, 1960, J. Paleontol., v. 34, p. 332, pl. 48, fig. 7.
The Leg 40 specimens have less chambers in the last whorl than the types (7 or 8 instead of 10) and very often show a slight keel. Rather scarce at both Sites (Santonian to early Maestrichtian).

Gaudryina healyi Finlay
(Plate 1, Figure 8)

Gaudryina healyi Finlay, 1936, Trans. Roy. Soc. New Zealand, v. 69, p. 311, pl. 25, fig. 34, 35.
Rather scarce at Site 363 (Campanian).

Gaudryina pyramidata Cushman
(Plate 1, Figures 9, 10)

Gaudryina laevigata Franke, var. *pyramidata* Cushman, 1926, A.A.P.G. Bull., v. 10, p. 587, pl. 16, fig. 8.
Fairly common at both Sites (Coniacian to Maestrichtian). Smooth-walled specimens (Plate 1, Figure 9) are restricted to Site 364.

Gavelinella beccariiformis (White)
(Plate 5, Figures 1, 2)

Rotalia beccariiformis White, 1928, J. Paleontol., v. 2, p. 287, pl. 16, fig. 2.
Fairly common at both sites (Santonian to Maestrichtian).

Gavelinella beccariiformis (White), conical variety (or subspecies)
(Plate 5, Figure 3)

Differs from typical *G. beccariiformis* in its planoconvex shape. Rather scarce at both sites (late Campanian to Maestrichtian).

Gavelinella brotzeni Said and Kenway
(Plate 5, Figures 4-6)

Gavelinella brotzeni Said and Kanawy, 1956, Micropaleontology, v. 2, p. 147, pl. 4, fig. 47.
Rare at Site 364 (Coniacian?, Maestrichtian). The specimens from the Maestrichtian appear to be conspecific with the types from Egypt, although slightly smaller. A less typical form (Plate 5, Figure 5), which is more delicately built and shows more distinctly depressed sutures, occurs in the Coniacian.

Gavelinella compressa Sliter
(Plate 5, Figure 12)

Gavelinella compressa Sliter, 1968, Univ. Kansas Paleontol. Contrib., v. 49, p. 122, pl. 24, fig. 2.
Slightly smaller than the type from the Campanian of California, possibly an ancestral form. Rare at both sites (Santonian to early Campanian).

Gavelinella costata Brotzen
(Plate 5, Figures 7, 8)

Gavelinella costata Brotzen, 1942, Sver. Geol. Unders., C, 451, p. 43, pl. 1, fig. 3.
Rather scarce at Site 363 (early Campanian, ?early Maestrichtian).

Gavelinella sp. aff. G. daini (Schijfsma)
(Plate 5, Figures 9-11)

Anomalina daini Schijfsma, 1946, Meded. Geol. Stichting, C-5-7, p. 98, pl. 6, fig. 3.
The spiral side is often more evolute than in Schijfsma's type and shows a more or less distinct central knob. Fairly common at Site 364 (late Coniacian to early Campanian).

Gavelinella eriksdalensis (Brotzen)
(Plate 5, Figures 13, 14)

Cibicides (*Cibicidoides*) *eriksdalensis* Brotzen, 1936, Sverig. Geol. Unders., C, 396, p. 193, pl. 14, fig. 5; text-fig. 69.
Fairly common at Site 364 (Coniacian).

Gavelinella menneri Keller
(Plate 5, Figures 15, 16)

Gavelinella menneri Keller, 1946, Soc. Nat. Moscou, n. s., v. 51, p. 103, 108; pl. 1, fig. 14-16; pl. 3, fig. 16, 17.
Rare at Site 363 (Maestrichtian).

Gavelinella popenoei (Trujillo)
(Plate 5, Figures 17, 18)

Anomalina popenoei Trujillo, 1960, J. Paleont., v. 34, p. 335, pl. 48, fig. 9.
Rather scarce at both sites (Santonian to early Campanian).

Gavelinella cf. velascoensis (Cushman)
(Plate 5, Figures 19-22)

Anomalina velascoensis Cushman, 1925. Contrib. Cushman Lab. Foram. Res., v. 1, p. 21, pl. 3, fig. 3.
Two types are present, one which is more rounded and symmetrical in cross-section than the holotype (Plate 5, Figures 19, 20), and one which is more distinctly planoconvex (Plate 5, Figures 21, 22). Rather scarce at Site 363 (late Campanian-Maestrichtian)

Gavelinella sp. indet.
(Plate 5, Figures 23-25)

Planoconvex (spiral side flat) to almost lenticular; periphery angular to slightly rounded. 10 to 12 chambers in the last whorl. Possibly close to *Eponides* (?) *zaratei* Frizzell. Rather scarce at Site 364 (Campanian-Maestrichtian).

Gavelinopsis cf. aracajuensis (Petri)
(Plate 2, Figures 23, 24, 28)

Eponides aracajuensis Petri, 1962, Fac. Filos. Cienc. Let. Univ. São Paulo, Bol. 265, Geol. no. 20, p. 115, pl. 15, fig. 1-3.
Mostly larger and less distinctly conical than the types. Possibly the ancestor of *Gavelinella menneri*. Rather common at Site 363 (Campanian to early Maestrichtian).

Globorotalites conicus (Carsey)
(Plate 4, Figures 22, 23)

Truncatulina refulgens (Montfort), var. *conica* Carsey, 1926, Texas Univ. Bull., 2612, p. 46, pl. 4, fig. 15.
Possibly an ancestor of *G. spineus*. Fairly common at Site 364 (late Coniacian to early Maestrichtian).

Globorotalites hiltermanni Kaever
(Plate 4, Figures 25, 26)

Globorotalites hiltermanni Kaever, 1961, Geol. Jb. (Hannover), v. 78, p. 418, pl. 20, fig. 1.
Rare at Site 363 (Santonian-early Campanian).

Globorotalites spineus (Cushman)
(Plate 4, Figures 21, 27)

Truncatulina spinea Cushman, 1926, Contrib. Cushman Lab. Foram. Res., v. 2, p. 22, pl. 2, fig. 10.
Fairly common at Site 364 (Santonian to Maestrichtian).

Globulina lacrima lacrima Reuss
(Plate 1, Figure 28)

Polymorphina (*Globulina*) *lacrima* Reuss, 1845, Verstein. Böhm. Kreideform., Stuttgart, I, p. 40, pl. 12, fig. 6; pl. 13, fig. 83.
Rather scarce at both sites (Santonian to Maestrichtian).

Globulina lacrima horrida Reuss
(Plate 1, Figure 34)

Globulina horrida Reuss, 1846, Verst. Böhm. Kreideform. (Stuttgart), II, p. 110, pl. 43, fig. 14.
Rare at Site 364 (Coniacian to Maestrichtian).

Gyroidina cf. bandyi (Trujillo)
(Plate 3, Figures 27, 28)

Eponides bandyi Trujillo, 1960, J. Paleontol., v. 34, p. 332, pl. 48, fig. 3.
Mostly smaller than the types, and often with straight rather than sigmoid sutures. Rather scarce at both sites (Coniacian to early Campanian).

Gyroidina beisseli White
(Plate 3, Figures 29, 30)

Gyroidina beisseli White, 1928, J. Paleontol., v. 2, p. 291, pl. 39, fig. 7.
Rather scarce at both Sites (Santonian to Maestrichtian).

Gyroidina bollii (Cushman and Renz)
(Plate 3, Figures 32, 33)

Eponides bollii Cushman and Renz, 1946, Cushman Lab. Foram. Res., Spec. Publ., 18, p. 44, pl. 7, fig. 23.
Fairly common at both sites (Santonian to Maestrichtian).

Gyroidina cf. grahami (Martin)
(Plate 3, Figures 31, 34)

Gyroidinoides grahami Martin, 1964, Jb. Geol. Bundesanstalt (Vienna), Sonderband 9, p. 95, pl. 13, fig. 1.
The small umbilicus mentioned by Martin can hardly be seen on the present specimens. Rather scarce at both sites (Coniacian to Maestrichtian).

Gyroidina mauretanica Charbonnier
(Plate 4, Figures 1, 2)

Gyroidina mauretanica Charbonnier, 1952, Soc. Géol. France Bull., s. 6, v. 2, p. 113, pl. 5, fig. 5.
Fairly common at both sites (Coniacian to Campanian, ?Maestrichtian).

Gyroidina mauretanica Charbonnier, subsp. indet.
(Plate 4, Figure 3)

The large final chamber, and usually some more chambers of the last whorl, are distinctly inflated. Rare at Site 364 (late Coniacian).

