BIOMETRIC ANALYSIS OF *LEPIDOCYCLINA(NEPHROLEPIDINA)* AND MIOGYPSINIDS FROM BABA AND AZKAND FORMATIONS (OLIGOCENE-MIOCENE) IN KIRKUK AREA, IRAQ

A THESIS

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THIS THESIS IS DEDICATED

TO

THE SPIRITS OF MY PARENTS,
MY WIFE (JWAN) AND MY TWO CHILDREN (HAMA AND DEYA),
MY BROTHERS AND SISTERS, AND ALL THOSE WHO LOVE ME

WITH MY LOVE AND RESPECT

IMAD

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Summary

The investigation is based on a well exposed and subsurface sequence of bioclastic limestone in Qarah Chauq Dagh section, and Kirkuk well-19, Bai-Hassan well-4 and Khabaz well-3 sections. The carbonates were deposited in a shallow open marine environment during Chattian to Aquitanian. Test of larger foraminifera *Lepidocyclina(Nephrolepidina)* and *Miogypsina* are abundant in the lower and upper parts of the carbonate succession. The internal morphology of the test has been thoroughly investigated.

Biometric research on *Lepidocyclina(Nephrolepidina)* reveals many morphometric series of *Lepidocyclina(Nephrolepidina)* includes that both the primitive and the youngest of *Lepidocyclina(Nephrolepidina)* lineage. These species are *Lepidocyclina(Nephrolepidina)praemarginata* from Chattian and *Lepidocyclina(Nephrolepidina)tournoueri* from Aquitanian respectively. The variation in the A_i-C combination is rather wide along this road, which causes quite a few exemplum intercentrate determinations, represented by *Lepidocyclina(Nephrolepidina)ex. interc. praemarginata-morgani* (Chattian) and *Lepidocyclina(Nephrolepidina)ex. interc. morgani-tournoueri* (Aquitanian).

Biometric analysis on *Miogypsina* reveals that the oldest species of *Miogypsina* are present in the lower part of the Khabaz well-3 and Qarah Chauq Dagh sequence represented by *Miogypsinoides complanata* and *Miogypsinoides formosensis*. The early Miocene association of the *Miogypsina s.s.* is often accompanied by associations of *Miogypsinoides*. Most of these are close to *Miogypsinoides bantamensis*. On the basis of the mean embryon size two types of assemblage of *Miogypsinoides* could be distinguished in the Early Aquitanian sediments. Type I with the smaller embryon (DI = 110-125 µm) resembles associations reported from African localities and Type II with the

larger embryon (D1 = 210-230 µm) conforms to associations known from the European stock. The data set for the main lineage of *Miogypsina* exhibit a distinct overall change in morphology of the nepiont, which change is in agreement with the principle of nepionic acceleration as defined by Tan Sin Hok.

The evolutionary trend in *Lepidocyclina(Nephrolepidina)* species corresponds to the lineage in the Europe-Mediterranean area which started at some level in the polygenetic middle part of the Oligocene continued upwards into the Early Miocene. The lineage shows progressive complication in preimbryonic chambers represented by an increasing in factors (C and A_i) and decreasing in factor (α).

It is clearly visible that evolution trend in *Miogypsina* depends on the gradual change in the mean values of (X) in encompassing the species, the early frequency of *Miogypsina s.s.* with mean values of (X= 9-12), recorded from lower part in sections associated with old Chattian *Miogypsinoides complanata* and *Miogypsinoides formosensis* with their mean values of (X) between (13-19).

Another frequency of the *Miogypsina s.s.* has occurred in the upper part of Azkand Formation with mean values of (X) between (9-11) represented by *Miogypsina gunteri-tani,* which occurred simultaneously with *Miogypsinoides bantamensis* with their mean values of (X) between (10-13).

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Chapter One

INTRODUCTION

1-1 Preface

Many groups of Orbitoidal Larger Foraminifera have been investigated with the application of biometric methods, in accordance with the evolutionary "Principle of nepionic acceleration" (Tan Sin Hok, 1932; 1936a,b; 1937; Bronimann, 1940; Drogger; 1952; 1963).

Recently another theory has been emphasized more strongly. It states that evolution shows a step-like pattern, i.e. instant changes are alternating with longer periods of stagnancy. (Drooger, 1984)

The Lepidocyclinidae and Miogypsinidae have been thoroughly investigated from different areas all over the world (e.g. Drogger, 1963; Raju, 1974; De Mulder, 1975; Geeraets, 1983: Chaproniere, 1984; Schiavinotto, 1985, Drooger and Laagland, 1986; Drooger and Rohling, 1987; Adam,1984, 1987; Matsumara, 1990; Rajue, 1991; Wildenborg, 1991,; Drooger, 1993; Saraswati, 1994, Ulrike, 1998; Boudagher-Fadel & Bnanner, 2000; Saraswati & Arunkumar, 2000; Muthukrishnan & Saraswati, 2001; Boudagher-Fadel, 2002; Saraswati, 2003).This has resulted in a clear picture of the major evolutionary lineages of the *Lepidocyclina(Nephrolepidina)* and Miogypsinids. As a consequence we have a good basis for our more detailed research.

The Oligocene-Miocene carbonates successions of the northeast Iraq were deposited in shallow open marine environment during Chattian to Aquitanian time interval. Tests of the larger foraminifera *Lepidocyclina (Nephrolepidina)* and *Miogypsina* are abundant in the lower and upper parts of the carbonate succession. The internal morphology of these tests has been thoroughly investigated. We will try to deduce the role of different evolutionary processes which had shaped the time series established for our *Lepidocyclina(Nephrolepidina)* and *Miogypsina*. The its last appearance at the end of the early lower Oligocene (i.e. the Cassigerinella chipolensis- Pseudohastegerina micra Zone of (Bolli , 1966) is found together with the *Globigerina ampliapertura* Bolli and made their last occurrence immediately below the first occurrence of *Globorotalia opima* Bolli. The Lower Oligocene of pelagic facies in Iraq may be condensed and reduced to few meters. Therefore, the Globigerina ampliapertura Zone represents lower to early middle Oligocene (Blow, 1969).

The Oligocene carbonate which is called Kirkuk group comprises from nine Formations [Anah , Bajwan, Shurau , Azkand, Baba , Sheikh Alas, Ibrahim, Tarjil and Palani]. (Bellen et al., 1959). It forms a sequence of reef –contiolled sediments of Oligocene age, in which three separate " cycles " can be distinguished, but Ditmar et al., (1971) laid the third cycle in Lower Miocene(Aquitanian) as shown in figure(1) .

The Miocene sequence in Iraq is relatively more represented than the Oligocene, although it occupied almost the same area and have the same trend, but it extends further southward. (Jassim and Karim, 1984).

In the neritic facies, the first appearance of *Miogypsina* marks the beginning of the Miocene. As well as, the first appearance of *Borelis melo curdica* Recheli. Announce the beginning of Middle Miocene. The Upper Miocene and the younger sediments, which prevailed over most Iraqi territory, have a continental facies. (Al-Hasshimi and Amer, 1985).

Age \ Facies		Reef/Back Reef	Fore Reef	Off-Shore
Miocene	Aquitanian	Anah	Azkand	Ibrahim
Oligocene	Chattian	Bajwan	Baba	Tarjil
	Rupelian	Shurau	Sheikh Alas	Palani

Fig.(1): Litostratigraphic units of Kirkuk Group subdivision is based on age, facies and the relationships between reef /back reef , fore reef and off-shore facies . (Modified from Bellen et al., 1956).

future reward may be that for at least part of the Oligocene –Miocene larger foraminifera can furnish evolutionary lineages which are as good as the zonation based on the planktonic organism.

The Oligocene – Miocene carbonates successions of the Northeastern Iraq are interesting from both stratigraphic and paleontological point of view. In this thesis, special attention will be paid to biometrical analyses on the successive entries of representatives of the foraminiferal *Lepidocyclina (Nephrolepidina)* and *Miogypsina* from Oligocene – Miocene paleontological configurations.

1-2 Geological framework

The Oligocene sediments in Iraq have relatively restricted area of distribution , and are reduced in thickness too (Bellen, 1956).

