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Calcareous nannoplankton zonation of Oligocene sections in Alabama (U.S.A.), on the islands of Trinidad and Barbados (W.I.), and the Blake Plateau (E coast of Florida, U.S.A.)

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with 3 figures in the text and 1 plate (I)

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ABSTRACT

Revised definitions of the three Oligocene nannoplankton zones, the *Ellipsolithus subdisticus* zone, the *Cyclococcolithus margaritae* zone, and the *Reticulofenestra laevis* zone, are given and the presence of these zones in sections on the Blake Plateau, in Alabama and on Barbados is shown. The new genus *Hayella* and two new species, *Hayella elegans* and *Cyclococcolithus bollii*, are described.

INTRODUCTION

Discoasters with a limited range are missing in the Oligocene. This must be the reason why this interval has received little study as far as the calcareous nannofossils are concerned. Oligocene sediments can hardly be divided into several zones with the light microscope. A detailed study of Oligocene nannofossils in the electron microscope made it possible to establish three zones in the Oligocene of JOIDES Hole 5 drilled on the Blake Plateau. ROTH and HAY (in HAY, MOHLER, ROTH, SCHMIDT, & BOUDREAUX, 1967) described 4 zones in the Oligocene of JOIDES Hole 5, but one of them (*Syracosphaera clathrata* zone) had to be abandoned later (ROTH, WORSLEY, WISE & HAY 1968) because *Syracosphaera clathrata* proved to have a longer range and made its first appearance already in the *Ellipsolithus subdisticus* zone.

The following three zones were established in JOIDES Hole 5 and found again in the Oligocene of Alabama.

Reticulofenestra laevis zone

Cyclococcolithus margaritae zone

Ellipsolithus subdisticus zone

The intervall formerly occupied by the *Syracosphaera clathrata* zone was added to the *Cyclococcolithus margaritae* zone.

The following samples were studied:
JOIDES Hole 5, Blake Plateau Florida

J 510, depth: 248' 9" below top	J 517, depth: 500' below top
J 509, depth: 260' 2" below top	J 502, depth: 519' 2" below top
J 508, depth: 303' 11" below top	J 516, depth: 530' below top
J 507, depth: 337' 11" below top	J 501, depth: 554' 10" below top
J 506, depth: 374' below top	J 515, depth: 589' 11" below top
J 505, depth: 410' below top	J 514, depth: 625' below top
J 519, depth: 429' 9" below top	J 513, depth: 657' 10" below top
J 504, depth: 445' below top	J 512, depth: 730' below top
J 518, depth: 460' 5 ¹ / ₂ " below top	J 511, depth: 800' below top
J 503, depth: 484' below top	

Alabama

Section at the Lone Star Cement Company Quarry, St. Stephens, Alabama, U.S.A.

Unnamed Clay member, between Glendon Limestone and Bucatunna Clay. A 100.

Marianna Limestone

A 853, 53' from the base	A 821, 21' from the base
A 848, 48' from the base	A 815, 15' from the base
A 843, 43' from the base	A 809, 9' from the base
A 839, 39' from the base	A 805, 5' from the base
A 833, 33' from the base	A 800, base of Marianna Limestone
A 827, 27' from the base	

Red Bluff Clay

A 613, 13' from the base
A 610, 10' from the base
A 608, 8' from the base
A 606, 6' from the base
A 604, 4' from the base
A 600, base of Red Bluff Formation

Barbados

Bath Cliff section

JS 1854 about 10' below top of upper section
JS 1856 near base of upper section
JS 1068 2' below top of middle section
JS 1858 in the middle of middle section
JS 1066 base of middle section.

REVISED DEFINITION OF THE ZONES

Ellipsolithus subdisticus zone

Definition: Interval from the last occurrence of *Discoaster barbadiensis* TAN SIN HOK to the first occurrence of *Cyclococcolithus margaritae* ROTH & HAY.

Authors: ROTH & HAY, 1967.

Type locality: JOIDES Hole 5, Lat. 30° 23' N, Long. 80° 08' W, Blake Plateau (J 512-J 501, most representative sample J 501, see fig. 1).

