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Oligocene - Miocene Boundary in Sheikh Ibrahim and Sasan Areas - NW Iraq

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ABSTRACT

Oligocene - Miocene boundary was studied in Sheikh Ibrahim and Sasan areas (west Mosul), where three core holes penetrated six formations of about 150–180 m thick, (Tarjil Fn., Ibrahim Fn., (Hamrin Fn.?), Serikagni Fn., Euphrates Fn.and Dhiban Fn.). According to paleontological studies of the formations twenty four planktic foraminiferal species and subspecies were identified. Four biostratigraphic zones were recognized (from older to younger):

Globorotalia kugleri Partial Range Zone (Late Oligocene).
Globigerinoides quadrilobatus primordius Interval Zone Early Miocene (Aquitanian).
Globigerinoides trilobus trilobus Interval Zone Early Miocene (Aquitanian-Burdgalian).
Praeorbulina transitoria - Globigerinoides diminutus Interval Zone Early Miocene (Burdgalian).

The lithological and paleontological attributs indicate that the Oligocene-Miocene boundary lies between Tarjil Fn. (Late Oligocene) and Ibrahim Fn. (Early Miocene).

الحد بين الاوليجوسين والمايوسين في منطقتي شيخ ابراهيم وسعسان شمال غرب العراق

الملخص

تم دراسة الحد بين الاوليجوسين والمايوسين في منطقتي شيخ ابراهيم وسعسان، وقد اختيرت ثلاثة ابار لبابية لهذه الدراسة حيث اخترقت ستة تكوينات رسوبية وبسمك150م–180م وهي تكوينات تارجيل وابراهيم و(حمرين؟) وسريكاكني والفرات والذيبان تعود ترسباتها لعمر الاوليجوسين المتأخر والمايوسين المبكر. ان دراسة الطباقية الحياتية ميزت اربعة وعشرون نوع وتحت نوع من الفورامنيفرا الطافية وقد حددت اربعة انطقة حياتية وهي من الاقدم الى الاحدث:

Globorotalia kugleri Partial Range Zone (Late Oligocene).
Globigerinoides quadrilobatus primordius Interval Zone (Early Miocene-Aquitanian).
Globigerinoides trilobus trilobus Interval Zone (Early Miocene,Aquitanian-Burdgalian).
Praeorbulina transitoria - Globigerinoides diminutus Interval Zone (Early Miocene-Burdgalian).

طبقاً لنتائج الطباقية الصخرية والطباقية الحياتية فان الحد بين الاوليجوسين والمايوسين يقع بين تكوين تارجيل (الاوليجوسين المتاخر) وتكوين ابراهيم (المايوسين المبكر)، وبهذه النتيجة فقد اصبح من المؤكد ان عمر تكوين ابراهيم هو المايوسين المبكر حيث درس التكوين من اللباب الصخري وقد تم مضاهاة المقطع في ثلاثة ابار مع البئر النفطي (حيث المقطع النموذجي لتكوين ابراهيم) وذلك لتاكيد عائدية المقطع الصخري.

INTRODUCTION

Oligocene - Miocene boundary has been studied in different parts of Iraq (Smout, 1960; AL-Hashimi & Amer, 1986; Abawi & Maroof, 1988; AL-Eisa, 1992) with inconclusive agreement about it chronostratigraphic position, Ibrahim Formation was promoted from Upper Oligocene to Lower Miocene in kirkuk area (AL-Eisa, 1992) and this may doubts about the correct characterization of the formation, There fore this research deals with the problem in Sheikh Ibrahim and Sasan areas (west Mosul), which is the type section area of Ibrahim Formation. Six Formations of about 150 -180m thick (Tarjil, Ibrahim, Hamrin, Serikagni, Euphrates, and Dhiban Fns.) were recognized in three core holes (SI-CH1, SS-CH13, & SS-Ch17; Fig.1). Due to unsuitablility cutting in core hole Ibrahim well No.1, a compensatory core hole SS-CH13 is chosen for a comprehensive biostratigraphic zonation, which showed very close correlation with Ibrahim well No.1 and farther support is gaind through integrated stratigraphic inspection with the other two core holes (SS-CH17and SI-CH1) concerned in this study.

The main objective of this study does not include a detailed description of facies and their interpretation as given by Al-Banna (1997), but brief recapitulation is included for elucidation.

LITHOSTRATIGRAPHY

The stratigraphic sequence of the studied section includs Tarjil Fn. of the Upper Oligocene; Ibrahim Fn. and (Hamren Fn.?) of the Lower Miocene (Aquitanian), and Serikagni Fn., Euphrates Fn., Dhiban Fn., of the Lower Miocene (Burdigalian).

