INTRODUCTION

This study was carried out in the vicinity of Akçataş and Cebeci villages, which are located to the northwest of Tosya town (SE Kastamonu). The study area is located in the western part of Kastamonu F32-d1 quadrangle of 1:25000 scale (Figure 1).

Geological studies carried out in the Tosya region have mainly focused on economical geology and tectonics. There are also a number of geological studies and geological research reports of the General Directorate of the Mineral Research and Exploration (MTA) carried out in the region. Early studies in the region belong to Coulant (1894) and Pilz (1937), which were concentrated on nickel deposits. Blumenthal (1939, 1948 and 1950) carried out geological research in the area and prepared a 1/100 000 scale geological map. Ayaroğlu (1980), concentrated on the economical possibilities of the region in his

Figure 1- Location map of the investigated area.

BIOSTRATIGRAPHY OF THANETIAN-ILERDIAN BENTHIC FORAMINIFERA IN THE AKÇATAŞ - CEBECİ (NW TOSYA - SE KASTAMONU) REGION

Nazire ÖZGEN - ERDEM*

ABSTRACT.- In this study, the benthic foraminiferal biostratigraphy and paleoecological features of Thanetian-Ilerdian unit were investigated in the northwest of Tosya (SE Kastamonu). The range of the unit, which had been determined as Paleocene-Eocene by former studies, was established as Thanetian-Ilerdian after conducting detailed paleontological research works on this unit. The unit begins with conglomerates from the base and continues with sandstones, sandy limestones and limestones upwards. *Haymanella paleocenica* Sirel, *Idalina sinjarica* Grimsdale, *Mississippina binkhorsti* (Reuss) and *Pseudocuvillierina?* sp. were described in the Thanetian levels of the unit. The Ilerdian levels are characterized by the following benthic foraminifera assemblages: *Glomalveolina lepidula* Schwager, *G. subtilis* Hottinger, *G. pilula* Hottinger, *G. karsica* Sirel, *Alveolina ellipsoidalis* Schwager, *A. moussoulensis* Hottinger, *A. corbarica* Hottinger, *A. laxa* Hottinger, *A. ilerdensis* Hottinger, *A. minervensis* Hottinger, *A. subpyrenaica* Leymerie, *A. decipiensi* Schwager, *A. aff. pisella* Drobne, *A. erki* Acar, *A. trempina* Hottinger, *A. aragonensis* Hottinger, *Orbitolites complanatus* Lamarck, *O. megasphericus* Zhang, *Opertorbitolites lehmanni* Montanari. The fossil content and sedimentological features indicate deposition in a shallow restricted platform (10-30 m depth) with low energy at the beginning and subsequently in a deeper carbonate shelf environment (40-80 m) conditions.

Key words: Benthic Foraminifera, Ilerdian, Thanetian, Tosya

INTRODUCTION

BIOSTRATIGRAPHY OF THANETIAN-ILERDIAN BENTHIC FORAMINIFERA IN THE AKÇATAŞ - CEBECİ (NW TOSYA - SE KASTAMONU) REGION

Nazire ÖZGEN - ERDEM*

ABSTRACT.- In this study, the benthic foraminiferal biostratigraphy and paleoecological features of Thanetian-Ilerdian unit were investigated in the northwest of Tosya (SE Kastamonu). The range of the unit, which had been determined as Paleocene-Eocene by former studies, was established as Thanetian-Ilerdian after conducting detailed paleontological research works on this unit. The unit begins with conglomerates from the base and continues with sandstones, sandy limestones and limestones upwards. *Haymanella paleocenica* Sirel, *Idalina sinjarica* Grimsdale, *Mississippina binkhorsti* (Reuss) and *Pseudocuvillierina?* sp. were described in the Thanetian levels of the unit. The Ilerdian levels are characterized by the following benthic foraminifera assemblages: *Glomalveolina lepidula* Schwager, *G. subtilis* Hottinger, *G. pilula* Hottinger, *G. karsica* Sirel, *Alveolina ellipsoidalis* Schwager, *A. moussoulensis* Hottinger, *A. corbarica* Hottinger, *A. laxa* Hottinger, *A. ilerdensis* Hottinger, *A. minervensis* Hottinger, *A. subpyrenaica* Leymerie, *A. decipiensi* Schwager, *A. aff. pisella* Drobne, *A. erki* Acar, *A. trempina* Hottinger, *A. aragonensis* Hottinger, *Orbitolites complanatus* Lamarck, *O. megasphericus* Zhang, *Opertorbitolites lehmanni* Montanari. The fossil content and sedimentological features indicate deposition in a shallow restricted platform (10-30 m depth) with low energy at the beginning and subsequently in a deeper carbonate shelf environment (40-80 m) conditions.

