

MICROBIOSTRATIGRAPHY OF THE PALEOCENE-LOWER EOCENE BOUNDARY IN THE FARS AREA, SOUTHWESTERN IRAN

by

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ABSTRACT

This paper describes the biostratigraphy of Paleocene-Lower Eocene foraminifera from the southwestern part of Iran. About 562 samples have been collected from four stratigraphic sections of the Zagros region in the Fars mountain range. These sections are located in an area about 1375 km² between the Persian Gulf in the South, the Fars area in the North and Khuzistan in the West. The stratigraphic sections from sub-coastal Fars to interior Fars are named Varvi, Gavbast, Chehel and Chadur.

The present paper is divided in two parts : the first part deals with Paleocene biostratigraphy, and the second part with studies of Lower Eocene microfauna.

The approximate thickness of Paleocene sediments varies between 32 and 590 meters whereas Lower Eocene sediments attain 153 meters maximum.

The Paleocene-Eocene boundary is easily identified by the extinction of *Globorotalis velascoensis* and *Globorotalia angulata* and also by the first appearance of *Globorotalia rex*, *Globorotalia wilcoxensis* and *Globorotalia aragonensis*.

KEY WORDS

Index foraminifera, Paleocene, Lower Eocene, Fars, Iran.

1. INTRODUCTION

In this paper the stratigraphy and micropaleontological investigation of outcrop samples, collected in measured stratigraphic sections from sub-coastal and interior Fars area (SW Iran), are discussed and presented. The material is composed of 562 carbonate samples which all have been examined in thin sections (Fig. 1).

Four stratigraphic sections have been studied in more detail : Varvi, Gavbast, Chehel and Chadur. The longest section is situated at Kuh-e Chadur (Sachun formation), the shortest section is from Larestan, Tang-e Chehel (Pabdeh formation).

Micropaleontological study shows that the above mentioned samples can be assigned to Paleocene-Eocene age, on the basis of index planktonic and benthonic foraminifera. Association of two types of

foraminifera shows an interfingering or gradational change from Pabdeh into Sachun and Jahrum formations.

The faunal assemblage of the Middle-Upper part of Paleocene, observed in the entire interval is as follows (Lower part of Paleocene is completely missing in the Fars area) :

Globigerina triloculinoides, *Globorotalia pseudobulloides*, *Globorotalia angulata*, *Globorotalia velascoensis*, *Globorotalia aequa*, *Globorotalia pseudomenardi*, *Globorotalia uncinata*, *Globorotalia laevigata*, *Globorotalia pusilla*, *Globorotalia cf. abundocamerata*, *Miscellanea minuta*, *Discocyclina seunesi*, *Glomalveolina primevea*, *Daviesina* sp.,

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Broeckinella arabica, *Ranikothalia* sp., *Alveolina* cf. *avellana*, *Kathina* sp. and *Saudia discoidea*.

The index foraminifera in the Lower Eocene sediments are *Globorotalia rex*, *Globorotalia wilcoxensis*, *Globorotalia aragonensis*, *Globorotalia formosa*, *Globorotalia gracilis*, *Alveolina aragonensis*, *Orbitolites complanata*, *Lockarita* sp., *Coskinolina* sp., *Spirolina* sp., *Discocyclina sowerbyi*, *Pellatispira* sp., *Asterocyclus stellata* and *Nummulites globulus*.

The above assemblages appear in both Chadur and Gavbast sections. Paleocene sediments are reduced in thickness in the Varvi section in sub-coastal Fars, because the lower to middle part of the Pabdeh formation is missing. This part of Pabdeh Formation contains many planktonic foraminifera ranging from the upper part of the Paleocene into the Lower Eocene. Pabdeh formation (Midden-Upper Paleocene to Lower Eocene) is also present in Tang-e Chehel, recognized by occurrences of marker planktonic and benthonic foraminifera.

2. SECTION OF VARVI (Tang-e Pushtband) (Fig. 2)

The studied time units in this particular section, are from Paleocene to Lower Eocene (Pabdeh Formation). Description of each unit is as follows :

2.1. Paleocene

Mainly alternating marls and marly limestone, occurring in two sequences. The lower sequence is mostly composed of microcrystalline marly limestone, alternating with marls reaching a thickness of 19 meters. It is disconformably overlying highly glauconitic, micritic limestone of Maestrichtian age. The Paleocene interval is very productive and contains *Globorotalia compressa*, *Globorotalia uncinata*, *Globorotalia pseudobulloides*, *Globigerina triloculinoides*, *Globorotalia aequa*, *Globorotalia laevigata*, *Globorotalia pseudomenardi*, *Globorotalia angulata* and *Globorotalia velascoensis*.

2.2. Lower Eocene

Lower Eocene sediments are conformably overlying the Paleocene attaining a thickness of 65 meters. Two shorter intervals are recognized. The lower part

attaining a thickness of 44 meters, lithologically consists of grey marly microcrystalline, partially cherty limestone with irregular bedding of chalky limestone. The upper part attaining a thickness of 21 meters, consists of micritic limestone, containing subangular pebbles and partially conglomeratic.

The Lower Eocene deposits are less fossiliferous. The Lower Eocene age is based on the appearance of some index planktonic foraminifera such as *Globorotalia rex*, *Globorotalia wilcoxensis* and *Globorotalia aragonensis*.

3. SECTION OF CHEHEL (Larestan area) (Fig. 3)

3.1. Paleocene

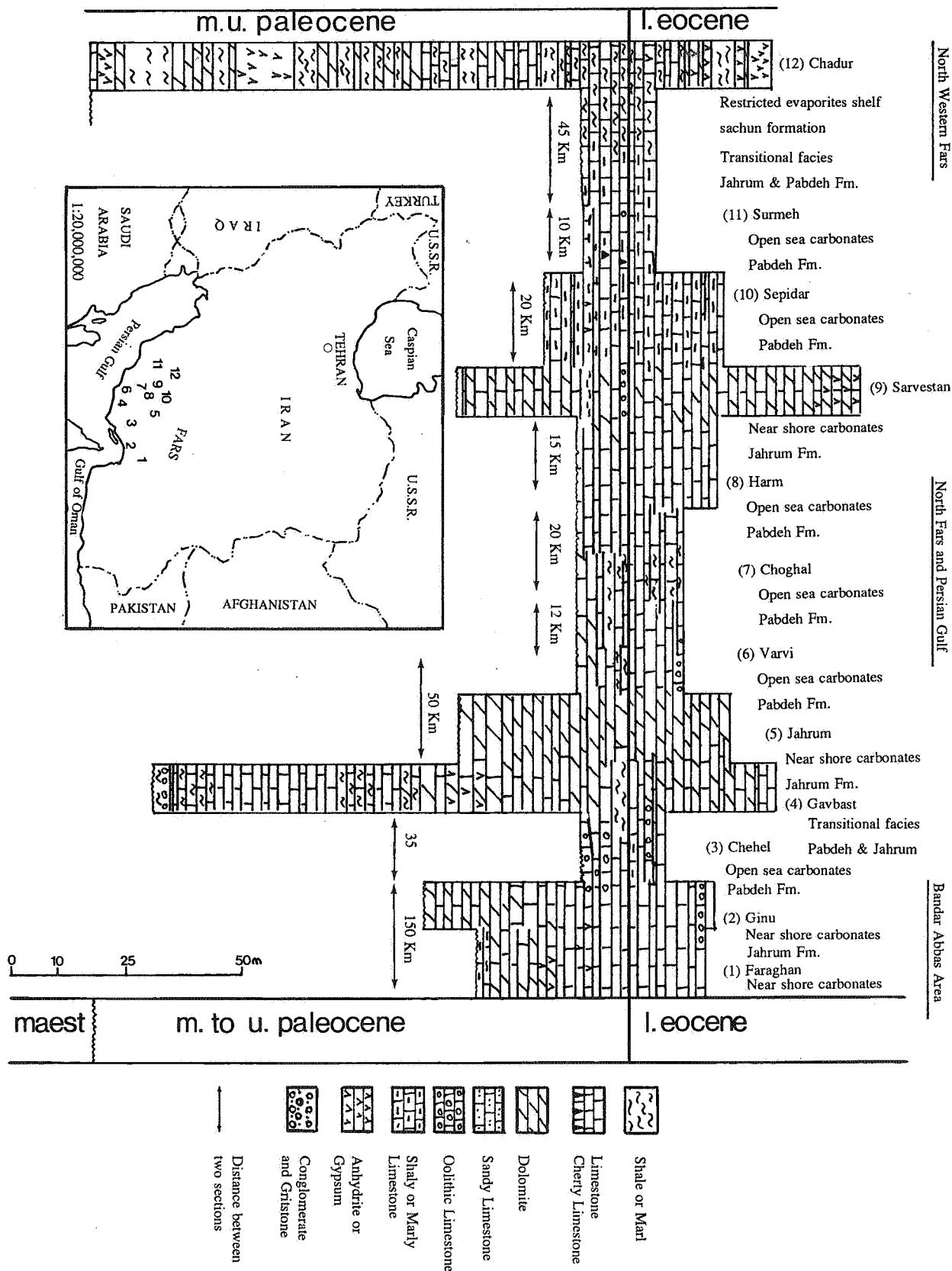
Paleocene sediments are disconformably overlying Maestrichtian deposits whereby the lower part of the Paleocene is missing. The middle part of the Paleocene lithologically consists of a buff weathering black slightly conglomeratic limestone. The upper part of the Paleocene consists of light brownish grey, microcrystalline limestone, locally which small concretions. The thickness of the Paleocene sediments reaches 51 meters in this stratigraphic section. This interval is assigned to the Middle to Upper Paleocene by the presence of index species such as *Globorotalia compressa*, *Globorotalia uncinata*, *Globorotalia pseudobulloides*, *Globigerina triloculinoides*, *Globorotalia aequa*, *Globorotalia laevigata*, *Globorotalia pseudomenardi*, *Globorotalia angulata* and *Globorotalia velascoensis*.