Gyroidina noda Belford
(Plate 4, Figures 4, 5)

Gyroidina noda Belford, 1960, Min. Res., Geol. Geoph., Canberra Bull., 57, p. 79, pl. 21, fig. 16-17.
Rare at Site 364 (Santonian to Maestrichtian).

Gyroidina quadrata Cushman and Church
(Plate 4, Figure 6)

Gyroidina quadrata Cushman and Church, 1929, Calif. Acad. Sci. Proc., s. 4, v. 18, no. 16, p. 516, pl. 41, fig. 7-9.
Rare at Site 364 (Coniacian).

Gyroidina rumoiensis Takayanagi
(Plate 4, Figures 7, 8)

Gyroidina globosa (Hagenow), subsp. *rumoiensis* Takayanagi, 1960, Sci. Rept. Tohoku Univ., s. 2, v. 32, p. 125, pl. 8, fig. 10.
Rather scarce at both sites (Santonian to Maestrichtian).

Gyroidina sp. indet.
(Plate 4, Figures 9-11)

Small, with 4 or 5 strongly inflated chambers. Rare at Site 364 (early Coniacian).

Gyroidinoides cf. globosa (Hagenow)
(Plate 4, Figure 28)

Nonionina globosa v. Hagenow, 1842, N. Jb. Min, p. 574.
The present specimens are less globular than Hagenow's types, but seem to correspond to Cushman's concept of the species (see Cushman, 1946). Rather scarce at both sites (Santonian to Maestrichtian).

Gyroidinoides octocamerata (Cushman and Hanna)
(Plate 4, Figure 29)

Gyroidina soldanii d'Orbigny, var. *octocamerata* Cushman and Hanna, 1927, Calif. Acad. Sci. Proc., s. 4, v. 16, p. 223, pl. 14, fig. 16-18.
Rather scarce at both sites (late Santonian to Maestrichtian).

Gyroidinoides sp. indet.
(Plate 4, Figures 30-32)

Flat trochospiral; last chambers distinctly inflated. Rare at Site 364 (Coniacian to early Santonian).

Lagena apiculata (Reuss)
(Plate 1, Figure 20)

Oolina apiculata Reuss, 1851, Haidingers Naturw. Abh., Vienna, Bd. 4, Abth. 1, p. 22, pl. 1, fig. 1.
Rare at both sites (Coniacian to Maestrichtian).

Lenticulina muensteri (Roemer)
(Plate 1, Figure 26)

Robulina münsteri Roemer, 1839, Verst. Nordd. Oolithen-Geb., Nachtrag, Hannover, p. 48, pl. 20, fig. 29.
Rather scarce at both sites (Santonian to Maestrichtian)

Lenticulina subangulata (Reuss)
(Plate 1, Figure 27)

Cristellaria subangulata Reuss, 1862. Sitz. K. Akad. Wiss. Wien, M.-Nath. Kl., v. 46, p. 74, pl. 7, fig. 7.
Rather scarce at Site 364 (Coniacian).

Lenticulina spp.

Small numbers of unidentified specimens occur in most samples of both sites.

Marginulina spp.

Scarce in a few samples of both sites.

Neoflabellina gibbera (Wedekind), subsp. indet.
(Plate 1, Figures 29, 30)

Flabellina interpunctata v. d. Marck, mut. *gibbera* Wedekind, 1940, N. Jb. Min. Geol. Pal., Beil.-Bd. 84, Abt. B, p. 191, pl. 10, fig. 1-4, 9; text-fig. 7.
Possibly a successor of the typical *N. gibbera*, which is a Santonian species (W. Koch, personal communication). The available specimens show slightly more complicated apertural loops than *N. gibbera* and resemble *N. gibbera* n. ssp. A in Hiltermann and Koch (1962; pl. 51, fig. 3). Scarce at Site 363 (early Campanian).

Neoflabellina sp. indet. aff. N. numismalis (Wedekind)
(Plate 1, Figures 31, 32)

Flabellina numismalis Wedekind, 1940, N. Jb. Min., Geol. Pal., Beil.-Bd. 84, Abt. B, p. 200, pl. 9, fig. 1-3; pl. 11, fig. 8, 9.
It differs from *N. numismalis* in being more elongated and in having flat, noninflated side walls. The initial spiral is more distinct, and the ornamentation is rather more irregular. Rare at Site 363 (Maestrichtian).

Neoflabellina cf. praereticulata Hiltermann
(Plate 1, Figure 33)

Neoflabellina praereticulata Hiltermann, 1952, Geol. Jb. (Hannover), v. 67, p. 53, pl. 3, fig. 37.
A single specimen with fairly typical ornamentation was found at Site 363 (Core 22, Section 1; late Campanian).

Nodosaria aspera Reuss
(Plate 1, Figure 24)

Nodosaria aspera Reuss, 1845, Verst. Böhm. Kreidef., pt. I, p. 26, p: 13, fig. 14, 15.
Rare at both sites (Campanian).

Nodosaria limbata d'Orbigny
(Plate 1, Figure 25)

Nodosaira limbata d'Orbigny, 1840, Mém. Soc. Géol. France, s. 1, v. 4, p. 12, pl. 1, fig. 1.
Rare at both sites (Coniacian?, Campanian-Maestrichtian).

Nodosaria spp.

Rare unidentified specimens occur at both sites.

Nuttallides bronnimanni (Cushman and Renz)
(Plate 3, Figures 1, 2)

Eponides bronnimanni Cushman and Renz, 1946, Cushman Lab. Foram. Res., Spec. Publ., 18, p. 45, pl. 7, fig. 24.
Fairly common at both sites (late Campanian to Maestrichtian)

Nuttallinella (?) cf. monterelensis (Marie)
(Plate 3, Figures 3-5)

Eponides monterelensis Marie, 1941, Mém. Mus. National Hist. Nat., Paris, n.s., 12, p. 224, pl. 34, fig. 325.
Marie's species is larger and has a rather more lobate periphery than the Leg 40 specimens. Fairly common at Site 364 (Santonian to Maestrichtian).

Nuttallinella sp. indet.
(Plate 3, Figures 6-8)

The specimens referred to this group are superfically very similar to *Nuttallides bronnimanni*, but the internal partitions, typical of *Nuttallides*, are not visible. Fairly common at Site 364 (Santonian to Maestrichtian).

Osangularia cordieriana (d'Orbigny)
(Plate 4, Figures 12, 13)

Rotalina cordieriana d'Orbigny, 1840, Mém. Soc. Géol. France, t 4, p. 33, pl. 3, fig. 9-11.
The determination is based on the revision of this species by Marie (1941) and Hermanni (1962). Rather scarce at both sites (late Santonian to Maestrichtian).

Osangularia incisa (Brotzen)
(Plate 4, Figures 14-17)

Parrella incisa Brotzen, 1948, Sverig. Geol. Unders., C, 493, p. 104, text-fig. 28.
The shape varies from lenticular to planoconvex. Rather scarce at Site 364 (Coniacian-Santonian).

Osangularia cf. lens Brotzen
(Plate 4, Figures 18-20)

Osangularia lens Brotzen, 1940, Sverig. Geol. Unders., C, 435, p. 30, text-fig. 8:1.
Rather larger than the type and with more (9 to 12) chambers in the last whorl. *O. velascoensis* (Cushman) is less distinctly lenticular and has a wider keel. Rather scarce at both sites (Maestrichtian).

Pleurostomella austinana Cushman
(Plate 3, Figure 12)

Pleurostomella austinana Cushman, 1933, Contrib. Cushman Lab. Foram. Res., v. 9, p. 64, pl. 7, fig. 13.
Rare at Site 364 (Coniacian to Campanian).

Pleurostomella obtusa Berthelin
(Plate 3, Figure 13)

Pleurostomella obtusa Berthelin, 1880, Mém. Soc. Géol. France, s. 3, t. 1, p. 29, pl. 1, fig. 9.
Rather scarce at both sites (Coniacian to early Campanian).

Praebulimina cf. beaumonti (Cushman and Renz)
(Plate 2, Figures 1, 2)

Buliminella beaumonti Cushman and Renz, 1946, Cushman Lab. Foram. Res., Special Publ., 18, p. 36, pl. 6, fig. 7.
The sutural lobes are less distinctly developed than in the types from Trinidad. Rather scarce at both sites (Coniacian?, Santonian-Campanian).

Praebulimina cf. navarroensis (Cushman and Parker)
(Plate 2, Figures 7, 8)

Bulimina reussi Morrow, var. *navarroensis* Cushman and Parker, 1935, Contrib. Cushman Lab. Foram. Res., v. 11, p. 100, pl. 15, fig. 11.
The present specimens are about twice as large as the types. Rather scarce at Site 363 (Campanian).