Tarjil Formation: Thickness (10.0 – 20.0 m)

Tarjil Fn. was recorded in two core holes (SI-CH1, SS-CH13) about 10-20m thick; uncoformably underlain by Palani Fn. and overlain by Ibrahim Fn.

.Two microfacies were recognized, the lower one is planktic foraminiferal lime-packstone microfacies, It consists of blue-grey limestone with beds of blue claystone, these are of deep basinal deposition. The upper microfacies is benthic foraminiferal lime packstone microfacies revealing a high percentage of *Rotalia viennoti* Greig, with a lesser

amount of *Lepidocyclina, Nummulites,* miliolids, bryozoa, echinoderm spines and pelecypoda. Thin beds of conglomerate in the upper part of the microfacies indicate a progressive upward shallowing in deposition (unconformity).

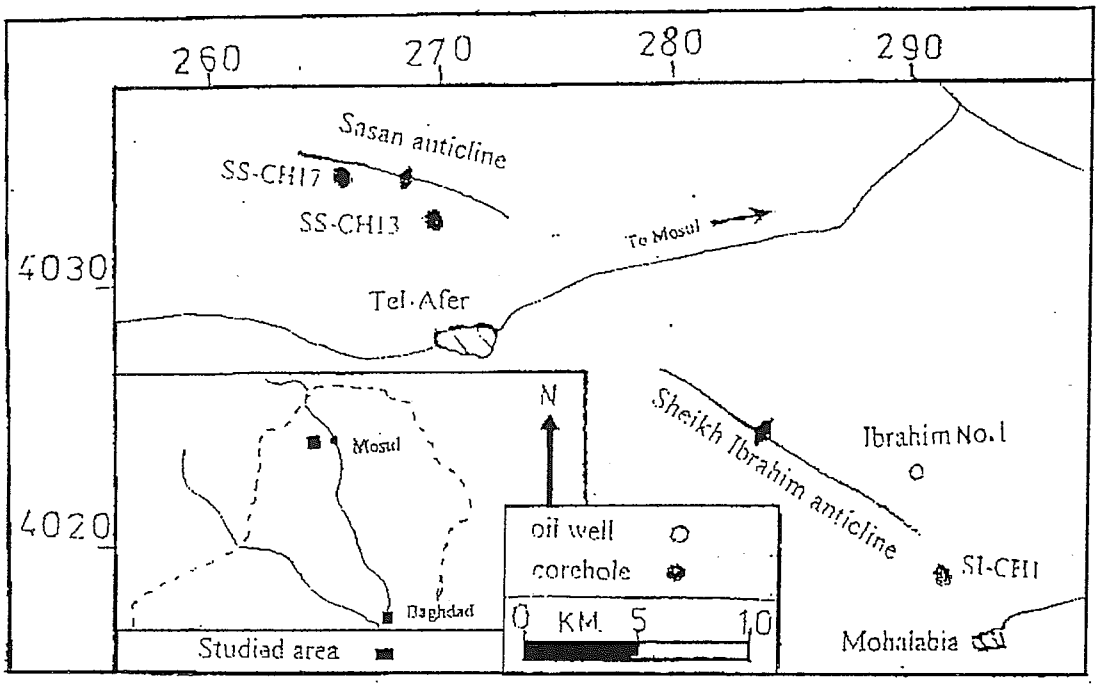

Fig.1: Location map

Ibrahim Formation: Thickness (12.0 – 14.0 m)

It is presents in core holes with 12 - 50m thick, generaly it is grey to light grey in colour, locally it is brown due to dolomitization. It is represented by planktic foraminiferal lime wackestone-packstone microfacies. It yielded a planktic foraminiferal assemblage (30-70)% including *Globorotalia*, *Globigerina*, and *Globigerinoides*. In addition the microfacies embraces a thin beds of blue claystone with parallel lamination. The microfacies having a characterstic features of open shelf deposition (Wilson, 1975).

(**Hamrin Formation?**): Thickness (4.2 – 14.0 m)

It consists of three facies, miliolidal lime packstone microfacies, anhydrite lithofacies, and lime packstone - grainestone microfacies. It is of lagoonal depostion.

Serikagni Formation: Thickness (27.0 – 64.0 m)

It includes a foraminiferal lime wackstone - packstone microfacies containing a high percentage of planktic foraminifera with red algae fragments, echinoderm spines and bryozoa in the upper part. It is of open marine and shelf deposition.

