32. BIOSTRATIGRAPHY OF LOWER CRETAZEUS BLAKE NOSE AND BLAKE-BAHAMA BASIN FORAMINIFERS DSDP LEG 44, WESTERN NORTH ATLANTIC OCEAN

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ABSTRACT

Deep Sea Drilling Project Sites 390 and 392, Blake Nose, penetrated about 30 meters of nannofossil ooze and limestone rich in excellently preserved Lower Cretaceous planktonic (over 12 taxa) and benthic (over 50 taxa) foraminifers. Range charts are presented and four standard planktonic zones and one benthic zone are recognized which allow a detailed regional correlation.

Drilling at DSDP Site 391 (Blake-Bahama Basin) penetrated about 400 meters of dark and variegated claystone and light limestone and shale with sparse, poorly preserved foraminifers assigned to four assemblages or zones, comprising Valanginian, Barremian, Aptian-Albian, and Upper Cretaceous sediments.

One assemblage zone (Dorothiapraehauteriviana) correlates Site 391 to Sites 101 and 105, DSDP Leg 11; another (Plectorecurvoides assemblage zone) may be diagnostic for the dark and variegated claystone facies both in the Atlantic and in the Pacific oceans.

The taxonomy and stratigraphic ranges of over 50 taxa are discussed and figured. Attention is focused on the intraspecific variation within the plexus Gavelinella-Lingulogavelinella on the basis of three previously described forms. Phylogenetic trends in the group of Gaudryina dividentes-Spiroplectinata are more complicated than previously established.

INTRODUCTION

During Leg 44 of the Deep Sea Drilling Project in the western North Atlantic Ocean, three sites, 389, 390, and 392, were occupied on the edge of the Blake Plateau in water approximately 2650 meters deep. This region is known as the Blake Nose (Figure 1), a northeast-jutting spur of the Blake Plateau, about 500 km east of Florida, USA.

The main objective of drilling at the Blake Nose sites was to provide more detailed information on the presence of the Cretaceous reef complex that circles the Gulf of Mexico, extends through Cuba and the Bahamas, and rims the escarpment of the Blake Plateau (see Site 389 Report, this volume).

Drilling at Site 389 was an abortive attempt to spud in on the Blake Nose; only Quaternary microfossils were recovered. The successful and detailed coring at nearby Holes 390, 390A, and 392A yielded a Lower Cretaceous (Barremian-Albian), uppermost Cretaceous and Paleogene marine sequence over 170 meters thick as determined from assemblages rich in nannofossils, foraminifers, and also (Paleogene) radiolarians. The pelagic nature of the post-Barremian sediment, well above the calcium carbonate compensation depth (CCD) and the virtual absence of overburden have contributed to the excellent preservation of foraminifer tests.

We drilled another site, 391, south of the Blake Nose near the center of the Blake-Bahama Basin (Figure 1) in water 4963 meters deep. The site was located on the landward side of the quiet magnetic zone where we hoped to recover Middle and possibly Lower Jurassic strata overlying basaltic basement. The four holes of this site yielded a composite section from uppermost Jurassic through Lower Cretaceous (1412 T. D.-649 m), immediately overlain by thick Miocene and thinner...
Quaternary beds. The presence of Upper Cretaceous strata could not be determined conclusively.

Upper Jurassic and Lower Cretaceous foraminifers (in Hole 391C) are few and poorly preserved; many core samples are barren. We attribute this in part to synsedimentary dissolution of tests at depth. The foraminiferal biostratigraphy is accordingly meager, especially if compared to the record in the Blake Nose sites.

The multiple biostratigraphic and paleoecologic interpretations at each site are presented in the individual site reports (Part I, this volume).

This chapter is an account of the planktonic and benthic foraminiferal biostratigraphy from the Lower Cretaceous beds, mainly at Sites 390 and 392. Some time was spent in examination of the variation in many taxa, details of which are in the Appendix on taxonomy. Most taxa are illustrated in Plates 1-11. Some of the determinations are provisional, pending more complete documentation of the variation in morphology and comparison to type material.

The Lower Cretaceous foraminifer stratigraphy of Site 391 shows little resemblance to the one of DSDP Sites 99, 100, 101, and 105, as studied by Luterbacher (1972). We make a brief comparison below in the paragraph on Regional Correlation.

PREVIOUS LITERATURE

Piston coring and dredgings along the Blake Escarpment, which separates the 1000-meter level of the Blake Plateau from the 5000-meter depth of the Blake-Bahama Basin, has revealed the presence of Neocomian to Aptian algal limestone and (?Albian-the Blake Plateau from the 5000-meter depth of the Blake Nose) and Delrioensis Rotalipora greenhomensis Praeglobotruncana (Moreman), eaglefordensis (Gandolfi), Globigerinelloides bentonensis (Subbotina), and age-diagnostic apytchi faunule. The informal Barremian benthic zone of Barremiana-Lenticulina (Marginulopsis) sigali, erected for Sites 390, 391, and 392 is correlated to the Barremian-lower Aptian planktonic zone of Hedbergella sigali (LC8).

For the benthic foraminifers, I used the ranges of species as given by a number of authors quoted in the text, including Bartenstein et al. (1957, 1966, 1973); Simon and Bartenstein (1962); Sigal (1965); Moullade (1966), Michael (1966, 1967); Ohm (1967); and Luterbacher (1972). The informal Barremian planktonic zone of Gavelinella barremiana-Lenticulina (Marginulopsis) sigali, erected for Sites 390, 391, and 392 is correlated to the Barremian-lower Aptian planktonic zone of Armanginian (LC8).

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The informal Barremian planktonic biostratigraphy of Sites 390, 391, and 392 follows van Hinte's (1976) zonal scheme in conclusion with taxonomic and biostratigraphic data mainly by Botelho, Moullade, Sigal (1966), Sigal (1965; 1966), Hermes (1969), Kuhry (1971), and Longoria (1974). I recognized four formal zones (Figure 2) in sediments from Sites 390 and 392: Ticineilla breggiensis Zone (LC17)—upper Albian Ticineilla primul Zone (LC15-16) —middle Albian Globigerinelloides algerianus Zone (LC11)—upper Aptian Globigerinelloides blowi Zone (LC9)—lower Aptian.

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Figure 2. Lower Cretaceous foraminifer biostratigraphy and lithology of Blake Nose Sites (390 and 392), and Blake-Bahama Basin Site (391), Leg 44, Deep Sea Drilling Project. Hole 392A, Core 1, and the upper part of Hole 390A, Core 14, consist of Campanian-Maestrichtian pelagic sediments.
Dorothy praehauteriviana Assemblage (Valanginian; Hole 391C, Core 26, Section 3, 60-62 cm and Core 24, Section 3, 14-16 cm; light colored limestone and shale)

The co-occurrence in Hole 391C of Dorothy praehauteriviana was tentatively dated Valanginian by the presence of Conorboides hofkeri (13, 14) with isolated specimens of Conorboides hofkeri (Bartenstein and Brand) (Plate 1, Figure 15) and Lenticulina ex gr. nodosa (Reuss) (Plate 1, Figure 16), indicates a Valanginian age (see Bartenstein, 1976b). The only other foraminifers are undiagnostic species of Lenticulina, Haplophragmoides, or other, well-preserved, stout specimens. Its range, i.e., upper Hauterivian to lower Aptian, correlates Cores 24 and 26 at Site 391 to the interval at Site 391 is dated, respectively, upper Hauterivian (Schmidt and Habib, this volume).

The assemblage in Hole 391C of this informal zone consists of rare, echinoid species of Hedbergella sigali and uppermost limestone in Hole 392A, Core 4; Hole 390, Core 6; top of light colored limestone unit in Hole 391C, Core 14, Section 3, 66-68 cm).

The zone correlates with the lower part of the Barremian-lower Aptian Hedbergella sigali Zone (LC8) (van Hinte, 1976).

At Sites 390 and 392, the informal Gavelinella barremiana-Lenticulina (M.) sigali Zone contains a variety of species. Restricted to the interval are Lenticulina (Marginulops), species of Gavelinella barremiana, and Lenticulina (Planeus) crepidularis (Roemer) (Plate 1, Figure 12). The zone correlates with the lower part of the Barremian-lower Aptian Hedbergella sigali Zone (LC8) (van Hinte, 1976).

In Hole 390, Core 6, there also are a dozen or more specimens of “Globigerina” heterotica Subbotina (Plate 9, Figures 9-15) (syn. G. kugleri) and Bolli from the Cuche and Toco formations, Barremian-Aptian of Trinidad). Van Hinte (1976), (following Subbotina's [1953] first description), restricts the species to upper Hauterivian strata. Michael (1967) seems to give the maximum range, i.e., upper Hauterivian to lower Aptian.
The following species present also occur in overlying Aptian-Albian strata at Sites 390 and 392: *Lenticulina* ex. gr. *ouachensis* Sigal (Plate 4, Figures 4, 8); *L. muensteri* (Roemer); *Gavelinella barremiana* Bettenstaedt (Plate 6, Figures 14-17); *Epistomina* ex. gr. *spinulifera* (Reuss)(Plate 8, Figures 1, 2); *Conoroatalites aptiensis* (Bettenstaedt) (Plate 8, Figures 13, 17; only present in this zone at Site 392).

*Conoroatalites intercedens-aptiensis* is known from middle-upper Barremian strata (e.g., Simon and Bartenstein, 1962; Sigal, 1965). Ranges of other species are: *Epistomina caracolla* and *E. ornata*, Valanginian-middle Barremian (Ohm, 1967; Bartenstein, 1976b); *Lenticulina* (*M.*) *sigali*, Hauterivian-Barremian (Sigal, 1965, sub *Marginulopsis* cf. *djaffensis*; Bartenstein et al., 1957); *L. crepidularis*, long ranging but locally more common in upper Valanginian-lower Barremian beds (Simon and Bartenstein, 1962); *Epistomina* ex. gr. *spinulifera*, middle Barremian-Albian (Sigal, 1965; Ohm, 1967); *Lenticulina meridiana*, Hauterivian-lower Barremian with peak in Hauterivian-Barremian (Bartenstein and Bolli, 1973; Bartenstein, 1976b); *L. ouachensis*, Hauterivian-Aptian (Bartenstein, 1976b); *Gavelinella barremiana*, middle-upper Barremian, ?Aptian (see discussion under G. *blowi* Zone).