Common species: *Ellipsolithus subdisticus* ROTH & HAY, *Cruciplacolithus tarquinius* ROTH & HAY, *Coccolithus joensuui* ROTH & HAY, *Coronocyclus serratus* HAY, MOHLER & WADE, *Sphenolithus pacificus* MARTINI, *Coccolithus floridanus* ROTH & HAY, *Pyrocyclus hermosus* ROTH & HAY, *Coccolithus sarsiae* BLACK, *Coccolithus eopelagicus* (BRAMLETTE & RIEDEL), *Blackites amplius* ROTH & HAY, *Reticulofenestra gartneri* ROTH & HAY, *Isthmolithus recurvus* DEFLANDRE, *Coccolithus paralitos* ROTH & HAY, *Transversopontis zigzag* ROTH & HAY, *Cyclococcolithus formosus* KAMPTNER, *Ericsonia fenestrata* (DEFLANDRE), *Syracosphaera clathrata* ROTH & HAY, *Hayella elegans* n.sp., and (only at very top) *Cyclococcolithus bolii* n.sp.

Cyclococcolithus margaritae zone

Definition: Interval from the first occurrence of *Cyclococcolithus margaritae* ROTH & HAY to the first occurrence of *Reticulofenestra laevis* ROTH & HAY

Authors: ROTH & HAY, 1967.

Type locality: JOIDES Hole 5, Lat. 30° 23' N, Long. 80° 08' W, Blake Plateau (516–J 519, most representative samples: J 502; see Fig. 1)

Common species: Those of the *Ellipsolithus subdisticus* zone, less: *Coccolithus joensuui* ROTH & HAY, plus: *Cyclococcolithus margaritae* ROTH & HAY.

Remarks: *Isthmolithus recurvus* disappears in the lower part of this zone.

Reticulofenestra laevis zone

Definition: Interval from the first occurrence of *Reticulofenestra laevis* ROTH & HAY, to the first occurrence of *Discoaster saundersi* HAY.

Authors: ROTH & HAY, 1967.

Type locality: JOIDES Hole 5, Lat. 30° 23' N, Long. 80° 08' W Plateau (J 505–J 510, most representative sample: J 507, see Fig. 1).

Common species: Those of the *Cyclococcolithus margaritae* zone, less: *Cyclococcolithus margaritae* ROTH & HAY, *Isthmolithus recurvus* DEFLANDRE and *Cyclococcolithus bolii*, n.sp., plus: *Reticulofenestra laevis* ROTH & HAY and *Reticulofenestra insignita* ROTH & HAY.

REMARKS TO THE OLIGOCENE SECTIONS STUDIED

JOIDES Hole 5

The study of intermediate samples between the ones used for the original definition and of samples across the Eocene Oligocene boundary brought only minor changes. Some of the ranges are longer than those listed by ROTH & HAY (in HAY et al. 1967).

Syracosphaera clathrata first appears at the base of the *Ellipsolithus subdisticus* zone and disappears in the upper part of the *Reticulofenestra laevis* zone. *Cruciplacolithus tarquinius* can be found as high up as the *Reticulofenestra laevis* zone.

Alabama.

A complete section of the Gulf coast Oligocene was collected at the Lone Star Cement Company Quarry near St. Stephens Alabama and the calcareous nannoplankton was studied in the electron and light microscopes. The Red Bluff Clay and

Joides Hole 5 Blake Plateau	Reticulofenestra laevis zone											
	J 510	J 509	J 508	J 507	J 506	J 505	J 519	J 504	J 518	J 503	J 517	
	Cyclococcolithus margaritae zone											
	J 502	J 516	J 501	J 515	J 514	J 513	J 512	J 511	Isthmolithus recurvus zone			
	Ellipsolithus subdisticus zone											
	Isthmolithus recurvus zone											
	Discoaster saipanensis											
	Discoaster barbadiensis											
	Ellipsolithus subdisticus											
	Ericsonia fenestrata											
Hayella elegans n.sp.												
Syracosphaera clathrata												
Cyclococcolithus formosus												
Cruciplacolithus tarquinius												
Cyclococcolithus margaritae												
Cyclococcolithus bollii n.sp.												
Reticulofenestra laevis												
Reticulofenestra insignita												

Fig. 1. Distribution of the most important species of calcareous nannofossils in JOIDES Hole 5, 30° 23' N, 80° 08' W, Blake Plateau, Western Atlantic.