Praebulimina reussi (Morrow)
(Plate 2, Figure 3)

Bulimina reussi Morrow, 1934, J. Paleont., v. 8, p. 195, pl. 29, fig. 12.
Rare at both sites (Santonian to Maestrichtian).

Praebulimina sp. indet. A
(Plate 2, Figures 4-6)

Similar to *P. cushmani* (Sandidge), but larger. Sometimes with few but distinct sutural lobes. Rather scarce at Site 363 (Maestrichtian).

Praebulimina sp. indet. B
(Plate 2, Figure 9)

Probably close to *P. carseyae plana* (Cushman and Parker), but rather larger; chambers not inflated. Rather scarce at Site 363 (Coniacian/Santonian).

Praebulimina sp. indet. C
(Plate 2, Figures 10, 11)

Comparable to *P. vitrea* (Cushman and Parker), but rather more fusiform in shape and with more embracing chambers. Rather scarce at Site 364 (Coniacian, ?Campanian).

Pullenia americana Cushman
(Plate 3, Figure 22)

Pullenia americana Cushman, 1936, Contrib. Cushman Lab. Foram. Res., v. 12, p. 76, pl. 1, fig. 4, 5.
Rare at both sites (Coniacian to Maestrichtian).

Pullenia coryelli White
(Plate 3, Figure 21)

Pullenia coryelli White, 1929, J. Paleontol., v. 3, p. 56, pl. 5, fig. 22.
Rare at both sites (Campanian-Maestrichtian).

Pullenia puentepiedraensis Galloway and Morrey
(Plate 3, Figures 23, 24)

Pullenia puentepiedraensis Galloway and Morrey, 1931, J. Paleontol., v. 5, p. 341, pl. 38, fig. 11.
Rare at Site 364 (Campanian-early Maestrichtian).

Reussella (?) sp. indet. aff. R. californica Cushman and Goudkoff
(Plate 2, Figure 14)

Reussella californica Cushman and Goudkoff, 1944, Contrib. Cushman Lab. Foram. Res., v. 20, p. 59, pl. 10, fig. 3-5.
The Leg 40 specimens are considerably shorter than the types but resemble their initial growth stage. Rather scarce at both sites (late Santonian to Maestrichtian).

Reussella cf. cushmani Brotzen
(Plate 2, Figure 15)

Reussella cushmani Brotzen, 1936, Sverig. Geol. Unders., C, 396, p. 135, pl. 8, fig. 7; text-fig. 47.
Smaller than the types, possibly an ancestral form. Scarce at Site 364 (early Coniacian).

Reussella szajnochae (Grzybowsky)
(Plate 2, Figures 16, 17)

Verneuilina szajnochae Grzybowsky, 1896, Roxpr. Akad. Umiej. Krakowie, v. 30, p. 287, pl. 9, fig. 19.
Variable in size; small specimens resemble *R. truncata* Hofker. Fairly common at both sites (late Santonian to Maestrichtian).

Rzehakina epigona (Rzehak)
(Plate 1, Figure 1)

Silicina epigona Rzehak, 1895, Ann. Naturhist. Hofmuseum (Vienna), v. 10, p. 214, pl. 6, fig. 1.
Very rare at Site 364, possibly also 363 (Campanian?, Maestrichtian).

Silicosigmoilina futabaensis Asano
(Plate 1, Figure 2)

Silicosigmoilina futabaensis Asano, 1950, Pacific Sci. (Honolulu), v. 4, p. 159, pl. 1, fig. 6, 7.
Rare at Site 363 (early Campanian).

Spiroplectammina chicoana Lalicker
(Plate 1, Figure 3)

Spiroplectammina chicoana Lalicker, 1935, Contrib. Cushman Lab. Foram. Res., v. 11, p. 7, pl. 1, fig. 8, 9.
Fairly common at Site 364 (late Coniacian-Santonian).

Spiroplectammina dentata (Alth)
(Plate 1, Figures 4, 5)

Textularia dentata Alth, 1850, Haidingers Naturw. Abh., v. 3, p. 262, pl. 1, fig. 13.
The surface ornamentation varies from distinctly costate to almost smooth. Fairly common at Site 364 (Santonian?, Campanian-Maestrichtian).

Spiroplectammina regularis Hofker
(Plate 1, Figure 6)

Spiroplectammina regularis Hofker, 1957, Geol. Jb. (Hannover), Beih. 27, p. 59, text-fig. 54.
Rather smoother walled than the types from Germany, but else identical. Scarce at Site 364 (Campanian-early Maestrichtian).

Spiroplectammina cf. semicomplanata (Carsey)
(Plate 1, Figures 7, 13)

Textularia semicomplanata Carsey, 1926, Texas Univ., Bull, 2612, p. 25, pl. 3, fig. 4.
The basal spiral portion is rather larger than in the type specimen. Rather scarce at both sites (late Coniacian to Maestrichtian).

Stensioeina pommerana Brotzen
(Plate 5, Figures 26-30, 31?)

Stensiöina pommerana Brotzen, 1936, Sver. Geol. Unders., C, 396, p. 166.
The ornamentation of the spiral side varies between that of a typical *S. pommerana* and that of *S. labyrinthica* Cushman and Dorsey. The latter is now regarded as a junior synonym of *S. pommerana* (Trümper, 1968). Fairly common at Site 363 (early Campanian). A single specimen of questionable identity (Plate 5, Figure 31) was found in Core 16 of Site 364.

Stensioeina (?) sp. indet.
(Plate 5, Figures 32-34)

Small, with about six chambers in the last whorl. The spiral suture is raised and contains an irregular row of teeth or pustules. Possibly related to the *S. exsculpta* group. Rare at both sites (Santonian to Campanian).

Tritaxia capitosa (Cushman)
(Plate 1, Figure 11)

Gaudryinella capitosa Cushman, 1933, Contrib. Cushman Lab. Foram. Res., v. 9, p. 52, pl. 5, fig. 8.
Rather scarce at Site 364 (Coniacian, Santonian).

Tritaxia insignis (Plummer)
(Plate 1, Figure 12)

Clavulina insignis Plummer, 1931, Univ. Texas Bull., 3101, p. 138, pl. 8, fig. 1-4.
Rare an Site 363 (Santonian to Maestrichtian).

Tritaxia trilatera (Cushman)
(Plate 1, Figure 17)

Clavulina trilatera Cushman, 1926, A.A.P.G. Bull., v. 10, p. 588, pl. 17, fig. 2.
Fairly common at Site 363 (Santonian to Maestrichtian).

Vaginulina spp.

Scarce representatives of several unidentified species occur at both sites.

Valvulineria allomorphinoides (Reuss)
(Plate 2, Figures 25-27)

Valvulina allomorphinoides Reuss, 1860, Sitzber. Akad. Wiss. Wien, v. 40, p. 223, pl. 11, fig. 6.
Rather scarce at both sites (Santonian to Maestrichtian).

Valvulineria brotzeni Nakkady and Talaat
(Plate 2, Figures 29, 32)

Valvulineria brotzeni Nakkady and Talaat, 1959, Micropaleont., v. 5, p. 460, pl. 7, fig. 2.
Rather scarce at both sites (Campanian-Maestrichtian).

Valvulineria camerata Brotzen
(Plate 2, Figures 30, 31)

Valvulineria camerata Brotzen, 1936, Sverig. Geol. Unders., C, 396, p. 155, pl. 10, fig. 2; text-fig. 57 (1-2).
Scarce at Site 364 (Coniacian).

Valvulineria (?) cf. gracillima ten Dam.
(Plate 2, Figures 33, 34)

Valvulineria gracillima ten Dam, 1947, Geol. and Mijnbouw, The Hague, n.s., v. 9, p. 27, text-fig. 4.
The types of *V. gracillima* are more lenticular in shape. Rather scarce at Site 364 (Coniacian to Santonian, ?early Campanian).

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REFERENCES

Belford, D.J., 1960. Upper Cretaceous foraminifera from the Toolonga Calcilutite and Gingin Chalk, Western Australia: Bur. Mineral Res., Geol. Geoph., Canberra, v. 57.

Bergquist, H.R., 1971. Biogeographical review of Cretaceous foraminifers of the Western Hemisphere: N. Am. Paleontal. Conv., Proc. Sept. 1969, Pt. L, p. 1565-1609.

Bertels, A., 1972. Buliminacea y Cassidulinacea (Foraminiferida) guias del Cretacico Superior (Maastrichtiano medio) y Terciario inferior (Daniano inferior) de la Republica Argentina: Rev. Espan. Micropal., v. 4, p. 327-353.