These ranges suggest that the assemblage which defines the informal zone of *Gavelinella barremiana-Lenticulina* (*M.*) *sigali* is lower-late Barremian in age.

Habib (this volume) dates Core 14 (as high as Section 2) in Hole 391C as upper Hauterivian or Barremian through ??upper Barremian. In Hole 390, Core 6, and Hole 392A, Core 4, nannofossils comprise the Barremian *M. hochschulzi* Zone—in close agreement with foraminifer age assignment.

Specimens in this zone in Holes 390 and 392A of *Gaudryina dividens* Grabert, *Hedbergella trocoidea* (Gandolfi), *Globigerinelloides alterianus* Cushman and Ten Dam, and *G. ferrolensis* (Moullade) are interpreted as cavings. The same may be true for indeterminate *Hedbergella*. The tests of these taxa, mostly large specimens, are also less carbonate coated than most found at this level; the preservation is more comparable to that of the same taxa in the overlying upper Aptian strata

*Globigerinelloides blowi* Zone (LC9; lower Aptian; top of limestone in Hole 390, Core 5, CC)

The presence in Sample 5, CC in Hole 390 of the lower Aptian partial range zone of *Globigerinelloides blowi* (LC9; van Hinte, 1976) is established on the basis of the presence of *Globigerinelloides blowi* Bolli, together with *Conoroatalites aptiensis* (Bettenstaedt), *Lenticulina* ex. gr. *ouachensis* (Sigal), and *Gavelinella barremiana* Bettenstaedt (3-G. *intermedia* [Berthelin]).

The latter two species do not range stratigraphically higher on the Blake Nose. Also present are *Lenticulina muensteri* (Roemer), *Praebulimina nannina* (Tappan) (Plate 9, Figures 16, 17), *Bolivina textilaroides* (Reuss), *Spirillina* sp., and small *Hedbergella* spp.

The zone has only been recognized in Hole 390, but it might also be present in Hole 392A in the interval between Cores 3 and 4 (see Figure 2).
Paleontologists are not certain whether *Globigerinelloides blowi* (Bolli) ranges throughout the Lower Aptian or only appears in its upper part as suggested by Moullade (1966) (see also Bolli, 1959; Longoria, 1974; van Hinte, 1976).

There is no agreement in the literature on the stratigraphic range of *Gavelinella barremiana* Bettenstaedt. According to Michael (1966) the species *sensu strictu* is indicative of middle-upper Barremian strata (cf. van Hinte, 1976), but as a variant of *G. intermedia* (Berthelin) morphologically similar specimens persist in the Aptian. Many authors, including Moullade (1966) and Bartenstein (1976b) show a middle Barremian-lower Aptian range. In Sample 390-5, CC, 1 of 24 specimens examined is morphologically intermediate between *G. barremiana* s.s. and *G. intermedia* s.s. The other specimens show the typical *G. barremiana* morphology and are similar to the specimens in the underlying zone.

Possibly the core-catcher sample incorporates some Barremian sediments and on the basis of nannofossil stratigraphy the sediment of 390-5, CC was assigned to the upper Barremian (Schmidt, this volume). However, except for *G. barremiana*, Barremian foraminifer species from the underlying zone are absent (Figures 3, 4).

The presence of some specimens of *Hedbergella trocoidea* (Gandolfi) in this sample with identical preservation to that of the overlayers and in situ specimens in the overlying strata is explained from cavings.
**Table 1: Lower Cretaceous Foraminifers**

<table>
<thead>
<tr>
<th>Calcareous Benthic Foraminifers</th>
<th>Arenaceous Benthic Foraminifers</th>
<th>Foraminiferal Stratigraphy</th>
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<td>Relohedrella atrina</td>
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<td>Plankton Zone</td>
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<td>Orbisphaerulina bryani</td>
<td>Lenticulina sp.</td>
<td>T. breggiensis</td>
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<td>Lenticulina acuminata</td>
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<td>Lenticulina araneiformis</td>
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<td>O. clavata</td>
<td>Lenticulina rugosa</td>
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<td>O. clavata</td>
<td>Lenticulina sp.</td>
<td>G. algerianus</td>
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<td>Lenticulina sp.</td>
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<tr>
<td>D. oxycona</td>
<td>Lenticulina sp.</td>
<td>LC 10-11</td>
</tr>
<tr>
<td>D. oxycona</td>
<td>L. vocontiana group</td>
<td>G. barremiana</td>
</tr>
<tr>
<td>L. vocontiana</td>
<td>L. nodosa group</td>
<td>LC 8</td>
</tr>
<tr>
<td>L. intermedia</td>
<td>L. sigali</td>
<td>Barremian</td>
</tr>
</tbody>
</table>

**Figure 4. Continued.**

Moullade (Plate 4, Figure 1) has only been found in this zone. The species is known from the upper Aptian of France, and the upper Aptian-lower Albian of Trinidad (Moullade, 1966; Bartenstein and Bolli, 1973).

Benthic species which have their stratigraphically lowest occurrence in the interval in the Blake Nose Sites are: *Gaudryina* ex. gr. *dividens* Grabert (Plate 2); *Gavelinella* ex. gr. *intermedia* (Berthelin) (Plate 6, Figures 5-13); *Osangularia utaturensis* (Sastri and Sastry) (Plate 7, Figures 5-12); *Lenticulina turgidula* (Reuss) (Plate 4, Figure 3); *Gyroidinoides primitiva* Hofker (Plate 8, Figures 9, 10); *Dorothy gradata* Berthelin (Plate 3, Figures 2, 3, 4). *Gaudryina* ex. gr. *dividens* and *Gavelinella* ex. gr. *intermedia* are most common. Both taxa and their related forms are discussed in some detail in the Appendix to this chapter.

*Osangularia utaturensis* (Sastri and Sastry), particularly common in Blake Nose Albian strata, is a cosmopolitan species known from (upper) Aptian through Albian beds (syn. *O. sp. aff. brotzeni* Gandolfi and *O. californica* Dailey; see Appendix).

The *Globigerinelloides algerianus* Zone at Sites 390 and 392 corresponds to the upper Aptian-lower Albian *P. angustus* nannofossil zone (Schmidt, this volume).

*Gaudryina* ex. gr. *dividens* Zone (upper Aptian-middle Albian; Hole 392A, Core 3; Hole 390, Core 5, Section 2, through Core 3, Section 3 and Hole 390A, Core 14, Section 5).

Because of its conspicuous morphology, abundance, and restricted range in Blake Nose samples, I have taken the presence of *Gaudryina* ex. gr. *dividens* Grabert (Plate 2) to comprise an informal zone. It correlates Hole 392A, Core 3 to Hole 390, Section 5-2 through Section 3-3 and to Hole 390A, Section 14-5. Following Grabert (1959; see also Simon and Bartenstein, 1962, and Bartenstein, 1976b) the taxon (and the morphologically closely associated *Spiroplectinata lata* Grabert; see description of the *Gaudrylna-Spiroplectinata plexus* in Appendix) ranges from upper Aptian to middle Albian in agreement with the Blake Nose planktonic biostratigraphy (see distribution charts of Figures 3, 4). On Sigal's (1965) range chart of Lower Cretaceous foraminifers *Gaudryina dividens* ranges from upper Barremian through (lower) Albian.

*Hedbergella trocoidea* Assemblage (upper Aptian-lower Albian; dark green-black claystone in Hole 319C, Core 11, Section 3, 45-47 cm)

In Hole 391C the only foraminifer evidence of Aptian-Albian beds is from tiny specimens of *Hedbergella trocoidea* (Gandolfi), *Globigerinelloides aff. ferrodens* (Moullade), and *Gavelinella aff. intermedia* (Berthelin) in Core 11. The species date the sample as upper Aptian-lower Albian. This agrees with age determinations for this depth by Habib (paleynomorphs, this volume) and Schmidt (nannofossils, this volume).

*Ticinella primula* Zone (LC15-16; middle Albian; marly nannofossil ooze and clay, variegated; Hole 390, Cores 4 and 4, Section 2, 75-77 cm; Cores 3, CC and 3, Section 3, 80-82 cm; Hole 390A, Cores 14, CC and 14, Section 5, 119-121 cm; Hole 392A, Core 3, Section 1, 46-48 cm)

Interval with prolific pelagic foraminifers, characterized by *Ticinella primula* Luterbacher (Plate 11, Figures 3-10) stratigraphically below the first occurrence of *T. breggiensis* (Gandolfi). The species dominates the assemblage. Except for isolated,
relatively poorly preserved (reworked) specimens in Hole 390-3-3, 80-82 cm of *Hedbergella* aff. *trocoida* (Gandolfi) (Plate 10, Figures 7, 8) and of some reworked *H. trocoidea* in Sample 392A-3-1, 46-48 cm, planktonic species from the underlying *Globigerinelloides algerianus* Zone are absent. The interpretation “reworked” in Section 392A-3-1 stems from the opaque, sugary preservation of the (few) specimens which are like that in the *G. algerianus* aff. *trocoida* (Hedbergella) Zone are absent. *Globigerinelloides algerianus* (F. M. Gradstein) (Tappan) (Plate 11, Figures 14-16); *planispira* van Hinte’s (1976) middle Albian partial range zone (Gandolfi) indicates Moullade’s (1966) and *breggiensis* (LC15-16). with *Ticinella primula* (Moullade) *Globigerinelloides ferreolensis* absence of *trocoida* (Gandolfi) and the absence of *chapters by Schmidt and Roth, this volume). (Carsey) (Plate 10, Figures 1, 2); *delrioensis* Blake Nose are, respectively, assigned an upper Aptian-

In Hole 390A in the lower part of Core 14, the middle Albian *Ticinella primula* Zone is immediately overlain by the upper Campanian *Globotruncanca calcarea* Zone (Site 390 Report; Part 1 of this volume). At Site 392 the Albian section below the disconformity with the upper Campanian strata appears more complete.