The Oligocene is less represented than the Eocene. It occupied limited area, located mainly within the Mesopotamian and most totally missing (Jassim and Karim, 1984). The formations of Oligocene are separated by break and unconformity from both underlying and overlying units. A characteristic feature of the Oligocene is the absence of the molasses sediments in the fore deep and the relatively narrow stripe of their distribution. On the other hand , the Oligocene together with the upper parts of the Eocene mark the formation on a new basin , occupying till that time , mostly emerged Khleisia uplift and the area of the Stable Shelf in the north of the Euphrates river(Buday,1980). The continuous sedimentation from the upper Eocene to lower Oligocene, particularly in the pelagic facies is not confirmed. There is some doubt about it. The Cassigerinella chipolensis- Pseudohastegerina micra Zone of Carebian (Bolli,1966); P.18 and P.19 zones of tropical region (Blow,1969) and Globigerina tapuriensis Zone and Globigerina selli –Globanomalina parbadoensis Zone of Syria (Bolli and Krasheninnkov, 1977) which represent the early Lower Oligocene are not recognized in the Iraqi sequence. But the taxon *Globanomalina micra* which is supposed to make

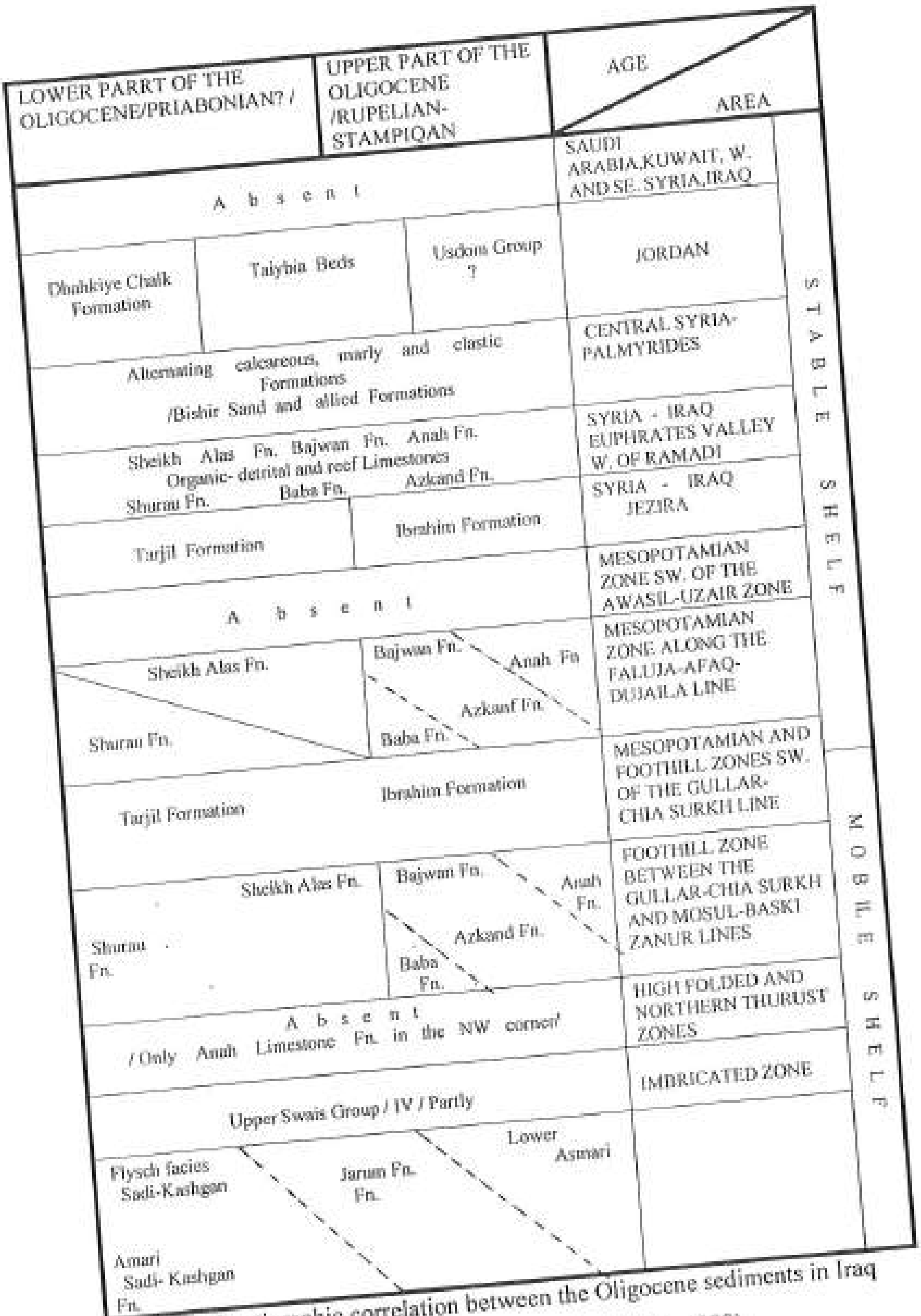


Fig.(2): Stratigraphic correlation between the Oligocene sediments in Iraq with the surrounding countries. (After Buday, 1980)

The Oligocene carbonate can be correlated with formations in the surrounding countries as seen in (Fig. 2)

1-3 Location of the studied area

The studied areas which include Kirkuk, Bai-Hassan, Khabaz, and Qarah chauq Dagh structures, located at the Himmerin-Makhul subzone – Foot hill zone of the unstable shelf area. (Buday and Jassim, 1987)

According to Al- Kadhimi et.al. (1996), the studied area is located along the Himmeren subzone which belongs to the Foot hill zone of the unstable shelf area, northeastern part of Iraq.The carbonate outcrops include Qarah Chauq Dagh area lies about (50 km) to the Northwest of Kirkuk area, but the subsurface section are represented by different oilfields (Kirkuk well – 19, Bai-Hassan well – 4 and Khabaz well - 3), about (10-20 km) southwest to northwest of Kirkuk city. (Fig. 3)

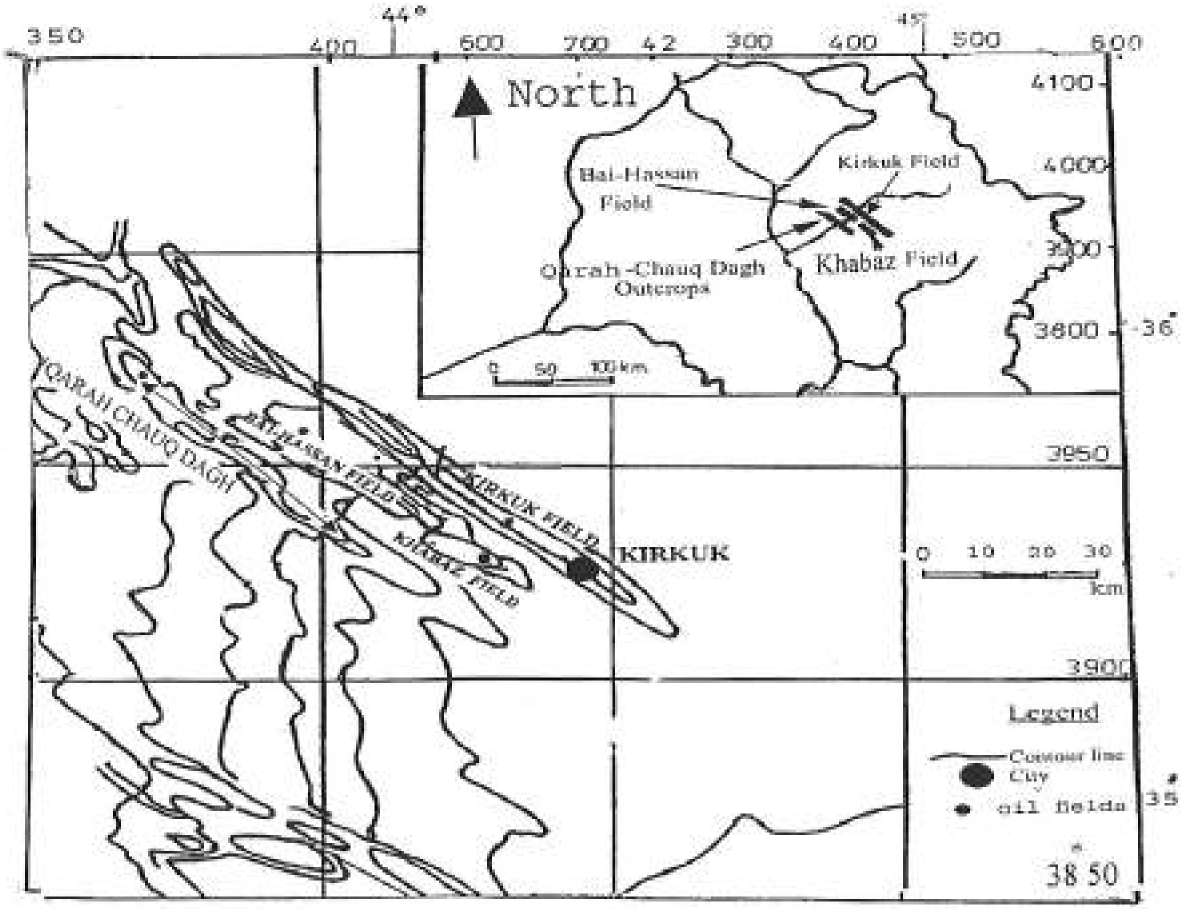


Fig. (3): Location map of the studied area.

1-4 Data Gathering

Larger foraminifera *(Lepidocyclina and Miogypsina)* are typically associated with shallow water carbonate sediment (Azkand and Baba) Formations and the facies change typically evolved continuously in this environment, so that it is seldom to find typical Miocene carbonate facies(Azkand formation) directly overlying Oligocene carbonates (Baba Formation) in the same sequence section, therefore the sampling is carried out from many surface and subsurface sections such as (Qarah chauq Dagh, Khabaz well-3, Bai-Hassan well- 4, and Kirkuk well-19 sections), led to a firmer placement of larger foraminifera (Lepidocyclinidae and Miogypsinidae), from Azkand and Baba Formations. Sampling was carried out during the spring times of the January 2002, (147) samples were collected from the whole studied sections, the carbonate samples have been prepared and analyzed in the laboratories of the Department of Geology , College of Science , University of Sulaimani . (500) thin oriented sections of individed *Lepidocyclina (Nephrolepidina)* and *Miogypsina* have been made for the biometric research.

The thin sections of the carbonates of the individed *Lepidocyclina (Nephrolepidina)*, *Miogypsina,* and *Miogypsinoides*, have been stored in the collections of the Department of Geology, Coll No. Kirkuk -19, - Bai-Hassan well -4, - Khabaz well -3, - Qarah chauq Dagh respectively .