3.2. Lower Eocene

Sediments which conformably overlie the Paleocene deposits consist of alternating purplish shale and white concretionary limestone in the lower part, pelmicroparitic pyritized, limestone in the middle part and platy, brown weathering grey microcrystalline limestone in the upper part.

The age of the Lower Eocene deposits is based on index planktonic foraminifera such as *Globorotalia gracilis*, *Globorotalia formosa*, *Globorotalia wilcoxensis*, *Globorotalia aragonensis* and *Globorotalia rex*.

In the uppermost part of the Lower Eocene some benthonic foraminifera occur such as *Nummulites globulus*, *Nummulites subatacicus*, *Orbitolites complanata*, *Pellatispira* sp., *Discocyclina* cf. *sowerbyi* and *Asterocyclus stellata*.

**Figure 1.** Location map of stratigraphic sections.

Diagrammatic facies distribution of the Paleocene-L. Eocene, illustrating three major types facies of Pabdeh, Sachun and Jahrum formations throughout S.W. to S.E. Fars basins ; it also shows several marine transgressions and regressions.
Datum : top of Paleocene.

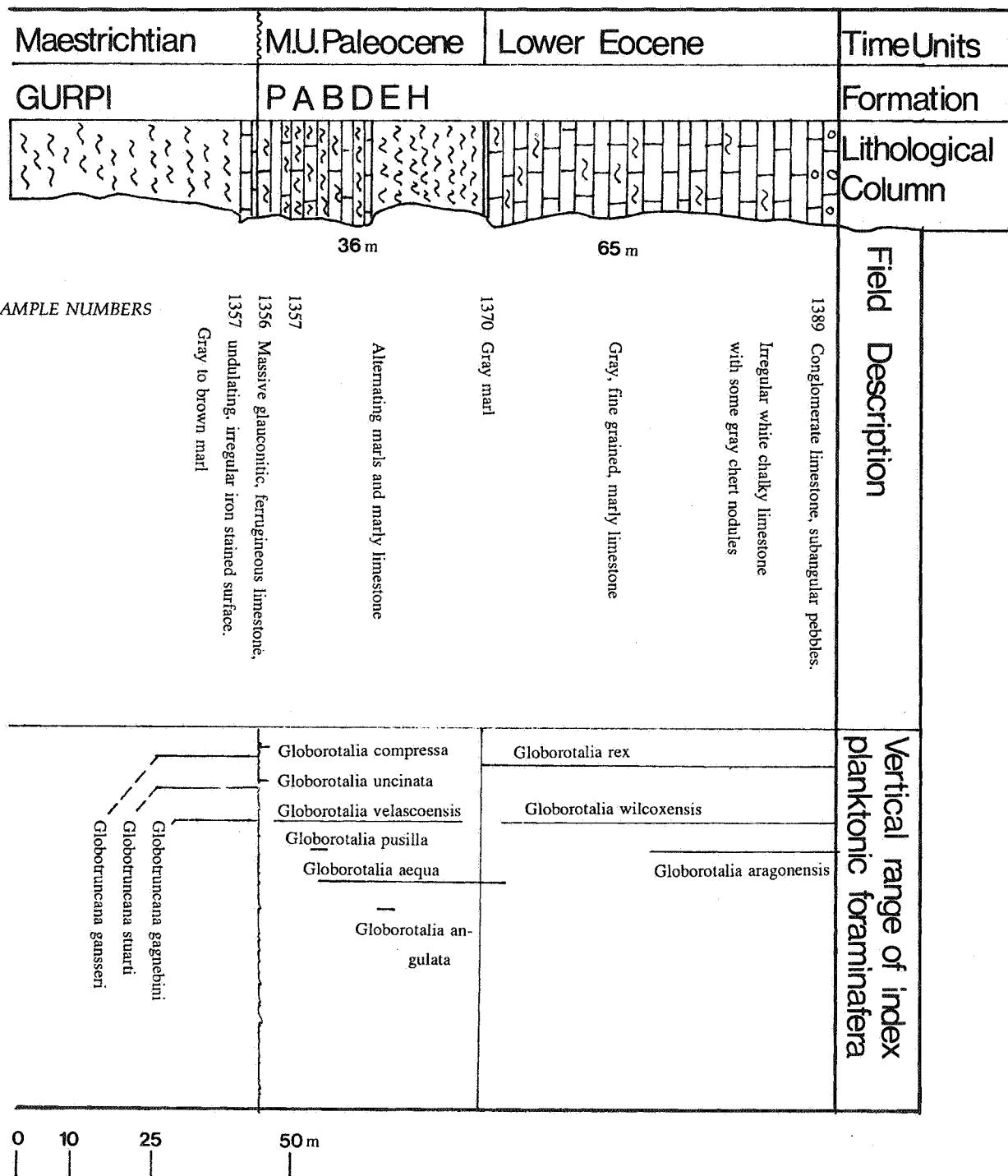


Figure 2. Biostratigraphic column of Kuh-E Varavi, Tang-E Pushtband Sub-Coastal Fars. Approximate coordinates N 625,000 -E 2,343,000.

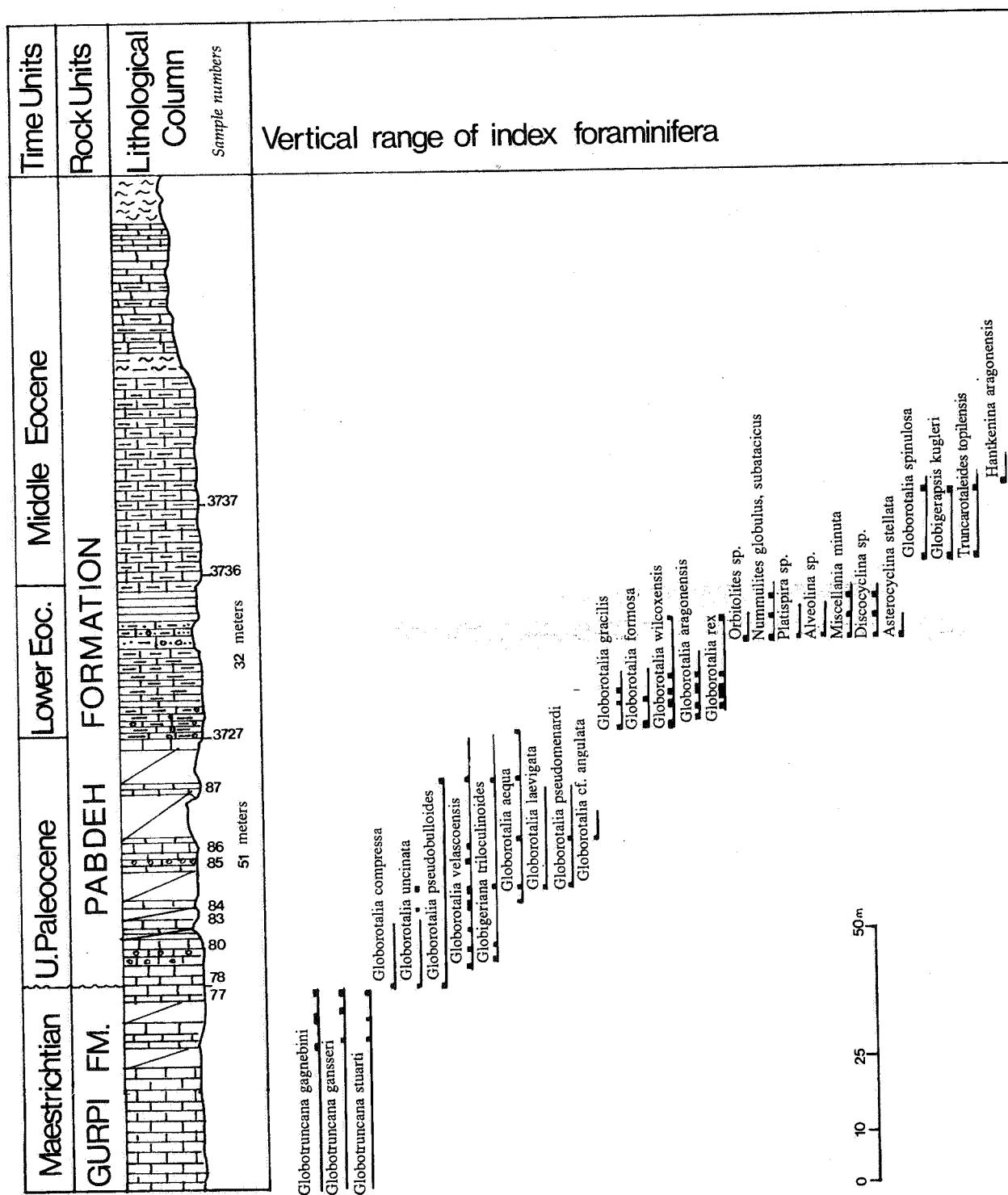


Figure 3. Biostratigraphic section of Pabdeh Formation in Tang-E Chehel, Larestan - Coastal Kerman area.
Coordinates N26°54'04" - E 54°05'22".