Core 2 of Hole 392A has a rich, largely pelagic assemblage with *Ticinella breggiensis* (Gandolfi) (Plate 11, Figure 1), and *Hedbergella amabilis* Loeblich and Tappan (Plate 11, Figures 11-13), which are restricted to this interval. *H. planispira* Tappan, *H. aff. delrioensis* (Carsey), and *Ticinella primula* Luterbacher also occur. Specimens transitional between *T. primula* and *T. breggiensis* are common (Plate 11, Figure 2).

Most workers agree that *T. breggiensis* occurs in the upper Albian (see Longoria, 1974, p. 96 for a summary of the literature). A few references, including Sigal (1966), mention a middle Albian appearance. In van Hinte’s (1976) zonal scheme (sensu Moullade, 1966) this species characterizes the *T. breggiensis* total range zone of lower upper Albian. It evolved from *T. primula* as is also suggested in our material.

Among the benthic species specimens of *Dentalina debilis* (Berthelin) (Plate 3, Figure 9) and *Lingulina loryi* (Berthelin) were not found below this zone. However, these species appear to be relatively long ranging (Hauterivian-Albian/Cenomanian, see Maync, 1973; Dailey, 1973). The other benthic species present also occur in the underlying zone of *Ticinella primula* Luterbacher. *Epistomina* ex. gr. *spinulifera* (Reuss) (Plate 8, Figures 1, 2) occurs with some relatively large specimens which are much better preserved than the few individuals present in the zone of *G. barremiana-L. (M.) sigali.*

Nannofossils in Hole 392A, Core 2 have been assigned to the lower-middle Albian (Schmidt, this volume).

**Plectorecurvoides Assemblage** (?Albian-Upper Cretaceous; dark green-black claystone; rare variegated intervals, Hole 391C, Cores 5 to 8, possibly as deep as Core 10)

In Hole 391C, Samples 5, CC, 6, CC, and 8, CC between 677.5 meters and ±800 meters below sea, bottom there is an exclusively siliceous arenaceous foraminifer assemblage. Many other samples in this dark claystone interval lack foraminifers.

**Ticinella breggiensis** Zone (LC17; upper Albian nannofossil ooze and clay, variegated; Hole 392A, Core 2)

In Hole 390A in the lower part of Core 14, the middle Albian *Ticinella primula* Zone is immediately overlain by the upper Campanian *Globotruncanca calcarea* Zone (Site 390 Report; Part 1 of this volume). At Site 392 the Albian section below the disconformity with the upper Campanian strata appears more complete.
“Spirillina.” Krasheninnikov (1973) found a fauna, quite similar to the 391C fauna in variegated clays in the Pacific Ocean; he assigned it to the Upper Cretaceous.

In the case of Plectorecurvoides assemblage in Hole 391C, I tentatively assigned it to the Albian-Upper Cretaceous on the basis of the ranges of Uvigerinammina, Bolivinopsis, Plectorecurvoides, and Glomospirella (see Loeblich and Tappan, 1964).

In Samples 391C, 9-2, 48-50 cm, and 10-2, 73-74 cm, isolated, poorly preserved, and small calcareous tests of Hedbergella and Patellina were found which would indicate a Cretaceous age. Tiny, well preserved tests of Globigerina and radiolarians found in Sample 5, CC and some deeper samples are probably contaminants, either from cavings or introduced during handling of the samples and/or residues.

Nannofossils in Cores 9 and 10 of Hole 391C are upper Aptian-lower Albian (Schmidt, this volume), palynomorphs in Cores 6-8 are dated as upper Albian, and in Cores 8-14 as upper Aptian-lower Albian (Habib, this volume).

**BLAKE NOSE BARREMIAN-ALBIAN BIOSTRATIGRAPHIC RECORD**

A comparison of the Barremian-Albian zones recognized in the Blake Nose Sites 390 and 392 with the standard zonation as compiled from many sources by van Hinte (1976) shows one conspicuous gap (Table 1). The gap is formed by the absence of Zones LC12-LC14, uppermost Aptian-lower Albian. The most notable species missing are “Globigerinelloides” gyroidinaeformis Moullade and Ticinella bejaouaensis Sigal.

At Hole 390 this gap might be caused by the lack of samples between Cores 5 (LC11) and 4 (LC15-16). However, in Hole 392A, LC11 almost immediately underlies LC15-16 within Core 3 (Figure 2).

Zone LC11 in Hole 392A has been recognized as high as Sample 3-2, 121-123 cm, whereas a sample of Core 3-1, 46-48 cm belongs in Zone LC15-16. The contact (or a highly condensed section representing uppermost Aptian-lower Albian strata) appears to be missing in the core.

Another gap in the Aptian-Albian Blake Nose record, as discussed earlier, is the absence of the

<table>
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<th>Standard Zones</th>
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<td>T. praeticinensis LC16</td>
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<td>T. bejaouaensis-G. gyroidinaeformis</td>
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</tr>
<tr>
<td>G. blowi LC9</td>
<td>x</td>
</tr>
<tr>
<td>H. sigali LC8</td>
<td>x (equivalent p.p.)</td>
</tr>
</tbody>
</table>

**ACKNOWLEDGMENTS**

I thank the Deep Sea Drilling Project for the opportunity to participate on Leg 44 and the management of the Geological Survey of Canada for permission to spend the time on the cruise and the subsequent onshore study. I extensively used the Geological Survey’s technical facilities including the new Cambridge Stereo Scan S-180. The Scanning Electron Microscope illustrations were prepared by P. Girouard, Dartmouth, N. S. Maisie Trapnell typed the manuscript and G. Cook drafted the figures.

Much appreciated help and advice was also provided by P. Ascoli, J. Bujak, and D. Walker, Dartmouth, N. S.; M. A. Buza and R. Cifelli, United States National Museum (USNM), Washington; H. Bartenstein, Celle; H. P. Luterbacher, Bordeaux; and T. Saito, New York.

**APPENDIX**

Stratigraphic list of the taxa occurring in the Lower Cretaceous Sediments of Hole 391C.

Specimens of all taxa are rare (1-9 specimens) unless stated otherwise.
“Globigerina” huterivica Subbotina

(Plate 9, Figures 9-15)


About 16 small, very poorly preserved Globigerina-like specimens occur in Section 390-6-1 and Sample 6, CC. Half of these are irregular in shape and are reminiscent of those in rich assemblages of “Globigerina” bathoniana Pazdrova of Middle Jurassic Grand Banks deposits (Gradstein, 1977), where over half of the specimens are no more than an irregular cluster of chambers. The more regularly structured forms in Section 390-6-1 and Sample 6, CC show the following features: low to medium high trochospire with globular chambers which increase in size slowly; four chambers in the last whorl; aperture arched often with lip; aperture mostly umbilical, rarely unibical to extra-umbilical; apertural arch varies from less than one-third as high to almost as high as wide. From the description of Globigerina graysonensis Tappan (Tappan, 1940, 1943; Bolli, 1959; Longoria, 1974) and from a comparison to the holotype, and hypotype in the United States National Museum, Washington, theBlake Nose Specimens do not fall within the range of variation of this species. The specimens are more similar to Globigerina kugleri Bolli (Bolli, 1959, and USNM holotype and paratypes; Marianos and Zingula, 1966, USNM hypotype). This species is probably a junior synonym of Globigerina huterivica Subbotina (often spelled “hauterivica”). Dailey (1973, sub G. huterivica) includes Globigerina sp. A, Marianos and Zingula, in G. huterivica but excludes G. kugleri sensu Marianos and Zingula because of a Gubkinella-like medium-high trochospire. From my observation of the USNM hypotype of G. kugleri sensu Marianos and Zingula, I include this specimen in G. huterivica, which agrees with the variation described by Subbotina (1953, p. 55, fig. 2, 3) and also agrees with the variation among Blake Nose specimens. Such G. huterivica resembles G. graysonensis, which shows considerable variation in height of the spire (Tappan, 1940, 1943; Bolli, 1959; Longoria, 1974).

G. huterivica is known from the Hauterivian of the Caucasus (Subbotina, 1953), the Taoro and Cuche formations (Barremian-Aptian) of Trinidad (sub G. kugleri; Bolli, 1959), the Buidden Canyon Formation in California (Hauterivian-Barremian range; Marianos and Zingula, 1966; Dailey, 1973), and the lower Aptian of (?) Mexico (Longoria, 1974; sensu Caucasella hauterivica). Lutcher (1972) found it at DSDP Site 105. According to Michael (1967) it is also known from Northwest Germany. The total range is upper Hauterivian to lower Aptian. Van Hinte (1976) restricts the species to the upper Hauterivian. Also known (sub G. kugleri) from the Neocomian (?) Valanginian-Aptian of the Scotti Shelf (Gradstein et al., 1975; P. Ascoli, personal communication).

Globigerinelloides blowi (Bolli)

(Plate 9, Figures 5-8)


First described as Planomalina blowi Bolli from the Aptian Leypoldina protuberans Zone, Cuche Formation, Trinidad (Bolli, 1959). Moullade’s (1966) description and figures are particularly close to our specimens. Type specimens of the species in the USNM, Washington, have a more lobate periphery with deeper incised sutures. The stratigraphic range is given as G. blowi to G. algerianus zones (Aptian; van Hinte, 1976)—only found in Sample 390-5, CC assigned to the lower Aptian G. blowi Zone.

Globigerinelloides ferreolensis (Moullade)

(Plate 9, Figures 1-4; Plate 10, Figures 14-17)

Bitticella ferreolensis Moullade, 1961, Rev. Micropal., v. 3, no. 4, p. 214, pl. 1, fig. 1-5.


Common at Sites 390 and 392 (G. algerianus Zone). Specimens have 7-8 chambers in the last whorl; the chamber shape is spherical to slightly ovate; test outline varies from roughly circular to somewhat elliptical. There is a tendency to a “Biglobigerinella” stage in three out of the several dozen specimens examined. The morphology is similar to that of the original figures and description of G. ferreolensis by Moullade (1966). Moullade defines the species as having 7-9 chambers in the last whorl with slightly ovate chambers which increase but slowly in size and with a tendency to a “Biglobigerinellid” stage.