1-5 Review on Baba and Azkand Formations

1-5.1 Baba Formation

The formation was first defined by Bellen in 1956 from Kirkuk well (109). Lithologically the formation consists of porous dolomitized limestones . In surface outcrops the limestone has a chalky appearance which is mostly massive , with some bedded parts (Bellen et al . 1959 , p.47) .

The formation was deposited in the fore-reef area of both the northeastern and southeastern margins of the Oligocene basin. Ditmar et.al. (1971, p.97), claim that the Baba Formation is representative for the northeastern areas only . Ctyroky and Karim (1971) proved the existence of the formation along the southeastern shore area , around Anah too ,where, according to Hay and Hart(1959) the thickness of the formation is even bigger than in the northeast ,fossils are abundant. In the type area Bellen et.al.(1959, p.47). recorded the presence of rare *Lepidocyclina s.l. spp. Nummulites intermedius fichteli,Operculina sp.,Rotalia viennoti, and Hetrostegina cf. assilinoides* .

The age of the formation, according to Bellen et al. (1959, p.47) is Middle Oligocene . The formation overlies in the type area, the lower Oligocene Shurau Limestone Formation conformably.

In the Anah area, the underlying formation is Sheikh Alas formation, An unconformable contact might be supposed there too. While the upper contact in the type area is conformable. The Bajwan Limestone Formation is the overlying unit. (Buday, 1980).

In the Anah area, the overlying unit is Anah Limestone Formation .The contact is , there gradational and conformable . This however, strongly supports the ideas of Ditmar et. al (1971, p.96). concerning the rough identity of the Anah-Azkand and Bajawan-Baba duplets. In eastern Iraq the formation occurs widespread in all wells south west of the Lesser Zab,on the Kirkuk structure, it also occurs on the Northeast flank of the Bai- Hassan structure, and a surface on the Northern dome of the Qarah chauq Dagh Northwards, the Baba Limestone is formed in a well No.1 Gusair No.1 and wells on the Ainzalah structure .(Bellen et al., 1959). The formation occurs along both the northeastern and southwestern shore areas of the Oligocene sea. On the surface it croups out on the Qarah Chauq Dagh. along the northeastern shore region , and along the Euphrates valley to the west of Anah, along the southwestern shore area . In subsurface section the formation occurs between Ain zala , Bai hassan , and Kirkuk in the northeast and in Anah,Hit, Faluja,Dujaila and (?)Afag in the southwest. (Buday, 1980). Although, the Baba Formation has been studied sedimentologically and paleontologically from different oil fields in Iraq, the late Oligocene age is suggested according to the prevalence of faunas content .

(Mohammed, 1983;, 1985; Bakkal and Al-Ghreri, 1993; El-Eisa, 1992, 1993, Al-Guburi. and El-Eisa, 2002).

1-5-2 Azkand Formation

The formation was first described by Bellen, 1956, from the surface outcrops of the Azkand cirque of the Qarah Chug Dagh structures. The formation consists in the type area of generally massive dolomitic and recrystallized limestones, generally with porosity (Bellen et al., 1959, p.45)

The same lithology was found in other sections too. The lithology is conspicuously identical with that of the Baba Limestone Formation. The thickness of the formation is variable, but it is usually around (100) m. The formation is of a fore-reef facies.

Fossils were relatively abundantly found. Among the most typical *Heterostegina* cf. *assilinoides, Miogypsinoides complanata*, and (in the lower part) *Lepidocyclina* s.l. spp. (Bellen et. al. 1959, p.46) should be quoted. The formation had been divided into a lower *Miogypsinoides-Lepidocyclina* Zone and into a higher *Miogypsinoides* Zone (Bellen et al., 1959, p.186).

The presence of *Miogypsinoides complanata* in the most lower part of the formation proves its late upper Oligocene age. The lower contact of the unit with the Baba limestone Formation, in the type area, is unconformable, which represented only (8m) thickness of dolomitized limestone, while the upper boundary is usually conformable and gradational , the overlying formation is usually the Anah Limestone Formation (Bellen et al., 1959, p.45).

In the western part of Iraq, the Anah Limestone formation overlies the Azkand Formation conformably. Azkand Limestone Formation is developed in sections along the Euphrates,It also occurs in M.P.C. well Mileh Thathar No.1. In the eastern part of Iraq, a few (isolated occurrences because wells were not drilled in areas where this formation should occur extensively below surface) are found in the Qaiyarah structure in M.P.C wells Gusair No.1 and Ibrahim No.1 (Bellen et al., 1959)

The formation is known from surface outcrops in the type structures and according to Bellen et al. (1959, p.46) along the Euphrates river valley too. The exact position of the later occurrences was not described. It is possible, that some of the outcrops, originally attributed to the Azkand, were later on incorporated into the Baba Formation. The formation occurs in subsurface sections along both the southwestern and northeastern shores of the Oligocene basin. (Buday, 1980)

Al-Hashimi and Amer(1985) studied the Azkand Formation in Wadi El-Kheskah,Anah Al-Qaim area, and Ibrahim well No.1. West Iraq, *Miogypsinoides complanata* , *Miogypsinoides deharti*, Rotalia viennoti, *Lepidocyclina(Nephrolepidina)*, *Heterostegina antillae Nummulites vascus*, *Miliolids* and Algae, were distinguished and suggested the upper Oligocene age of the Formation .

The biostratigraphy and microfacies of Azkand Formation have been investigated throughly in different Oil fields in north and north west of Iraq and proved it's late Oligocene-Early Miocene age (e.g. I.O.C Staffs,1988; Al-Hadad, 1991; El-Eisa,1994; I.O.C. Staffs,1992; Abid.1997; Al-Guburi and El-Eisa.2002).

1-6 Historical review and literature on *Lepidocyclina (Nephrolepidina.)* and *Miogypsina*

1-6-1 *Lepidocyclina(Nephrolepidina)*

The name *Lepidocyclina* was introduced by Gümbel (1868) and *Nummulites mantelli* Morton, 1833 was selected as the type species. Especially in the first half of the 20th century in the indo pacific, in America and in Europe , for biostratigraphic purposes , larger foraminifera including *Lepidocyclina* were highly valued: this led to the pseudo-chronostratigraphic "Leter stage" classification of the Indonesians Tertiary by Van der Vlerk and

Umbgrov (1927), having recognized the separate taxonomic position of the Lepidocyclina group. Scheffen(1932) introduced the family of the Lepidocyclinidae .

Verbeek and Fennema (1896) were the first to present a systematic study of the Indonesian Lepidocyclinidae. . They paid attention to the chamber from the equatorial layer and to the size of the embryon .

A large number of later studies deal with the morphological features and /or introduce new species : H. Douville (1898) , Newton and Holland (1899), Schlumberger (1900) , Lemoine and H. Douville (1904) , Rutten (1911 , 1912, 1913, 1914), H. Douville (1911, 1924/25), Vaughan(1924), Van der Vlerk (1924,1925, 1928, 1929), Scheffen (1932), Gaudri (1934) and more recently Eames et al.(1962) and Cole (1938) . Their discussion centered mainly on which of the features could serve as a basis for a 'reliable' taxonomic system . In general *Lepidocyclina* is subdivided into four subgenera, based on the form of the embryon : *Isolepidina* , *Nephrolepidina*, *Eulepidina* and *Trybliolepidina* . The last name is invalid and the first one must be replaced by *Lepidocyclina* s.s Eulepidina *clearly* represents a separate lineage, whereas the other three subgenera represent more or less successive stages of the main lineage.

Tan Sin Hok (1935, 1936) was the first to emphasize the importance of the peri-embryonic chambers for the classification and recognition of evolution. His analysis of Lepidocyclinid assemblages showed a time related increase in the degree to which the protoconch is embraced by the deutroconch, and an increase in the number of chambers formed directly from the deutroconch (ad-auxiliary chambers) . He supposed that these trends reflected the phylogenitic development of the Lepidocyclinidae and he suggested that statistical analysis of populations should be applied to obtain further information. Following these suggestion, Mohler (1946) was the first to record data on chambers of auxiliary chambers, on the diameter of the protoconch and deutroconch, and on the shape of the embryon .

Van der Vlerk (1957, 1959 a,b, 1963, 1973, 1974) developed the biometrical approach still further by introducing and or defining a number of parameters . From all the parameters C, D_I, D_{II}, B and A ;(or a similar expression to indicate the degree to which the protoconch is embraced by the deutroconch) this author finally selected the lastly one of the group as being the most reliable. In 1963 Van der Vlerk recognized that he could not place the Lepidocyclinids in the area outside America in either the X or Y lineage of Grimsdale(1959) which had been based on stolon arrangements in the equatorial chambers . Hence, he concluded that there was only one lineage. Using only parameter A, without ever stating a range of variation or standard errors to the means, he tried to show the time depended change in this factor, arranging samples from the Caribbean, Europe and Indonesia in supposedly correct stratigraphic order . A more detailed investigation of material from East Java and Madura (Van der Vlerk and Postuma, 1967) reveals a less smooth development of A, but the significance of the fluctuations remains obscure.

Matsumaru (1971) dealed extensively with *Lepidocyclina* in Japan, External and internal morphology, and the "classical" parameters were studied by using statistical methods. He recognized three form groups in the phylogenitic development of *Lepidocyclina*, and regarded A_i as the most reliable factor and C as the least useful.

Publications about European material are from Drogger and Freudenthal(1964), Freudenth (1966) and Meulenkamp and Amato (1972), The first two authors found no satisfactory evolutionary development of the parameters A , B, A+B and C. In their opinion C is the best, relatively speaking.

