------ Raf. Jour. Sci., Vol.16, No.2 Geology, Special Issue, pp. , 2005 ------

Sedimentary Cycles and Microfacies Analysis of Lower Miocene Formations in Sinjar and Sharafaddin Areas, NW Iraq.

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(Received 24/8/2002 , Accepted 1/10/2002)

ABSTRACT

Two surface sections of Lower Miocene rocks were studied in Sinjar and Sharafaddin areas NW Iraq. Four formations were recognized (Ibrahim, Hamrin, Serikagni and Euphrates Formations) embracing five microfacies and one lithofacies. Their depositional environment and the recognition of unconformable surfaces elucidated the presence of two sedimentary cycles. The stratigraphic distribution of the planktic foraminifera in Sinjar section permits the recognition of three biozones, which are assigned to Early Miocene age.

الدورات الترسيبية والتحليل السحني لتكوينات المايوسين السفل في منطقتي سنجار وشرف الدين شمال- غرب العراق

الملخص

درس مقطعين سطحيين لتكوين المايوسين الاسفل شمال غرب العراق، ميز فيهما أربعة تكوينـات صخرية هي ابراهيم وحمرين؟ وسريكاكني والفرات. وقد احتوت هذه التكوينات على خمسة سحنات دقيقة وسحنة صخارية، وعكست بيئاتها الترسيبية وسطوح عدم التوافق المميزة تواجد دورتين ترسـيبيتين فـي صخور المايوسين الاسفل. أوضحت أنواع ألفورامنيفرا الطافية في مقطع سنجار عائديها الى ثلاثة أنطقة حياتية تعود لعمر المايوسين المبكر.

INTRODUCTION

Two surface sections of Lower Miocene rocks were studied near Sinjar area (in the southern limb of Sinjar anticline) and in Sharafaddin area (in the northern limb of Sinjar anticline) (Fig.1).

The Lower Miocene rocks included Serikagni, Euphrates and Dhiban Formations (Bellen et al., 1959; Buday, 1980; Al-Hashimi and Amer, 1985). While in Kirkuk area Al-Eisa (1992) mentioned that Lower Miocene rocks consist of two cycles, the first is comprised of Ibrahim, Azkand and Anah Formations, whereas the second is comprised of Serikagni, Euphrates and Dhiban Formations. The same results in Sheikh Ibrahim and

Sasan areas given by (Al-Banna, 1997; Al-Banna et al., 2002) and they added a new unit (Hamrin Formation?) to the first cycle.

Sedimentologic and biostratigraphic studies of the surface sections are use to charactrise the sedimentary cycles, formations and age.