From the original descriptions of G. ferreolensis and G. barrti the two species seem to overlap morphologically. G. barri has 8-10 ovate
to nearly circular chambers, circular test outline (Bolli, Loeblich, and Tappan, 1957, p. 25, pl. 1, fig. 13-18b) or globular chambers with common "Biglobigerinellid" stage (Longoria, 1974). Longoria restricts *G. ferreolensis* to specimens with 7-9 globular chambers, ovate test outline, and no paired final chamber.

**Globigerinelloides aff. saundersi** (Bolli)  
(Plate 10, Figure 4)


**Globigerinelloides saundersi** (Bolli), Longoria, 1974, Rev. Esp. Micropal. num. extra., p. 88, 89, pl. 3, fig. 2, 6-12; pl. 9, figs. 8, 9.

Three specimens in Sample 392A-2, CC, (CSS. cabri) - G. algerianus Zone, which have 6-8 rather than 4-6 chambers in the last whorl as defined by Bolli (1959); see also Longoria, 1974.

**Hedbergella amabilis** Loeblich and Tappan  
(Plate 11, Figures 11-13)


Flat trochospire, open umbilicus; smooth-walled, finely perforate chambers laterally somewhat flattened; sutures distinct, often constricted, giving rise to strongly lobate periphery; usually 6, rarely 5 or 7 chambers in the last whorl; last chambers often elongated. In the Blake Nose specimens there is a variation of specimens with little elongation of the last chamber to much elongated last chamber(s). Specimens transitional between *H. amabilis* and *H. planispira* (Tappan) are also present. Loeblich and Tappan (1961) reported this species from Cenomanian sediments in submarine Core A167-25 from the Blake Plateau. Pessagno (1967) gives a range from Cenomanian to Barremian. Pessagno (1967; see also Bolli, 1966) and Tappan (1940; sub *G. planispira*) visit to the USNM, Washington, I compared specimens to the holotype and paratypes by Tappan (1940; sub *G. planispira*).

**Hedbergella planispira** (Tappan)  
(Plate 11, Figures 14-16)

*Globigerina planispira* Tappan, 1940, J. Paleontol., v. 14, no. 2, p. 122, pl. 19, fig. 12.

**Hedbergella planispira** (Tappan), Longoria, 1974, Rev. Esp. Micropal. num. extra., p. 64-65, pl. 11, fig. 4-16; pl. 20, fig. 4; pl. 23, fig. 1-7, 11-13, 17-18; pl. 24, fig. 10.

Outline circular to slightly oval; the few whorls occur in a flat coil; mostly 6 to 8 chambers in the last whorl; chambers of subglobular to globular shape, increasing slowly in size; wide umbilicus. During a visit to the USNM, Washington, I compared specimens to the holotype and paratypes by Tappan (1940; sub *Globigerina planispira*) from the Smoky Mountain Formation, Texas, to hypotypes from the Duck Creek Formation (Tappan, 1943) and to *Praeglotruncana planispira* (Tappan) and *Praeglotruncana modesta* Bolli (= *H. planispira*, see Loeblich and Tappan, 1961, p. 20) from the Mardide Formation, Trinidad (Bolli, 1959).

Conocanarian *H. trocoidea* (Gandolfi) identified by Loeblich and Tappan (1961) from submarine Core A167-25 on the Blake Plateau was incorporated in *H. planispira* by Pessagno (1967); see also Michael, 1972, p. 211.

**Hedbergella aff. trocoidea** (Gandolfi)  
(Plate 10, Figures 7, 8)

*Anomalina lorneiana* d'Orbigny var. *trocoidea* Gandolfi, 1942, Riv. Ital. Paleontol., v. 48, no. 4, p. 98, pl. 2, fig. 1; pl. 4, fig. 2, 3; pl. 13, fig. 2-5.

**Hedbergella trocoidea** (Gandolfi) Longoria, 1974, Rev. Esp. Micropal. num. extra., p. 69-72, pl. 17, fig. 1-16; pl. 18, fig. 3-5.

Several specimens in Sample 390B-3, 80-82 cm (*Ticinella primula* zone) which resemble the species *sansident* as found in large numbers in the *Globigerinelloides algerianus* Zone in Holes 390, 392A. However, the specimens lack the densely pustulose, beaded wall and have more constricted sutures.

**Epistomina chapmani Ten Dam**  
(Plate 8, Figures 3, 4)


A dozen or more specimens of a smooth-walled *Epistomina* occur in Hole 392 in the *Ticinella primula-T. brevissima* Zones. The umbilical side is more convex than the spiral side, there are 5-6 chambers in the last whorl. Three specimens are round in outline and keeled, the others are more lobate and non-keeled. Sutures are flush to slightly depressed and curved backward slightly; the chamber walls have a discontinuous pore pattern as often occurs in *E. supracretacea* Ten Dam and *E. elegans* (d'Orbigny). The dental apertures are discontinuous rather than continuous along the periphery as in *E. caracolla* and *E. supracretacea* (see Ohm, 1967) and close to the periphery. There is no umbo as is always present in *E. caracolla* (Roemer). The specimens are identified as *E. chapmani* Ten Dam known from the middle Barremian-Albian of Europe (incl. USSR) and California (Ohm, 1967; Dailey, 1973). The original description by Ten Dam mentions 8 chambers in the last whorl; Ohm illustrates specimens with 7 chambers. Pyritized specimens identified as *E. chapmani* by P. Ascoli from the Scotto Shelf Lower Cretaceous (P. Ascoli, personal communication) show a variation of 6-9 chambers in the last whorl.

**Epistomina cretosa Ten Dam**  
(Plate 8, Figures 5)

*Epistomina cretosa* Ten Dam, 1947, Geol. Mijnb., v. 8, no. 2, p. 29, fig. 6. Ohm, 1967, Palaeontographica, Bd. 127A, p. 148, pl. 20, fig. 2, text-fig. 43.

Known from upper Hauterivian through Albian strata (Ohm, 1967), but at the Blake Nose only found in Albian beds at Site 392. Grand Banks specimens from the Amoco IOE Puffin B-90 well (Jenkins et al., 1974) are less stoutly built and have less curved sutures than the ones from the Blake Nose.

**Epistomina ornata (Roemer)**  
(Plate 4, Figure 11)

*Planulina ornata* (Roemer), 1841, Kreidegebirge, p. 98, pi. 15, fig. 25. *Epistomina ornata* (Roemer), Ohm, 1967, Palaeontographica, Bd. 127A, p. 135, pl. 3, fig. 1-2; pl. 5, fig. 7.

The Blake Nose specimens in Hole 390, Core 6 (Barremian) compare well with the specimens of this species from the Cuche Formation, Trinidad present in the USNM, Washington (Bartenstein et al., 1957). Its range seems to be upper Valanginian-lower Barremian as first established in West German localities. In Trinidad it occurs as high as middle Barremian (see Bartenstein et al., 1957; Simon and Bartenstein, 1962; Ohm, 1967; Dailey, 1973). In the Canadian Atlantic Shelf it is used as a Neocomian-Barremian marker in the Verrill Canyon Formation (Gradstein et al., 1975).

**Gavelinella-Lingulogavelinella**

Eighteen samples in Holes 390, 390A, and 392A, belonging in the *G. barremiana* and *L. sigillata* to *T. brevissima* Zones (Barremian-upper Albian) contain rare to frequent occurrences of specimens of several taxa of *gavelinellids*; some of the *gavelinellids* have been assigned to genera and species described in the literature.
Gavelinella barremiana
(Plate 6, Figures 1-7)

Gavelinella barremiana Bettenstaedt, 1952, Senckenb., v. 33, p. 275, 276, pl. 2, fig. 26-29; Michael, 1966, Senckenb. Leth., v. 47, no. 5/6, p. 430-432, pl. 50, fig. 1-3.

In Samples 390-5, CC, 390-6-1, and 392A-4-1, 110-112 cm (G. barremiana-L. sigali Zone) species are relatively small (less than 250 µm in diameter) and mostly flat or slightly convex; the sutures curve backward; the apertural side is involute with a narrow, mostly open umbilicus; the spiral, aboral side is evolute. Many specimens have slender tongue-like apertural flaps reaching over the umbilical suture; these are faintly visible in Plate 6, Figures 14, 17. From a comparison with the detailed description by Michael (1966) the specimens clearly belong in Gavelinella barremiana Bettenstaedt. According to Michael (1966) (see also Bartenstein, 1976b), the species is cosmopolitan and ranges from middle-upper Barremian, with forms transitional to G. intermedia in lower Aptian. Van Hinte (1976) restricts the species to the Barremian. Also known from the Cuche Formation (Barremian) in Trinidad (Bartenstein et al., 1957) and the Scotian Shelf and Grand Banks (Gradstein et al., 1975) where it is used as a Barremian (-lower Aptian) marker.

**“Gavelinella”** sp. A-C, G. intermedia (Berthelin) and G. intermedia (Berthelin)-G. ammonoides (Reuss)

In 15 samples in Holes 390, 390A, and 392A, assigned to the G. blowi through T. breggiensis zones, gavelinellids which show considerable and rather continuous variation in morphology occur rarely to frequently.

Gavelinella intermedia (Berthelin) is probably one of the more common forms. Other closely related specimens show features of such recently proposed genera as Lingulogavelinella and Orithostella (sensu Eicher and Worstall, 1970; Scheibnerova, 1971, 1974).

Because of the wide, rather continuous variation and absence of clear stratigraphic trends in the forms observed. I do not deem it useful, in this preliminary account to split this group into formal taxa. Also, there is no common opinion on the ranking of characters (if possible at all) to define such genera as Gavelinella, Lingulogavelinella, and Orithostella (compare Michael, 1966; Malapris-Bizouard, 1967; Scheibnerova, 1971, 1974; and Eicher and Worstall, 1970) and on the species level there are many potential synonyms in European and American literature. For these reasons I prefer to describe the variation without drawing detailed taxonomic conclusions. In order to draw such conclusions, a comparison to types and variations of established taxa is desirable.

On the distribution chart of Figures 2 and 3, specimens of Gavelinella sp. A-C, G. intermedia, and G. intermedia-ammonoides have been referred to as “G.” intermedia group; data on distribution of individual members of this group are in the text.