De Mulder (1975) subdivided the European *Nephrolepidina* lineage into three successive species with species boundaries based on mean values of C and A .

Geerates, (1983) studied the biometrical analysis of early middle Oligocene *Nephrolepidina praemarginata* and *Heterostegina* sp. associations from Spain, suggested two distinct lineage based on the large mean protoconchi diameters, New parameters was designed to study the relation between *Heterostegina* and *Cycloclypeus*, and proved that the *Nephrolepidina* assemblages contain some highly evolved specimens belongs to a second megalospheric generation .

Drooger and Lagland(1986) debated the subgeneric group of *Lepidocyclina (Nephrolepidina and Eulepidina)* from the Mediterranean – European realm, found to correspond to no more asingle zone of the larger foraminifera and divided the area into five subzones on the basis of the morphometric development in the genera *Lepidocyclina, Cycloclypeus* and Miogypsinids.

Adam,(1987) subdivided *Lepidocyclina* into three subgenera *Lepidocyclina (Lepidocyclina), Lepidocyclina (Eulepidina),* and *Lepidocyclina (Nephrolepidina)* on the nature and arrangement of their periembryonic chambers, in particular, the presence or absence of adauxiliary chambers as well as, the evolutionary history of the Lepidocyclinidae is discussed briefly.

Lepidocyclina(Nephrolepidina) from European- Mediterranean area, belong to a single independent phylogenitic lineage showing different evolutionary velocity , which is beginning by *Lepidocyclina(N.) praemarginata – Lepidocyclina(N.) morgani – Lepidocyclina (N.) tournoueri* , on the basis combination of two parameters : the degree of embracement of the protoconch by the deuteroconch (FactorA) and the number of accessory auxiliary chambers on the deuteroconch (Factor C). (Drooger and Rohling,1988)

According to Matsmaru (1992), some taxa of the subgenus (*Nephrolepidina*) in Lepidocyclinidae are described and illustrated from the upper Miocene in Japan.

New method based on the biometric analyses of the early meanic equatorial chamber applied by Schiavinotto(1992) from central Apennines, Ales, two *Nephrolepidina tournoueri* populations were recognized. Drooger, (1993) studied the morphometric and evolution of radial foraminifera, including *Lepidocyclina(Nephrolepidina) and Lepidocyclina(Eulepidina)* by using two parameters (A_1)and (C) .

The biometric parameters of *Lepidocyclina (Nephrolepidina)* from the Oligocene-early Miocene of India studied to evaluate their biostratigraphic importance, the interrelations of morphometric parameters of *Nephrolepidina* are estimated statistically and the evolutionary trend is shown by

Nepgrolepidina appears to be a gradual sustained change with interval of arrested evolution. (Saraswati, 1994)

Saraswati, (1995) studied the biometry of early Oligocene *Lepidocyclina* from Kutch, India, shows that biometrically significant distinction exists between *Eulepidina* and *Nephrolepidina* by using factors analyses and suggests that the size of the embryonic chambers, grade of enclosure and curvature of the common wall together explain the maximum variance in *Lepidocyclines* .

The Oligocene/Miocene larger foraminifera assemblages of Iran studied by Ulrike, (1998) stated that the first appearance of *Lepidocyclia(Nephrolepidina)* consist of several species with Eulepidinis predominating about ten species been found.

Morphometric of some *Lepidocyclina* foraminifera discussed by Saraswati and Arun Kumar(2000), they involve simple arithmetical to multivariate statistical analyses of quantitative information expressing size and shape of the biological forms. The grade of enclosure of the protoconch (Parameter A and the number of aduxiliary chambers (Parameter C) are found to be useful in the definition of the species *Nephrolepidina* in the Indo-Pacific and Mediterranean regions. The authors proved that the morphometric analyses of some Indo-Pacific species, suggest that the two subgenera are distinctly different.

Muthukrishnan and Saraswati, (2001) supposed that *Lepidocyclina* in the Indian region is represented by two subgenera, *Lepidocyclina(Nephrolepidina)* and *Lepidocyclina(Eulepidina)*, the morphometric of these subgenera are debated to examine if the two subgenera are taxonomically valid and to view of the fact that the aduxiliary chambers are not visible very often.

Boudagher-Fadel (2002) argued the relationships between planktonic and larger benthonic foraminifera in middle Miocene to lower Pliocene of Indonesia, fifteen species of benthonic foraminifera are described and illustrated with one newly proposed taxon , *Lepidocyclina pillaria*.

Saraswati, (2003) emphasized the morphometrics of foraminifera, shows that the most foraminiferal morphometrs are limited to size, due partly to easy measurements and partly to its significance in documenting evolutionary trends especially in *Lepidocyclina*.

1-6-2 *Miogypsina*

The genus *Miogypsina* name was officially introduced by Sacco in 1893. The type species was described from a locality in northern Italy, known as the "Colli di Torino" in 1841 Michelotti had already described specimens of the same genus from the same general locality , but he classified them in Nummulitid genera .

In the early decades of the last century several descriptive studies on *Miogypsina* were published among others by (Schlumberger, 1900; Vaughan,1924,; Yabe Hanzawa, 1928), which resulted in a large number of new species names .The taxonomy was entirely based on a typological species concept . At that time the phylogeny of this group of larger foraminifera was a topic of subordinate importance.

This changed when Tan Sin Hok (1936, 1937) recognized a time-dependent morphological trend in Indonesian *Miogypsina on* the basis of the nepionic chamber arrangement, but Hok also used a typological concept in his classification. From his research it appeared that in the course of geological time the initial spiral length had been reduced by the introduction of chambers with two apertures at continuously earlier ontogentical stages .This process went on until the deutroconch was equipped with two apertures, from which two chambers originated simultaneously, called the principal auxiliary chambers, in his later publication Hok recognized that these two chambers changed in phylogeny from strongly unequal in size to equality . Hok introduced the term nepionic acceleration for the time –bound sequence of morphotypes in *Miogypsina*. It means that the onest of radial (orbitoidal) growth or sectorial growth in *Miogypsina* – changed to earlier ontogenetically stages in the course of evolution.

The typological species concept in the taxonomical classification of *Miogypsina* was also applied by later authors (e.g. Bronimann, 1940). A series drawback of this approach is the introduction of a multitude of species names, which around 1950 had resulted in 60 to 70 different *Miogypsina* species . This practice naturally did not contribute to a transparent structure of the classification scheme for this genus.

Drooger (1952) in his thesis on American Miogypsinidae introduced the population concept for the classification .In this way the natural morphological variation within individual species was accounted for. In the period from 1953 untill 1966 Drogger performed many biometric studies on *Miogypsina*, especially from Europian. north Africa and Indonesian localities . Other investigators, who studied *Miogypsina* with the same method are Souaya, (1961;Egypt) and Raju, (1974;India), but in the fifties and sixties micropaleontologists like Cole and Hanzawa continued to use the typological approach in the determination of the Miogypsinids species .

Ujiie (1966) studied the evolutionary lines of Miocene Miogypsinids population from Japan by using parameters X, γ, α, and β.

In each lineage there is an irregular increase in embryon size, but in addition sudden drops have been documented. Large time-bound shifts in embryon size were found for *Miogypsina* as well, such as at the evolutionary level where *Miogypsina* s.s. originates from *Miogypsinoides* (Raju, 1974).

De Bock (1976) presented a detailed study of morphological feature in *Miogypsina*. He found that *Miogypsinoides* possesses a well-developed canal system, whereas in *Miogypsina* s.s. such a system is lacking. On the other hand the later has a more complex stolon system than the former.

The biometric method appeared to be a useful tool in the study of the evolution of *Miogypsina* and Orbitoidal foraminifera in general .A through insight was built up in the evolution of the main lineage of Miogypsina and of its regional offshoots in the circum –Mediterranean, Indo-Pacific and central American bioprovinces; 20 to 30 species remained (Drogger, 1963), all based on nepionic chamber configurations. Some adjustments of the evolutionary scheme of *Miogypsina* in the Indo-Pacific realm resulted from the research of Raju, (1974) and Drooger & Raju, (1978).

Al-Omari and Sadek, (1972) recorded for the first time in Iraq *Miogypsina* s.s. from Lower fars (Fatha Formation) thus placing the Lower part of this fopmation in the upper Burdugalian stage. . Al-Omari and Sadek, (1975) identified *Miogypsina s.s.* globulina (Michelotti) for the fist time from yhe Miocene strata in Northern Iraq, based on statistical study of 20 specimencs from Bashiqa area.

The detailed research on the phylogeny of *Miogypsina* made this genus a very useful tool for chronostratigraphical correlations, especially on a regional scale (Drooger, 1956; Drooger & Laagland, 1986).

The biometric study of *Miogypsina* was not merely restricted to its nepionic characteristics; it also revealed a lot of data on the embryon size of the studied assemblages. Drooger & Raju (1973) assumed that there is a positive relation in each *Miogypsina* species between the mean embryon size and latitude, which relation might reflect a dependence of the embryon size on light intensity . The authors further speculated that there could also be an increase of the mean embryon size with depth, an idea later on was substantiated indeed for several other groups of larger foraminifera, such as recent *Heterostegina* and *Operculina* (Fermont, 1977a and b; Biekart et al., 1985). The authors found a more or less gradual increase of the mean embryon diameter with depth. Actually the depth-linked cline in embryon size seems to be of a more complex, as was shown for *Operculina* (Fermont et al., 1983). Embryon size would increase down to a certain depth limit, below its level the size is decreasing again.