Brotzen, F., 1936. Foraminiferen aus dem schwedischen untersten Senon von Eriksdal in Schonen: Sveriges Geol. Unders., C, 396, Arsbok 30, no. 3.

Camacho, H.H., 1954. Some Upper Cretaceous foraminifera from Argentina: Contrib. Cushman Found. Foram. Res., v. 5, p. 31-35.

Castelain, J., Faulkner, J.S., de Klasz, I., Meijer, M., and Rérat, D., 1962. Répartition stratigraphique d'*Afrobolivina afra* Reyment dans quelques bassins côtiers de l'Afrique occidentale: Rev. Micropal., Paris, v. 5, p. 54-58.

Cushman, J.A., 1946. Upper Cretaceous foraminifera of the Gulf Coastal region of the United States and adjacent areas: U.S. Dept. Int., Geol. Survey, Prof. Paper 206.

Cushman, J.A. and Jarvis, P.W., 1932. Upper Cretaceous foraminifera from Trinidad: U.S. Natl. Mus., Proc. v. 80, p. 1-60.

Cushman, J.A. and Renz, H.H., 1947. Further notes on the Cretaceous foraminifera of Trinidad: Contrib. Cushman Lab. Foram. Res., v. 23, p. 31-51.

De Klasz, I., 1965. Biostratigraphie du bassin Gabonais: Mém. Bur. Rech. Géol. Min., Paris, v. 32, p. 277-303.

Frizzell, D.L., 1943. Upper Cretaceous foraminifera from northwestern Peru: J. Paleontol., v. 17, p. 331-353.

Graham, J.J. and Church, C.C., 1963. Campanian foraminifera from the Stanford University campus, California: Stanford Univ. Publ., Geol. Sci., v. 8, p. 1-90.

Hanzlikova, E., 1972. Carpathian Upper Cretaceous foraminifers of Moravia (Turonian-Maastrichtian): Rospr. Ustr. Ustavu Geol., v. 39.

Herm, D., 1966. Micropaleontological aspects of the Magellanese Geosyncline, southernmost Chile, South America: Second West African Micropal. Coll. Proc., Leiden (Brill), p. 72-86.

Hermanni, E. v., 1962. Zur Artfassung von Osangularien aus der Oberkreide (Foraminiferen): N. Jb. Geol. Pal., Abh., Bd. 115, p. 263-288.

Hiltermann, H. and Koch, W., 1962. Oberkreide des nördlichen Mittel-Europa. Leitfoss. der Mikropal.: Berlin (Borntraeger), p. 299-338.

Lange, F.W., 1975. Stratigraphy of the Cretaceous sedimentary basins of Brazil. Fifth African Coll. Micropal., Rev. Espan. Micropal. Proc., Ser. 7, v. 3, p. 565-621.

Loeblich, A.R. and Tappan, H., 1964. Treatise of Invertebrate Paleontology, part C, Protista 2: Univ. Kansas Press.

Macfadyen, W.A., 1933. Fossil foraminifera from the Burdwood Bank and their geologic significance: Discovery Rept., Cambridge Univ. Press, v. 7, p. 1-16.

Malumian, N., 1968. Foraminiferas del Cretacico Superior y Terciario del subsuelo de la Provincia Santa Cruz, Argentina: Ameghiniana, v. 5, p. 191-227.

Malumian, N., Masiuk, V., and Riggi, J.C., 1971. Micropaleontologia y sedimentologia de la perforacion SC-1, provincia Santa Cruz, Republica Argentina: Rev. Asoc. Geol. Argentina, v. 26, p. 175-208.

Marie, P., 1941. Les foraminifères de la Craie à Belemnitella mucronata du Bassin de Paris: Mém. Mus. Nat. Hist. Naturelle, n. sér., v. 12, p. 1-296.

Martin, L., 1964. Upper Cretaceous and lower Tertiary foraminifera from Fresno County, California: Jahrb. Geol. Bundesanstalt, Vienna, Sonderband 9.

Petri, S., 1962. Foraminiferos cretaceos de Sergipe: Bol. Geol., 265, n. 20.

Scheibernova, V., 1973. Non-tropical Cretaceous foraminifera in Atlantic deep-sea cores and their implication for continental drift and palaeooceanography of the South Atlantic Ocean: Rec. Geol. Survey N. S. Wales, v. 15, p. 19-46.

Schnitker, D., 1972. Paleoecology of the "Marnes de Nay" (upper Maestrichtian) in the regions of Pau (southwestern France): Centre Rech. Pau—SNPA Bull., v. 6, p. 289-312.

Sliter, W.V., 1968. Upper Cretaceous foraminifera from southern California and northwestern Baja California, Mexico: Univ. Kansas Paleontol. Contrib., Ser. N. 49, Protozoa, Art. 7.

Smali, M., 1973. Foraminiferi campaniano-maastrichtiani della Dorsale Medio-atlantica: Riv. Ital. Paleontol., v. 79, p. 35-100.

Tappan, H., 1962. Foraminifera from the Arctic Slope of Alaska. Part 3, Cretaceous foraminifera: U.S. Dept. Int., Geol. Survey, Prof. Paper 236-C.

Todd, R., 1970. Maestrichtian (late Cretaceous) foraminifera from a deep-sea core off Southwestern Africa: Rev. Espan. Micropal., v. 2, p. 131-154.

Trujillo, E.F., 1960. Upper Cretaceous foraminifera from near Redding, Shasta County, California: J. Paleontol., v. 34, p. 290-346.

Trümper, E., 1968. Variationsstastistische Untersuchungen an der Foraminiferen-Gattung *Stensioeina* Brotzen: Geologie (Berlin), Beiheft 59.

Wall, J.H., 1967. Cretaceous foraminifera of the Rocky Mountain Foothills, Alberta: Res. Council of Alberta Bull. 20.

Webb, P.N., 1971. New Zealand Late Cretaceous (Haumurian) foraminifera and stratigraphy: a summary: N. Zealand J. Geol. Geophys., v. 14, p. 795-828.

———, 1973. Upper Cretaceous-Paleocene foraminifera from Site 208 (Lord Howe Rise, Tasman Sea), DSDP, Leg 21. *In* Burns, R.E., Andrews, J.E., et al., Initial Reports of the Deep Sea Drilling Project, Volume 21: Washington (U.S. Government Printing Office), p. 541-573.

PLATE 1

Figure 1	*Rzehakina epigona* (Rzehak). 80×. Sample 364-13-1, 58-60 cm. Catalog Number C 33391 (Natural History Museum, Basel, Switzerland).
Figure 2	*Silicosigmoilina futabaensis* Asano. 80×. Sample 363-23-2, 58-60 cm. C 33390.
Figure 3	*Spiroplectammina chicoana* Lalicker. 50×. Sample 364-20-5, top. C 33398.
Figures 4, 5	*Spiroplectammina dentata* (Alth). 50×. 4. Sample 364-15-1, 58-60 cm. C 33387. 5. Sample 364-16, CC. C 33388.
Figure 6	*Spiroplectammina regularis* Hofker. 100×. Sample 364-14, CC. C 33384.
Figures 7, 13	*Spiroplectammina* cf. *semicomplanata* (Carsey). 50×. 7. Sample 363-19 CC. C 33386. 13. Sample 364-16-4, 58-60 cm. C 33385.
Figure 8	*Gaudryina healyi* Finlay. 50×. Sample 363-23-2. 58-60 cm. C 33377.
Figures 9, 10	*Gaudryina pyramidata* Cushman. 50×. 9. Sample 364-16, CC. C 33375. 10. Sample 363-20, CC. C 33374.
Figure 11	*Tritaxia capitosa* (Cushman). 50×. Sample 364-23-1, 80-82 cm. C 33381.
Figure 12	*Tritaxia insignis* (Plummer). 50×. Sample 363-25-2, 58-60 cm. C 33372.
Figures 14, 15	*Dorothia* cf. *oxycona* (Reuss). 50×. 14. Sample 364-19, CC. C 33380. 15. Sample 363-25, CC. C 33379.
Figure 16	*Dorothia* cf. *trochoides* (Marsson). 50×. Sample 364-16, CC. C 33382.
Figure 17	*Tritaxia trilatera* (Cushman). 50×. Sample 363-22, CC. C 33371.
Figure 18	*Dorothia bulletta* (Carsey). 40×. Sample 363-19, CC. C 33376.
Figure 19	*Dorothia* sp. indet. aff. *D. bulletta* (Carsey). 50×. Sample 363-22, CC. C 33378.
Figure 20	*Lagena apiculata* (Reuss). 50×. Sample 364-16, CC. C 33394.
Figure 21	*Dorothia pupa* (Reuss). 50×. Sample 363-18, CC. C 33373.
Figure 22	*Dorothia trochoides* (Marsson). 50×. Sample 364-16-1, 82-84 cm. C 33383.
Figure 23	*Clavulina gabonica* Le Calvez, de Klasz and Brun. 50×. Sample 364-20-5, top. C 33370.
Figure 24	*Nodosaria aspera* Reuss. 40×. Sample 364-14, CC. C 33397.
Figure 25	*Nodosaria limbata* d'Orbigny. 40×. Sample 364-15, CC. C 33398.
Figure 26	*Lenticulina muensteri* (Roemer). 50×. Sample 364-14, CC. C 33395.
Figure 27	*Lenticulina subangulata* (Reuss). 100×. Sample 364-23-3, 58-60 cm. C 33396.
Figure 28	*Globulina lacrima lacrima* Reuss. 100×. Sample 364-16, CC. C 33392.
Figures 29, 30	*Neoflabellina gibbera* (Wedekind), subsp. indet. 50×. Sample 363-24, CC. 29, C 33400. 30, C 33399.
Figures 31, 32	*Neoflabellina* sp. indet. aff. *N. numismalis* (Wedekind). 50×. Sample 363-20, CC. 31. C 33401. 32. C 33402.
Figure 33	*Neoflabellina* cf. *praereticulata* Hiltermann. 50×. Sample 363-22-1, 77-79 cm. C 33403.
Figure 34	*Globulina lacrima horrida* Reuss. 100×. Sample 364-21, CC. C 33393.