Euphrates Formation: Thickness (46.0 – 63.0 m)

It consists of assorted lime microfacies, the fossils assemblage of this microfacies are reflecting different depositional environment (fore barrier, barrier, subtidal, patch reef, and intertidal).

Dhiban Formation: Thikness (3.0 m)

It includes lime mudstone microfacies, lime grainstone microfacies and evaporite lithofacies of lagoonal and tidal flat deposits.

BIOSTRATIGRAPHY

The section in core hole SS-CH13 yielded rich planktic foraminiferal assemblage. 24 planktic foraminiferal species and subspecies belonging to five genera were recorded (plate1-2).The stratigraphic distribution of the formations and taxa is shown in figure (2), the stratigraphic distribution of the planktic foraminifera recorded in the section permits the recognition of four biozones, these are from base to top :

Globorotalia kugleri Partial Range Zone

Globigerinoides quadrilobatus primordius Interval Zone

Globigerinoides trilobus trilobus Interval Zone

Praeorbulina transitoria - Globigerinoides diminutus Interval Zone

These zones are correlated with their established equivalents (Bolli, 1957, 1970; in Trinidad), (Blow, 1969, 1979; in Tropical regions), (Bolli & Premoli Silva, 1973; in the Caribean sea), (Bolli & Saunders, 1985 in Tropical regions), (Abawi and Maroof, 1992; in NW Iraq), (Table 1).

***Globorotalia kugleri* Partial Range Zone**

Base: the base of the zone is marked by the upper part of the basal coglomerate bed of Tarjil Formation in which indicated by the initial appearance of *Globorotalia kugleri* Bolli.

Top: the top of the zone is placed below the horizon of the first occurence of frequent *Globigerinoides primordius* Blow and Manner.

Characteristics: The zone is defined as apart of the range of *Globorotalia kugleri* and below the first appearance of frequent *Globigerinoides primordius.*

Correlation: The *Globorotalia kugleri* Zone correlated with *Globorotalia kugleri* zone of (Bolli, 1957, 1970; Bolli & Premoli Silva, 1973). It is also correlated with the upper part of *Globigerina angulisuturalis* Zone of (Blow, 1969,1979). The frequent occurence of *Globorotalia kugleri* at depth (203-207) m and the frequent appearance of *Globigerinoides primordius,* above depth 200 m promote their separation into two zones which delineates the Oligocene - Miocene boundary (Bolli & Saunders, 1985).

***Globigerinoides primordius* Interval Zone**

Base: The base of the zone is placed at the horizon of the first appearance of frequent *Globigerinoides primordius.*