A biometric research has been performed on thirty three populations of Miogypsinids from north Italy by Mortrara, (1987), He recognized the following associations: *Miogypsina(Miogypsinoides) complanata* Schlumberger, *Miogypsina(M.) ex.interc. complanata-formosensis*, *Miogypsina(M.) formosensis* Yabe and Hanzawa, *Miogypsina(M.)bantamensis* Drooger, *Miogypsina(M.) ex.interc.basraensis-gunteri* and *Miogypsina(Miogypsina) gunteri* Cole statistics treatment and significant parameters in primitive single spiraled Miogypsinid indicated strong correlation between X, γ, D_2/D_1

Raju, (1991) argued numerical classification and phylogeny of the Miogypsinidae in India from Oligocene-Lower Miocene and subdivided the area into (10) zones with the *Miogypsina(Miogypsinoides) bermudezi* Range Zone at the base and *Miogypsina(Miogypsina) antillea* zone at the top..

The biometric analyses of Miogypsinidae with their evolutionary aspects investigated by (Wildenborg, 1991) near Mineo (Sicily) states that the morphometric series of *Miogypsina,* is not complete, because of the sedimentary hiatuses and changes in the local environment. The early Miocene associations accompanied by associations of *Miogypsinoides* and two types of assemblages of *Miogypsinoides* distinguished based on the mean embryon size.

Boudagher-Fadel et. al., (2000) described some taxa larger benthonic foraminifera Miogypsinidae with specialization of Miogysinodella from Miocene of Borneo trends.

1-7 The purpose of investigation

Oligocene-Miocene carbonate rocks of the (Kirkuk well -19, Bai-Hassan well -4, Khabaz well -3 and Qarah Chauq Dagh sections) offer the potentials to investigate the details substantial part of the *Lepidocyclina (Nephrolepidina)* and Miogypsinids lineages.

The aim of this thesis is to study:-

1- The biometric analysis of the *Lepidocyclina (Nephrolepidina)*; *Miogypsinoides and Miogypsina s.s.* .

2- The evolutionary aspects of the *Lepidocyclina (Nephrolepidina)*; *Miogypsinoides* and *Miogypsina s.s.*. More details about the studies is given in chapters 3, 4, 5 and 6.

Chapter Two

THE CARBONATE SEDIMENTS

2-1 The Sections

The investigated carbonate sequences are divided into surface and subsurface sections as follows :

2-1-1 Surface section

The investigated Miocene carbonates (Azkand Formation) exposure lies in Qarah chauq-Dagh structure which is located about (50Km) in northwest of Kirkuk city. At many places the valley walls are sufficiently well exposed for a meaningful description and sampling of the carbonate sediments, (26) samples were collected within an interval between (1-3) meters.(Figs. 3 and 5)

2-1-2 Subsurface Sections

Three subsurface sections are chosen to investigate the biometric analysis of *Lepidocyclina(Nephrolepidina)* and Miogypsinids from Oligocene-Miocene carbonate sediments, these sections are as follows :-

1-- Kirkuk well-19

Additional information was provided by the Kirkuk well-19 section to ensure from microfacies of Oligocene Baba Formation. (20) Samples are taken within an interval of one meter.(Fig. 4)

2- Bai-Hassan well-4

(51) samples are taken to investigate the Oligocene carbonate sediments (Baba Formation) within an interval of one meter.(Fig. 4)

3. Khabaz Well-3

(50) samples are taken to study the Miocene carbonates (Azkand Formation) within an interval about one meter. (Fig. 5)

2-2 General Remarks

2-2-1 -*Whole-rock thin-sections*

In addition to the field observations, which concerned among other things grain size, sedimentary structures and the degree of indurations, thin-sections of rock samples were investigated to acquire more detailed lithological and micropaleontological information. The thin-section, which measure about eight square centimeter, usually were made perpendicularly to the bedding-planes, . This procedure was followed to level down the effect of small-scale vertical variations so that a representative picture of the entire rock sample could be furnished. In some cases additional thin-sections were cut parallel to the bedding-Planes.

The lithological features, microscopically investigated are the grain size, the type of grains and the texture. The proportion of coarse grains which measure more than 0.5 mm, provided a useful means for the definition of the coarseness of the sediment. The term 'fine' corresponds with 0 to 25% of coarse grains, 'coarse" means 25-60% of coarse grains and 'very coarse' refers to more than 60% of coarse grains.

For the classification of the carbonates the Dunham terminology (1962) was used, which was combined with the classification of Embry & Klovan (1971).

The total numbers of several groups of larger foraminifera were determined by counting them in thin-sections. Specimen were included in the counting only if more than half of its tests were preserved in the particular thin section. The encrusting foraminifera were dealt with in a different way; they were counted only if their diameter in the thin-section exceeded the value of half a millimeter.

The total numbers of the larger foraminifera are figured logarithmically because they fluctuate enormously, viz. between 0 and nearly 150 specimens per thin section. The thin sections with zero frequencies were not entered in the figures.

The absolute numbers of the separate taxa of larger foraminifera are not completely comparable. Because they are slightly influenced by the variation in the scanning surface of the thin-sections and by the effects of sedimentary processes, such as sorting. These problems can partly be overcome by using the relative frequencies of the larger foraminiferal taxa. The major drawback of this procedure is that the percentages are interdependent. A high relative frequency of one group of foraminifera will squeeze the relative proportions of all other groups, which may result in distorted correlations between various groups.

2-1-1 Subdivision of larger foraminifera

The frequencies of seven mainly generic groups of larger foraminifera were determined. These taxa are:

1-*Miogypsina s.s.*

2-*Miogypsinoides.*

3-*Amphistegina.*

This genus shows a large variation in the transverse outline and in the degree of trochospirally. The morphological diversity of this group probably indicates that it is polytypical or multispecific.

4- *Pararotalia*

Two morphotypes can be distinguished, one with a smooth surface and the other with a pustulous outline.

5- *Lepidocyclina*

This genus shows a distinct variation in size. Specimens with a relatively large diameter, i.e. larger than 2mm, are present in the lowermost part of Baba Formation (Units I,II) and lower part of Azkand Formation (Units V,VI), Individuals of relatively small size prevail in the upper part of Baba Formation (Units III,IV), Azkand Formation (Units VII,VIII).

6- Nummulitidae.

The Nummulitids comprise the following genera: *Heterostegina, Operculina* and *Spiroclypeus*. Both evolute and partly involute specimens were lumped in *Heteroistegina*. *Cycloclypeus* occurs at a few level only.

7- Encrusting foraminifera.

This entity consists mainly of Acervulinid genera. Fragments of specimens which resemble *Victoriella* have also been included in this group.

Taxa of extremely low frequency have not been included in the counting in the units of different sections.

2-3 **Subdivision of the Carbonates**

As mentioned in chapter one, there is seldom to notice carbonate sequence which shows the Miocene carbonate facies (Azkand Formation) overlies directly the Oligocene carbonate facies (Baba Formation), if it gained, will represent only one of the facies partially. Therefore many sections are adopted to recover the contemporaneous of Oligocene-Miocene sequence section. The observations mainly refer to Khabaz well-3 and Bai-Hassan well -4 sections, the backbone of our investigation, additional information was provided by the Qarah Chauq Dagh and Kirkuk well -19 sections. The Miocene limestone series (Azkand Formation) and the underlying Oligocene limestone (Baba Formation) were subdivided into the following (8) units from bottom to top (figs.4, and 5)

2-3-1 Subdivision of Oligocene carbonates (Baba Formation)

Oligocene carbonates of the Baba Formation subdivided into four units which are the followings from the lower part to the upper part of the section .(Fig. 4)

Unit I : Fine to very coarse bioclastic larger foraminiferal packstone grading to grainstone.

(Plate 4 , Fig., 1)

The lower part of Baba limestone Formation consists of beds of fine to very coarse packstone, often grading into grainstones.

The thickness of Unit I, exposed in the Kirkuk well -19 section is about 18meters. The thin- sections showed that the average grain size of the coarse fraction often exceeds the value of 5mm. The coarse grains are usually well rounded. Angular coarse grains are rare, sorting is generally poor when the orientation of the bioclasts is variable, the coarse fraction of the sediments of larger foraminifera, algae (Melobesioids).

Larger Foraminifera

The relative frequencies of *Lepidocyclina* and of the encrusting foraminifera are much higher in the lower part, its relative frequencies between 22 and 65 and its large diameter of up to one centimeter; *Lepidocyclina(Eulepidina), Lepidocyclina(Nephrolepidina), Nummulites, Heterostegina*, and *Operculina* in the upper part of the Unit I .(Fig.6)

Interpretation

The appearance of coarse bioclasts of shallow marine origin probably points to shallowing during deposition of the upper part of unit I.