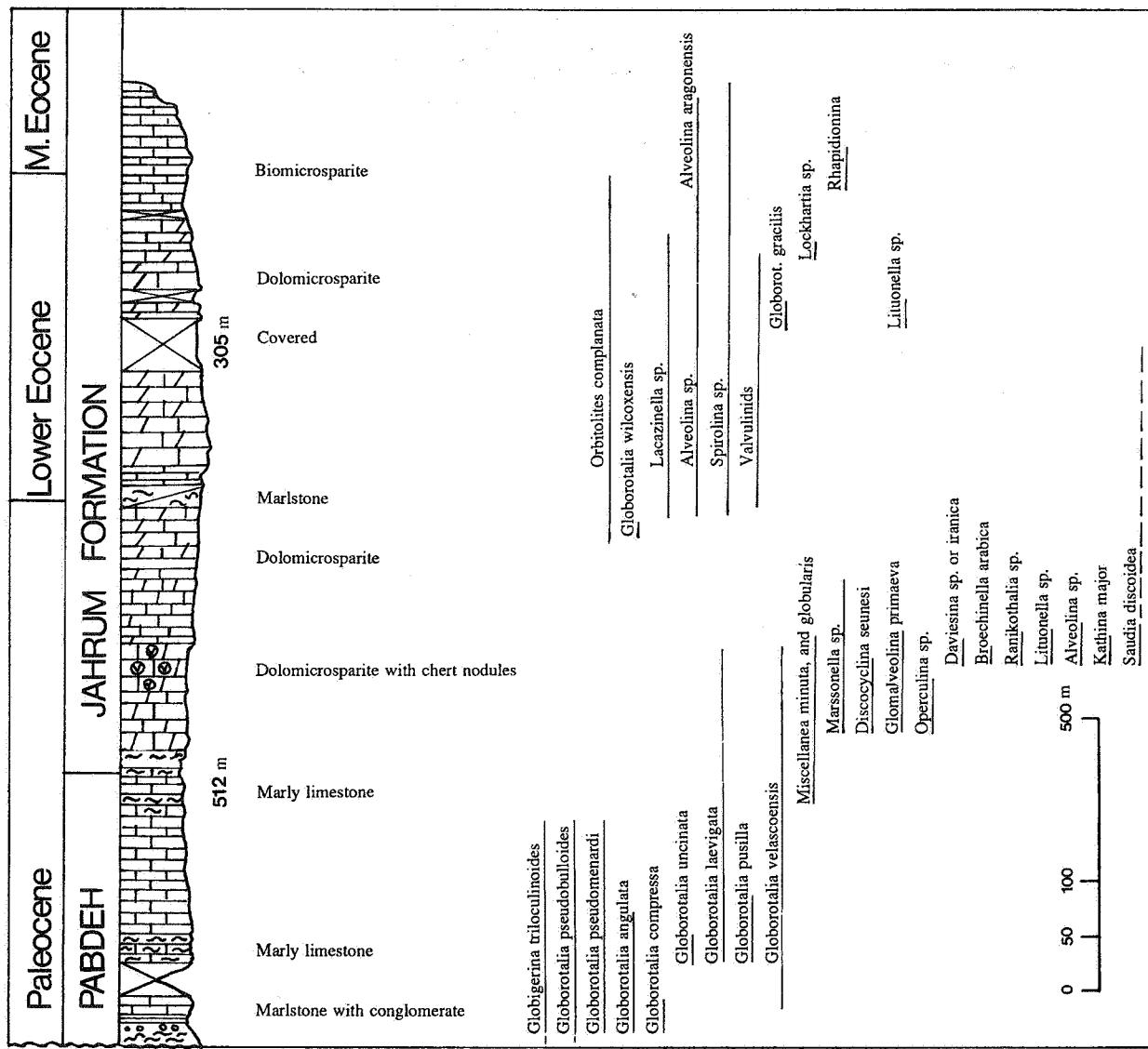


Figure 4. Biostratigraphic columnar section from Tang-E Kalat in Kuh Gavbast, S.W. Iran.
Approximate coordinates N 635,310 - E 2,376,400.

4. SECTION OF KUH-E GAVBAST, SUB-COASTAL FARS AREA (Fig. 4)

The thickest sediments of Paleocene - Lower Eocene age are present in this stratigraphic section, which is more than 790 meters. Two formations were recognized in this section, passing from the Pabdeh formation in the Jahrum formation. Description of each time unit is as follows :

4.1. Paleocene

Sediments reaching a thickness of 482 meters in this locality are disconformably overlying the Gurpi formation of Maestrichtian age. Paleocene sediments lithologically can be divided in two parts. The lower interval (320 m) is mainly composed of grey microcrystalline, partially chalky limestone with some intercalation of grey to white marls. The upper interval

(162 m) is marked by a brownish grey dolomitic, crystalline limestone with some gypsum nodules in middle part of this interval. The lower interval contains many planktonic foraminifera, whereas some benthonic foraminifera are present in the upper interval. This transition between two types of foraminiferae assemblages indicates a gradational change of the Pabdeh into the Jahrum formation.

The Paleocene faunal assemblages observed in the entire interval are as follows : *Globigerina triloculinoides*, *Globorotalia pseudobulloides*, *Globorotalia angulata*, *Globorotalia velascoensis*, *Globorotalia aequa*, *Globorotalia pseudomenardi*, *Globorotalia uncinata*, *Globorotalia laevigata*, *Globorotalia pusilla*, *Globorotalia cf. abundocamerata*, *Miscellanea minute*, *Discocyclina seunesi*, *Operculina sp.*, *Glomalveolina primevea*, *Daviesina sp.*, *Broeckinella arabica*, *Ranikothalia sp.*, *Lituonella sp.*, *Alveolina sp.*, *Kathina major* and *Saudia discoidea*.

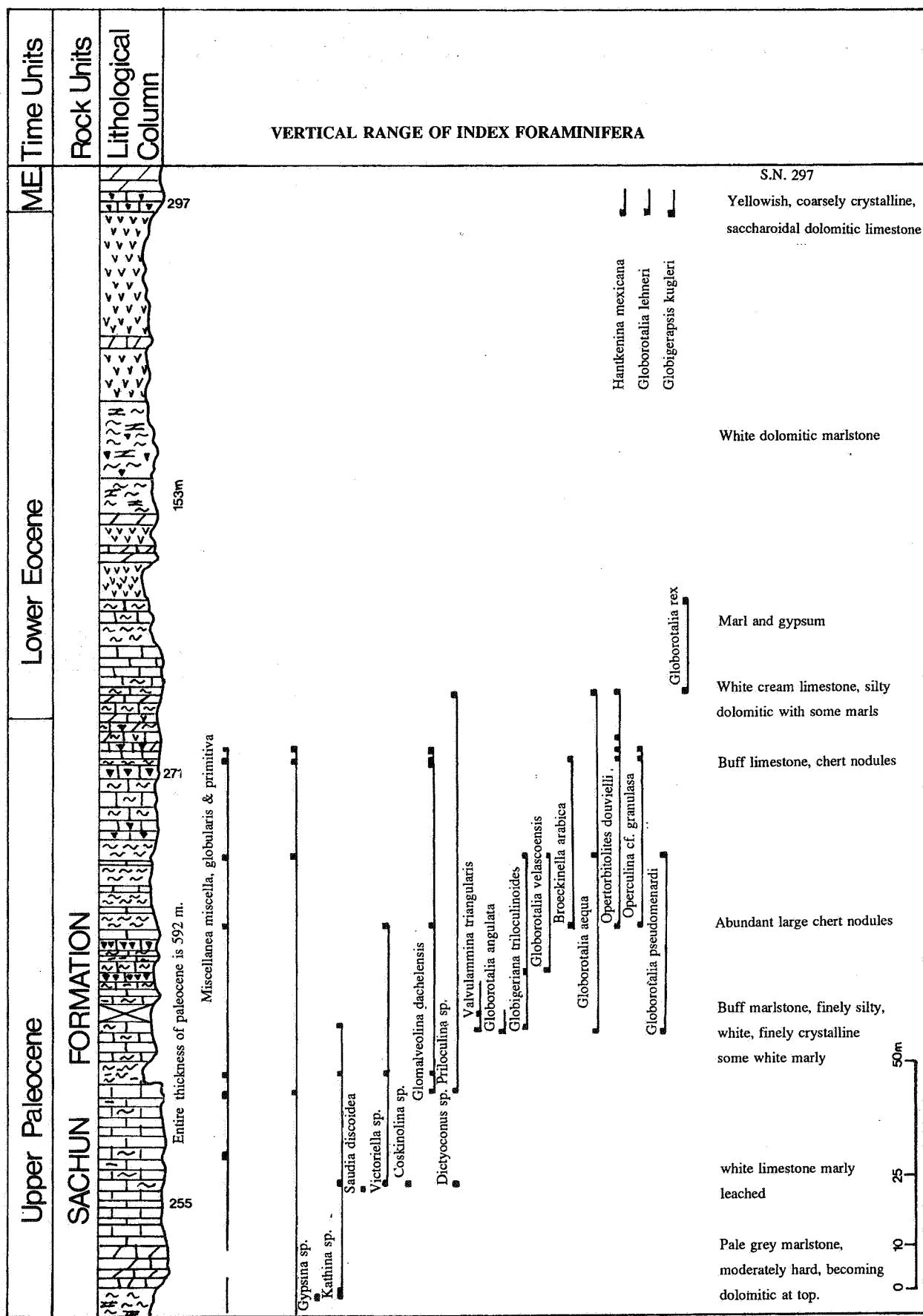


Figure 5. Kuh-E Chadur (Sachun) stratigraphic section, S.W. Iran.
Approximate coordinates N 774,500 - E 2,433,500.

4.2. Lower Eocene

Lower Eocene sediments attaining a thickness of 375 meters and conformably overlying the Paleocene deposits, mainly consist of dolomitic limestone with some gypsum nodules in the lower part. The contact of this time unit with the underlying stage lithologically consists of grey microcrystalline partially oolithic well bedded limestone (varying in thickness from 10 m to 30 m). The recognized Lower Eocene index foraminifera in this part of the section are : *Globorotalia wilcoxensis*, *Globorotalia aragonensis*, *Orbitolites* sp., *Alveolina* sp., *Lacazinella* sp., *Spirolina* sp., *Saudia discoidea*, *Lockhartia cf. diversa*, *Coskinolina* sp. and *Periloculina* sp.

5. CHADUR STRATIGRAPHIC SECTION (Fig. 5)

This section has been measured in the interior Fars, and it is well developed when compared with sub-coastal Fars stratigraphic columnar sections. Chadur section is slightly over 1030 meters thick entirely assigned to the Sachum formation. Micropaleontological study shows that this interval ranges from the Maestrichtian to the Paleocene - Lower Eocene. Description of each time unit is as follows :

5.1. Paleocene

Paleocene sediments attain a thickness of about 562 meters in this section. They are disconformably overlying Maestrichtian deposits and can be subdivided lithologically in two intervals. The lower interval which attains 312 meters consists of massive gypsum and dolomite alternating with marlstone and gypsiferous dolomite. This lithology type is not fossiliferous. Because of its position it should correspond to the lower part of the Paleocene (this interval is not shown on the attached columnar section).