Gavelinella sp. A
(Plate 5, Figures 1-7, 10-12)

Relatively large (up to 500 µm in diameter), low trochospiral, flat or low biconvex to plano- or concavoconvex specimens with 8-10 narrow chambers in the last whorl. Sutures curve strongly backward, and may be partially limbate, but more often are slightly depressed; chamber wall is coarsely perforated. The aboral side is partially to fully involute, and in the younger samples may show an imperforate boss; the oral side is more involute with a wide, shallow umbilicus; the aperture is a narrow slit at the base of the last chamber, reaching from over the subacute periphery to the relative involute (oral) side and continuing along the umbilical suture. Most specimens have distinct, tongue-like, apertural flaps which reach into the umbilicus and overlap each other in an imbricate manner, going backward along the suture; there is some variation in the shape and size of these flaps; the flaps are less perforate than the rest of the test or imperforate (Plate 5, Figure 4). Found in Sample 390-5-2, 60-62 cm (G. algerianus Zone) and 392A-2-1, 86-89 cm, 392A-2-2, 146-148 cm, 392A-2-3, 104-106 cm, 392A-2, CC, and 392A-3-1, 46-48 cm (T. primula and T. breggiensis zones).

Except for the larger size of the test, many of these specimens resemble G. barremiana as present in underlying samples which may have been ancestral to Gavelinella sp. A. Compare Plate 5, Figure 5 and Plate 6, Figure 17.

Gavelinella intermedia (Berthelin)
(Plate 6, Figures 5-13; Plate 7, Figure 13)


Gavelinella intermedia (Berthelin), Michael, 1966, Senckenb. Leth., v. 47, no. 5/6, p. 432-434, pl. 50, fig. 4-13.

Gavelinella sp. A Grade into a group of specimens with a more convex oral side and often less developed tongue-like imperfect flaps, specifically in those (small) specimens with limbate sutures. The aboral side may have an imperfectorate boss. These specimens compare with Gavelinella intermedia (Berthelin) as described by Michael (1966); see also Scheibnerova (1974). The taxon is most common in Sample 390-5-1, 87-89 cm, and also in 392A-2, CC, 392A-3-3, 50-52 cm (G. algerianus-T. breggiensis zones).

In Sample 390A-14-5, 119-121 cm and 390A-14, CC and also in 390-3, 80-82 cm (T. primula Zone). Many specimens assigned to the G. intermedia group are relatively tightly asymmetrically-coiled, and have a broadly rounded periphery (Plate 6, Figures 11, 12) and small apertural flaps (when visible).

Gavelinella sp. B
(Plate 5, Figure 8)

A third group present with rarely occurring individuals in Samples 390-5-1, 87-89 cm, 390-3, 80-82 cm, and possibly in 392A-3, CC (G. algerianus-T. breggiensis zones) shows a markedly flat to concave oral side, no limbate sutures and larger tongue-like flaps than Gavelinella sp. A. The flaps reach more than halfway along the chamber sutures, rarely observed in Gavelinella sp. A. The flaps are largely imperfectorate.

In 392A-3, CC some symmetrically biconvex specimens are possibly related to this form and resemble Orithostella indica Scheibnerova from the Albian of the Eastern Indian Ocean (DSDP Leg 27) (Scheibnerova, 1974).

Gavelinella sp. C
(Plate 7, Figures 14-16)

A fourth group, Gavelinella sp. C, is present in Samples 390A-14, CC, 392A-2-1, 84-86 cm, 392A-2-3, 80-82 cm, and 392A-3-1, 46-48 cm (T. primula Zone). All specimens (rare to common) have a flat to low convex, rather evolute, oral side and usually a fully involute and almost always more convex aboral side. The umbilicus is generally very narrow. Some specimens are strongly planoconvex. There is a limbate spiral suture; no distinct apertural flaps were observed. In the more planoconvex specimens the sutures are more curved backward, often with a sudden turn halfway. Gavelinella sp. C and more tightly coiled members of Gavelinella intermedia, as in Sample 390A-14, CC, may be the same taxon.

Gavelinella intermedia-ammonoides (Reuss)
(Plate 6, Figures 1-4)

In Samples 390-5-1, 87-89 cm, 390-3, CC, 392A-3-3, 104-106 cm, and 392A-3, CC (G. algerianus-T. breggiensis zones) there are rare, fairly small Gavelinella-type specimens in which the younger chambers of the last whorl increase considerably in width. The test is asymmetrically-symmetrically biconvex, with the spiral side often flatter. The aperture occurs on the umbilical side with a narrow lip. The umbilicus is narrow.

The specimens tend to G. ammonoides (Reuss) which according to Michael (1966) originated from G. intermedia in middle Albian time. Variants of G. barremiana and G. intermedia resembling G. ammonoides, also occur stratigraphically lower. In Samples 390-5-1, 87-89 cm and 392A-3, CC the specimens intergrade with G. intermedia.

G. ammonoides occurs in the middle Albian-Turonian of Europe (Michael, 1966). Bartenstein and Bolli (1973) list it as probably present in upper Aptian-lower Albian beds in Trinidad.

Lingulogavelinella ciryi Malapris-Bizouard
(Plate 5, Figures 9, 13-17)

Lingulogavelinella ciryi ciryi Malapris-Bizouard, 1967, Rev. Micropal., v. 10, no. 2, p. 137, 138, pl. 1, fig. 16-19; pl. 2, fig. 16-20.
In Samples 392A-2, 146-148 cm and 392A-3, 46-48 cm (T. primula-T. breggizensis zones) there are some specimens of a tiny gavelinellid (less than 300 μm in diameter) which differ from other gavelinellids in the samples by its small size, low asymmetrically biconvex test, and rounded periphery. It has 7-8 chambers in the last whorl. Two specimens from the lower sigmoid portions in the last chambers (Plate 5, Figure 14). Imperforate apertural flaps, which may be triangular in shape (Plate 5, Figure 13) are well developed.

From the detailed description by Malapris-Bizouard (1967) we may be dealing with Lingulogavelinella cyma known from the Albian (including Variscan) of France and also mentioned by Maync (1973) in Albian beds in DSDP Site 120 on Gorringer Bank, North Atlantic Ocean.

Plexus of Gaudryina dividens Grabert-Spiroplectinata lata Grabert (Plate 2, Figures 1-18)

Gaudryina dividens Grabert, 1959, Abb. Senckenb. Naturf., Ges. 498, p. 9-11, pl. 1, fig. 35; pl. 2, fig. 16-30; pl. 3, fig. 53-59.

Gaudryina dividens var. compacta Grabert, 1959, Abb. Senckenb. Naturf., Ges. 498, p. 11, pl. 1, fig. 6-8; pl. 3, fig. 48-52.


Spiroplectinata lata Grabert, 1959, Abb. Senckenb. Naturf., Ges. 498, p. 16, pl. 1, fig. 9, pl. 2, fig. 31-35; pl. 3, fig. 60-76.

In the Blake Nose samples belonging to the G. algerianus-T. primula zones (upper Aptian-middle Albian) rare to frequent Gaudryina and Spiroplectinata occur which are widely varied in morphology and in size. Tests are triserial, triserial-biserial, or triserial-biserial-uniserial, the triserial portion, which is triangular in outline, may be greatly shortened and its sides may be strongly depressed. The biserial portion is also of variable length and may be roughly triangular to trapezoidal or rectangular, with parallel margins or strongly flattened and with diverging margins (flabelliform). Some specimens, especially in Sample 392A-3, CC have more rounded biserial chambers. Chambers of a uniserial part of the test are rounded in outline; the aperture is terminal in the form of a small, elongate or “circular” opening. The wall is composed of minute carbonate particles, including many nanofossils (Plate 2, Figure 3); there are scattered, relatively large pores in the wall. The USNM types in Washington and description of Gaudryina subcristata Cushman and G. alexandra Cushman from the upper Cretaceous, Buck Creek Formation (Texas, Oklahoma) do not fully compare with the Blake Nose specimens. G. subcristata has a more flattened, triserial portion (see also Tappan, 1943, p. 490, pl. 78, fig. 28, 29) and might be a stunted and diagenetically flattened G. alexandra. G. alexandra differs from the Blake Nose specimens because of its more pronounced and sharper triserial and biserial periphery (see also Grabert, 1959, p. 10, 11, 45, 46).

From the detailed description and illustrations by Grabert, 1959 (see also Simon and Bartenstein, 1962, p. 285, 286) the Blake Nose specimens fall within the plexus of Gaudryina dividens-Spiroplectinata of Aptian-Albian age. This plexus, which in northwestern Europe includes several Gaudryina and Spiroplectinata species, shows a strong reduction of the triserial part through time and a progressive increase in the flat biserial stage of the test.

From a comparison to the literature, the Blake Nose specimens may be compared with G. dividens. The Blake Nose specimens differ from the Blake Nose specimens because of its more pronounced and sharper triserial and biserial portions (Plate 2, Figures 9-13, 16-18) in Gaudryina dividens Grabert. Specimens with less reduced triserial and biserial portions (Plate 2, Figures 12, 13) have been described by Grabert (1959) as the variant G. compacta. Some specimens, especially in Samples 392A-3, CC and in 390-5-1, 87-89 cm (both upper Aptian) have more rounded biserial chambers and resemble G. reicheli Bartenstein, Bettenstaedt, and Bolli (Plate 2, Figures 14, 15) from the Aptian-lower Albian of Trinidad and possibly California (cf. Spiroplectinata californica Dailey; see Bartenstein et al., 1966; Bartenstein and Bolli, 1973; Dailey, 1970, 1973). Isolated specimens in Sample 392A-3, 46-48 cm (T. primula Zone, middle Albian) and over one hundred specimens in Samples 390-5-1, 87-89, 392A-3, 50-53 cm and 392A-3, CC (all belonging in the upper Aptian [S. lata], G. alexandra) possess a strongly reduced triserial, depressed triangular test, and an often long biserial part with moderately to strongly flattened chambers much wider than high and rarely a uniserial test portion (Plate 2, Figures 1-8). Such specimens belong in Spiroplectinata and have been identified as S. lata, first described by Grabert from the lower-middle Albian of Germany (see also Simon and Bartenstein, 1962, p. 285, 286) the Blake Nose Spiroplectinata lata species are readily separable from Gaudryina type one, with few transitional individuals.