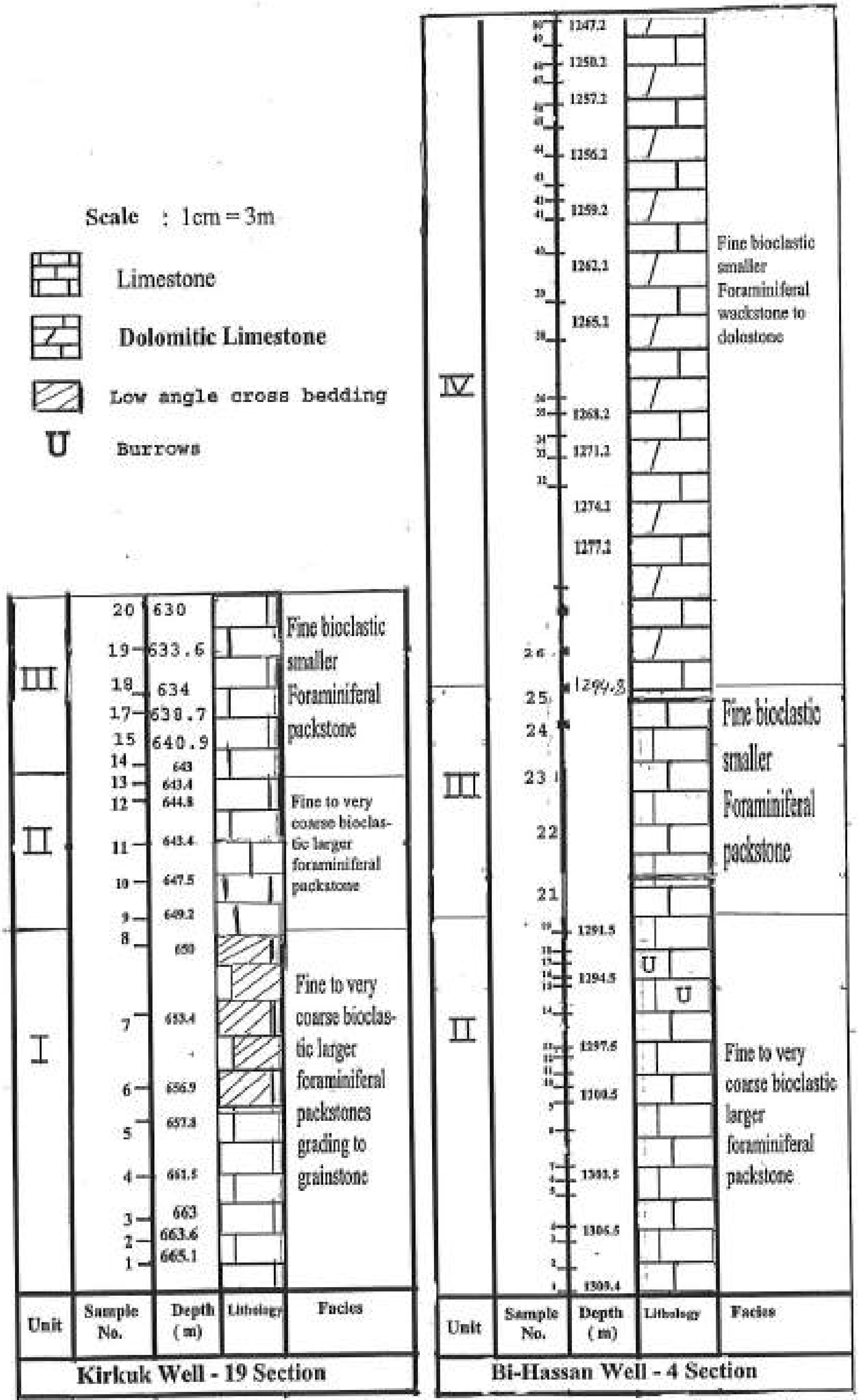


Fig.(4): Lithostratigraphic columns of the sections Kirkuk well-19 and Bai-Hassan Well-4, Oligocene carbonates (Baba Formation)

Unit II : Fine to very coarse bioclastic larger foraminiferal packstone
(Plate 1 , Fig.2)

The lower most interval in Oligocene shallow water carbonate, characterized by presence of larger foraminifera, was distinguished as Unit II. This part of the succession consists of bedded, fine to very coarse packstone.

The thickness of the Unit II, is about (9) meters in Bai-Hassan well -4 and about (8) meters in Kirkuk well -19. Although distinct fluctuations in the average grain size occur throughout, Unit II as whole shows a fining upwards trend. In the lower part of the Unit II, the relative frequency of the planktonic foraminifera in the associations of smaller foraminifera (=p/p+B) is variable with a peak value of 55 percent, especially in Bai-Hassan well- 4 that indicated as a transitional zone to Tarjil formation. The coarse fraction of the packstone is dominated by larger foraminifera, echinoid and algal bioclasts, especially the later, which in most cases are of the Melobesioid type, generally have a subrounded shape.

Larger Foraminifera

In order to enlarge the data set for the basal part of Unit II, some thin sections of Bai-Hassan well 4 section were analysed in addition to thin sections of Kirkuk well-19 section. Preservation of the larger foraminifera varies moderate to well, the total number of the large foraminifera in the analyzed thin sections varies between 10 and 17specimens.*Lepidocyclina(Eulepidina),Lepidocyclina(Nephrolepidins)* attains its highest relative frequencies in the lower part of this unit, once it exceeds 10 percent. In the upper part the proportion of this genus is 5 percent or more. Another groups of importance is *Heterostegina* and *Operculina* with a percentage ranging from 5 to 40. The group of *Pararotalia* which constitutes about 35% in the lower part.(Fig.6)

Interpretation

The types of bioclasts with high P/(P+B) ratio indicate that the sediment were deposited on a relatively shallow, open marine slope or platform. The fining upwards trend in Unit II is probably related to a slight overall deeping of the environment or a shift to a more protected environment.

Unit III : Fine bioclastic smaller foraminiferidal packstones
(Plate 3 , Fig. 1)

This unit with a thickness of about (11) meters in Bai-Hassan well-4 and (9) meters in Kirkuk well- 19, consists of vaguely bedded, fine and medium-fine packstone, in which larger bioclasts are very rare (Fig. 4), Bioturbation is the most frequently observable sedimentary structure in Unit III, small scale burrows are present.

The lower part of the unit are marked by the increase of the grain size, above this the trend is reversed: coarse packstones vary to median packstones. Large bioclasts were met with in the basal part of unit which makes this sediments grading into a floatstone, The large components are algal, encrusting foraminifera and large foraminifera.

Larger foraminifera

The relative frequencies of *Lepidocyclina* and of the encrusting foraminifera are much higher in the lower part of Unit III, *Lepidocyclina* is a very characteristic element of the unit by its large relative frequencies between 25 and 75 percent and its diameter about 5 millimeter and the Nummulitids remain present in the lower part of Unit III.(Fig.6)

Interpretation

The appearance of large bioclasts of shallow marine origin points shallowing during the deposition of the lower part of Unit III and continues the shallowing during the deposition the upper part of the unit for the occurrence of coral patches.

Unit IV : Fine bioclastic smaller foraminiferal wackstones to dolostones
(Plate 3, Fig.2)

This unit has a thickness of about 35meters exposed in Bai-Hassan well -4 only. The lower parts are dolomitized, showing very clear grains of rhombohedral grains of dolomite, The upper parts of unit characterized by the relative frequencies of *Lepidocyclina*, but with bad preservation.

Larger foraminifera

The relative frequency of *Lepidocyclina* in the upper part of this unit, which subjected to dolomitization., the lower part are dolomitized without fossils.(Fig.6)

Interpretation

The appearance of dolomite in the lower part of this unit indicated for shallowing during the deposition and the formation of sabhka environment.

2-3-2 Subdivision of the Miocene carbonates (Azkand Formation)

The Miocene carbonates of the Azkand Formation subdivided into four units which are the following from the lower part to the upper part of the section:

Unit V : Fine bioclastic smaller Foraminiferal packstone
(Plate 1 , Fig.2)

This unit with a thickness of about (36) meters in Khabaz well-3 section and (24) meters in Qarah chugh Dagh section consists of porosy bedded fine and medium-fine packstones, which larger bioclasts are very rare. The thickness of individual beds varies between (35) cm and (1) meters.

Bioturbation is the most frequent; both small and large scale burrows are present. The lower (10) meter of unit V are marked by a decrease of grain size, especially in Khabaz –well 3 section, above this (10) meters the trend is reversed : Fine packstone are replaced by medium fine packstone, which are followed by coarse packstones in the top part of Unit V.

The relative frequency of the planktonic foraminifera is present in the lower part of the unit, especially in Khabaz –well 3 section. Bioclast larger than a millimeter are not common, but the large bioclasts in the basal part, which makes this sediment grading into a floatstone, especially in Qarah chauq Dagh section, the larger components, are coral packstones and echinoid fragments with crusting foraminifera and larger foraminifera.