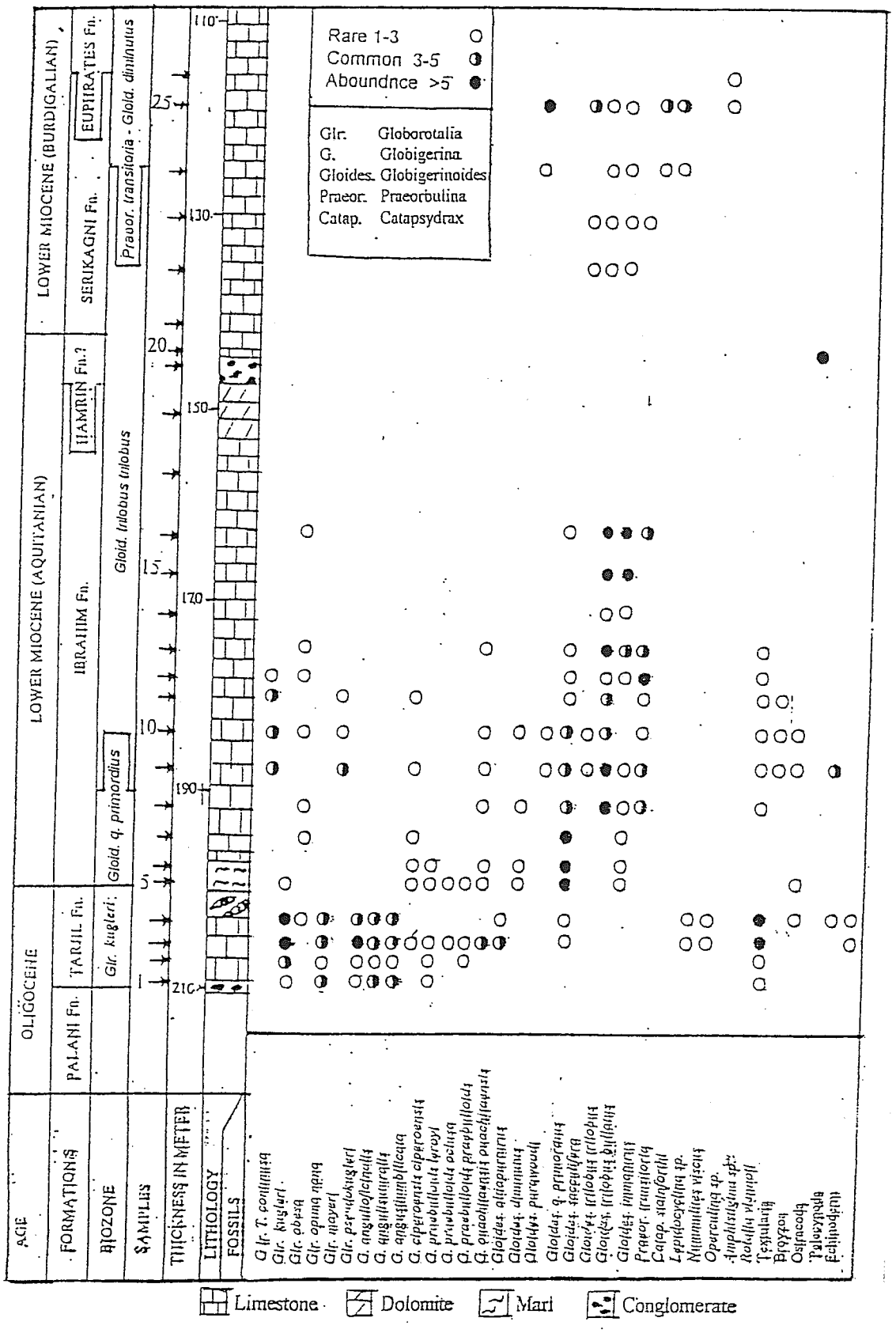

Fig.2 : Distribution of planktic foraminifera and other fossils in the Upper Oligocene-Lower Miocene Formations , in Sassan area, SS-CH13:

Table 1 :Correlation of the zonal scheme of core hole SS-CH13 with other zonal scheme

Age	Blow (1969,1979)		Bolli (1957,1970) Bolli & Premoli Silva (1973) Bolli &Saunders (1985)	Abawi & Maroof (1992)	Present work Well SS-CH 13
Lower Miocene	N.8	Gloides sicanus-Gltella insueta	Prae or. Glomerosa		Prae or. transitoria - Gloides diminutius
	N.7	Gltella insueta-Gloides trilobus	Gltella Insueta	Praeor. transitoria – Gloides sicanus	
	N.6	Gltella insueta-Glneta dissimilis	Catap. Stainforthi	Catap. stainforthi – Catap. dissimilis	Gloides Trilobus
	N.5	Globoq. praedehiscens – Globoq. dehiscens	Catap. Dissimilis	Globoq. praedehiscens – Globoq.d. dehiscens	Trilobus
	N.4	Gloides q. primordius – Glr. T. kugleri	Gloides primordius	Gloides primordius	Gloides q. primordius
Oligocene	N.3	Gl. angulisuturalis	Glr. Kugleri ——— Glr. c. ciperoensis	Gl. angulisuturalis ———	Glr. kugleri ———

Glr. Globorotalia; G. Globigerina; Gloides. Globigerinoides; Praeor. Praeorbulina; Catap. Catapsydrax

Top: The top of the zone is placed below the first appearance of *Globigerinoides trilobus trilobus* Reuss.

Characteristics: The zone is characterized by the occurence of frequent *Globigerinoides primordius* prior to the first appearance of *Globigerinoides tilobus trilobus* .

Correlation: the *Globigerinoides primordius* zone correlated with the *Globigerinoides primordius* zone (Bolli, 1957, 1970; Bolli & Premoli Silva, 1973; Bolli & Saunders, 1985) which is assigned to earliest Miocene. The zone is also equivalent to the *Globigerinoides quadrilobatus primordius / Globorotalia (T.) kugleri* zone of (Blow, 1969, 1979), which is also assigned to earliest Miocene.

***Globigerinoides trilobus trilobus* Interval Zone**

Base: The base of the zone is marked by the first appearance of *Globigerinoides trilobus trilobus* Russ.

Top: The top of the zone is placed at the first occurence of *Praeorbulina transitoria* Blow and *Globigerinoides diminutus* Bolli.