The upper interval which attains a thickness of 280 meters is composed of marlstone, dolomite and cherty limestone which grade upwards into marl and micrite. The age of this interval is definitely Upper Paleocene, on the basis of the presence of benthonic and planktonic foraminifera such as *Kathina* sp., *Glomalveolina primevea*, *Keramosphaera iranica*, *Victoriella* sp., *Dictyoconus* sp., *Miscellanea miscella*, *Broekinella arabica*, *Opertobiroliches douvielli*, *Operculina* cf. *granulosa*, *Glomalveolina dachelensis*, *Globorotalia angulata*, *Globorotalia velascoencis* and *Globorotalia pseudomenardi*.

5.2. Lower Eocene

Lower Eocene deposits attain a thickness of slightly more than 150 meters. They are conformably overlying Paleocene sediments. This interval is poorly fossiliferous in dolomitic, slightly silty limestone beds with some chert nodules. The majority of this interval is composed of thick gypsum beds with thin intercalations of dolomite; and also of massive gypsum in the uppermost part of this interval. The recognized markers in the base of the Lower Eocene are rare *Globorotalia rex*, *Globorotalia aequa* and *Opertobiroliches* sp., confirming the Lower Eocene age for the basal part of this interval. The Sachum formation ranges up to the Middle Eocene because of the presence of *Globigerapsis kugleri*, *Globorotalia lehneri* and *Hantkenina mexicana*.

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PLATE 1

All figured specimens are from Middle Paleocene.

Figure 1. *Globorotalia aequa*, X 120, KRD 1365.

Figure 2. *Globorotalia pusilla*, X 110, KRD 1810.

Figures 3 & 4. *Globorotalia pusilla*, X 130, KRD 1361.

Figure 5. *Globorotalia pusilla*, X 85, KRD 1845.

Figures 6 & 7. *Globorotalia abundocamerata*, X 110 and 15, KRD 1810-1790.

Figure 8. *Globorotalia laevigata*, X 90, KRD 1788.

Figure 9. *Globorotalia uncinata*, X 140, SY 87.

Figures 10 & 11. *Globorotalia uncinata*, X 110, SY 87 - KRD 1787.

Figures 12 & 13. *Globorotalia ehrenbergi*, X 120, KRD 1796.

Figures 14 & 15. *Globorotalia pseudobulloides*, X 70 and 90, KRD 1782-1840.

Figures 16 & 17. *Globorotalia pseudomenardi*, x 105, KRD 1782-1845.

Figure 18. *Globorotalia pseudomenardi*, X 120, KRD 1806.

Figure 19. *Globorotalia pseudomenardi*, X 85, KRD 1786.

Figure 20. *Globigerina triloculinoides*, X 130, KRD 1363.

Figures 21-26. *Globigerina triloculinoides*, X 100, KRD 1818-1361-1363.

Figures 27-28. *Globorotalia compressa*, X 165, KRD 1357.

Figures 29-30. *Globorotalia compressa*, X 110, KRD 1357.

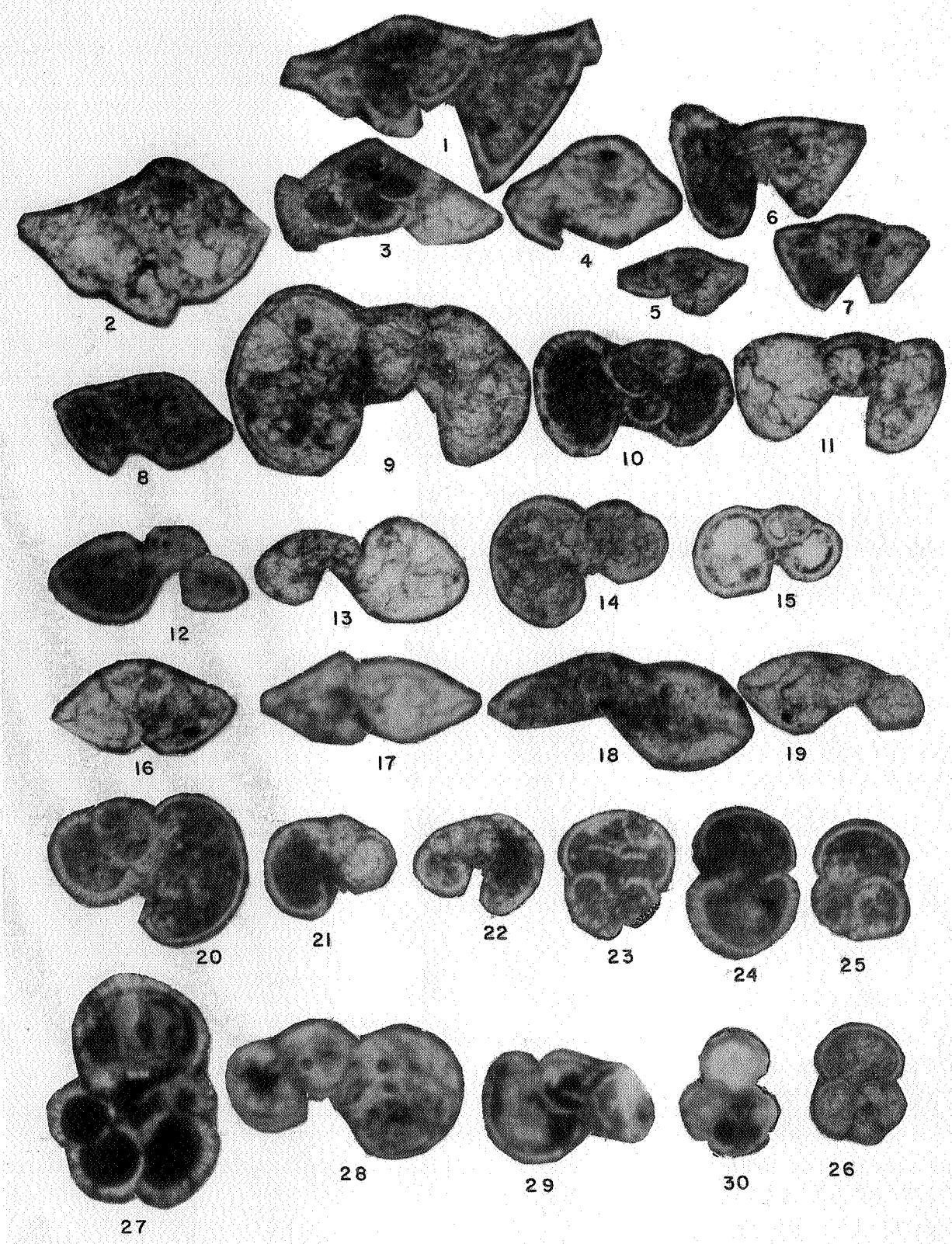


PLATE 2.

Figure 1. *Globorotalia aragonensis*, X 100 (L. Eocene), LETP 3728.

Figure 2. *Globorotalia rex*, X 120 (L. Eocene), LETP 3728.

Figure 3. *Globorotalia wilcoxensis*, X 100 (L. Eocene), LETP 3728.

Figures 4-5. *Globorotalia aequa*, X 100 (Paleocene), KRD 1363.

Figures 6-7. *Globorotalia aequa*, X 75 (Paleocene), KRD 1363.

Figures 8-14. *Globorotalia velascoensis*, X 75 to 100 (Paleocene), KRD 1786, KRD 1800, SY 86, KRD 1761, SY 84, KRD 1809, SY 86.

Figures 15-18. *Globorotalia angulata*, X 85 (Paleocene), KRD 1782.

Figures 19-20. *Globorotalia angulata*, X 150 (Paleocene), KRD 1782.

Figure 21. *Globorotalia angulata*, X 100 (Paleocene), KRD 1782.

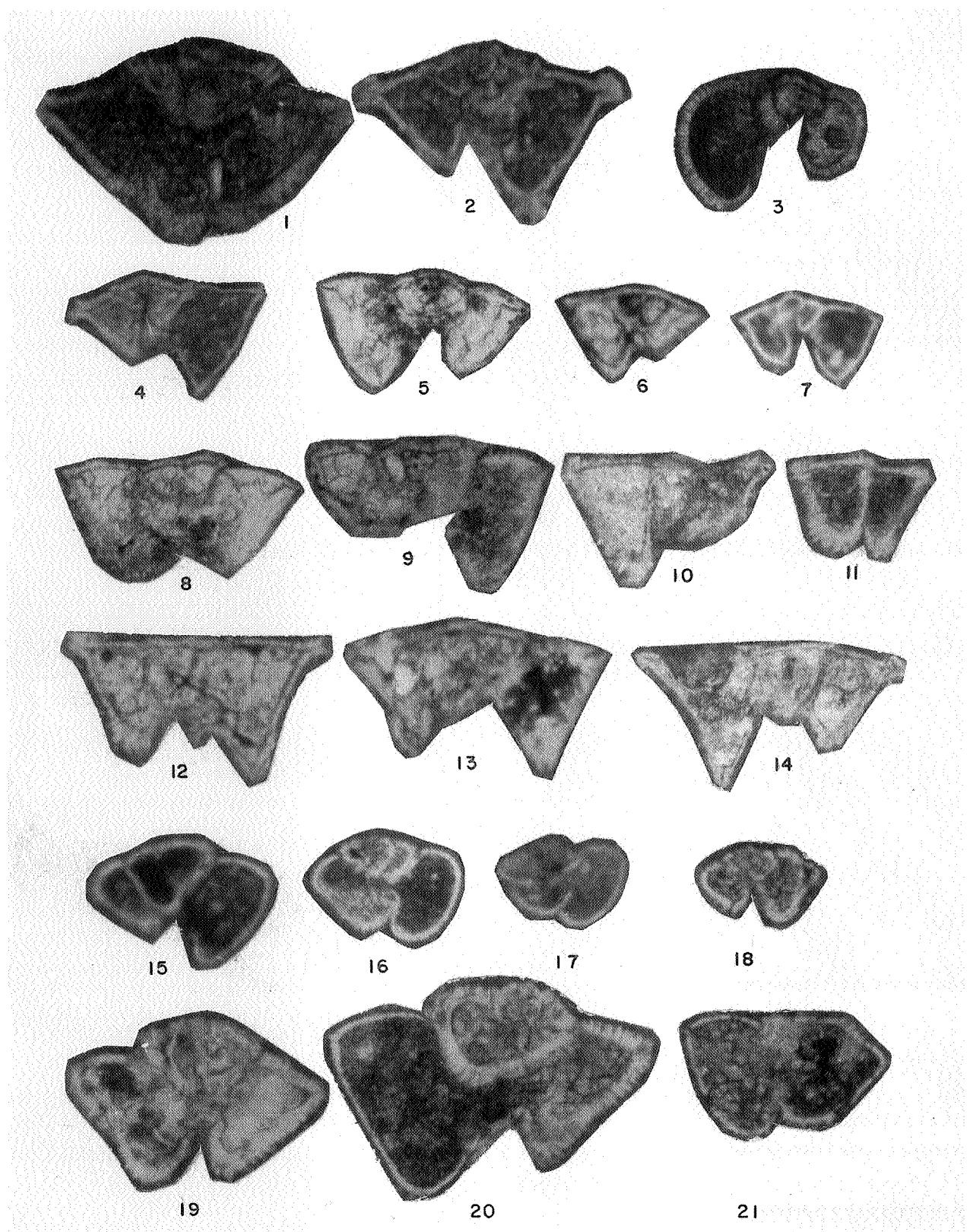


PLATE 3

All figured specimens are from lower Eocene.