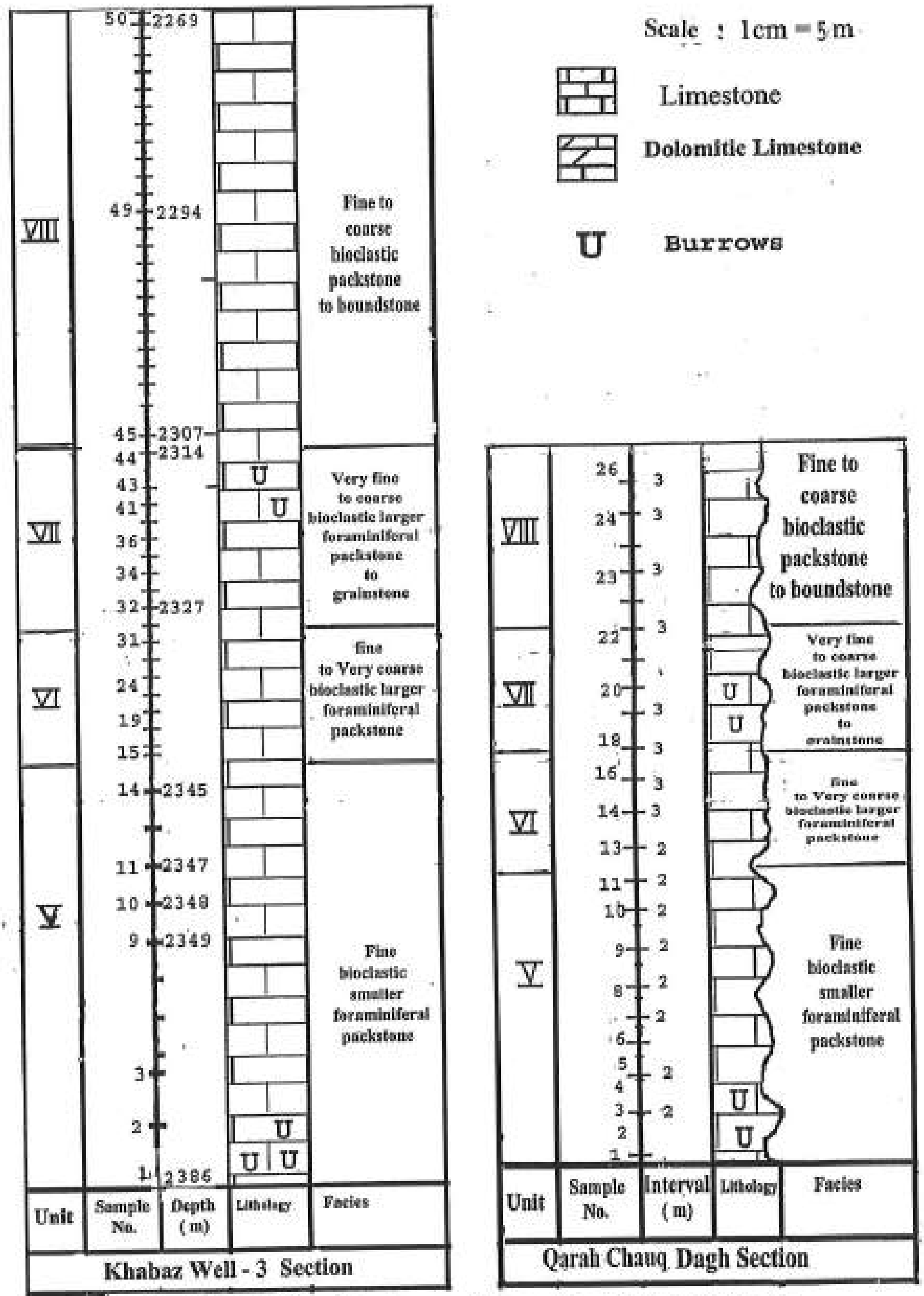


Fig.(5):- Lithostratigraphic column of the sections Khabaz well-3 and Qarah Chauq Dagh, Miocene carbonates, (Azkand Formation).

Larger Foraminifera

The relative frequencies of *Lepidocyclina* is rare, attains proportions between (5) and (25) percent and its larger diameter of up to (1) centimeter, *Miogypsina* and *Miogypsinoides, Amphistegina* and the Nummulitidae (*Heterostegina* and *Operculina*) remain present in the lower part of Unit V.(Fig.7)

Interpretation

The disappearance of coarse bioclasts of shallow marine origin points to deepening during the deposition of the lower part of Unit I. Renewed swallowing during the deposition of upper part is suggested by appearance of dolomitic limestone especially in Qarah Chauq- Dagh section .

Unit VI : Fine to very coarse bioclastic larger foraminiferal packstone
(Plate 4 , Fig.2)

The thickness of Unit VI, which amounts to about (10) meters in Qarah Chaugh Dagh section increases to about (13) meters in Khabaz well -3 section. The lowermost interval in the Khabaz well -3 section characterized by the presence of larger foraminifera was distinguished as Unit VI. This part of the succession consists of bedded, fine to very coarse packstones.

The thickness of the individual beds varies between (50) centimeters and (2) meters. A general investigation of the smaller benthonic showed that trochospiral and planispiral types clearly outnumber the serial ones. Usually the average grain size of the coarse part of the carbonate sediments is smaller than five millimeter, only once in the thin extremely coarse zone near the base of Unit VI. The coarse portion of the packstones is dominated by larger foraminifera and Algal bioclasts which have subrounded shape.

Larger Foraminifera

Preservation of the larger foraminifera varies from poor to moderately well, the total number of the larger foraminifera in the analyzed thin sections varies between (16) and (250) specimens.

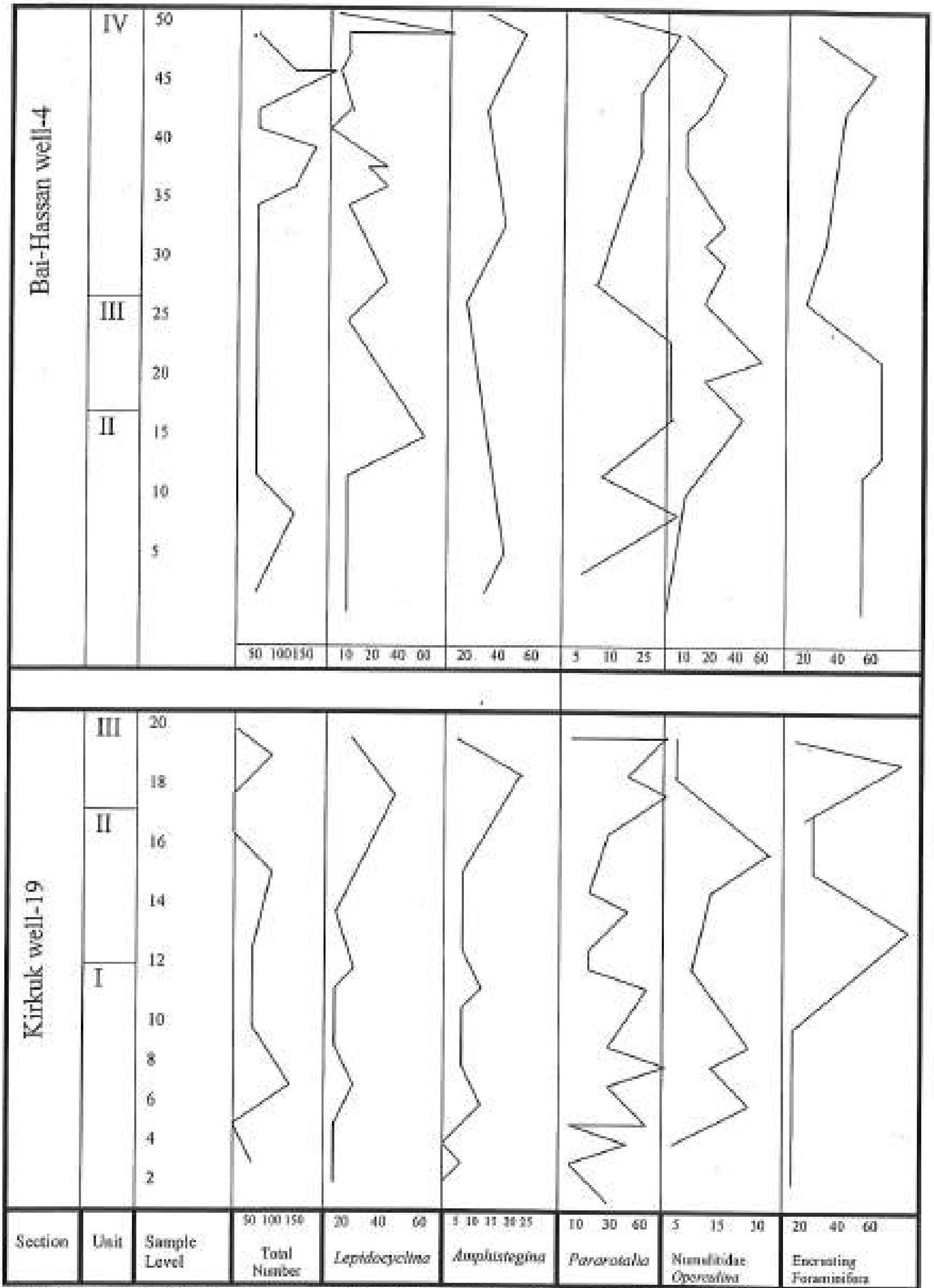


Fig.(6): Total Numbers and relative frequencies of the larger Foraminifera in thin sections of Units(I, II and II) Kirkuk well-19 section and Units (II, II and IV), Bai-Hassan well-4 section, Oligocene Carbonates (Baba Formation).

Miogypsinoides attains its highest relative frequencies in the lower part of this unit, once it exceeds (30) percent, The group of *Pararotalia* which constitutes about 40% in the lowest of the Unit VI in Qarah Chugh Dagh section. Another group of importance is *Amphistegina* with a percentage ranging from (5) to (15), The Nummulitids are met with *Heterosteginid* and *Spiroclypeus* types in the lower part and *Operculina* in the upper part, the frequency of *Lepidocyclina(Eulepidina)* and *Lepidocyclina(Nephrolepidina)*, do not reach (1), but in the lowermost meters exceeds the (30) percent level.(Fig.7)

Interpretation

The type of bioclasts, indicate that the sediments were deposited on a relatively shallow, open marine slope or platform, The fining upwards is probably to slight overall deepening of the environment.

Unit VII: Very fine to coarse bioclastic larger foraminiferal packstones to grainstone.

(Plate 2 , Fig. 2)

The upper units in the Qarah Chauq Dagh and Khabaz well -3 sections consist of beds of fine to very coarse packstones, often grading into grainstones.