Key words: Benthic Foraminifera, Ilerdian, Thanetian, Tosya

INTRODUCTION

This study was carried out in the vicinity of Akçataş and Cebeci villages, which are located to the northwest of Tosya town (SE Kastamonu). The study area is located in the western part of Kastamonu F32-d1 quadrangle of 1:25000 scale (Figure 1).

Geological studies carried out in the Tosya region have mainly focused on economical geology and tectonics. There are also a number of geological studies and geological research reports of the General Directorate of the Mineral Research and Exploration (MTA) carried out in the region. Early studies in the region belong to Coulant (1894) and Pilz (1937), which were concentrated on nickel deposits. Blumenthal (1939, 1948 and 1950) carried out geological research in the area and prepared a 1/100 000 scale geological map. Ayaroğlu (1980), concentrated on the economical possibilities of the region in his

Figure 1- Location map of the investigated area.

* Cumhuriyet Üniversitesi, Mühendislik Fakültesi, Jeoloji Mühendisliği Bölümü, 58140, Sivas
E-posta: nozgen@cumhuriyet.edu.tr
This study aimed at putting forward the benthic foraminiferal biostratigraphy, determining the stratigraphic range and interpreting paleoecological features of this unit. The stratigraphic distributions of the benthic foraminifera, which are described in this study, have also been correlated with Tethyan Belt shallow benthic Foraminifera biozones (Serra-Kiel et al., 1998). Towards realizing these objectives, three stratigraphic sections, which are named as Akçataş, Karapınar and Kirenler, have been measured and some 86 systematic samples were collected from the unit (Figure 2, 4-6). Systematic descriptions are based on oriented and random thin sections. All thin sections containing the benthic foraminifera described and shown in this paper are stored in

Figure 2- Geological map of Akçataş-Cebeci region (Yılmaz and Tüysüz, 1984).
The paleontological collection of Cumhuriyet University, Department of Geological Engineering, Sivas (Turkey).

**STRATIGRAPHY**

The Liassic aged Bekirli Metamorphics constitute the basement of the study area (Tüysüz, 1986) and consist of schist, marble, diabase and metadiabase. The limestones, which are dated as Upper Cretaceous in previous studies, were observed as a small outcrop in the vicinity of Cebeci village. *Hellenocyclus beotica* Reichel, *Siderolites* sp. and *Orbitoides* sp. are described in the samples obtained from the unit, which was then assigned to the Late Maastrichtian age (Figure 3). The unit, whose age is determined as Thanetian-Ilerdian in this study, starts with a thin conglomerate level in the base, which overlies Bekirli Metamorphics unconformably. The conglomerates are followed by sandstones, sandy limestones and limestones toward the upper levels. The sandstones are yellowish-brown coloured, well-compacted and carbonated. The sandy limestones are yellowish sometimes gray.

![Figure 3- Generalized columnar section of the investigated area (nonscale).](image-url)
coloured, well-compacted and fossiliferous. The
limestones, which outcropped most, are gray-
white sometimes yellowish coloured, thin-dense
textured, fossiliferous and contain small amount
of clays. Sedimentary petrography analyses
show that the unit is presented with boundstones
and wackestones, which contain benthic foramin-
iferal fragments within a micritic cement.