Alabama St. Stephens Quarry	Reticulofenestra laevis zone										
	A 100	A 853	A 848	A 843	A 839	A 833	A 827	A 821	A 815	A 809	A 805
Ellipsolithus subdisticus zone	Cyclococcolithus margaritae zone										
	A 800	A 613	A 610	A 608	A 606	A 604	A 600	A 507			
	Isthmolithus recurvus zone										
Discoaster saipanensis											
Discoaster barbadiensis											
Ellipsolithus subdisticus											
Ericsonia fenestrata											
Hayella elegans n.sp.											
Syracosphaera clathrata											
Cyclococcolithus formosus											
Cruciplacolithus tarquinius											
Cyclococcolithus margaritae											
Cyclococcolithus bollii n.sp.											
Reticulofenestra laevis											

Fig. 2. Distribution of the most important species of calcareous nannofossils in the section at the Lone Star Cement Company Quarry, St. Stephens, Alabama, U.S.A.

the lowermost 5 feet of the Marianna limestone belong to the *Ellipsolithus subdisticus* zone. The Forest Hill Sand lying between the Red Bluff Clay and the Marianna limestone is practically barren of nannofossils. The Marianna Limestone from 5 feet above the base to the top can be assigned to the *Cyclococcolithus margaritae* zone. The Glendon Limestone contains only very few and badly preserved coccoliths. Just above the Glendon Limestone *Reticulofenestra laevis* was found in an unnamed clay member at the base of the Bucatunna Clay. These sediments must belong to the *Reticulofenestra laevis* zone. Samples from the Bucatunna Clay and from the Chickasawhay Limestone contain only very few coccoliths belonging to long ranging species.

The distribution of the important species in this Alabama section is similar to the one in the JOIDES well, as can be seen on Fig.2.

LEVIN & JOERGER's (1967) Biostratigraphic unit II is nearly equivalent to the *Ellipsolithus subdisticus* zone and their Biostratigraphic unit III to the *Cyclococcolithus margaritae* zone.

Barbados Bath Cliff	Ellipsolithus subdisticus zone		Cyclococcolithus margaritae zone			
	JS 1066	JS 1858	JS 1068	JS 1856	JS 1854	
<i>Cyclococcolithus formosus</i>						
<i>Ericsonia fenestrata</i>						
<i>Cruciplacolithus tarquinius</i>						
<i>Cyclococcolithus margaritae</i>						
<i>Cyclococcolithus bollii</i> n.sp.						

Fig. 3. Distribution of the most important species of calcareous nannofossils in the Bath Cliff section, Barbados (W.I.)

Barbados

Sediments from the middle and upper part of the Bath Cliff section were also studied. The preservation in many of the of the samples is not very good and quite a few of the representative species are missing. Nevertheless, two of the Oligocene zones could be found. The lowermost part of the section belongs to the *Ellipsolithus subdisticus* Zone, the upper part to the *Cyclococcolithus margaritae* zone. According to SAUNDERS and CORDEY these sediments contain planktonic foraminifera typical of the *Globigerina selii* zone.

Trinidad

Only one sample from each planktonic foraminiferal zone was available. In the *Globigerina ampliapertura* zone most of the species known from the *Reticulofenestra laevis* zone were still present. *Reticulofenestra laevis* makes its last occurrence in this

zone. Coccoliths belonging to the genus *Reticulofenestra* are quite abundant in this zone. In the *Globorotalia opima opima* zone the number of species appears to be reduced. This process of reduction in the number of small coccolith species continues up to the *Globorotalia kugleri* zone. Especially coccoliths of the genus *Reticulofenestra* are fairly rare above the *Globigerina ampliapertura* zone. Discoasters become quite abundant and might allow a fine zonation of this Upper Oligocene intervall. No formal zonal names should be proposed until a continuous section has been studied.