Characteristics: The zone is defined by the first appearance of the *Globigerinoides trilobus trilobus* and below the joint occurance of *Praeorbulina transitoria and Globigerinoides diminutus* .

Correlation: It is a long range zone, therefore it is correlated with N.5, N.6 zones of Blow (1969, 1979), also correlated with *Catapsydrax dissimils* zone and *Catapsydrax stanforthi* of Bolli (1957, 1970) Bolli & Premoli Silva (1973) Bolli & Saunders (1985). Which is assigned to the upper part of Aqutanian and lower part of Burdigalian.

***Praeorbulina transitoria - Globigerinoides diminutus* Interval Zone**

Base: The based of this zone is placed on the joint occurence of *Praeorbulina transitoria* Blow and *Globigerinoides diminutus* Bolli. The appearance of *Globigerinatella insuta* Cushman & Stainforth usually marks the base of the this zone has not been recorded in the samples.

Top: the top of the zone extends in the Euphrates Formation of lagoonal environment which is rich in benthic foraminifera, while the planktic foraminifera disappear so the upper part which is marked by the first appearance of the *Orbulina suturalis* has not been recorded.

Correlation: the zone is correlated with *Globigerinatella insuta* zone Bolli (1957,1970), Bolli & Premoli Silva (1973) Bolli & Saunders (1985). It is also correlated with *Praeorbulina transitoria - Globigerinoides sicanus* zone Abawi & Maroof(1992); which are assigned to late Early Miocene.

OLIGOCENE -MIOCENE BOUNDARY

Some of the previous studies have placed Oligocene - Miocene boundary between Ibrahim Fn. and Serikagni Fn. (Khider, 1983; AL-Hashimi & Amer, 1986; Abawi & Maroof, 1988; Hani, 1991), while other placed it between Tarjil Fn. and Ibrahim Fn. (AL-Eisa, 1992). The stratigraphic sequence in well (Ibrahim No.1) was given by (AL-Hashimi & Amer, 1986), they named Azkand Fn. to the section between Palani and Ibrahim Formations (Fig.3), where as the same section in other core holes in the same area is named as Tarjil Fn. for many geological reasons (AL-Banna, 1997).

In this research Tarjil Fn. revealed *Globorotalia kugleri* interval zone which is assigned to Late Oligocene, while Ibrahim Fn. revealed *Globigerinoides primordius* zone of lower Miocene; and lower part of *Globigerinoides trilobus trilobus* zone assigened to Lower Miocene (Aqutanian). On the other hand Serikagni Fn., Euphrates Fn. and Dhiban Fn. included the upper part of *Globigerinoides trilobus trilobus* interval zone and *Praeorbulina transitoria - Globigerinoides diminutus* zone assigned to the Lower Miocene (Burdigalian).

According to the lithological and paleontological lines of evidence, the Oligocene - Miocene boundary should lie between Tarjil Fn. and Ibrahim Fn. in the studied area.