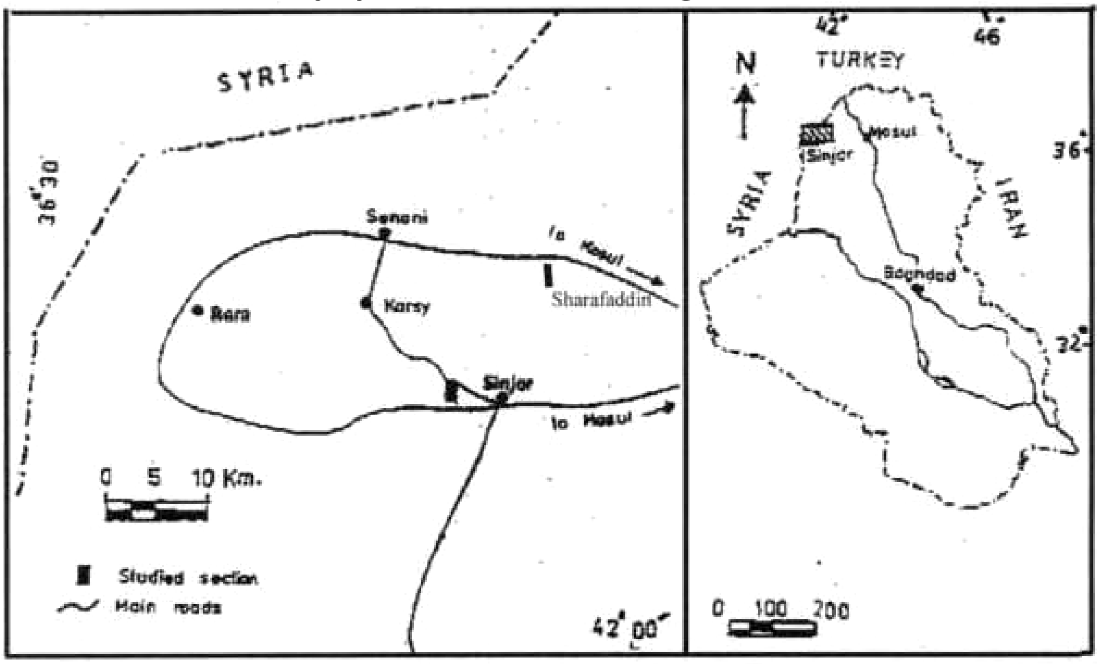

Fig.1: Location map.

LITHOSTRATIGRAPHY

Lithological studies are based on 41 samples collected from Sinjar and Sharafaddin surface sections. The sedimentary facies and their environmental subdivisions established the presence of four formations with about 105-175m thickness, represented by Ibrahim, Hamrin?, Serikagni and Euphrates Formations (Figs.2-3).

Ibrahim Formation:

The formation is represented by pale brown limestone rocks, It is unconformably overlying the Tarjil Formation (Oligocene) and conformably overlained by (Hamrin Formation?) in sharafaddin area. Two microfacies were recognized in Ibrahim Formation.

Lime mudstone microfacies: (Sh1)

This microfacies is represented by pale browen limestone and marly limestone with thicknees ranging between 10-28m. Allochems percentages are less than 10% mainly belonging to planktic foraminifera assemblages of *Catapsydrax*, *Globigerinodes*, *Globigerina* and *Globorotalia*. Microspar cement filling some forams was recognized. All the evidences are indicative of outer shelf environment and it is match to SMF3 within FZ3 (Flugel, 1982). "Lime

wackestone - packstone microfacies: (Sh2)

The microfacies is characteristically yellowish to pale brown limestone and marly limestone with thickness ranging between 8-20m. The allochems percentage ranges between 20-70 % and typified mainly by diverse Early Miocene planktic foraminifera