DESCRIPTION OF A NEW GENUS AND TWO NEW SPECIES

Plant Kingdom

Division Phaeophyta WETTSTEIN (1901) emend. ROTHMALER, 1949

Class Coccolithophyceae ROTHMALER, 1951

Order Heliolithae DEFLANDRE, 1952

Genus *Hayella* n. gen.

Diagnosis: Coccoliths consisting of two circular shields having T-shaped elements. Centre solid or with a small circular pore.

Type species: *Hayella elegans* n. sp.

Remarks: The Coccoliths of *Hayella* differ markedly from those of *Cyclococcolithus*. In *Cyclococcolithus* the elements are strongly imbricate whereas in *Hayella* they are not imbricate and touch each other only in the centre and at the margin, where the T-ends interlock. The shape and construction of the elements is somewhat similar in *Emiliana*, but *Emiliana* has elliptical placoliths with a fairly large central pore.

Hayella elegans n. sp.

Diagnosis: A small species of *Hayella* having a distal shield with about 19–23 T-shaped elements and a proximal shield with about 12–16 T-shaped elements.

Description: Placolith circular with shields of nearly the same size (distal shield somewhat larger), slightly convex distally, concave proximally, elements more numerous in the distal shield. The elements of the distal shield taper towards the centre and have a short marginal cross piece. Only narrow slits are left between the elements. The rays of the proximal shield are stouter with a short stem of constant thickness and a thick polygonal cross piece, leaving elliptical gaps between the rays.

The connecting column is very short and consists of the continuations of the shield elements which are dextrally imbricate. The central pore is very small, less than 1/10 of the total diameter of the coccolith.

Holotype: A 600380

Diameter of holotype: 2.5 μ .

Paratype: A 800307

Diameter of paratype: 1.9 μ .

Type locality: Lone Star Cement Company Quarry, St. Stephens, Alabama U.S.A.

Type level: Base of Red Bluff Clay.

Distribution: Abundant in the *Ellipsolithus subdisticus* zone, rare in the *Cyclococcolithus margaritae* zone and in the *Reticulofenestra laevis* zone in JOIDES Hole 5, the Alabama Tertiary and the Neuengammer Gassande, N Germany.

Cyclococcolithus bollii n.sp.

Diagnosis: A small species of *Cyclococcolithus* with 8 elements and a small central depression.

Description: The distal shield consists of 8 wedge-shaped elements dextrally imbricate. The sutures are straight and slightly inclined counterclockwise. The periphery is smooth. The central depression is small, about 1/10 of the diameter of the coccolith. The smaller proximal shield is concave and consists of 8 elements. The sutures are straight except near the centre where they are folded. The two shields are very close together and seem to touch each other.

Remarks: *Cyclococcolithus bollii* differs from *Cyclococcolithus margaritae* in having only about half as many elements and a much smaller central depression.

Holotype: A 821207

Diameter of holotype: 4 μ .

Paratype: A 827119

Diameter of paratype: 4.2 μ .

Type Locality: The Lone Star Cement Company Quarry, St. Stephens, Alabama, U.S.A.

Type level: Marianna limestone, 21' from its base.

Distribution: Makes its first appearance at the very top of the *Ellipsolithus subdisticus* zone and disappears at the top of the *Cyclococcolithus margaritae* zone in JOIDES Hole 5, Alabama and Barbados.

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Plate I

Electron micrographs of carbon replicas. St. Stephens Quarry, Alabama.

- Fig. 1. *Hayella elegans* n.sp. Holotype A 600380, 25000 \times , proximal view, base of Red Bluff Clay.
- Fig. 2. *Hayella elegans* n.sp. Paratype 1800307, 24000 \times , distal view, base of Marianna Limestone.
- Fig. 3. *Cyclococcolithus bollii* n.sp. Holotype A 821207, 10000 \times , distal view, 21' above base of Marianna Limestone.
- Fig. 4. *Cyclococcolithus bollii* n.sp. Paratype A 827119, 10000 \times , proximal view, 27' above base of Marianna Limestone.