Table 2, shows, in descending stratigraphic order, the number of specimens of this Gaudryina-Spiroplectinata plexus per sample at Site 390 (Holes 390, 390A) with triserial, triserial-biserial, or triserial-biserial-uniserial tests. The tabulation does not show a trend in time toward reduction of the triserial part, or an increase in the length of the biserial portion (Grabert, 1959).

In order to arrive at a more meaningful phylogenetic analysis, we need to eliminate the ontogenetic effect on the test-building plan. This requires more material so that we can analyze the phylogenetic trend on specimens which have reached a certain ontogenetic stage.

Table 3 shows the stratigraphic distribution of the four taxa recognized in the Blake Nose sites. It fails to show the postulated trend in time of Gaudryina (G. -Spiroplectinata (S.).

**Table 2**

| Number of Specimens of the Gaudryina-Spiroplectinata Plexus per Sample in Holes 390 and 390A |
|---|---|---|---|---|
| Comments | Sample (interval in cm) | Triserial | Triserial-Biserial | Biserial-Universal | Total |
| 1-3 birelial pairs | 390A-14-5, 119-121 | 7 | 21 | 4 | 32 |
| 1 specimen strongly flattened bialerial pair and reduced triserial pair | 390A-14, CC | 3 | 10 | 3 | 16 |
| 1-5 birelial pairs | 390-3-3, 80-82 | 8 | 27 | 2 | 37 |
| 390-3, CC | 3 | 10 | 14 |
| 390-4, CC | 4 | 3 | 7 |
| 390-4, CC | 2 | 1 | 2 |
| 1-7 pairs birelial, relatively flat, reduced triserial pair | 390-51, 87-89 | 3 | 40 | 5 | 48 |
| 3 specimens strongly flattened bialerial pairs and reduced triserial pair | 390-52, 60-62 | 1 | 1 |

**Table 3**

| Stratigraphic Distribution of the Four Taxa Recognized From Holes 390 and 390A (Blake Nose) |
|---|---|---|---|
| Sample | Location | Taxa | |
| 390-3-3, 80-82 cm | Middle Albian | G. dividens var. lata | |
| 390-3, CC | Middle Albian | G. dividens | |
| 390-4, CC, 75-77 cm | Middle Albian | G. dividens var. lata | |
| 390-4, CC | Middle Albian | G. dividens | |
| 390A-14, 119-121 cm | Middle Albian | G. dividens, G. dividens var. compacta* | |
| 390A-14, CC | Middle Albian | G. dividens* | |
| 390A-2-1, 84-86 cm | Middle Albian | G. dividens | |
| 390A-2-2, 146-148 cm | Middle Albian | G. dividens var. compacta | |
| 390A-3, 146-48 | Middle Albian | G. dividens* S. lata | |
| 390A-3, 50-52 cm | Upper Aptian | G. dividens, G. dividens var. reicheli | |
| 390A-3, CC | Upper Aptian | S. lata, G. dividens var. reicheli | |

Note: If more than one species occurs in sample, the predominate taxon is marked with an asterisk.
The presence of more *S. lata*-type specimens in the upper Aptian than in the Albian deposits suggests that the phylogenetic trend of *Gaudryina* divides to *Spiroplectinata* spp. is more complicated than previously suggested. More detailed study, including a direct comparison to material from northwestern European localities, is desirable.

**Lenticulina (Planularia) crepidularis** (Roemer)

(Plate 4, Figure 9; Plate 1, Figure 12)

**Planularia crepidularis** N. Roemer, 1842, Neue Kreide-Form., p. 273, pl. 78, fig. 4.

**Lenticulina (Astacolus) crepidularis** (Roemer), Bartenstein, Bettenstaedt, and Bolli, 1957, Eclog. Geol. Helv., v. 50, p. 29, 30, pl. 3, fig. 55, pl. 4, fig. 82, 83.

This species is cosmopolitan and long-ranging, but locally more common in the upper Valanginian-lower Barremian sediments (Simon and Bartenstein, 1962). It is also known from the Cuche Formation in Trinidad (Bartenstein et al., 1957) stratigraphically not higher than Barremian and on the Canadian Atlantic Shelf in the Verrill Canyon Formation where it is used as a Neocomian marker (Gradstein et al., 1975). At Sites 390, 391, and 392, it only occurs in the Barremian Zone of *G. barremiana-L. sigali*.

**Lenticulina ex. gr. ouachensis** Sigal

(Plate 4, Figures 4, 8):


**Lenticulina (Lenticulina) ouachensis ouachensis** (Sigal), Bartenstein, Bettenstaedt, and Bolli, 1957, Eclog. Geol. Helv., v. 59, no. 1, p. 25, 26, pl. 3, fig. 50; pl 4, fig. 71, 76.

This includes a few specimens in the zones of *G. barremiana/L. sigali* and *G. breggiensis* (Barremian-lower Aptian) which show some variation in the extent of the umbilical collar. Specimens with a wide umbilical collar compare to specimens of *L. ouachensis-ouachensis* in the USNM, Washington, from the Cuche Formation, Trinidad (Bartenstein et al., 1957). The cosmopolitan species with its subspecies occurs in Valanginian to Aptian beds (Simon and Bartenstein, 1962; Sigal, 1965; Moullade, 1966; Dailey, 1973; Luterbacher, 1975). It has also been found at DSDP Sites 120 on Gorging Bank off Portugal (Maync, 1973), 105, Hatteras Abyssal Plain (Luterbacher, 1972), and from the Canadian Atlantic Shelf (Gradstein et al., 1975).

**(Marginulopsis) sigali** Bartenstein, Bettenstaedt, and Bolli

(Plate 4, Figures 5-7)


**Lenticulina (Marginulopsis) sigali** Bartenstein, Bettenstaedt, and Bolli, 1957, Eclog. Geol. Helv., v. 57, no. 1, p. 32, 33, pl. 5, fig. 99; pl. 6, fig. 130, 121c.

An easily recognizable species which occurs in small numbers in Sites 390 and 392 where it defines the Barremian zone of *G. barremiana-L. (M.) sigali*. A paratype of this species in the USNM, Washington, from the Cuche Formation, Trinidad (Bartenstein et al., 1957) is very similar to some of the more slender specimens in Sample 390-4-2 75-77 cm, rather flat instead of planoconvex specimens with a lobate rather than a more circular outline and with flaring chambers also occur (Plate 7, Figure 9).

From the figures and description of Osangularia sp. aff. brotzeni (Gandolfi) in Moullade (1966), the form and *O. utaturensis* might be the same species. Moullade (1966) gives a range for O. sp. aff. brotzeni from uppermost Aptian-middle Albian in the “Fosse vocontienne,” southeast France. On the Blake Nose at Sites 390 and 392 *O. utaturensis* occurs in the G. algerianus-T. breggiensis zones (upper Aptian-upper Albian). It is especially common in the Blake Nose Albian strata.

**Osangularia insigna** Dailey

(Plate 7, Figures 1-4)


**O. insigna secunda** Dailey, 1970, Ibid., p. 109, fig. 14, fig. 2.

Specimens assigned to this species (incl. *O. insigna secunda*) are mostly about half the size of *O. utaturensis*. Diagnostic features are mostly symmetrical biconvex test, the large umbilical boss and the weakly curved sutures. There are 10-12 chambers in the last whorl. Dailey (1970) describes the species from the upper Albian-Cenomanian of California (Budden Canyon Formation). In Hole 392A, Blake Nose, it ranges through the zones of *T. primula-T. breggiensis* (middle-upper Albian).

**Orthokarstenia shastaensis** Dailey

(Plate 3, Figures 1-4)


**Test elongate; short initial triserial part is followed by one pair of biserial chambers in turn followed by up to five uniserial chambers which slowly increase in size; sutures are constricted; the calcareous perforate wall is finely spinose to papillate except often along the sutures which are smooth. The aperture is a rounded or elliptical opening on a short neck.**

Dailey (1970) mentions the absence of a tooth plate, but assumes this to be a result of poor preservation. The Blake Nose specimens also lack a clear tooth plate, but in the aperture, remnants of some kind of tooth-like structure seem present (Plate 3, Figures 3, 4). The Blake Nose specimens differ from the ones in the Budden Canyon Formation in having a finely spinose to papillate, rather than smooth to papillate wall; but this difference may relate to preservation.

Bartenstein and Bolli (1973, p. 414) erroneously place *O. shastaensis* in synonymy of *Bigenerina clavellata* Loeblich and Tappan. The species also occurs in Trinidad (H. Bartenstein, personal communication).

In California, *O. shastaensis* is known from the Aptian through Cenomanian sediments and on the Blake Nose in the middle-upper Albian zones of *T. primula-T. breggiensis*.
This smooth *Reinholdella* species was first described from the Budden Canyon Formation, California where it ranges from Aptian through Conocambian (Dailey, 1970). Barstenstein and Bolli (1973, p. 415) state that *Conomorphus bulgaricus* Barstenstein, Battenstaedt, and Kovatcheva from the Barremian of Bulgaria may be closely related. On the Blake Nose, *R. ultima* occurs in the middle-upper Albian zones of *T. primula-T. breggiensis*.

**REFERENCES**


Saito, T., Burkle, L.H., and Hays, J.D., 1974. Implications of some pre-Quaternary sediment cores and dredgings. In


PLATE 1
Hole 391C

Figure 1  *Plectorecurvoides* sp.; 391C-5, CC; *Plectorecurvoides* assemblage. The biserial coil is vaguely visible in the last chamber pair. ×150.

Figure 2  *Plectorecurvoides* sp.; 391C-5, CC; *Plectorecurvoides* assemblage. ×150.

Figure 3  *Trochammina* sp.; 391C-8, CC; *Plectorecurvoides* assemblage. ×112.

Figure 4  *Trochammina globigeriniformis* (Parker and Jones) 391C-8, CC; *Plectorecurvoides* assemblage. ×200.

Figure 5  *Bolivinopsis* sp.; 391C-5, CC; *Plectorecurvoides* assemblage. ×250.

Figure 6  *Glomospira* sp.; 391C-6, CC; *Plectorecurvoides* assemblage. ×145.

Figure 7  *Uvigerammina* sp.; 391C-5, CC; *Plectorecurvoides* assemblage. ×200.