Figures 1 & 2. *Globorotalia gracilis*, X 100, KRD 1368.

Figures 3 & 4. *Globorotalia formosa*, X 140 and 110, KRD 1388.

Figure 5. *Globorotalia formosa*, X 65, LETP 3728.

Figure 6. *Globorotalia aragonensis*, X 100, KRD 1379.

Figure 7. *Globorotalia aragonensis*, X 160, KRD 1378.

Figure 8. *Globorotalia wilcoxensis*, X 125, KRD 1381.

Figures 9 & 10. *Globorotalia wilcoxensis*, X 80, LETP 3728 - KRD 1372.

Figures 11 & 12. *Globorotalia rex*, X 125, KRD 1382 - KRD 1373.

Figures 13 & 14. *Globorotalia rex*, X 90, KRD 1373 - LETP 3734.

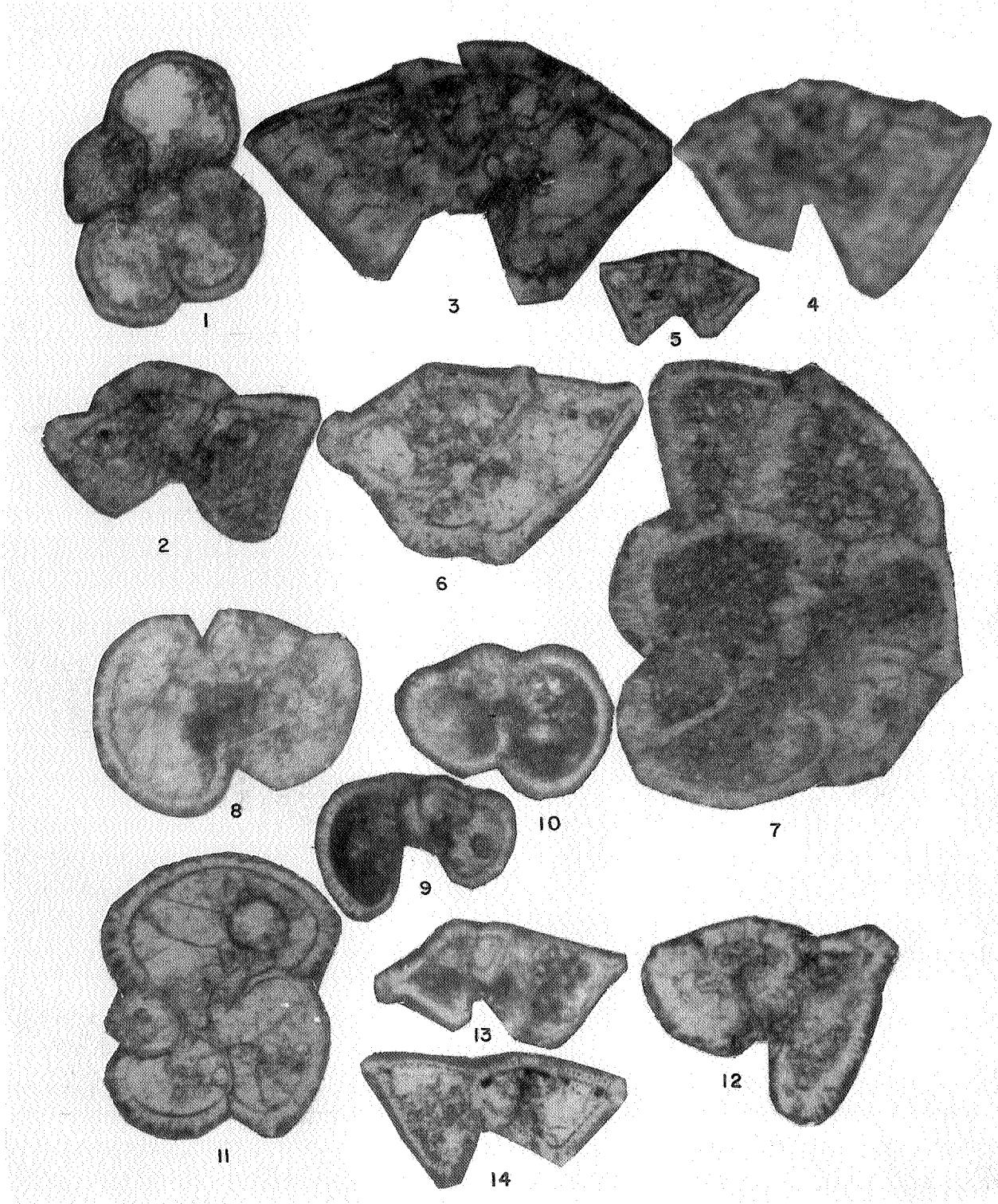


PLATE 4.

All figured specimens are from Paleocene.

Figure 1. *Broeckinella arabica*, X 45.

Figure 2. *Glomalveolina primaeva*, X 80.

Figure 3. *Lacazinella* sp., X 50.

Figure 4. *Valvulinids*, X 35.

Figure 5. *Rhapydionina* sp., X 50.

Figure 6. *Lituonella* sp., X 50.

Figure 7. *Keramosphaera iranica*, X 50.

Figure 8. *Miscellanea miscella*, X 40.

Figure 9. *Miscellanea globularis*, X 45.

Figures 10 & 11. *Coskinolina* sp., X 50.

Figure 12. *Saudia discoidea*, X 50.

Figures 13 & 14. *Orbitolites* sp., X 40.

Figures 15 & 16. *Discocyclina seunesi*, X 45.

Figures 17 & 18. *Ranikothalia* sp., X 35.

Figure 19. *Ranikothalia* sp., X 75.

Figure 20. *Ranikothalia* sp., X 35.

Figures 21-23. *Kathina* cf. *delseata*, X 35.