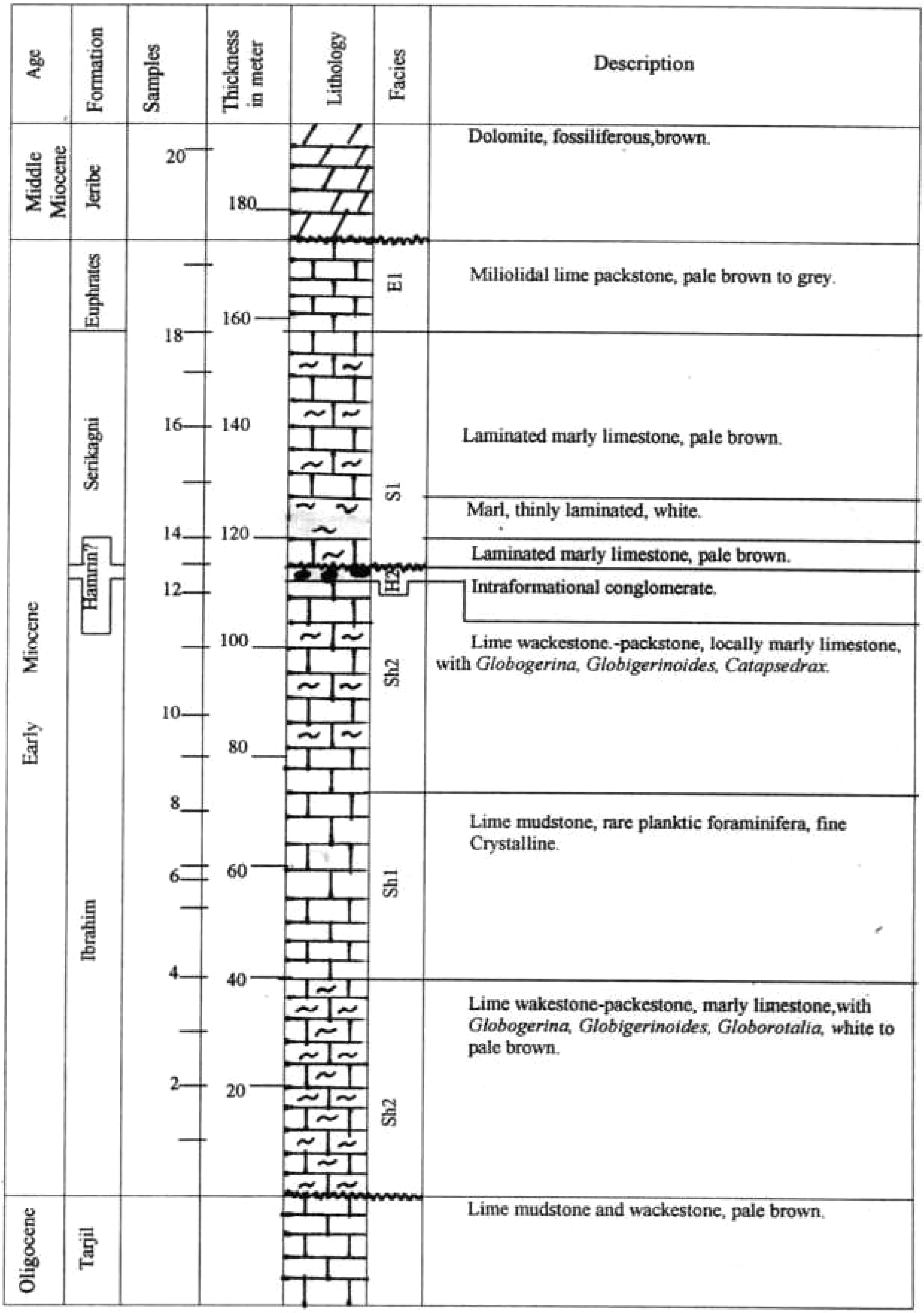

Fig. 2: Lithological section of Sharafaddin area

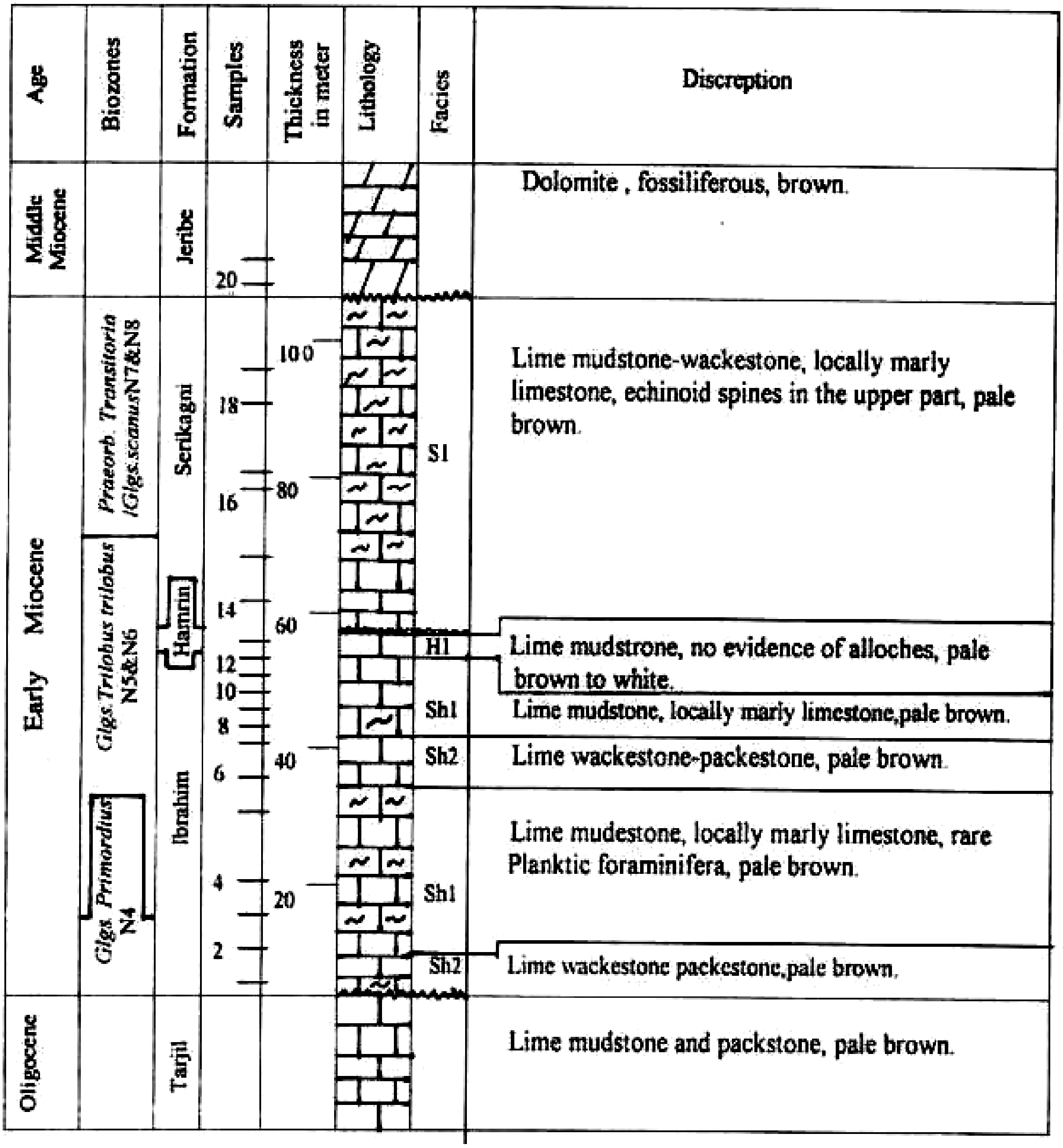

Fig.3: Lithological section of sinjar area.

species belonging to *Globigerinoids*, *catapsydrax*, *Globigerina*, and *Globorotalia* (Fig.4), in addition to the rare occurrence of benthic foraminifera belong to *Lenticulina*, *Eponides and