Haymanella paleocenica Sirel, Idalina sinjarica
Grimsdale, Mississippina binkhorsti (Reuss),
Pseudocuvillierina? sp., Rotalia sp., Miscellanea
sp. and Discocyclina sp. are found in the lower
levels of the unit. These levels are aged Thanet-
ian. Idalina sinjarica Grimsdale, G. lepidula Sch-
wager, G. subtilis Hottinger, G. karsica Sirel, A.
elipsoidalis Schwager, Orbitolites complanatus
Lamarck, O. megasphericus Zhang, Opertorbito-
lites lehmanni Montanari, Glomalveolina sp., Tri-
loculina sp., Alveolina sp., Orbitolites sp., Opertor-
bitolites sp., Cribrobulumina sp., Lockhartia
sp., Asterigerina sp., Miscellanea sp., Nummu-
lites sp., Operculina sp., Discocyclina sp. and
Haddonia sp. have been determined in the Lo-
er Ilerdian levels. G. lepidula Schwager, G. pilu-
la Hottinger, A. ellipsoidalis Schwager, A. mou-
soulensis Hottinger, A. corbarica Hottinger, A.
laxa Hottinger, A. ilerdensis Hottinger, A. mine-
rvensis Hottinger, A. subpyrenaica Leymerie, A.
decipiens Schwager, A. aff. pisella Drobne, A. er-
ki Acar, O. complanatus Lamarck, O. megas-
phercus Zhang, Opertorbitolites lehmanni Monta-
nari, Glomalveolina sp., Alveolina sp., Orbito-
lites sp., Opertorbitolites sp., Cribrobulumina sp.,
Lockhartia sp., Asterigerina sp., Miscellanea sp.,
Rotalia sp., Gyspina sp., Nummulites sp., Assi-
linha sp., Operculina sp. and Discocyclina sp.
sp. have been defined in the Middle Ilerdian levels.
G. lepidula Schwager, G. trempina Hottinger, A.
aragonensis Hottinger, O. complanatus Lamarck,
Op. lehmanni Montanari, Alveolina sp., Orbi-
tolites sp., Opertorbitolites sp., Cribrobulumina
sp., Lockhartia sp., Miscellanea sp., Asterigerina
sp., Rotalia sp., Gyspina sp., Nummulites sp., Assi-
linha sp., Alveolina sp. and Discocyclina sp.
(Plate I, II). However this formation has not been
named in the previous studies, to avoid a confu-
sion, the formation has not been named in this
study either. But instead, the unit is stated as
Thanetian-Ilerdian aged. Eocene basalts are ob-
served in places in the investigated area (Yilmaz
and Tüysüz, 1984). The youngest deposits are
Quaternary alluviums.

MEASURED STRATIGRAPHIC SECTIONS

Akçataş measured stratigraphic section

The section was measured within Akçataş
village, which is located 10 km northwest to the
Tosya town (Figure 2). The section is situated in
the Kastamonu F32d1 quadrangle (start point:
4 561 000 - 585 100; end point: 4 560 900 -
585 100). Some 27 samples were collected
along the section, which advanced from north to
south for a total of 90 m in thickness (28 m Lower
Ilerdian and 62 m Middle Ilerdian) (Figure 4). The
unit is represented by gray, varigated coloured,
thin-dense textured limestones in this section.
Idalina sinjarica Grimsdale, Glomalveolina sub-
tilis Hottinger, G. lepidula Schwager, G. karsica
Sirel, Alveolina ellipsoidalis Schwager, Orbito-
lites complanatus Lamarck, Opertorbitolites
lehmanni Montanari, Glomalveolina sp., Alveo-
lina sp., Opertorbitolites sp., Cribrobulumina sp.,
Lockhartia sp., Asterigerina sp., Miscellanea sp.,
Nummulites sp., Operculina sp., Discocyclina sp.
and Haddonia sp. were described in the Early
Ilerdian levels. The benthic foraminifera such as
G. lepidula Schwager, G. pilula Hottinger, Alveo-
lina ellipsoidalis Schwager, A. moussoulensis
Hottinger, A. laxa Hottinger, A. minervensis
Hottinger, A. subpyrenaica Leymerie, A. decipi-
ens Schwager, A. aff. pisella Drobne, Orbito-
lites complanatus Lamarck, O. megasphericus
Zhang, Opertorbitolites lehmanni Montanari,
Glomalveolina sp., Alveolina sp., Opertorbitolites
sp., Cribrobulumina sp., Lockhartia sp., Asterigerina
sp., Miscellanea sp., Nummulites sp., Operculina
sp., Discocyclina sp. and Discocyclina sp. were determined in the Middle
Ilerdian levels (Figure 4).
Karapınar measured stratigraphic section