Plate 4

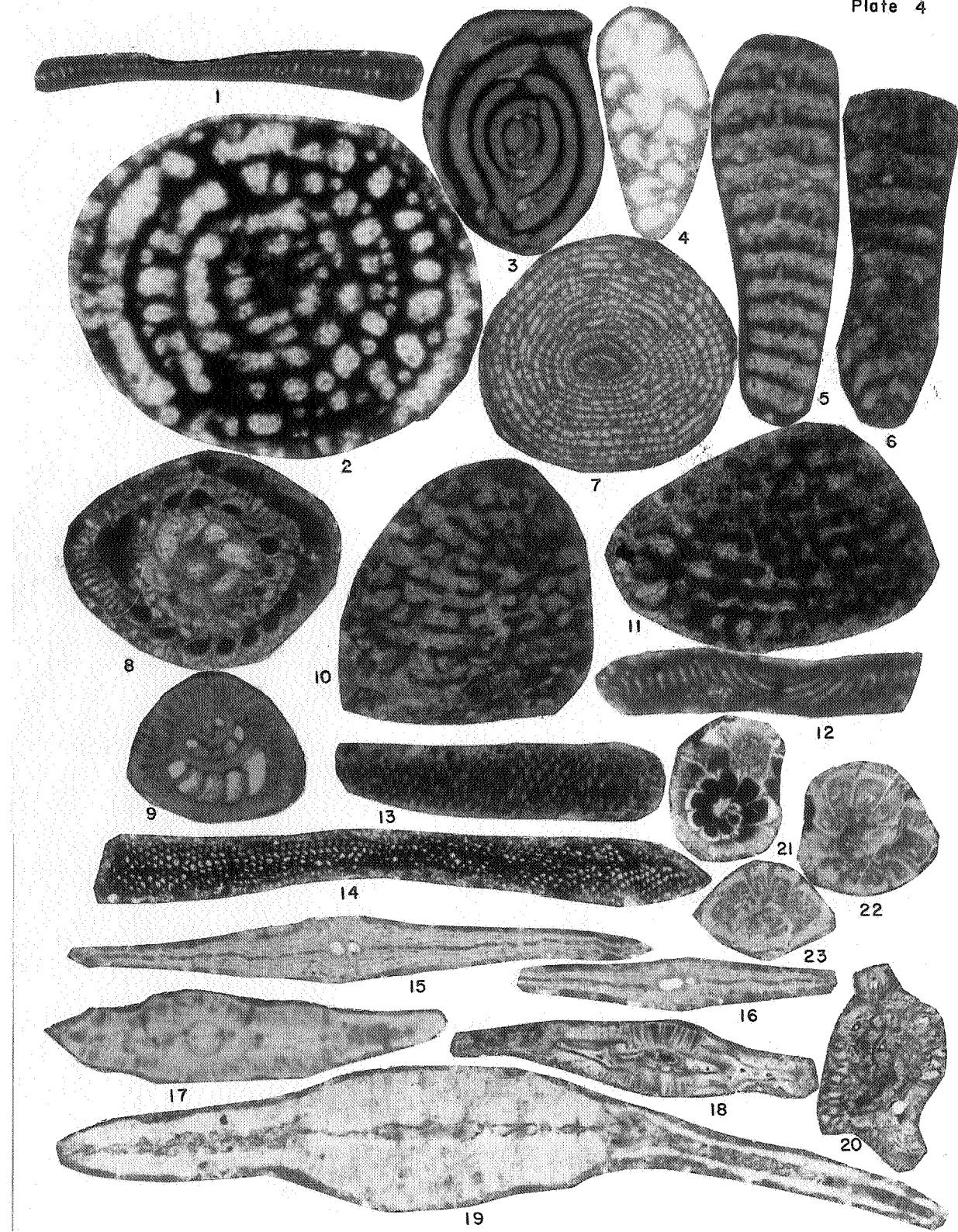
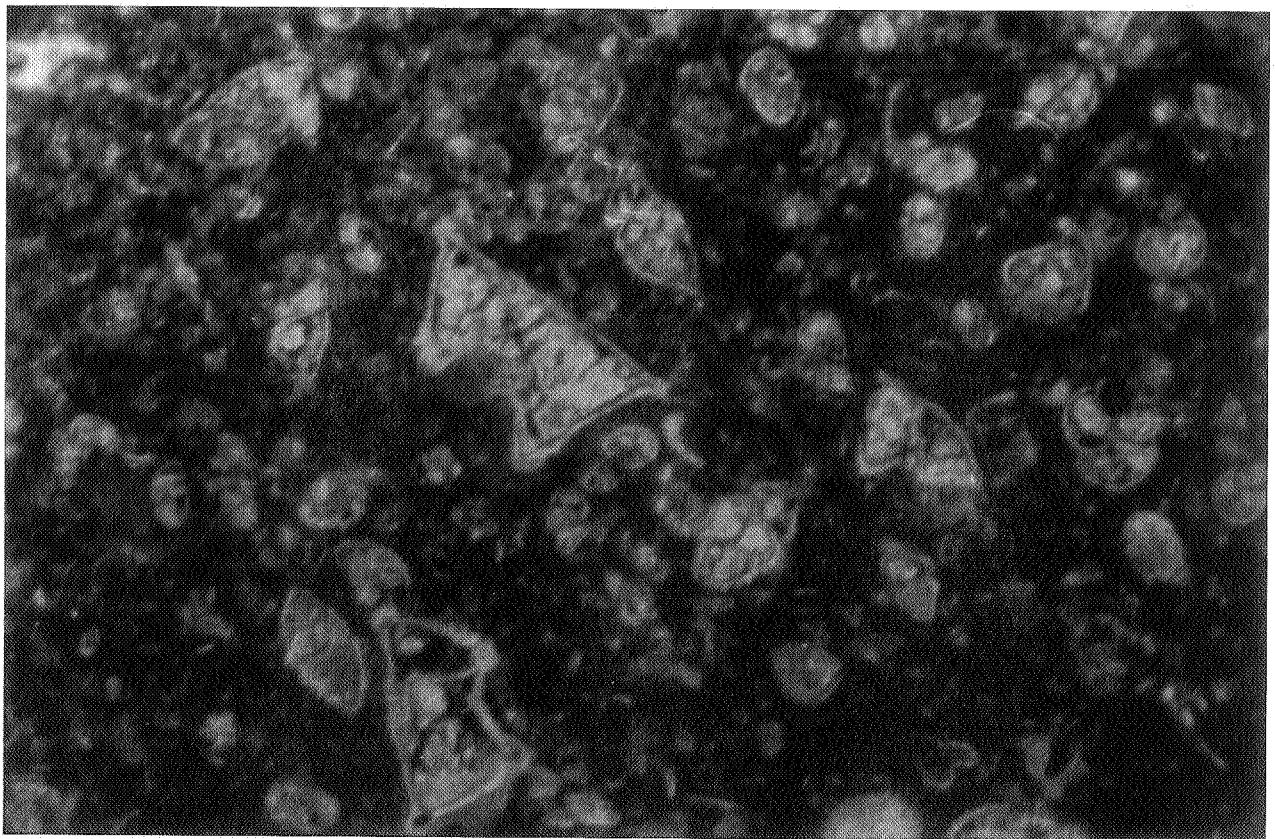


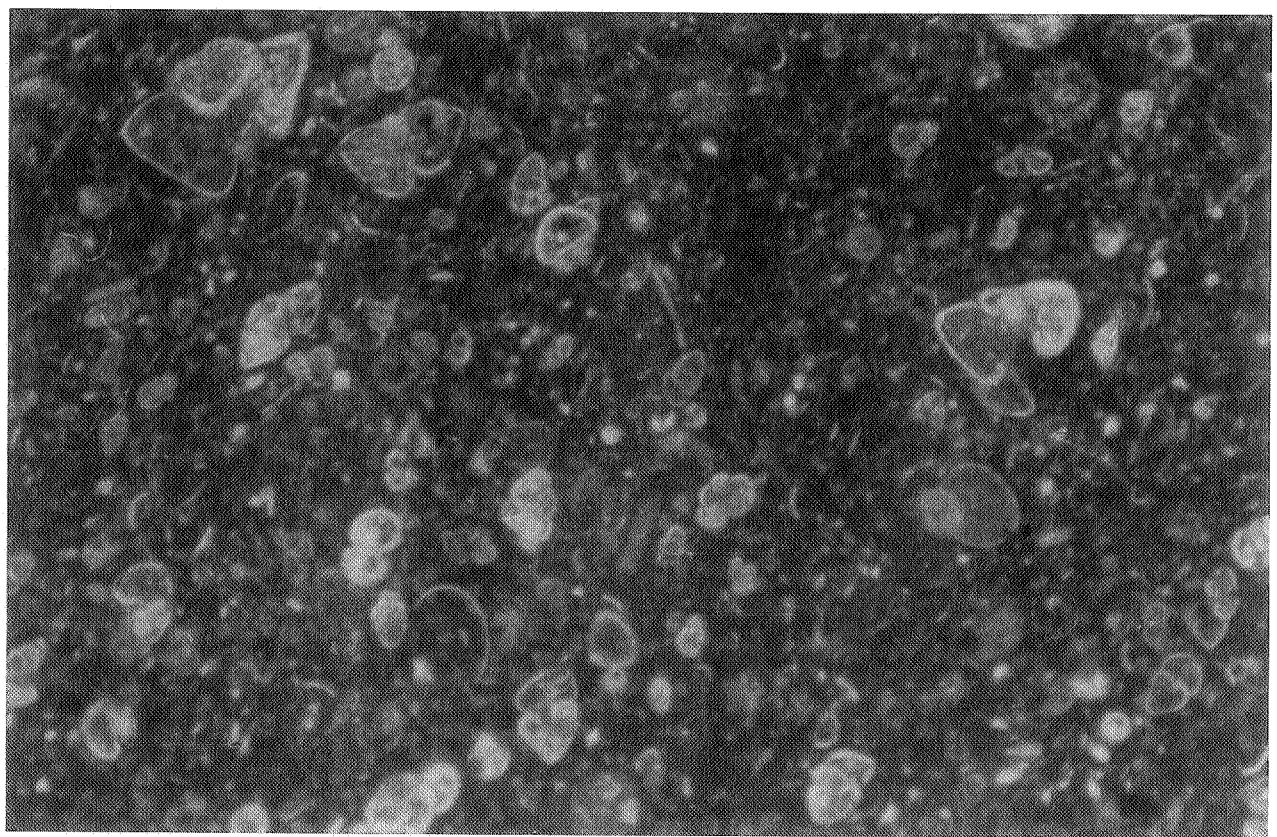
PLATE 5.

Figure 1. Biomicrite, bioturbated, with irregularly shaped microsparitic intraclasts ; the biotic components are *Globorotalia velascoensis*, *Globorotalia aequa*, *Globorotalia cf. laevigata*, X 75, SY 84.
Age : Paleocene - Pabdeh Formation.

Figure 2. Biomicrite, with small and rounded microsparitic intraclasts ; biotic components are *Globorotalia angulata*, *Globorotalia aequa*, *Globorotalia pseudomenardi* and *Globigerina triloculinoides*, X 55, KRD 1782.
Age : Paleocene - Pabdeh Formation.



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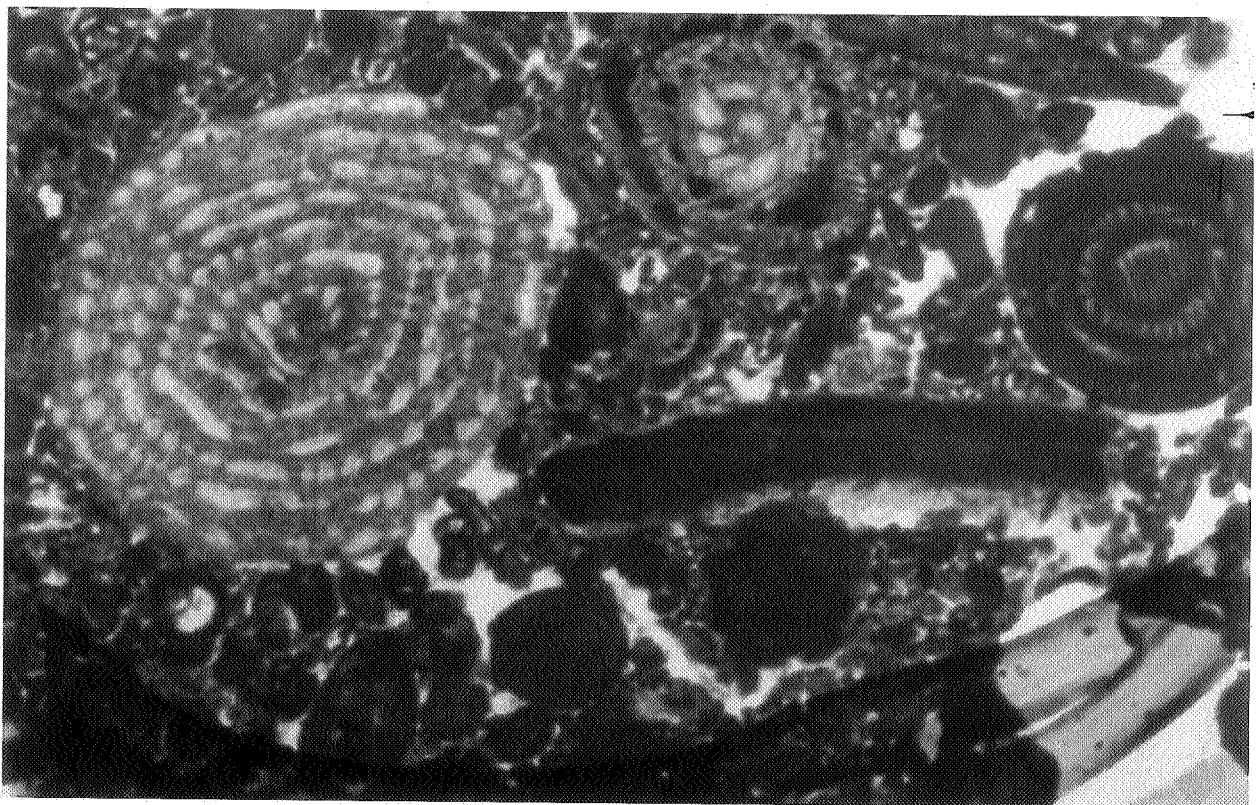
PLATE 6