Uvigerina*. All the paleontological attributes indicate an upper bathyal environment with water depth ranging between 200-600m (Miller et al., 1985; Berregren and Miller, 1989) and it is correlated with SMF3 within FZ1 (Flugel, 1982).

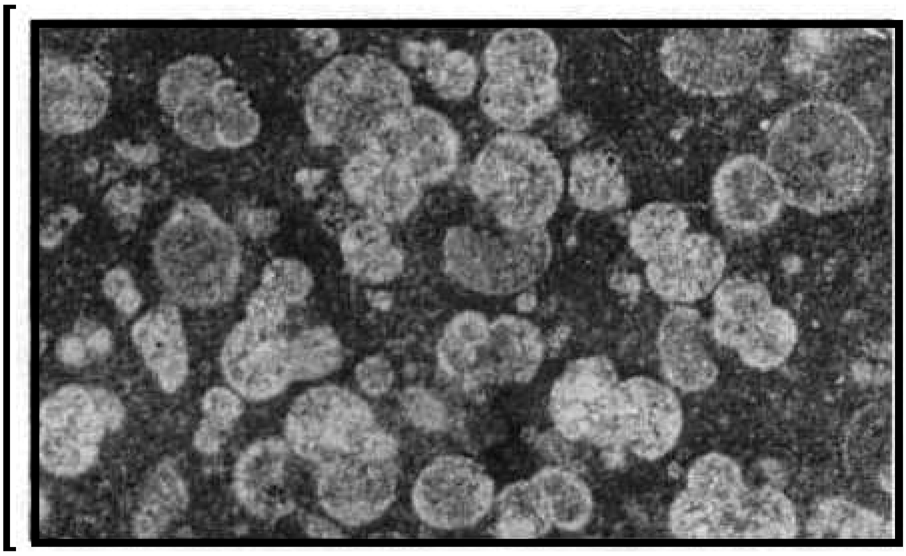

Fig. 4: Lime wackestone-packstone microfacies (Sh2), X40, depth 10m Ibrahim Formation, Sinjar section.