PLATE 1

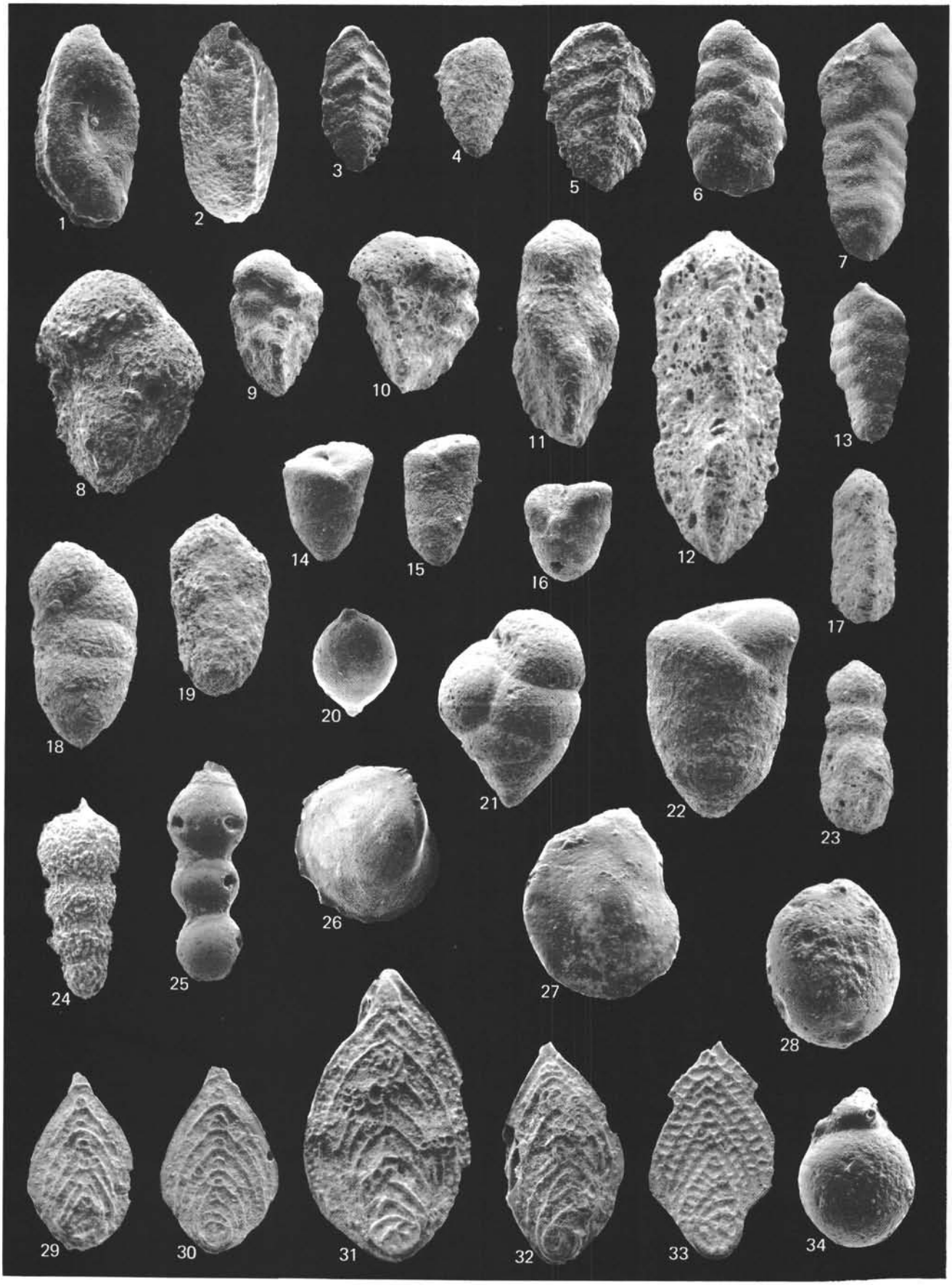
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PLATE 2

Figures 1, 2 — *Praebulimina* cf. *beaumonti* (Cushman and Renz). 100×. Sample 363-23-2, 58-60 cm.
1. Apertural view. C 33414.
2. Side view of another specimen. C 33415.

Figure 3 — *Praebulimina reussi* (Morrow). 100×. Sample 363-22, CC. C 33418.

Figures 4-6 — *Praebulimina* sp. indet. A. 50×. Sample 363-20, CC.
4. C 33413.
5. C 33529.
6. C 33530.

Figures 7, 8 — *Praebulimina* cf. *navarroensis* (Cushman and Parker). 100×. Sample 363-22, CC.
7. C 33417.
8. C 33416.

Figure 9 — *Praebulimina* sp. indet. B. 100×. Sample 363-25, CC. C 33531.

Figures 10, 11 — *Praebulimina* sp. indet. C. 100×. Sample 364-23-3, 58-60 cm.
10. C 33420.
11. C 33419.

Figures 12, 18, 19 — *Bolivinoides draco draco* (Marsson). 50×. Sample 63-18, CC.
12. C 33410.
18. C 33412.
19. C 33411.

Figure 13 — *Eouvigerina* cf. *hispida* Cushman. 50×. Sample 363-18-3, top. C 33421.

Figure 14 — *Reussella* (?) sp. indet. aff. *R. californica* Cushman and Goudkoff. 50×. Sample 364-16-4, C 33430.

Figure 15 — *Reussella* cf. *cushmani* Brotzen. 100×. Sample 364-23-3, 58-60 cm. C 33431.

Figures 16, 17 — *Reussella szajnochae* (Grzybowsky). 50×.
16. Sample 364-16, CC. C 33428.
17. Sample 363-23-2, 58-60 cm. C 33429.

Figures 20-22 — *Conorbina* cf. *marginata* Brotzen. 100×. Sample 364-20, CC. Three different specimens.
20. Umbilical view. C 33458.
21. Peripheral view. C 33459.
22. Spiral view. C 33457

Figures 23, 24, 28 — *Gavelinopsis* cf. *aracajuensis* (Petri). 50×. Sample 363-22, CC.
23. Umbilical view. C 33442.
24. Peripheral view. C 33444.
28. Spiral view. C 33443.

Figures 25-27 — *Valvulineria allomorphinoides* (Reuss).
25. Spiral view. 50×. Sample 363-19, CC. C 33526.
26. Umbilical view. 100×. Sample 363-24, CC. C 33524.
27. Spiral view. 100×. Sample 364-14-1, 106-108 cm. C 33525.

Figures 29, 32 — *Valvulineria brotzeni* Nakkady and Talaat. 100×. Sample 363-23-2, 58-60 cm.
29. Spiral view. C 33478.
32. Umbilical view of a different specimen. C 33477.

Figures 30, 31 — *Valvulineria camerata* Brotzen. Sample 364-22, CC.
30. Umbilical view, 100×. C 33527.
31. Spiral view, 80×. C 33528.