Figure 1. Pelbiomicrite with microsparitic patches and small rounded intraclasts associated with scattered rounded micritic pellets ; biotic constituents are *Keramosphaera iranica*, *Miscellanea miscella*, *Glomalveolina primevea*, rotalids and algal remains, X 45, KRD 1875.

Age : Paleocene - Jahrum Formation.

Figure 2. Biomicrosparite with various shapes of micritic intraclasts ; the recognized benthonic foraminifera are *Broeckinella arabica*, *Glomalveolina primevea*, *Miscellanea miscella* and *Periloculina* sp. X 45, KRD 1875.

Age : Paleocene - Jahrum Formation.



1



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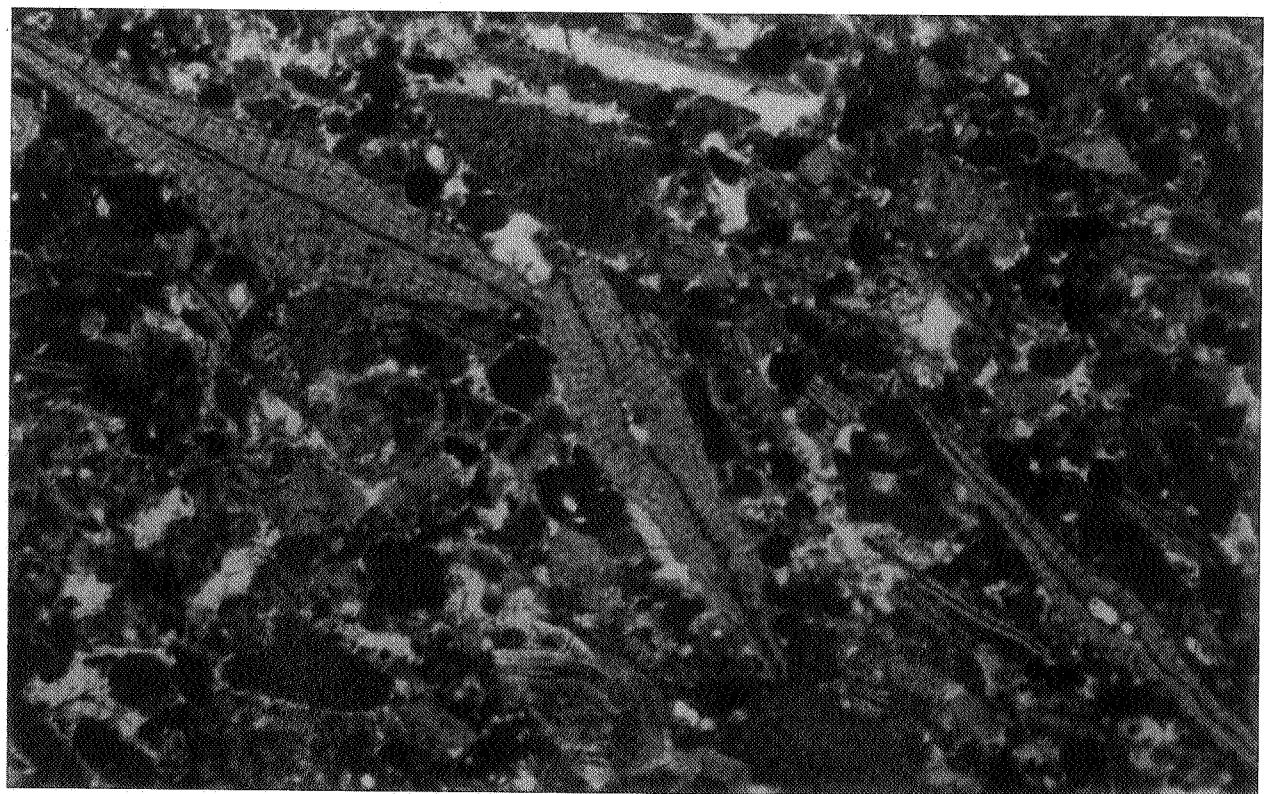
PLATE 7

Figure 1. Biomicrite, cryptocrystalline matrix, sparry calcite cement fills many foraminiferal chambers ; biotic constituents are *Ranikothalia* sp., *Operculina* sp. and *Nummulites* cf. *convexa*. X 35.
Age : Paleocene - Jahrum Formation.

Figure 2. Pelmicrite with various shapes of microsparitic intraclasts, well sorted ; biotic components are *Discocyclina seunesi* and *Miscellanea* sp. X 40.
Age : Paleocene - Jahrum Formation.