Hamrin Formation:

The unformal name of (Hamrin Formation?) was given by Ahmad and Al- Eisa (1996) to the lithounit between Ibrahim and Sirikagni Formations, which consists of three beds (dolomite, anhydrite and miliolidal limestone beds) in Hamrin well no.2. Recently Al-Banna, (1997); Al-Banna and Amin, (2000) amended that the formation included also lime conglomerate lithofacies. Accordingly, common surability in opinion among recent research is that there is an alternatively justaposed lagoonal deposits and / or exposure surface between Ibrahim and Serikagni Formations, which can be named as (Hamrin Formation?).

Lime mudstone microfacies: (HI)

This microfacies is displayed as 4.0 meter bed of fine crystalline limestone. No evidence of allochems is found; it consists domineering of micrite which mainly accumulates in shallow warm water of a restricted platform there fore it can be compared with the SMF22 within FZ8 (Wilson, 1975; Flugel, 1982).

Intraformational conglomerate lithofacies: (H2)

The facies consists of 2.0 meter of conglomerate embracing carbonate pebbles ranging in size between 5cm to 20cm some of them having sharp edge (Fig.5). Equicrystalline and drusy cement show high abundance in this facies. It extends laterally for hundreds meters, the microfacies is sandwiched between Ibrahim and Serikagni Formations.

The available criteria suggested that this type of conglomerate is an intraformational conglomerate accumulated in the shallowest part of the basin. Fabrics of the cement probably indicate that the facies was located to the vadose zone or exposed to the surface.

Fig. 5: Intraformational conglomerate lithofacies, (Hamrin Formation?) in Sharafaddin section.

Serikagni Formation:

The formation consists of Globigerinal limestone as it was described by Bellen, 1957 in Bellen et al., 1959). In the studied sections the formation is characterised by pale brown lime mudstone-wackstone microfacies. Serikagni Formation is unconformably overlying (Hamrin Formation?) and conformably underlying Euphrates Formation in Sharafaddin area, while it is unconformably overlying (Hamrin Formation?) and underlying Jeribe Formation in Sinjar area. One microfacies was recognized in Serikagni Formation:

Lime mudstone - wackestone microfacies : (Sl)

The microfacies described as pale brown to white limestone and marly limestone, generally laminated. Planktic foraminifera forming the main allochems, their percentage ranging between 5-40% of the total facies content, the fauna is represented by *Globigerinoides, Preaorbulina and Globigerina*. Benthic foraminifera appear with low diversity represented by *lenticulina, Anomalina and Cibicidoides*. The wackestone found in the lower part of the microfacies, while it becomes mudstone in the upper part with the presence of echinoid spines indicating nearness to open marine outer shelf environment. It can be matched with SMF8 within FZ.2 (Flugel, 1982).

Euphrates Formation:

The formation is composed of shelly and chalky, well bedded recrystalhzed limestone in the type section near wadi Fuhaimi in west Iraq (Bellen et al., 1959). The previous studies of the formation outlined spectrum of depositional environment included fore barrier, barrier, subtidal, patch reef and intertidal (Kamal, 1988; Al-Mola, 1990; Al-Banna, 1997; Al-Banna et al., 2000). The formation appear in Sharafaddin area with 18m thickness, it consists of one microfacies.

Miliolidal lime packstone microfacies: (El)

This microfacies is characteristically yellowish grey limestone, allochems attaining 75% of the total content. They consist mainly of benthic foraminifera represented by miliolid (*Quinqueloculina, Triloculina, Spiroloculina), Nonion, Bolivina , Nonionella and Ammonia beccari* (Linne). The occurrence of miliolid imposes high salinity lagoonal environment with depth less than 40m (Wilson, 1975; Hidly and Adams, 1976) it is counterpart in SMF 18 in Z7(Flugel,1982).