Figure 8  *Glomospirella* sp.; 391C-6, CC; *Plectorecurvoides* assemblage. ×100.

Figure 9  *Gavelinella intermedia* (Berthelin); 390A-14, CC; 66-68 cm; *G. barremiana-L. sigali* Zone. ×225.

Figure 10  *Gavelinella barremiana* Bettenstaedt; 391C-14-3, 66-68 cm; *G. barremiana-L. sigali* Zone. ×250.

Figure 11  *Hedbergella sigali* Mouliade; 391C-14-3, 66-68 cm; *G. barremiana-L. sigali* Zone. ×350.

Figure 12  *Lenticulina crepidularis* (Roemer); 391C-14-3, 66-68 cm; *G. barremiana-L. sigali* Zone. ×250.

Figure 13  *Dorothia praehauteriviana* Dieni and Massari (small triserial stage only); 391C-26-3, 60-62 cm; *Dorothia praehauteriviana* assemblage. ×250.

Figure 14  *Dorothia praehauteriviana* Dieni and Massari; 391C-26-3, 60-62 cm; *Dorothia praehauteriviana* assemblage. ×70.

Figure 15  *Conorboides hofkeri* (Bartenstein and Brand); 391C-26-3, 60-62 cm; *Dorothia praehauteriviana* assemblage (pseudo-arenaceous appearance due to pyritization of test). ×300.

Figure 16  *Lenticulina ex gr. nodosa* (Reuss); 391C-26-3, 60-62 cm; *Dorothia praehauteriviana* assemblage. ×60.
PLATE 2

Group of *Gaudryina dividens* Grabert at Sites 390, 392

Figure 1  
*Spiroplectinata lata* Grabert; 390-5-1, 87-89 cm; *Globigerinelloides algerianus* Zone. ×70.

Figure 2  
*Spiroplectinata lata* Grabert; 390-5-1; 87-89 cm; *Globigerinelloides algerianus* Zone. ×67.

Figure 3  
Carbonate particles, including nannofossils, are the building material of *Spiroplectinata lata* Grabert and other taxa in the group of *Gaudryina dividens* Grabert (detail of Figure 2). ×625.

Figure 4  
*Spiroplectinata lata* Grabert; 390A-3-3, 50-52 cm; *Globigerinelloides algerianus* Zone. ×80.

Figure 5  
*Spiroplectinata lata* Grabert; 390A-3-1, 46-48 cm; *Ticinella primula* Zone. ×130.

Figure 6  
*Spiroplectinata lata* Grabert; 392A-3-1; 50-52 cm; *Globigerinelloides algerianus* Zone. ×50.

Figure 7  
*Spiroplectinata lata* Grabert; 392A-3-3, 50-52 cm; *Globigerinoides algerianus* Zone. ×57.

Figure 8  
*Gaudryina dividens* Grabert; 390A-14-5, 119-121 cm; *Ticinella primula* Zone. ×185.

Figure 9  
*Gaudryina dividens* Grabert; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×55.

Figure 10  
*Gaudryina dividens* Grabert; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×55.

Figure 11  
*Gaudryina dividens* Grabert var. *compacta* Grabert; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×55.

Figure 12  
*Gaudryina dividens* Grabert var. *reicheli* Bartenstein, Bettenstaedt and Bolli; 390-5-1, 87-89 cm; *Globigerinelloides algerianus* Zone. ×55.

Figure 13  
*Gaudryina dividens* Grabert var. *reicheli* Bartenstein, Bettenstaedt and Bolli; 392A-3, 50-52 cm; *Ticinella primula* Zone. ×55.

Figure 14  
*Gaudryina dividens* Grabert var. *reicheli* Bartenstein, Bettenstaedt and Bolli; 390-5-1, 87-89 cm; *Globigerinelloides algerianus* Zone. ×60.

Figure 15  
*Gaudryina dividens* Grabert var. *reicheli* Bartenstein, Bettenstaedt and Bolli; 392A-3, 50-52 cm; *Ticinella primula* Zone. ×60.

Figure 16  
*Gaudryina dividens* Grabert; 392A-3-1, 46-48 cm; *Ticinella primula* Zone. ×110.

Figure 17  
*Gaudryina dividens* Grabert; 390A-14-5, 119-121 cm; *Ticinella primula* Zone. ×50.

Figure 18  
*Gaudryina dividens* Grabert; 392A-3-1, 46-48 cm; *Ticinella primula* Zone. ×60.
PLATE 3
Sites 390, 392

Figure 1  Orthokarstenia shastaensis Dailey; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×110.

Figure 2  Orthokarstenia shastaensis Dailey; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×110.

Figure 3  Orthokarstenia shastaensis Dailey; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×110.

Figure 4  Orthokarstenia shastaensis Dailey, a detail of aperture in earlier chamber; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×325.

Figure 5  Pleurostomella obtusa Berthelin; 390-3-3, 80-82 cm; Ticinella primula Zone. ×100.

Figure 6  Pleurostomella obtusa Berthelin; 390-3-3, 80-82 cm; Ticinella primula Zone. ×100.

Figures 7, 8  Pleurostomella obtusa Berthelin; 390-3-3, 80-82 cm; Ticinella primula Zone. ×50. (Figure 7; details of aperture of specimen in Figure 8. ×250.)

Figure 9  Dentalina debilis (Berthelin); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×60.

Figure 10  Tristix excavatus (Reuss); 390-3-3, 80-82 cm; Ticinella primula Zone. ×65.

Figure 11  Pleurostomella obtusa Berthelin; 390-3-3, 80-82 cm; Ticinella primula Zone. ×220.

Figure 12  Dorothia trochus (d'Orbigny); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×100.

Figure 13  Dorothia sp.; 390-3-3, 80-82 cm; Ticinella primula Zone. ×90.

Figure 14  Dorothia gradata (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×65.

Figure 15  Dorothia gradata (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×65.

Figure 16  Dorothia gradata (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×65.

Figure 17  Dorothia gradata (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×65.
Figure 1  
*Lenticulina vocontiana* Moullade; 392A-3-3, 50-52 cm; *Globigerinelloides algerianus* Zone. ×90.

Figure 2  
*Lenticulina meridiana* Bartenstein, Bettenstaedt, and Kovatcheva; 392A-4-1, 110-112 cm; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×55.

Figure 3  
*Lenticulina turgidula* (Reuss); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×75.

Figure 4  
*Lenticulina* ex. gr. *ouachensis* (Sigal); 392A-4-1, 110-112 cm; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×87.

Figure 5  
*Lenticulina (Marginulopsis) sigali* Bartenstein, Bettenstaedt, and Bolli; 390-6, CC, *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×100.

Figure 6  
*Lenticulina (Marginulopsis) sigali* Bartenstein, Bettenstaedt, and Bolli; 392A-4-1, 110-112 cm; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×100.

Figure 7  
*Lenticulina (Marginulopsis) sigali* Bartenstein, Bettenstaedt, and Bolli; 392A-4, CC; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×100.

Figure 8  
*Lenticulina* ex. gr. *ouachensis* Sigal; 392A-4-1, 110-112 cm; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×80.

Figure 9  
*Lenticulina crepidularis* (Roemer); 390-6, CC; *Gavelinellina barremiana-Lenticulina (M.) sigali* Zone. ×80.

Figure 10  
*Lenticulina* ex. gr. *nodosa* (Reuss); 392A-4, CC; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×80.

Figure 11  
*Epistomina ornata* (Roemer); 390-6, CC; *Gavelinella barremiana-Lenticulina (M.) sigali* Zone. ×80.
PLATE 5

Gavelinellids at Sites 390, 392

Figure 1  
Gavelinella sp. A (spiral view); 390-5-2, 60-62 cm; 
Globigerinelloides algerianus Zone. ×90.

Figures 2, 3  
Gavelinella sp. A; 390-5-2, 60-62 cm; 
Globigerinelloides algerianus Zone. ×90.

Figure 4  
Tongue-like flaps which cover the umbilicus in an 
imbricate manner in Gavelinella sp. A. Detail of 
Figure 3. ×350.

Figure 5  
Gavelinella sp. A (small, concavo-convex; 
reminiscent of G. barremiana Bettenstaedt); 392A- 
2-3, 104-106 cm; Ticinella breggiensis Zone. ×157.

Figures 6, 7  
Gavelinella sp. A; 392A-2-3, 104-106 cm; Ticinella 
breggiensis Zone. ×135.

Figure 8  
Gavelinella sp. B (?Orithostella); 390-5-1, 87-89 cm; 
Globigerinelloides algerianus Zone. ×110.

Figure 9  
Tongue-like flaps which form an imbricate 
umbilical cover in Lingulogavelinella ciryi Malapris-Bizouard. Detail of Figure 13. ×500.

Figures 10, 11  
Gavelinella sp. A (transitional to G. intermedia 
Berthelin); 392A-2-3, 104-106 cm; Ticinella 
breggiensis Zone. ×100.

Figure 12  
Gavelinella sp. A (spiral view); 392A-2-3, 104-106 
cm; Ticinella breggiensis Zone. ×100.

Figures 13, 14  
Lingulogavelinella ciryi Malapris-Bizouard; 392A- 
2-2, 146-148 cm; Ticinella breggiensis Zone. ×115.

Figure 15  
Lingulogavelinella ciryi Malapris-Bizouard (note 
crenulate sutures and vague umbilical flaps); 
392A-2-2, 146-148 cm; Ticinella breggiensis Zone. 
×150.

Figures 16, 17  
Lingulogavelinella ciryi Malapris-Bizouard; 390-3- 
3, 80-82 cm; Ticinella primula Zone. ×115.
PLATE 6
Gavelinellids at Sites 390, 392

Figures 1, 2  Gavelinella intermedia (Berthelin)-Gavelinella ammonoides (Reuss); 390-3, CC; Ticinella primula Zone. ×120.

Figure 3  Gavelinella intermedia (Berthelin)-Gavelinella ammonoides (Reuss); 392A-3, CC; (?Schackoina cabri-) Globigerinelloides algerianus Zone. ×130.

Figure 4  Gavelinella intermedia (Berthelin)-Gavelinella ammonoides (Reuss); 392A-3, CC; (?Schackoina cabri-) Globigerinelloides algerianus Zone. ×150.