This section was measured from the Karapınar ridge, which is 1 km northwest of the Akçataş village (Figure 2). The section is located in the Kastamonu F32d1 quadrangle (start point: 4 561 600 - 584 500; end point: 4 561 500 - 584 500) and has been measured from north to south. Middle-Upper Ilerdian levels of unit are ob-served in this section. A total of 65 m thickness (27 m Middle Ilerdian and 38 m Upper Ilerdian) was measured and some 24 samples collected (Figure 5). Middle Ilerdian levels are formed from sandy limestones in the base; gray, white coloured, dense textured limestones in the top and are characterized by Glomalveolina lepidula Schwager, Alveolina moussoulensis Hottinger, A. ilerdensis Hottinger, A. minervensis Hottinger, A. subpyrenaica Leymerie, A. decipiensis Schwager, Orbitolites complanatus Lamarck, O. megasphericus Zhang, Opertorbitolites lehmanni Montanari, Glomalveolina sp., Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobolumina sp., Lockhartia sp., Miscellaneous
Upper Ilerdian levels are represented by yellowish coloured, well-compacted sandstones, gray-yellowish coloured, dense textured sandy limestones and gray sometimes yellowish coloured, dense textured limestones from base to top. *G. lepidula* Schwager,* A. trempina* Hottinger,* Orbitalites complanatus* Lamarck,* Alveolina* sp., *Orbitalites* sp., *Operforbitalites* sp., *Lockhartia* sp., *Miscellanea* sp., *Nummulites* sp., *Assilina* sp., *Operculina* sp., *Discocyclina* sp., *Rotalia* sp. and *Gypsina* sp. were observed in these levels (Figure 5).

**Kirenler measured stratigraphic section**

This section was measured from Kirenler ridge, which is 500 m southwest of Çibanköy (Figure 2). It is situated in the Kastamonu F32 d1 quadrangle (start point: 4 561 750 - 586 200; end point: 4 561 650 - 586 250). Previously Lower-Middle Ilerdian levels were studied by Özgen (1998). In this subsequent study, basal and top levels of this section are worked. A total thickness of 59 m (7 m Thanetian, 18 m Lower Ilerdian, 26 m Middle Ilerdian and 8 m Upper Ilerdian) was measured and 35 samples collected (Figure 6). The section starts with conglomerates...
in the base and continues with sandstones with carbonate, gray sometimes yellowish colored, thin-dense textured clayey limestones toward top levels. *Haymanella paleocenica* Sirel, *Idalina sinjarica* Grimsdale, *Mississippina binkhorsti* Reuss, *Pseudocuvillierina?* sp., *Rotalia* sp., *Miscellanea* sp. and *Discocyclina* sp. were described in the levels containing sandstones with carbonate. These levels are given Thanetian age. The Lower Ilerdian levels are characterized by *Idalina sinjarica* Grimsdale, *G. lepidula* Schwager, *G. karsica* Sirel, *A. ellipsoidalis* Schwager, *Orbitolites complanatus* Lamarck, *O. megasphericus* Zhang, *Opertorbitolites lehmanni* Montanari,

<table>
<thead>
<tr>
<th>AGE</th>
<th>Sampleno</th>
<th>FOSSILS</th>
<th>LITHOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>THANETIAN</td>
<td></td>
<td></td>
<td>Conglomerate</td>
</tr>
<tr>
<td>LOWER ILERDIAN</td>
<td>7</td>
<td></td>
<td>Sandstone with carbonate</td>
</tr>
<tr>
<td>MIDDLE ILERDIA</td>
<td>18</td>
<td></td>
<td>Thin-dense textured clayey limestone</td>
</tr>
<tr>
<td>UPPER ILERDIA</td>
<td>25</td>
<td></td>
<td>Gray-dark gray yellowish colored</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>35</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 6- Kirenler section, SW Çibanköy, NW Tosya, SE Kastamonu.
Triloculina sp., Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobulumina sp. and Nummulites sp.