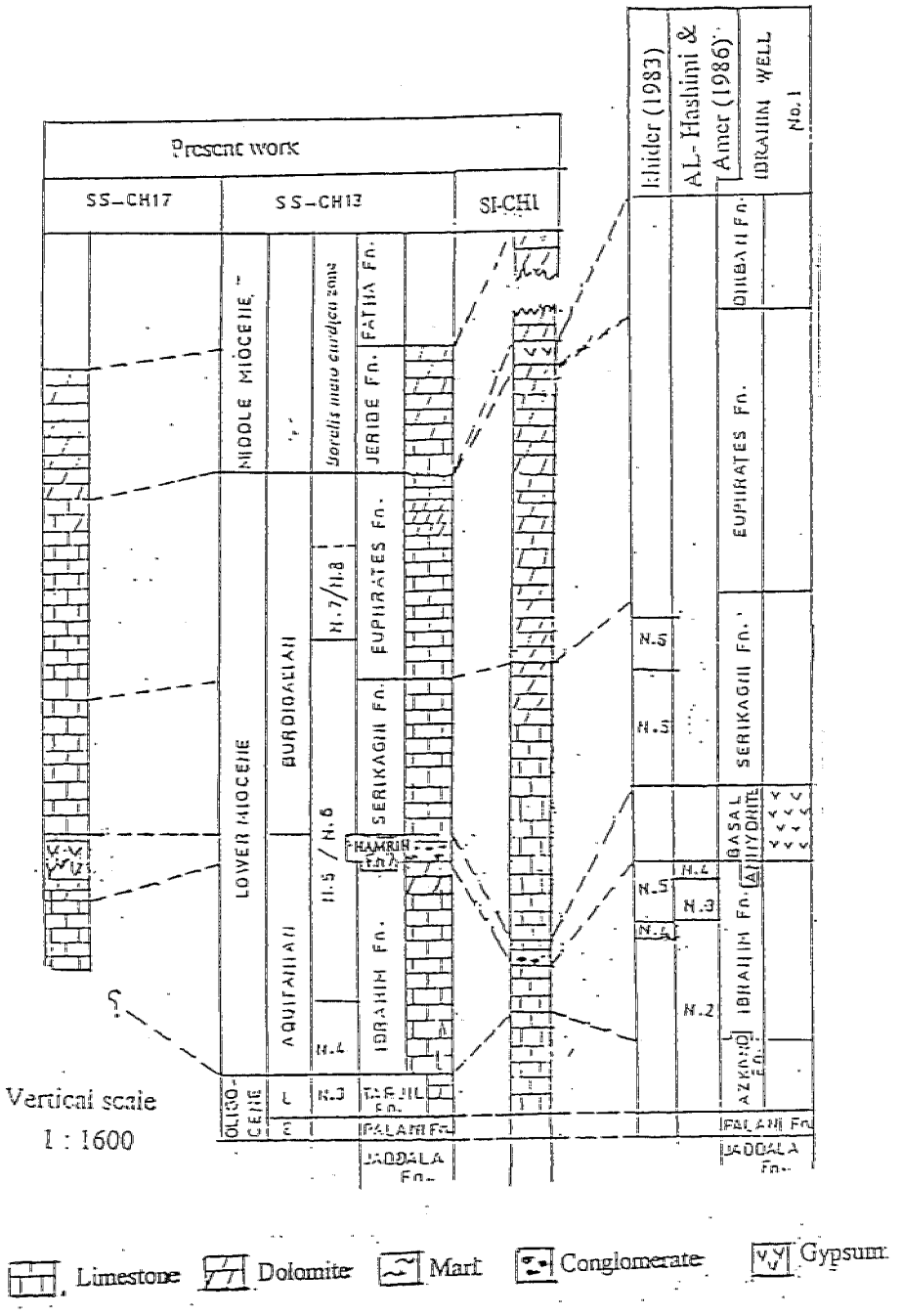

Fig.3: Correlation section of SS-CH17 ,SS-CH13 and SI-CH1 with Ibrahim well No.1

CONCLUSION

Lithological and paleontological attributes promoted Ibrahim Formation from Upper Oligocene to Lower Miocene, there fore the Oligocene - Miocene boundary lies between Tarjil Fn. and Ibrahim Fn. in the type section area of Ibrahim Formation (Sheikh Ibrahim and Sasan areas).

Based on this result the last cycle of Oligocene will include Tarjil Fn., Baba Fn. and Bajwan Fn., while the first cycle of Lower Miocene will be represented by Ibrahim Fn., Askand Fn. and Anah Fn. .