Figures 5, 6  Gavelinella intermedia (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×90.

Figure 7  Gavelinella intermedia (Berthelin); 390A-14, CC; Ticinella primula Zone. ×135.

Figure 8  Gavelinella intermedia (Berthelin); 390A-14-5, 119-121 cm; Ticinella primula Zone. ×112.

Figures 9, 10  Gavelinella intermedia (Berthelin); 392A-3, CC; (?Schackoina cabri-) Globigerinelloides algerianus Zone. ×135.

Figures 11, 12  Gavelinella intermedia (Berthelin); 390-3-3, 80-82 cm; Ticinella primula Zone. ×75.

Figure 13  Gavelinella intermedia (Berthelin); 390-5-1, 87-89 cm; Globigerinelloides algerianus Zone. ×110.

Figure 14  Gavelinella barremiana (Bettenstaedt) (Note the flap on the last chamber reaching over the umbilicus.); 392A-4, CC; Gavelinella barremiana-Lenticulina (M.) sigali Zone. ×235.

Figure 15  Gavelinella barremiana (Bettenstaedt) (spiral view); 390-5, CC; Globigerinelloides blowi Zone. ×260.

Figures 16, 17  Gavelinella barremiana (Bettenstaedt); 390-5, CC; Globigerinelloides blowi Zone. ×260.
PLATE 7
Sites 390, 392

Figures 1, 2 Osangularia insigna Dailey; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×125.

Figure 3 Osangularia insigna Dailey; 392A-2-3, 104-106 cm; Ticinella breggiensis Zone. ×195.

Figure 4 Osangularia insigna Dailey; 392A-2-3, 104-106 cm; Ticinella breggiensis Zone. ×130.

Figures 5, 6 Osangularia utaturensis (Sastri and Sastry); 390-3-3, 80-82 cm; Ticinella primula Zone. ×100.

Figures 7, 8 Osangularia utaturensis (Sastri and Sastry); 390-3-3, 80-82 cm; Ticinella primula Zone. ×90.

Figure 9 Osangularia utaturensis (Sastri and Sastry); 390-4-2, 75-77 cm; Ticinella primula Zone. ×100.

Figures 10, 11 Osangularia utaturensis (Sastri and Sastry); 390-4-2, 75-77 cm; Ticinella primula Zone. ×112.

Figure 12 Osangularia utaturensis (Sastri and Sastry); 390-3-3, 80-82 cm; Ticinella primula Zone. ×112.

Figure 13 Gavelinella intermedia (Berthelin); 390A-14-5, 119-121 cm; Ticinella primula Zone. ×110.

Figure 14 Gavelinella sp. C; 392A-3-1, 46-48 cm; Ticinella primula Zone. ×92.

Figures 15, 16 Gavelinella sp. C; 392A-3-1, 46-48 cm; Ticinella primula Zone. ×92.
PLATE 8
Sites 390, 392

Figure 1  
Epistomina ex. gr. spinulifera (Reuss); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×67.

Figure 2  
Epistomina ex. gr. spinulifera (Reuss); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×27.

Figure 3  
Epistomina cretosa Ten Dam (spiral view); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×95.

Figure 4  
Epistomina cretosa Ten Dam (umbilical view); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×95.

Figure 5  
Epistomina chapmani Ten Dam; 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×85.

Figure 6  
Ceratolamarckina sp.; 392A-3-1, 46-48 cm; Ticinella primula Zone. ×160.

Figure 7  
Reinholdella ultima Dailey (umbilical view); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×87.

Figure 8  
Reinholdella ultima Dailey (spiral view); 392A-2-1, 84-86 cm; Ticinella breggiensis Zone. ×87.

Figures 9, 10  
Gyroidinoides primitiva Hofker; 390-3-3, 80-82 cm; Ticinella primula Zone. ×150.

Figure 11  
Valvulineria gracillima Ten Dam; 390-3-3, 80-82 cm; Ticinella primula Zone. ×140.

Figure 12  
Valvulineria gracillima Ten Dam; 390-3-3, 80-82 cm; Ticinella primula Zone. ×200.

Figure 13  
Conorotalites aptiensis (Bettenstaedt); 392A-4-1, 110-112 cm; G. barremiana-L. sigali Zone. ×115

Figures 14, 15  
Conorotalites aptiensis (Bettenstaedt); 390-3-3, 80-82 cm; Ticinella primula Zone. ×160.

Figures 16, 17  
Conorotalites aptiensis (Bettenstaedt); 392A-4-1, 110-112 cm; G. barremiana-L. sigali Zone. ×200.
PLATE 9
Sites 390, 392

Figure 1  Globigerinelloides ferreolensis (Moullade); 390-5-1, 87-89 cm; G. algerianus Zone. ×195.

Figure 2  Globigerinelloides ferreolensis (Moullade); 390-5-1, 87-89 cm; G. algerianus Zone. ×195.

Figures 3, 4 Detail of wall of G. ferreolensis (Moullade) in Plate 10, Figure 15, showing coating of test with carbonate particles, including nannoconid (enlarged in Figure 4) and other nannofossils. Respectively, ×500 and ×2250.

Figure 5  Globigerinelloides blowi (Bolli); 390-5, CC; G. blowi Zone. ×375.

Figure 6  Globigerinelloides blowi (Bolli); 390-5, CC; G. blowi Zone. ×275.

Figure 7  Globigerinelloides blowi (Bolli); 390-5, CC; G. blowi Zone. ×250.

Figure 8  Globigerinelloides blowi (Bolli); 390-5, CC; G. blowi Zone. ×250.

Figures 9, 10 “Globigerina” hoterivica Subbotina; 390-6-1; Gavelinella barremiana-Lenticulina (M.) sigali Zone. Respectively, ×155 and ×135.

Figures 11, 12 “Globigerina” hoterivica Subbotina; 390-6, CC; Gavelinella barremiana-Lenticulina (M.) sigali Zone. ×175.

Figure 13 “Globigerina” hoterivica Subbotina; 390-6, CC; Gavelinella barremiana-Lenticulina (M.) sigali Zone. ×175.

Figure 14 “Globigerina” hoterivica Subbotina; 390-6, CC; Gavelinella barremiana-Lenticulina (M.) sigali Zone. ×175.

Figure 15 “Globigerina” hoterivica Subbotina; 390-6, CC; Gavelinella barremiana-Lenticulina (M.) sigali Zone. ×175.

Figure 16 Praebulimina nannina (Tappan); 390-5, CC; Globigerinelloides blowi Zone. ×375.

Figure 17 Praebulimina nannina (Tappan); 390-5, CC; Globigerinelloides blowi Zone. ×375.
Figure 1  *Hedbergella delrioensis* (Carsey); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×250.

Figure 2  *Hedbergella delrioensis* (Carsey); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×250.

Figure 3  *Leupoldina pustulans* (Bolli); 392A-3, CC; (?*Schackoina cabri*) *Globigerinelloides algerianus* Zone. ×120.

Figure 4  *Globigerinelloides aff. saundersi* (Bolli); 392A-3, CC; (?*Schackoina cabri*) *Globigerinelloides algerianus* Zone. ×120.

Figure 5  *Hedbergella trocoidea* (Gandolfi); 390-5-1, 87-89 cm; *Globigerinelloides algerianus* Zone. ×75.

Figure 6  *Hedbergella trocoidea* (Gandolfi); 390-5-1, 87-89 cm; *Globigerinelloides algerianus* Zone. ×75.

Figure 7  *Hedbergella aff. trocoidea* (Gandolfi); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×150.

Figure 8  *Hedbergella aff. trocoidea* (Gandolfi); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×150.

Figures 9, 10  *Globigerinelloides algerianus* Cushman and Ten Dam; 390-5-1, 87-89 cm; *G. algerianus* Zone. ×80.

Figure 11  *Globigerinelloides algerianus* Cushman and Ten Dam; 390-5-1, 87-89 cm; *G. algerianus* Zone. ×80.

Figures 12, 13  *Globigerinelloides algerianus* Cushman and Ten Dam; 390-5-1, 87-89 cm; *G. algerianus* Zone. ×80.

Figure 14  *Globigerinelloides ferreolensis* (Moullade); 390-5-1, 87-89 cm; *G. algerianus* Zone. ×155.

Figure 15  *Globigerinelloides ferreolensis* (Moullade); 390-5-1, 87-89 cm; *G. algerianus* Zone. ×155.

Figure 16  *Globigerinelloides ferreolensis* (Moullade); 390-5-1, 87-89 cm; *G. algerianus* Zone. ×155.

Figure 17  *Globigerinelloides ferreolensis* (Moullade); 390-5-1, 87-89 cm; *G. algerianus* Zone. ×155.
Figure 1  *Ticinella breggiensis* (Gandolfi); 392A-2-1, 84-86 cm; *Ticinella breggiensis* Zone. ×125.

Figure 2 Specimen transitional between *Ticinella primula* Luterbacher and *Ticinella breggiensis* (Gandolfi); 392A-2-1, 84-86 cm; *Ticinella breggiensis* Zone. ×125.

Figure 3  *Ticinella primula* Luterbacher; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×200.

Figure 4  *Ticinella primula* Luterbacher; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×150.

Figures 5, 6  *Ticinella primula* Luterbacher; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×150.

Figures 7, 8  *Ticinella primula* Luterbacher; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×135.

Figures 9, 10  *Ticinella primula* Luterbacher; 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×135.

Figure 11  *Hedbergella amabilis* Loeblich and Tappan; 392A-2-1, 84-86 cm; *Ticinella breggiensis* Zone. ×135.

Figure 12  *Hedbergella amabilis* Loeblich and Tappan; 392A-2-1, 84-86 cm; *Ticinella breggiensis* Zone. ×135.

Figure 13  *Hedbergella amabilis* Loeblich and Tappan; 392A-2-1, 84-86 cm; *Ticinella breggiensis* Zone. ×135.

Figures 14, 15  *Hedbergella planispira* (Tappan); 390-3-3, 80-82 cm; *Ticinella primula* Zone. ×325.

Figure 16  *Hedbergella planispira* (Tappan); 392A-2-2, 146-148 cm; *Ticinella breggiensis* Zone. ×230.