In the Middle Ilerdian aged levels, G. lepidula Schwager, A. ellipsoidalis Schwager, A. mossovensis Hottinger, A. corbarica Hottinger, A. ilerdensis Hottinger, A. minervensis Hottinger, A. erki Acar, Orbitolites complanatus Lamarck, O. megasphericus Zhang, Opertorbitolites lehmanni Montanari, Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobulumina sp., Asterigerina sp., Miscellanea sp., Rotalia sp. and Nummulites sp. were found. Late Ilerdian aged levels are represented by G. lepidula Schwager, A. trempina Hottinger, A. aragonensis Hottinger, Orbitolites complanatus Lamarck, Opertorbitolites lehmanni Montanari, Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobulumina sp., Asterigerina sp., Miscellanea sp., Rotalia sp. and Nummulites sp. were found. Late Ilerdian aged levels are represented by G. lepidula Schwager, A. trempina Hottinger, A. aragonensis Hottinger, Orbitolites complanatus Lamarck, Opertorbitolites lehmanni Montanari, Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobulumina sp., Asterigerina sp., Miscellanea sp., Rotalia sp. and Nummulites sp. were found. Late Ilerdian aged levels are represented by G. lepidula Schwager, A. trempina Hottinger, A. aragonensis Hottinger, Orbitolites complanatus Lamarck, Opertorbitolites lehmanni Montanari, Alveolina sp., Orbitolites sp., Opertorbitolites sp., Cribrobulumina sp., Asterigerina sp., Miscellanea sp., Rotalia sp. and Nummulites sp. (Figure 6).

BIOSTRATIGRAPHY AND DISCUSSION

In this section stratigraphic ranges of benthic foraminifera defined in the studied area are correlated with Shallow Benthic Foraminifera Biozones (SBZ) of the Tethyan Belt (Serra-Kiel et al., 1998).

Similar to Serra-Kiel et al., (1998), Idalina sinjarica Grimsdale is observed in the Thanetian-Lower Ilerdian levels of the unit (SBZ 3-6).

As in the Tethyan Belt Shallow Benthic Foraminifera Biozones (Serra-Kiel et al., 1998), Glomalveolina lepidula Schwager is found in the Ilerdian (SBZ 5-9) levels of the study area. In the Tethyan Belt Biozones, while Alveolina mossovensis Hottinger, A. subpyrenaica Leymerie and A. laxa Hottinger are shown in the lower levels of Middle Ilerdian (SBZ 7), A. corbarica Hottinger is shown in the upper levels of Middle Ilerdian (SBZ 8) and A. decipiens Schwager is shown in Middle Ilerdian (SBZ 7-8) by Serra-Kiel et al., (1998). However, these species are observed in the Middle Ilerdian levels of the northwestern Tosya region. According to Serra-Kiel et al. (1998) A. trempina Hottinger characterizes Upper Ilerdian levels (SBZ 9) in the Tethyan biozones. The same stratigraphic range has been determined for A. trempina Hottinger in the studied area. A. ellipsoidalis Schwager indicate Early Ilerdian (SBZ 6) in the Tethyan biozones (Serra-Kiel et al., 1998) and Early-Middle Ilerdian in this study. A. aragonensis Hottinger and A. ilerdensis Hottinger are shown in the Middle-Late Ilerdian (SBZ 7-9) of the Tethyan biozones (Serra-Kiel et al., 1998). The former species is found in the Upper Ilerdian levels while the latter is observed in the Middle Ilerdian levels of the studied area.