Figures 33, 34 — *Valvulineria* (?) cf. *gracillima* ten Dam. 100×. Sample 364-23-3, 58-60 cm.
33. C 33476.
34. C 33475.

PLATE 2

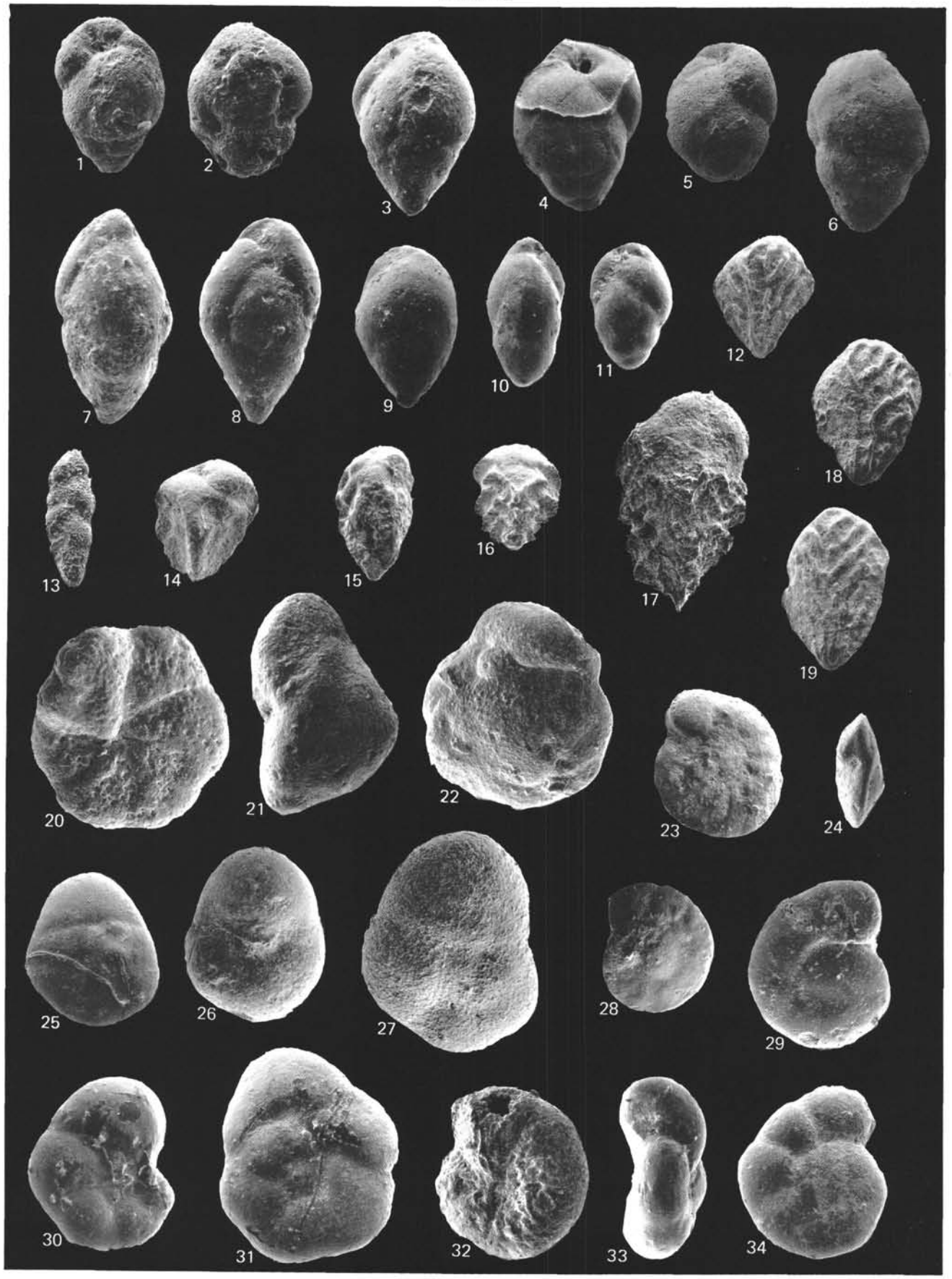
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PLATE 3

Figures 1, 2 *Nuttallides bronnimanni* (Cushman and Renz). 100×. Sample 363-21-4, 8-10 cm.
1. Peripheral view. C 33494.
2. Umbilical view of another specimen. C 33495.

Figures 3-5 *Nuttallinella* (?) cf. *monterelensis* (Marie). 100×.
3. Umbilical view. Sample 364-12-1, 58-60 cm. C 33515.
4. Side view. Sample 364-12-1, 58-60 cm. C 33516.
5. Spiral view. Sample 364-16, CC. C 33517.

Figures 6-8 *Nuttallinella* sp. indet. Sample 364-11, CC.
6. Spiral view, 100×. C 33511.
7. Peripheral view, 100×. C 33512.
8. Umbilical view, 80×. C 33510

Figures 9-11 *Eponides* sp. aff. *E. birdi* Trujillo. 100×. Sample 363-24, CC. Three different specimens.
9. Umbilical view. C 33470.
10. Peripheral view. C 33472.
11. Spiral view. C 33471.

Figure 12 *Pleurostomella austinana* Cushman. 100×. Sample 364-19, CC. C 33426.

Figure 13 *Pleurostomella obtusa* Berthelin. 50×. Sample 364-23-1, 80-82 cm. C 33427.

Figure 14 *Ellipsoidella* cf. *robusta* (Cushman). 50×. Sample 364-19-2, 58-60 cm. C 33422.

Figure 15 *Ellipsoidella solida* Brotzen. 50×. Sample 363-25, CC. C 33423.

Figure 16 *Bandyella greatvalleyensis* (Trujillo). 100×. Sample 364-14, CC. C 33425.

Figure 17 *Bandyella* sp. indet., 50×. Sample 363-23-2, 58-60 cm. C 33424.

Figures 18 *Coryphostoma incrassatum incrassatum* (Reuss). 40×. Sample 363-21-4, 8-10 cm. C 33408.

Figure 19 *Coryphostoma incrassatum crassum* (Vasilenko and Mjatliuk). 40×. Sample 363-20, CC. C 33407.

Figure 20 *Corphostoma* cf. *limonense* (Cushman). 40×. Sample 363-19-4, 58-60 cm. C 33409.

Figure 21 *Pullenia coryelli* White. 50×. Sample 363-23-2, 58-60 cm. C 33491.

Figure 22 *Pullenia americana* Cushman. 100×. Sample 363-23-2, 58-60 cm. C 33492.

Figures 23, 24 *Pullenia puentepiedraensis* Galloway and Morrey. 100×.
23. Side view. Sample 364-15-1, 58-60 cm. C 33493.
24. Apertural view. Sample 364-13-1, 58-60 cm. C 33533.

Figure 25 *Aragonia ouezzanensis* (Rey). 50×. Sample 364-11, CC. C 33405.

Figure 26 *Aragonia velascoensis* (Cushman). 50×. Sample 363-19-2, 58-60 cm. C 33404.

Figures 27, 28 *Gyroidina* cf. *bandyi* (Trujillo). Sample 364-19, CC.
27. Spiral view, 100×. C 33467.
28. Peripheral view, 50×. C 33468.

Figures 29, 30 *Gyroidina beisseli* White. 50×. Sample 363-23-2, 58-60 cm.
29. C 33473.
30. C 33474.

Figures 31, 34 *Gyroidina* cf. *grahami* (Martin). 100×. Sample 364-19, CC.
31. Spiral view. C 33462.
34. Umbilical view. C 33463.

Figures 32, 33 *Gyroidina bollii* (Cushman and Renz). 50×. Sample 363-24, CC.
32. C 33532.
33. C 33469.