1

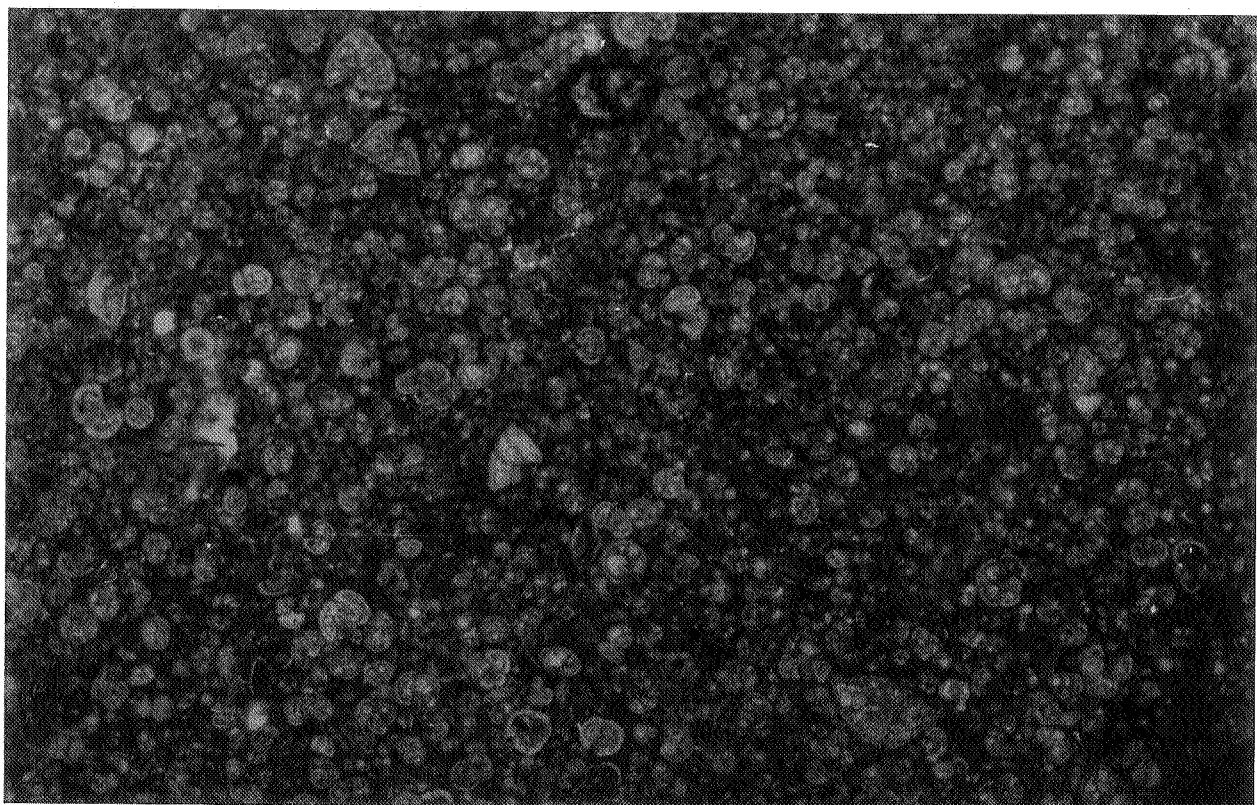


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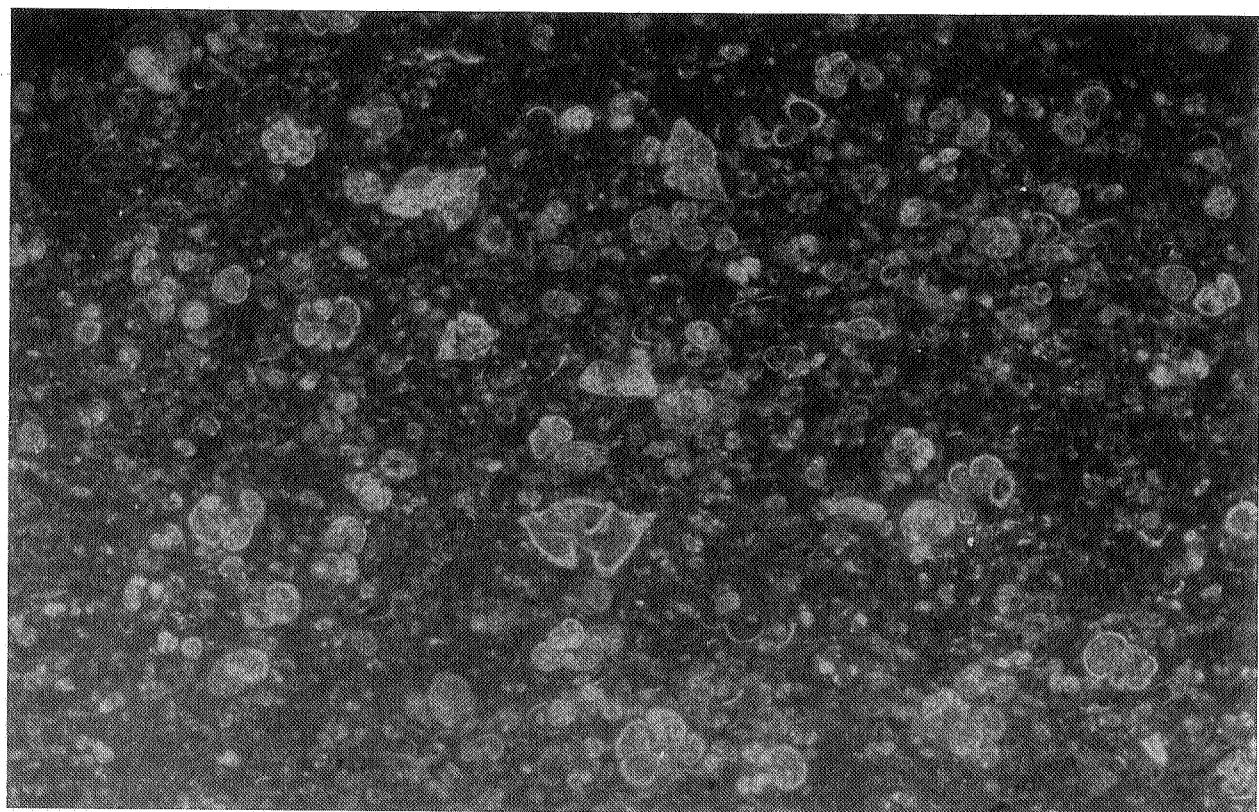
PLATE 8

Figure 1. Biomicrite, cryptocrystalline matrix, sparry calcite cement fills all planktonic foraminiferal chambers ; biotic constituents are *Globorotalia rex*, *Globorotalia aragonensis*, *Globorotalia wilcoxensis* and *Globorotalia formosa*. X 30, LETP 3732Age : Lower Eocene - Pabdeh Formation.

Figure 2. Biomicrite with rounded and small microsparitic intraclasts ; biotic constituents are *Globorotalia formosa*, *Globorotalia gracilis*, *Globorotalia wilcoxensis* and *Globorotalia cf. rex*. X 35, LETP 3730. Age : Lower Eocene - Pabdeh Formation.



1

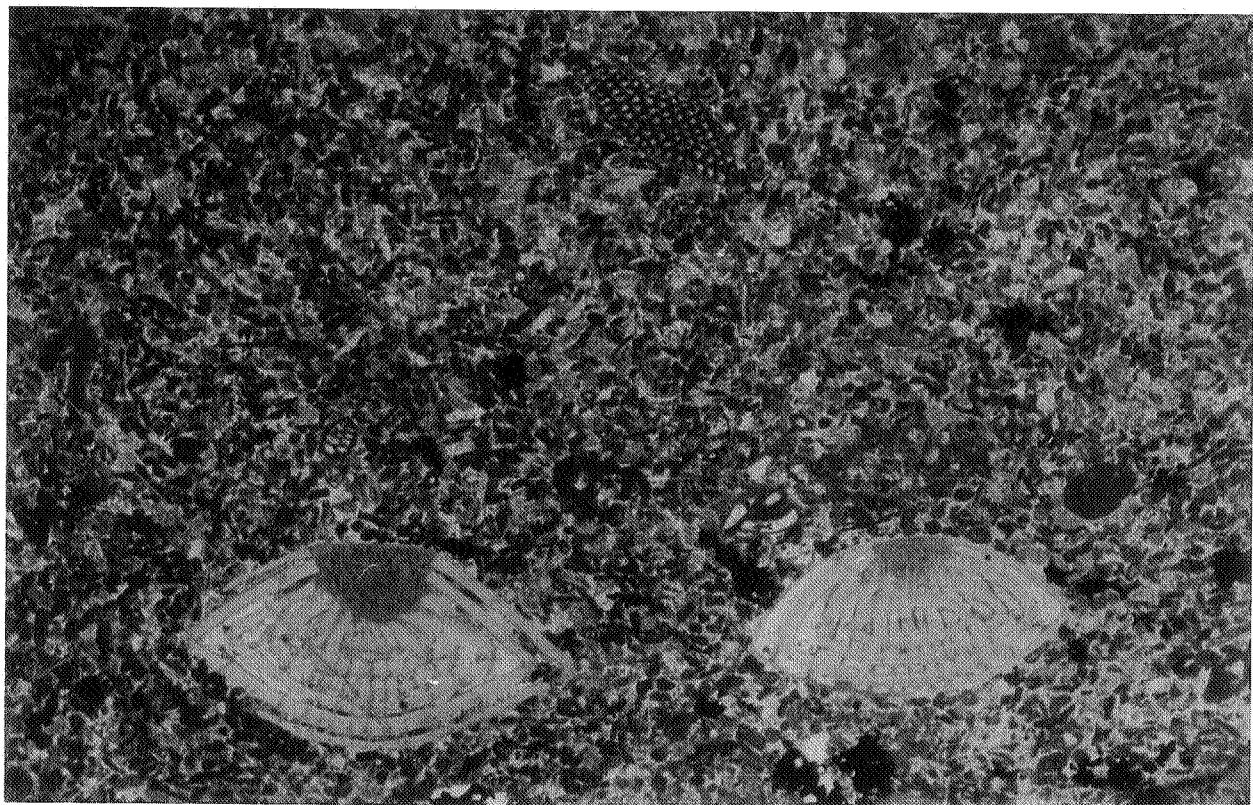


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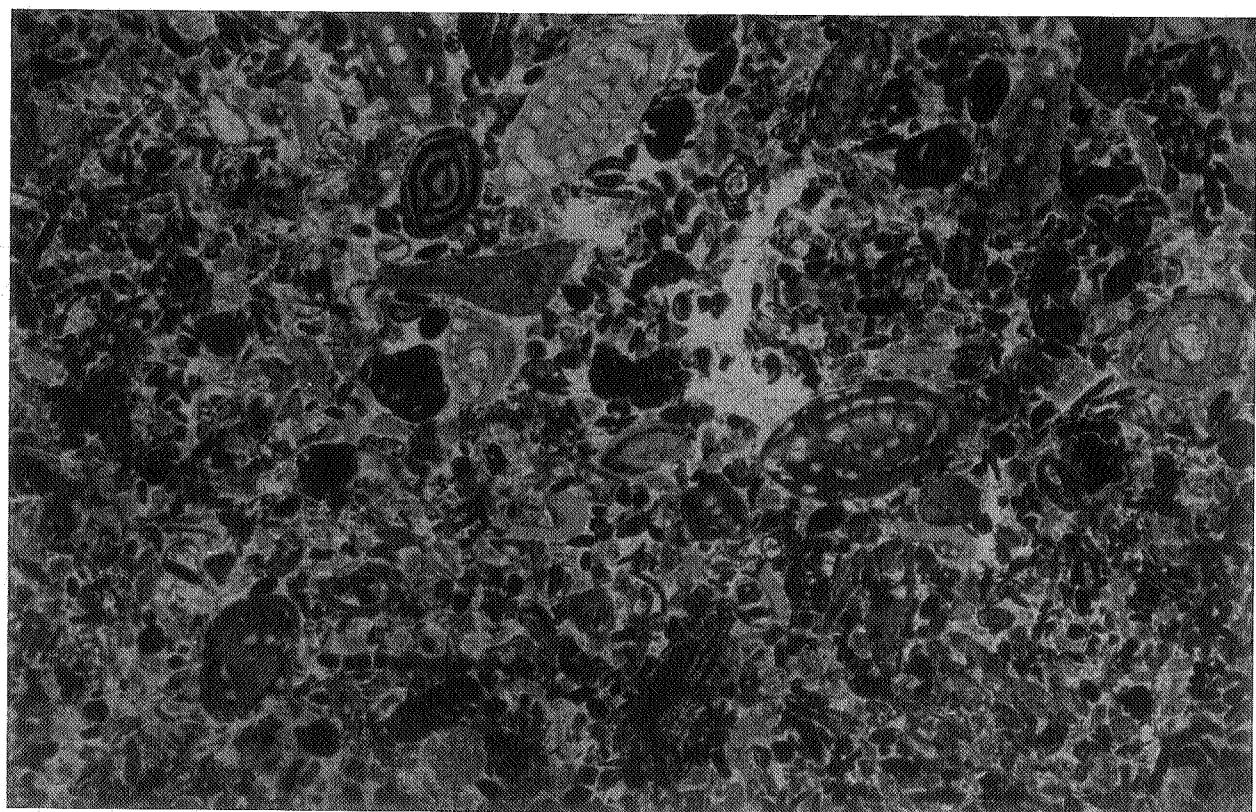
PLATE 9

Figure 1. Pelmicrosparite with WELL sorted, small, rounded micritic pellets ; biotic components are *Nummulites* cf. *subatacicus*, *Orbitolites complanata* and rare miliolids and textularids. X 35, LETP 3733.
Age : Lower Eocene - Jahrum Formation.

Figure 2. Pelmicrosparite with rounded and elliptical micritic pellets ; biotic constituents are *Pellatispira* sp., *Nummulites* sp., *Periloculina* sp. and *Alveolina* sp. X 30, LETP 3733.
Age : Lower Eocene - Jahrum Formation.



1



2