PALEOENVIRONMENTAL INTERPRETATION

Paleoenvironmental interpretations of the Thanetian-Ilerdian unit are mainly based on Alveolina species, other described benthic foraminifera and sedimentological data. As in most benthic foraminifera the test shape of Alveolina genus is an important criterion in the paleoecological studies (Hottinger, 1960, 1977, 1997; Lutherbacher, 1970; Hottinger and Dreher, 1974; Larsen, 1976; Hallock and Glenn, 1986). Hottinger (1960) stated that species of Alveolina ellipsoidalis, Alveolina subpyrenaica and Alveolina decipiens groups live in restricted platform environments with normal salinity. Similarly Lutherbacher (1970), in his study on environmental distribution of Tertiary benthic foraminifera of Tremp basin, expressed that spheric alveolinids were found in lagoonal deposits while elongated alveolinids restricted in platform deposits. Both studies revealed that Orbitolites and Opertorbitolites inhabit together with these Alveolina species in identical environmental conditions. These types of environments, where low energy conditions are dominant, are characteristic for Alveolina, Orbitolites and Opertorbitolites assemblages (Hottinger, 1960).

The presence of Upper Cretaceous limestones with larger benthic foraminifera in the stu-
died area indicates the activity of shallow water conditions during this period. The units in the region were affected from the Laramian phase of Alpin orogenesis in the end of Late Cretaceous (Ayaroğlu, 1980). Following this period sea advanced forward and covered the region in the Thanetian. The beginning of Thanetian-Ilerdian unit with a basal conglomerate, and continuing with sandstones and sandy limestone lithologies are the evidences of this transgression. Poor fossil content of Thanetian levels which is mostly characterized by small rotaliid foraminifera (Cuvillierina, Mississippina, Miscellanea, Rotalia) indicate restricted platform environment with abnormal salinity (Hottinger, 1960).

However, Lower-Middle Ilerdian levels of the unit contain abundantly Alveolina, Opertorbitolites and Orbitolites species. These fossil assemblages with porcellaneous shell walls (Grenier, 1969; Murray, 1973; Reiss and Hottinger, 1984) and boundstones and wackestones with micritic cement indicate low energy conditions. Presence of these fossil assemblages and sedimentological data show that these levels of the unit were deposited in a shallow (about 10-30 m depth) restricted platform environment with normal salinity. Starting from upper levels of Middle Ilerdian and to the Upper Ilerdian, genera Nummulites and Assilina become more dominant. These fossil assemblages indicate the development of a deep (40-80 m depth) carbonate shelf environment in this period (Henson, 1950; Hottinger, 1960; Örçen et al., 1994).

CONCLUSION

In this study paleontological investigations are carried out on Thanetian-Ilerdian unit, which outcrops in the southeast (NW Tosya) of Kastamonu. In the study area a unit, which was aged Paleocene-Eocene by previous studies conducted in the region, unconformably overlies the Bekirli Metamorphics. However this study determined that the unit is Thanetian-Ilerdian aged.

The unit begins with basal conglomerate and continues upward with sandstones, sandy limestones and limestones. The following benthic foraminifera are described: Haymanella paleocenea Sirel, Idalina sinjarica Grimsdale, Mississippina binkhorsti (Reuss) in the Thanetian levels; Idalina sinjarica Grimsdale, G. lepidula Schwager, G. subtilis Hottinger, G. karsica Sirel, A. ellipsoidalis Schwager, Orbitolites complanus Lamarck, O. megasphericus Zhang, Opertorbitolites lehmanni Montanari in the Lower Ilerdian levels; G. lepidula Schwager, G. pilula Hottinger, A. ellipsoidalis Schwager, A. mousoulensis Hottinger, A. corbarica Hottinger, A. laxa Hottinger, A. ilerdensis Hottinger, A. minervensis Hottinger, A. subpyrenaica Leymerie, A. decipiens Schwager, A. aff. pisella Drobne, A. erki Acar, O. complanus Lamarck, O. megasphericus Zhang, Op. lehmanni Montanari in the Middle Ilerdian levels and G. lepidula Schwager, A. trempina Hottinger, A. aragonensis Hottinger, O. complanus Lamarck, Op. lehmanni Montanari in the Upper Ilerdian levels. The stratigraphic range of these species presents close similarities with Tethyan Belt Shallow Benthic Foraminifera Biozones (Serra-Kiel et al., 1998) except for a few differences. The fossil assemblage and sedimentological data indicate the deposition of the Thanetian levels in restricted platform environment with abnormal salinity, the deposition of the Lower-Middle Ilerdian levels in a shallow and restricted platform environment with normal salinity, and finally the deposition of the Upper Ilerdian levels in a deep carbonate shelf environments in the region.