PLATE 3

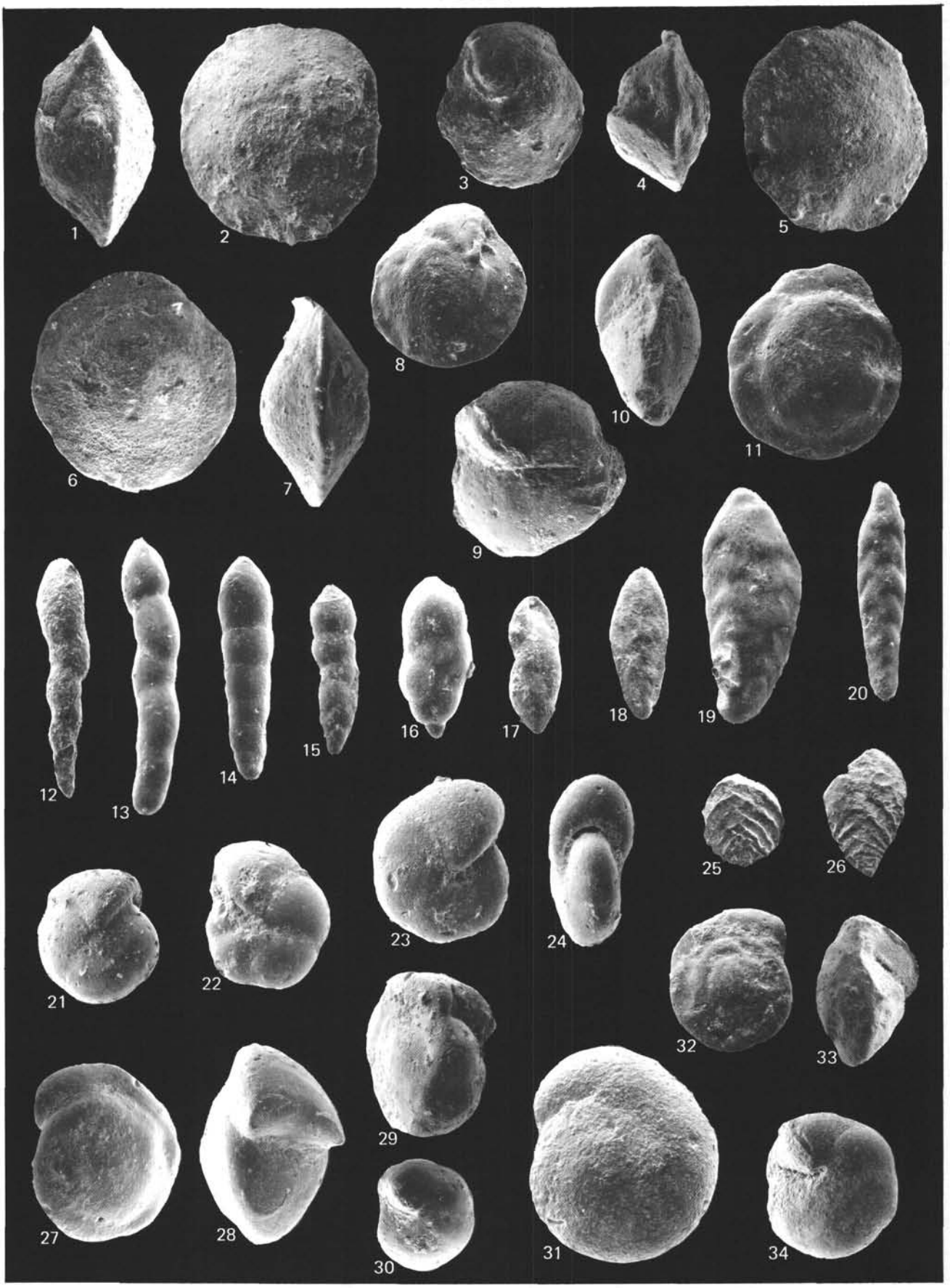
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PLATE 4

Figures 1, 2 — *Gyroidina mauretanica* Charbonnier. 100×. Sample 364-21, CC.
1. Peripheral view. C 33460.
2. Spiral view of another specimen. C 33461.

Figure 3 — *Gyroidina mauretanica* subsp. indet., 100×. Sample 364-21, CC. C 33464.

Figures 4, 5 — *Gyroidina noda* Belford. 100×.
4. Spiral view. Sample 364-18-2, 58-60 cm. C 33487.
5. Peripheral view. Sample 364-16, CC. C 33486.

Figure 6 — *Gyroidina quadrata* Cushman and Church. Spiral view, 100×. Sample 364-21, CC. C 33505.

Figures 7, 8 — *Gyroidina rumoiensis* Takayanagi. 100×. Sample 364-20, CC.
7. Spiral view. C 33465.
8. Umbilical view. C 33466.

Figures 9-11 — *Gyroidina* sp. indet., 100×. Sample 363-23-2, 30-33 cm.
9. Spiral view. C 33536.
10. Umbilical view. C 33535.
11. Peripheral view (Same specimen as Fig. 10).

Figures 12, 13 — *Osangularia cordieriana* (d'Orbigny). 50×. Sample 363-23-2. 58-60 cm.
12. Spiral view. C 33499.
13. Umbilical view. C 33500

Figures 14-17 — *Osangularia incisa* (Brotzen). 100×.
14. Umbilical view. Sample 364-23-1, 80-82 cm. C 3351.
15. Peripheral view of a lenticular specimen. Sample 364-17-4, 58-60 cm. C 33514.
16. Spiral view. Sample 364-23-2, 30-33 cm. C 33534.
17. Peripheral view of a conical specimen (same as Figure 16).

Figures 18-20 — *Osangularia* cf. *lens* Brotzen. Sample 363-20, CC.
18. Umbilical view, 50×. C 33498.
19. Peripheral view, 50×. C 33497.
20. Spiral view, 40×. C 33496.

Figures 21, 27 — *Globorotalites spineus* (Cushman). Sample 364-15-1, 58-60 cm.
21. Spiral view, 80×. C 33509.
27. Umbilical view, 100×. C 33508.

Figures 22, 23 — *Globorotalites conicus* (Carsey). 100×. Sample 364-20-5, top.
22. Peripheral view. C 33507.
23. Umbilical view. C 33506.

Figure 24 — *Charltonina florealis* (White). 50×. Peripheral view. Sample 363-20, CC. C 33501.

Figures 25, 26 — *Globorotalites hiltermanni* Kaever. 80×. Sample 363-24, CC.
25. Umbilical view. C 33485.
26. Peripheral view. C 33484.

Figure 28 — *Gyroidinoides* cf. *globosa* (Hagenow). 100×. Oblique spiral view. Sample 363-21-4, 8-10 cm. C 33482.

Figure 29 — *Gyroidinoides octocamerata* (Cushman and Hanna). 80×. Spiral view. Sample 363-21-4, 8-10 cm. C 33483.

Figures 30-32 — *Gyroidinoides* sp. indet., 100×.
30. Peripheral view. Sample 364-23-3, 58-60 cm. C 33481.
31. Spiral view. Sample 364-20, CC. C 33479.
32. Umbilical view. Sample 364-20, CC. C 33480.

PLATE 4

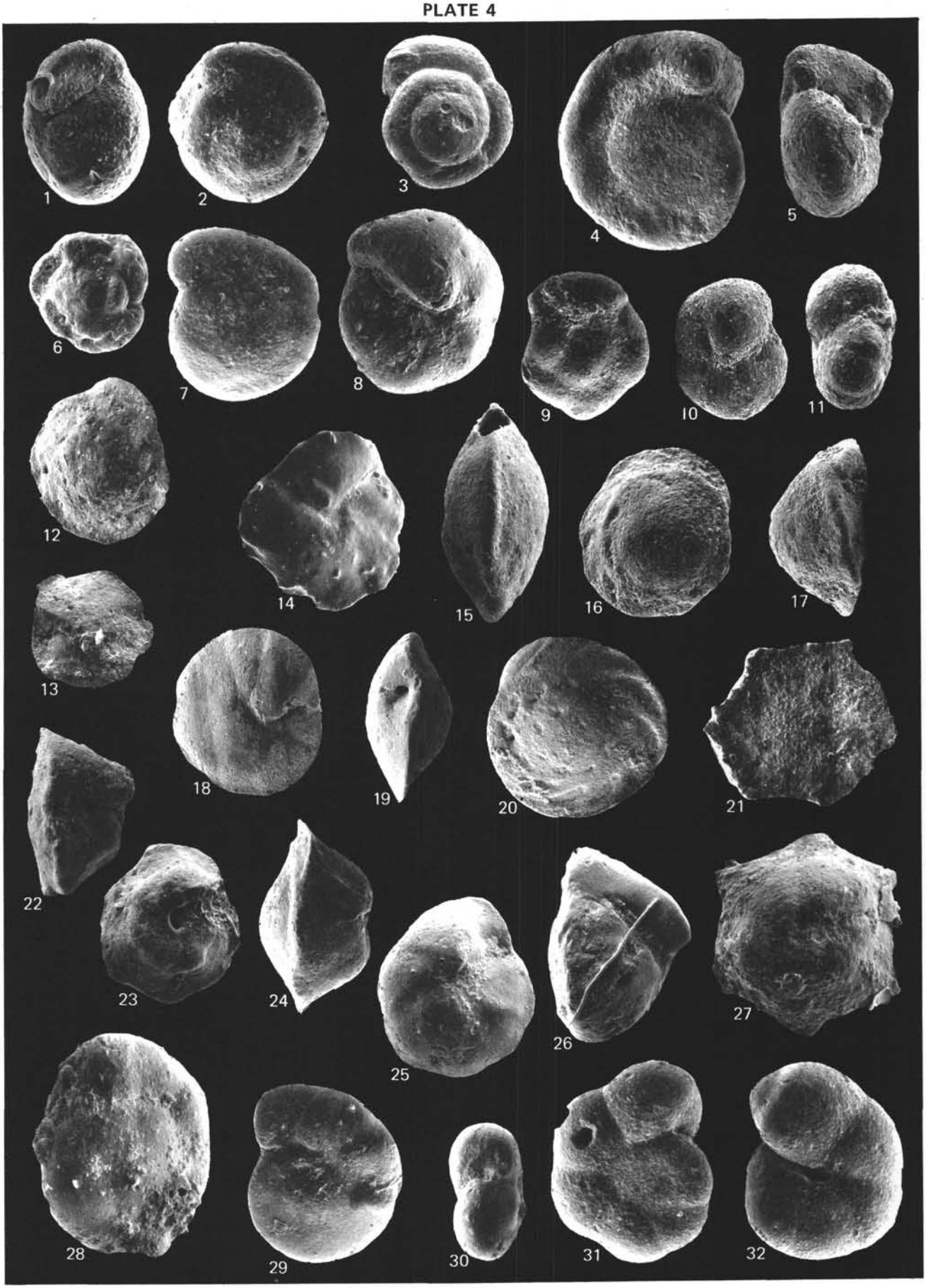
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PLATE 5