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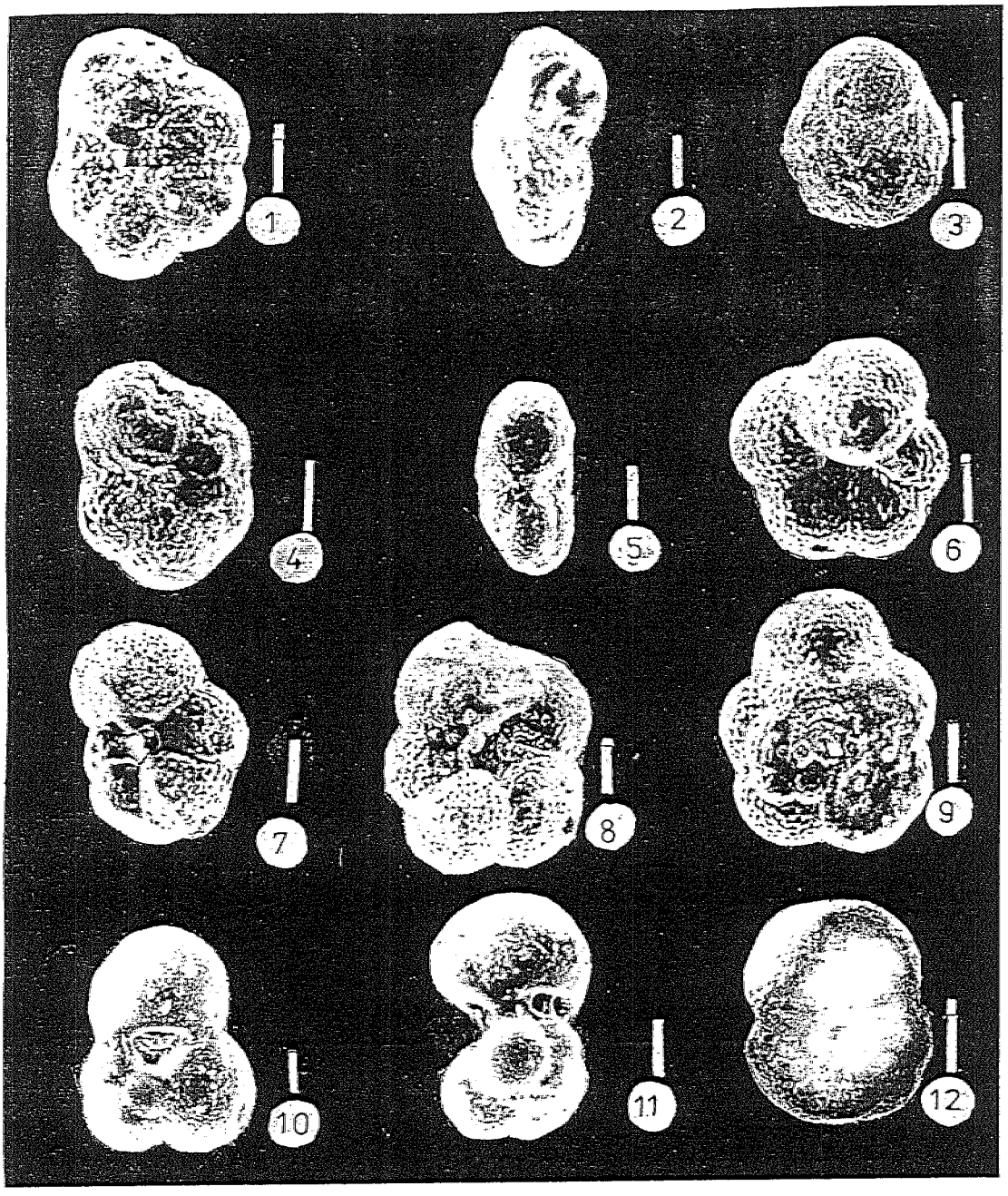

Plate-1 Core hole SS-CH13 scale 100 micron

1. *Globorotalia kuglari* Bolli, umbilicus view, depth 205.0 m. Tarjil Fn.
2. *Globorotalia kuglari* Bolli, side view, depth 205.0 m. Tarjil Fn.
3. *Globorotalia opima nana,* umbilicus view, depth 205m. Tarjil Fn.
4. *Globorotalia (T.) pseudokuglari* Blow, umbilicus view, depth 205.0 m. Tarjil Fn.
5. *Globorotalia (T.) pseudokuglari* Blow, side view, depth 205.0 m. Tarjil Fn.
6. *Globigerina angulioffícinalis* Blow, umbilicus view, depth 205.0 m. Tarjil Fn.
7. *Globigerina angustiumblicata* Blow, umbilicus view, depth 199.0 m. Ibrahim Fn.
8. *Globigerina ciberoensis ciberoensis* Blow, umbilicus view, depth 199.0 m. Ibrahim Fn.
9. *Globigerina ciberoensis ciberoensis* Blow, spiral view, depth 199.0 m. Ibrahim Fn.
10. *Globigerinoides altiaperturus* Bolli, spiral view, depth 199.0 m. Ibrahim Fn.
11. *Globigerinoides altiaperturus* Bolli, side view, depth 199.0 m. Ibrahim Fn.
12. *Globigerinoides diminutus* Bolli, umbilicus view, depth 125.0 m. Serikagni Fn.