BIOSTRATIGRAPHY OF SINJAR SECTION

The studied Sinjar section yielded abundant and good preserved planktic foraminiferal assemblages in some interval, while it show rare occurrence at levels 33m, 60-70m thick and absence at level 55m. Twenty two planktic foraminiferal species and subspecies belonging to seven genera were recorded from the studied section, the stratigraphic distribution of the planktic foraminifera permits the recognition of three biozones within Ibrahim, Hamrin? and Serikagni Formations (Fig. 6), these are from base to top:

Globigerinoides primordius Zone.
Globigerinoides trilobus trilobus Zone.
Praeorbulina transitoria- Globigerinoides sicanus Zone.

The present zones are correlated with similar zones established by Bolli (1957,1975) in Trinidad, Blow (1969,1979) in Tropical regions worldwide, Bolli andPremoli Silva (1973) in the Caribean sea, Bolli and Saunders, (1985) in the low latitude regions and by Lidz and McNeill, (1995) in Great Bahama Bank. It is also correlated with studies done in Iraq by Abawi and Maroof (1992) in Sinjar area and by Al-Banna et al. (2002) in Sheikh Ibrahim and Sasan areas (Fig.7).

***Globigerinoides primordius Partial Range Zone*.**

Base: The base of this zone is placed at the horizon of the first appearance of frequent *Globigerinoides primordius* BlowandBanner, which is represent the Oligocene/Miocene boundary.

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

Thickness: 14m.

Characteristics: The most important criteria for recognition of this zone are frequent occurrence of the nominated taxon, plus the occurrence of other species as shown in Fig. 7.

Correlation: the *Gigs. primordius* Zone is correlative to the *Gigs. Primordius* Zone of Bolli, 1957, 1970; Bolli and Premoli Silva, 1973; Bolli and Saunders, 1985; Abawi and Maroof, 1992; Lidz and McNeill, 1995 and Al-Banna et al., 2001. All the previous zones are assigned to Earlist Miocene age equivalent to zone N4 of (Blow, 1969, 1979).

***Globigerinoides trilobus trilobus* Partial Range Zone.**

Base: The base of the zone is marked by the first appearance of Gigs. *Trilobus trilobus* Reuss.

Top: The top of the zone is marked by the last occurrence of *Catapsydrax dissimilis* Cushman and Bermudez.