ACKNOWLEDGEMENT

The support of the Council of Scientific Research Projects of Cumhuriyet University is acknowledged.
REFERENCES


Henson, F.R.S. 1950. Middle Eastern Tertiary Pene roplidae (Foraminifera) with remarks on the phylogeny and taxonomy of the family. West Yorkshire Printing Co., 70p.


PLATES
Haymanella paleocenica Sirel, Thanetian

Figure 1-2- Vertical sections, megalospheric form (Kirenler section, Ncb. 2), 1-X50, 2-X40.

Idalina sinjarica Grimsdale, Thanetian

Figure 3- Axial section, megalospheric form (Kirenler section, Ncb.2), X20.

Mississippina binkhorsti (Reuss), Thanetian

Figure 4- Subaxial section (Kirenler section, Ncb.3), X30

Pseudocuvillierina? sp., Thanetian

Figure 5- Axial section, megalospheric form (Kirenler section, Ncb.3), X30

Figure 6- Equatorial section, megalospheric form (Kirenler section, Ncb. 3), X30

Glomalveolina lepidula Schwager, Ilerdian

Figure 7- Axial section, megalospheric form (Kirenler section, Ncb.7), X30.

Glomalveolina karsica Sirel, Early Ilerdian

Figure 8- Axial section, megalospheric form (Kirenler section, Ncb.9), X30.

Alveolina erki Acar, Middle Ilerdian

Figure 9- Axial section, megalospheric form (Kirenler section, Ncb.18), X20.

Alveolina ellipsoidalis Schwager, Early Ilerdian

Figure 10- Axial section, megalospheric form (Kirenler section, Ncb. 12), X20.

Alveolina corbarica Hottinger, Middle Ilerdian

Figure 11- Axial section, megalospheric form (Kirenler section, Ncb. 17), X20.

Alveolina ilderensis Hottinger, Middle Ilerdian

Figure 12- Axial section, megalospheric form (Kirenler section, Ncb. 27), X20.

Alveolina decipiens Schwager, Middle Ilerdian

Figure 13- Axial section, megalospheric form (Akçataş section, Ak.26), X20.
PLATE II

*Alveolina subpyrenaica* Leymerie, Middle Ilerdian
Figure 1- Axial section, megalospheric form (Akçataş section, Ak.8) X20.

*Alveolina aragonensis* Hottinger, Late Ilerdian
Figure 2- Axial section, megalospheric form (Kirenler section, Ncb.33) X20.

*Alveolina trempina* Hottinger, Late Ilerdian
Figure 3- Axial section, megalospheric form (Kirenler section, Ncb.32), X20.

*Alveolina aff. pisella* Drobne, Middle Ilerdian
Figure 4- Axial section, megalospheric form (Akçataş section, Ak.18), X20.

*Alveolina minervensis* Hottinger, Middle Ilerdian
Figure 5- Axial section, megalospheric form (Akçataş section, Ak.8), X20.

*Opertorbitolites lehmanni* Montanarii, Middle Ilerdian
Figure 6- Axial section, megalospheric form (Akçataş section, Ak.11), X20.

*Orbitolites megasphericus* Zhang, Early- Middle Ilerdian
Figure 7- Axial section, megalospheric form (Akçataş section, Ak. 22), X20
Figure 8- Axial section, megalospheric form (Kirenler section, Ncb.6), X20.

*Orbitolites complanatus* Lamarck, Ilerdian
Figure 9- Axial section, megalospheric form (Kirenler section, Ncb.7), X20.

*Discocyclina* sp., Middle Ilerdian
Figure 10- Axial section, megalospheric form (Akçataş section, Ak.25), X20.