Figures 1, 2 — *Gavelinella beccariiformis* (White). 50×. Sample 364-11, CC.
1. Spiral view. C 33432.
2. Umbilical view. C 33433.

Figure 3 — *Gavelinella beccariiformis* (White), conical variety. 50×. Peripheral view. Sample 364-11, CC. C 33434.

Figures 4-6 — *Gavelinella brotzeni* Said and Kenawy. 100×.
4. Umbilical view. Sample 364-11, CC. C 33489.
5. Spiral view. Sample 364-22, CC. C 33490.
6. Spiral view. Sample 364-11, CC. C 33488.

Figures 7, 8 — *Gavelinella costata* Brotzen. 50×. Sample 363-24, CC.
7. Spiral view. C 33455.
8. Umbilical view. C 33456.

Figures 9-11 — *Gavelinella* sp. aff. *G. daini* (Schijfsma). 100×. Sample 364-20-5, top.
9. Spiral view. C 33436.
10. Peripheral view. C 33437.
11. Umbilical view. C 33435.

Figure 12 — *Gavelinella compressa* Sliter. 50×. Spiral view. Sample 364-20-5, top. C 33451.

Figures 13, 14 — *Gavelinella eriksdalensis* (Brotzen). 50×. Sample 364-23-1, 80-82 cm.
13. Spiral view. C 33448.
14. Umbilical view. C 33447.

Figures 15, 16 — *Gavelinella menneri* Keller. Sample 363-19-2, 58-60 cm.
15. Umbilical view, 40×. C 33446.
16. Spiral view. 50×. C 33445.

Figures 17, 18 — *Gavelinella popenoei* (Trujillo). 50×. Sample 364-19, CC.
17. Spiral view. C 33449.
18. Umbilical view. C 33450.

Figures 19-22 — *Gavelinella* cf. *velascoensis* (Cushman). 50×.
19. Peripheral view. Sample 363-19, CC. C 33439.
20. Spiral view. Sample 363-20, CC. C 33438.
21. Spiral view of a planoconvex specimen. Sample 363-22, CC. C 33441.
22. Peripheral view. Sample 363-22, CC. C 33440.

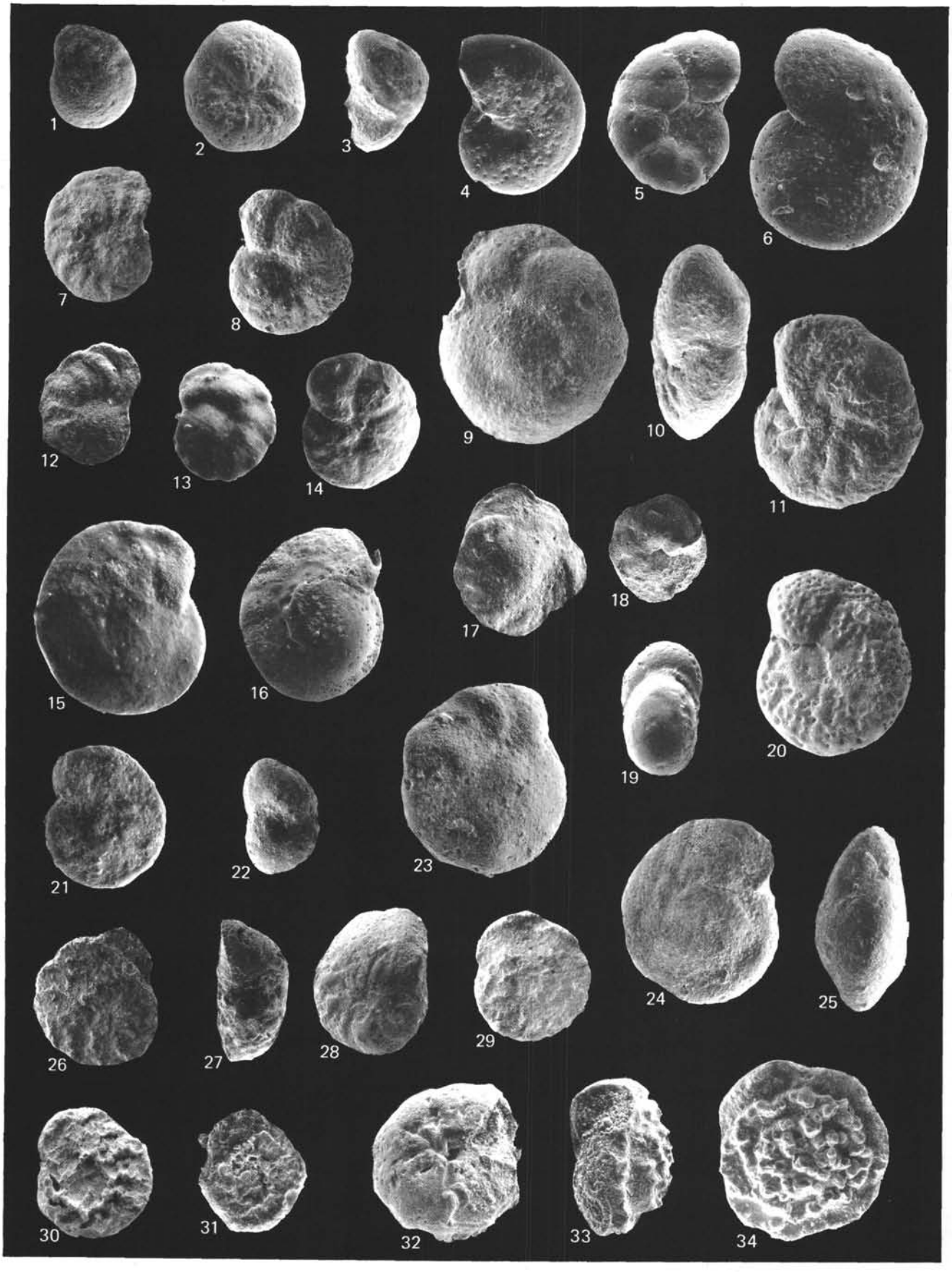
Figures 23-25 — *Gavelinella* sp. indet., 100×. Sample 364-16-1, 82-84 cm.
23. Umbilical view. C 33453.
24. Spiral view. C 33452.
25. Peripheral view. C 33454.

Figures 26-30 — *Stensioeina pommerana* Brotzen. 50×.
26. Spiral view. Sample 363-24, CC. C 33518.
27. Peripheral view. Sample 363-24, CC. C 33521.
28. Umbilical view. Sample 363-24, CC. C 33519.
29. Spiral view. Sample 363-24, CC. C 33520.
30. Spiral view. Sample 363-23, CC. C 33522.

Figure 31 — *Stensioeina* sp. (*pommerana*?). 50×. Spiral view. Sample 364-16, CC. C 33523.

Figures 32-34 — *Stensioeina* (?) sp. indet., 100×. Sample 364-19, CC.
32. Umbilical view. C 33503.
33. Peripheral view. C 33504.
34. Spiral view. C 33502.

PLATE 5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