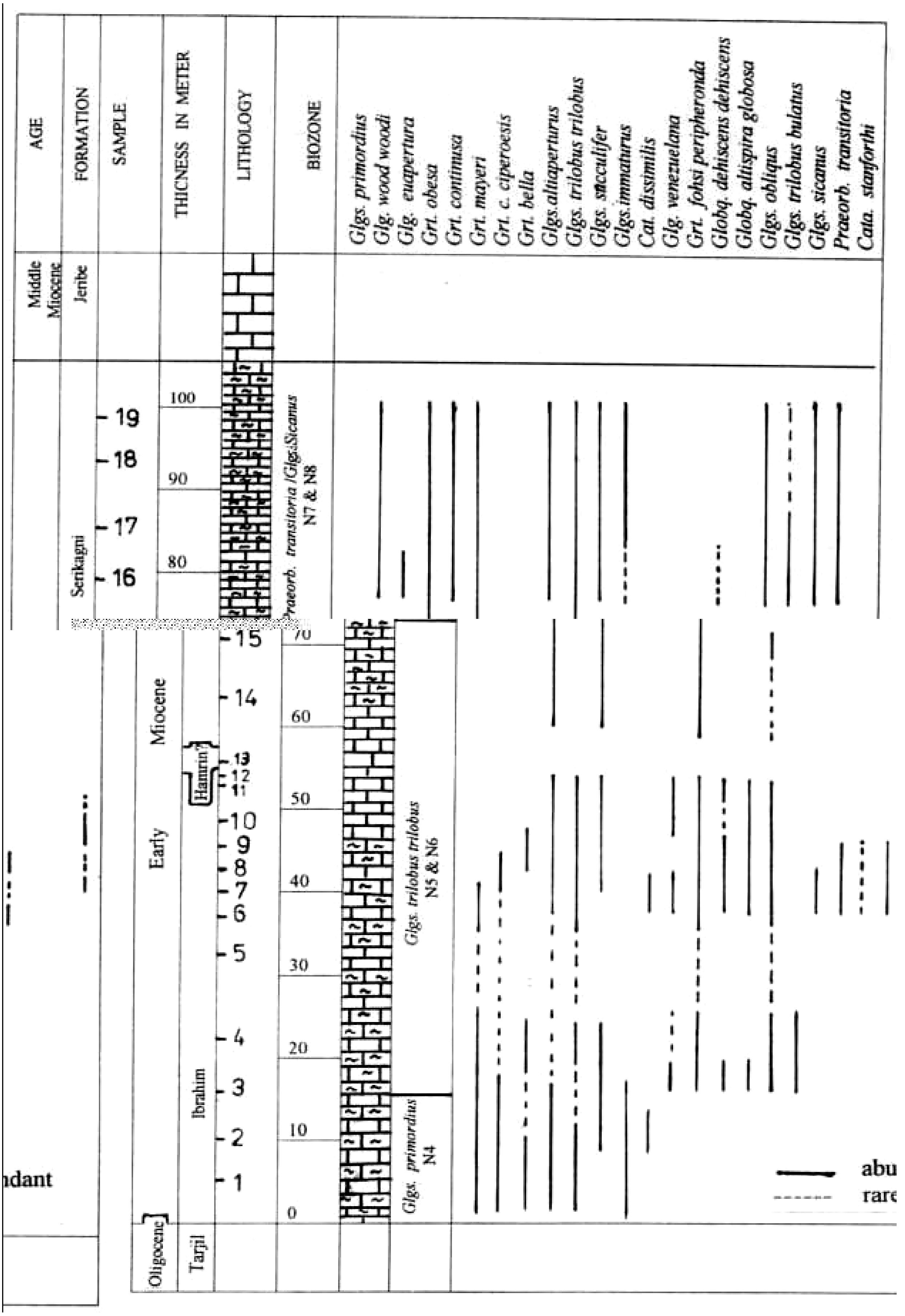

Fig. 6: Distribution and biostratigrabhic zonation of planktic foraminifera in Sinjar section

Thickness: 59m

Characteristics: The zone is defined as the partial range zone of the nominate taxon from its first occurrence to the last occurrence of *Catapsydrax dissimilis*.

Correlation: Based on faunal assemblage the present zone is correlated with N5 and N6 Zones of Blow (1969, 1979), it also correlative to *Catapsydrax dissimilis* Zone and *Catapsydrax stanforthi* Zone of Bolli (1957, 1970); Bolli and Premoli Silva (1973); Bolli and Saunders (1985) and Lidz and McNeill (1995). All these ones are assigned to the Early Miocene (Late Aqutainian and Early Burdigalian).

Praeorbulina transitoria-Globigerinoides sicanus **Assemblage Zone.**

Base: The base of this zone is marked by the extinction of *Catapsydrax dissimilis*.

Top: The top of the zone is placed at the disappearance of all planktic species at the contact between Serikagni and Jeribe Formations.

Thickness: 27m.

Bolli(1957,1970);Bolli &Premoli Silva (1973); Bolli and Saunders (1985), Lidz&McNeill (1995)	Blow (1969,1979)		Abawi & Maroof (1992)	Al - Banna et al., (2002)	Present work
Praeorb. glomerosa	N8	*Glgs. sicanus-Glgtella isueta*	------------------ *Praeorb. transitoria-Glgs. sicanus*	*Praeorb. transitoria-Glgs. diminutius*	*Praeorb. transitoria-Glgs. sicanus*
Glgtella. insueta	N7	*Glgtella. insueta-Glgs. trilobus*			
Catap. stainforthi	N6	*Glgtella. insueta-Globigerinita disimilis*	*Catap. stainforthi-Catap. dissimilis*	*Glgs. trilobus trilobus*	*Glgs. trilobus trilobus*
Catap dissimilis	N5	*Globoq. praedehiscens-Globoq.d. dehiscens*	*Globoq. praedehiscens-Globoq.d. dehiscens*		
Glgs. primordius	N4	*Glgs. primordius-Grt.(T.) kugleri*	*Glgs. primordius*	*Glgs. primordius*	*Glgs. primordius*

Abbreviations: *Glgs*: *Globigerinoides*; *Catap*: *Catapsydrax*; *Grt*: *Globoeotalia*; *Glgtella*: *Globogerinatella*; *Praeorb*: *Praeorbulin*a; *Globoq*: *Globoquadrina*.