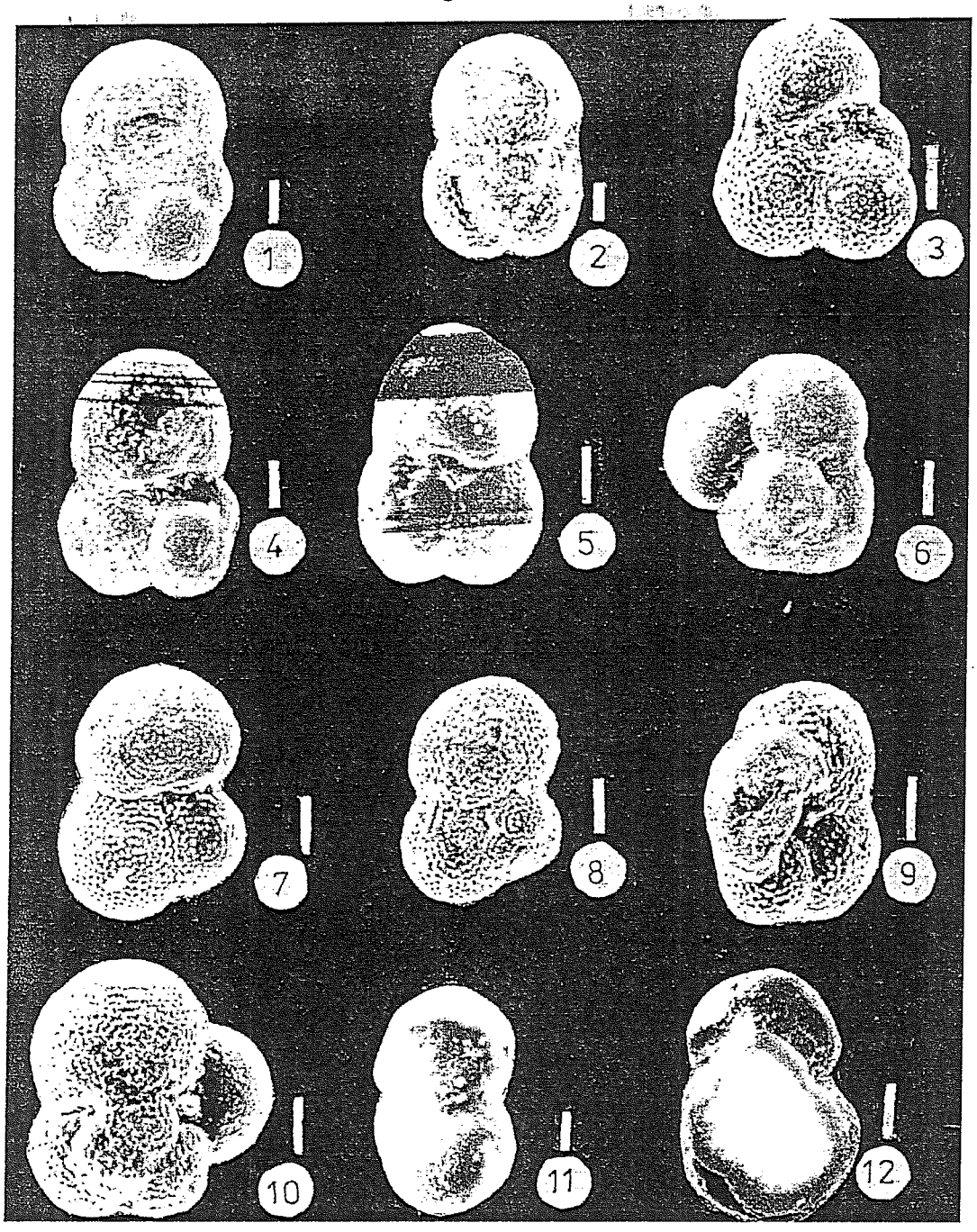

Plate-2 Core hole SS-CH13 scale 100 micron

1.*Globigerinoides immaturus* Le Roy , umbilicus view, depth 191.0 m. Ibrahim Fn.
2.*Globigerinoides immaturus* Le Roy, spiral view, depth 191.0 m. Ibrahim Fn.
3.*Globigerinoides parawood* Keller , umbilicus view, depth 172.0 m. Ibrahim Fn.
4.*Globigerinoides primordius* Blow and Manner , umbilicus view, depth 199.0 m. Ibrahim Fn.
5.*Globigerinoides primordius* Blow and Manner , spiral view, depth 199.0 m. Ibrahim Fn.
6.*Globigerinoides succulifera brady*, spiral view, depth 125.0 m. Serikagni Fn.
7.*Globigerinoides trilobus* Reuss , umbilicus view, depth 162.0 m. Ibrahim Fn.
8.*Globigerinoides trilobus* Reuss, spiral view, depth 162.0 m. Ibrahim Fn.
9.*Globigerinoides trilobus bulatus* chang , umbilicus view, depth 162.0 m. Ibrahim Fn.
10.*Globigerinoides trilobus bulatus* chang , spiral view, depth 162.0 m. Ibrahim Fn.
11.*Praeorbulina transitoria* Blow, umbilicus view, depth 125.0 m. Serikagni Fn.
12.*Praeorbulina transitoria* Blow, spiral view, depth 125.0 m. Serikagni Fn.