Fig.7: Correlation of the zonal scheme with other zonal schemes.

Characteristics: The zone is defined by the concurrent ranges of the nominate taxa above the last occurrence of *Catapsydrax disimilis* to the upper boundary of Serikagni Formation were all the planktic species disappeared.

Correlation: Based on the faunal assemblage the zone is equivalent to the *Globigerinatella insueta/Praeorbulina glomerosa* Zone of Bolli, (1957, 1970; Bolli and Premoli Silva (1973), Bolli and Saunders (1985) and Lidz and McNeill (1995). The zone is also correlated with the N7 and N8 Zones of Blow (1969, 1979) which are assigned to late Early Miocene

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LOWER MIOCENE SEDIMENTARY CYCLES

The two studied sections of Lower Miocene start with unconformity surface between Tarjil Formation (Oligocene) and Ibrahim Formation (Lower Miocene) This unconformity surface was also recorded by Al-Eisa (1992) in Kirkuk area and Al-Banna (1997); Al-Banna et al. (2002) in Sheikh Ibrahim and Sasan areas.

The upper part of the Oligocene consists of benthic wackestone microfacies, which is including pelecypod shells and echinoid assemblages as indication of shallow marine environment (Al-Banna and Al-Mutwali, 2002).

The lithologic sections of the studied rock displayed two sedimentary cycles (Fig. 2and3). The first one started with lime wackestone-packstone microfacies (Sh2) (8-40m thick) of deep marine environment, as a result of sea transgression following the latest Oligocene regression. Then lime mudestone microfacies (Sh1) of about 20-33 meter thick overleis microfacies (Sh2) with the accompanying low sea level fall; as there is no evidence of exposure surface or shallow marine environment found in this microfacies, but it is shallowness than microfacies (Sh2). Its upper boundary shows transitional change to lime wackesfone-packstone microfacies (Sh2) with thickness ranging between (6-32m) signaling the second transgression. Microfacies (Sh2) overlain by microfacies (Sh1) of (10m) thick, which are followed by, lime mudstone microfacies (HI). The upper boundary of this package was sharp in Sinjar section, while microfacies (Sh2) (in Sharafeddin area) is unconformably overlain by intraformational conglomerate microfacies (S2) with two meter thick. Shortly the first cycle was bounded by two unconformable surfaces embracing two sea level drops, which are represented by two parasequence in sequence stratigraphic nomenclatures (23-5 ~ 19.0 m.y).

Lithostratigraphic correlation of the studied sections with core hole SS-CH13in Sasan area (Al-Banna, 1997; Al-Banna et al., 2002) (Fig.8) and other studies (Al-Eisa, 1992) elucidated that Sinjar section (0-56m) and Sharafaddin section (0-114m) belonging to Ibrahim and Hamrin Formations, which are representing the first Lower Miocene cycle. The second cycle started by wackestone- mudstone microfacies overlying Hamrin Formation gives an indication of the second cycle transgression. The microfacies is laminated and become rich in mudstone in the upper part with the appearance of echinoid spines. Their thicknesses ranging between (20 - 47 m). The upper boundary is sharp and overlain by the Jeribe Formation (Middle Miocene) in Sinjar area as the end of the Lower Miocene cycles. While in Sharafaddin area, the microfacies (Sl) transitionally changes to miliolidal lime packstone microfacies typical of lagoonal environment. Its upper boundary is sharp with Jeribe Formation.

The lithostratigraphic correlation of the second cycle with core hole SS-CH13 in Sasan area (Al-Banna et al., 2002) (Fig. 8) and other studies (Al-Esia, 1992) shows that the sections (56-116m) and (114-175m) are belonging to Serikagni and Euphrates Formations.

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