The thickness of the individual beds ranges from (40) centimeters to (1) meter at the top of Unit VII in Qarah Chauq Dagh section.

Large scale types of burrows are present with diameter varying between (2) and (3) centimeter. Coarse calcarenite grain size are dominated in the lower part of Unit VII replace by medium fine calcarenite toward the upper part of this unit.

The thickness of Unit VII in the Khabaz well 3 section is (15) meters, while in Qarah Chugh Dagh section is about (12) meters. Thin sections showed that the average grain size of the coarse fraction exceeds the value of two millimeters especially in the lower part of the unit but it is never larger than two millimeters in the upperparts. The coarse grains are usually well rounded, The orientation of the bioclasts is variable and the coarse fraction of the sediments consist of the clasts of larger foraminifera, Echinoides, Algae (Melobesioids)

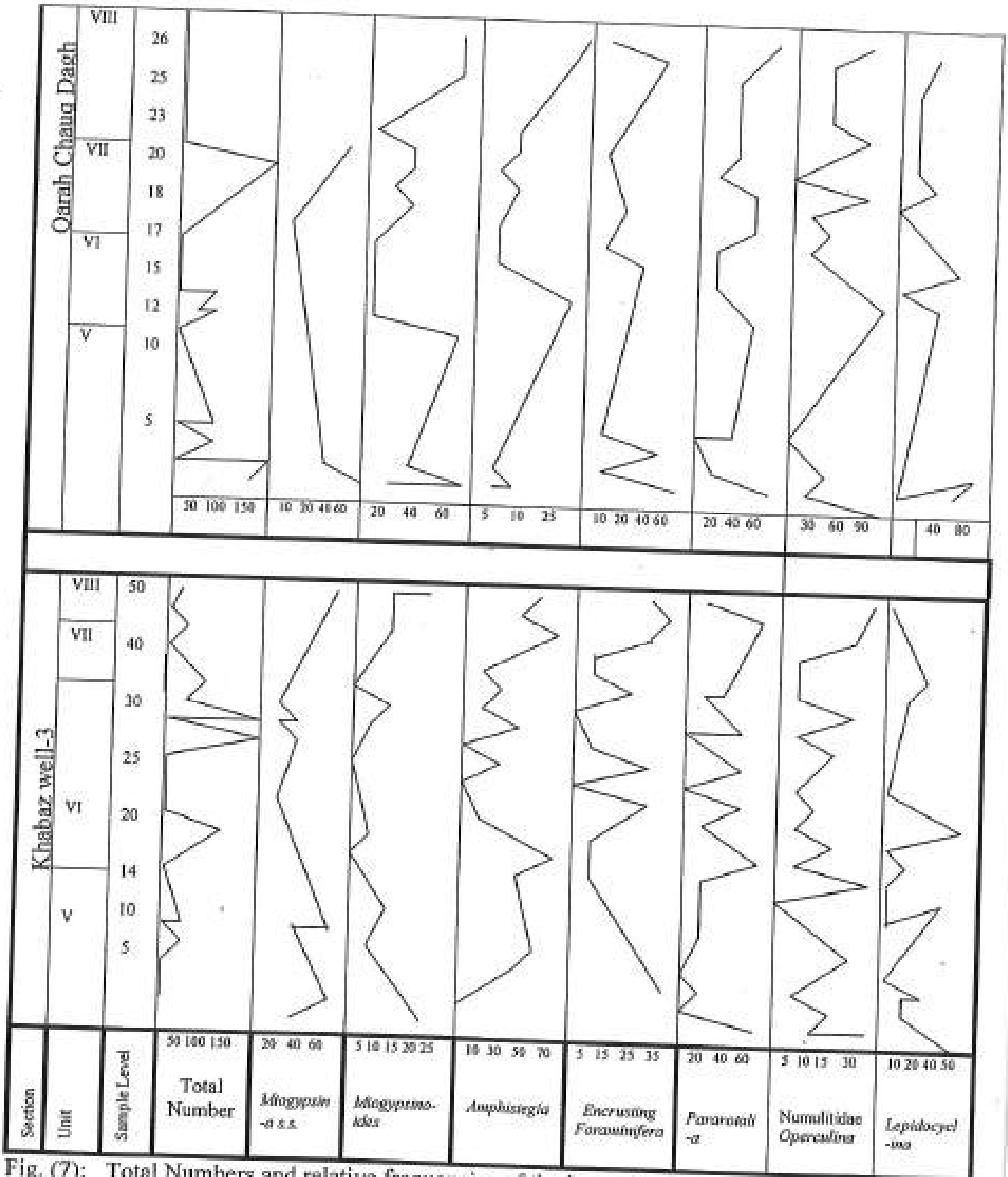


Fig. (7): Total Numbers and relative frequencies of the larger Foraminifera in thin sections of Units (V, VI, VII and VIII) Khabaz well-3 and Qarah Chauq Dagh sections section, Miocene Carbonates (Azkand Formation).

Larger Foraminifera

Many larger foraminifewra were found in the lower part of unit, these are *Lepidocyclina(Nephrolepidina)*, *Amphistegina*, *Heterostegina*, *Pararotalia* *Miogypsiona s.s* ,and *Miogypsinoides*, that the later increase their percentage toward the upper part of the Unit VII.

The number of larger foraminifera in the sections of this Unit VII is greater, sometimes approximately the value of (500).

Miogypsins s.s dominates the assemblages in the upper part sample, Its relative frequency varies between 50-60%, *Amphistegina* complements these associations, there is drastic changes which are seen in the proportion of both genera. The proportion of *Miogypsinoides* continues to increase in the zone of relatively low frequency of *Miogypsina s.s.*

The relative frequency of *Lepidocyclina (Nephrolepidina)* increases to about 60% at the lower part of unit with the associations of encrusting foraminifera (*Heterostegina*) .(Fig.7)

Interpretation

The swallowing trend way distinctly prolonged during the deposition of the larger part of unit as indicated by the continuation of the coarsening upward trend and the coarse grained carbonated accumulated in a shallow sublittoral open marine environment.

Unit VIII : Fine to coarse bioclastics packstone to boundstone.
(Plate 2, Fig. 1)

This unit with a thickness about (34) meters in Khabaz well -3 section and about (15) meter in Qarah chauq Dagh section, consist of vaguely bedded fine to medium packestone in which large bioclast are very rare. The lower part of the unit are marked by fine –medium packestone which are followed by coarse packestone in the top part of Unit VIII. Bioclasts fraction consist of *Lepidocyclina(Nephrolepidina)*, *Miogypsinoides* and *Miogypsina s.s.* encrusting foraminifera, *Pararotalia*, coral patches which make this sediment grading into a floatstone.

Larger Foraminifera

The relative frequencies of *Lepidocyclina (Nephrolepidina)*, which is rare in Unit VIII, attain proportions between (5) and (16) percent, *Miogypsinoides* remain present in the upper part . The coral parts are very common in this unit in both Khabaz well 3 and Qarah chauq Dagh sections are marked for the reef building zone.(Fig.7)

Interpretation

The presence of larger foraminifera and the abundance of coral patch indicate for the shallowing marine environment, during the deposition of this unit.

2-4 Paleoenvironmental Consideration

Although of no immediate importance to our study of the larger foraminifera, some remarks can be made about the sediments of Units (I and II).

The negative trend of the average grain size and the presence of cross-bedding in the lower part of Unit (I), point to a decrease of the hydrodynamic energy and probably to a slight deepining or a more protected position on the slope or platform during the deposition of this interval and the positive percentage of planktonic foraminifera in the lower part of Unit (I), may be continued during the sedimentation of the lower interval (Tarjil Formation) . Simultaneously the sedimentation of medium packstone was replaced by accumulation of fine packstone and the absence of glauconite suggests that the sedimentation rate increased considerably renewed shallowing as suggested for the upper part of unit I and continued to the Unit (II), this interpretating is based on the increase of the average grain size and the massive return of the larger foraminifera and of other bioclasts especially, *Lepidocyclina(Nephrolepidina)*, *Nummulite intermedius*, *Operculina*, *Heterostegina*, typical of the shallow marine realm. The upward decrease of the depositional depth is disputable for the upper most part of Unit (III) in Bai-Hassan-4 section, in which the increase of the average grain size does not continue.

However , in Kirkuk well- 19 section coarse packstone dominate the carbonates up to the highest level in Unit (III), the lateral changes in grain size point to an increase of the hydrodynamic energy in the direction of Kirkuk well-19 section, the appearance of porously dolomitic limestone in the lower part of Unit (III), indicate the sedimentation rate because very low and the hard grounds near the top of the carbonate sequence.

The hard ground at the boundary between the Units (III) and (IV) may represent the final expression of the shallowing trend during the deposition of the carbonate slope or platform in the Bai-Hasan well-4 section but this shallowing is expressed roughly in Kirkuk-well-19 section, because of the appearance small size of *Lepidocyclina(Nephrolepidina)* and coral patches in the lower part of the Unit (V). The depositional environment of the Oligocene carbonate (Baba Formation) can be characterized as a part of an isolated slope or platform area, where open marine conditions prevailed throughout.

As mentioned formerly it is uncommon to see the Miocene carbonate Unit (V), onlape the Oligocene Unit (IV) because of lateral and upward facies changes as result of coral- building form deposition type of the lower Miocene epoch and reduction the Miocene basin if compared with upper Oligocene basin, although the transition from unit (IV) to Unit (V) our data suggest the possible deepening trend during the deposition of Unit (V). This view is supported by the further increase of relative frequency of small foraminifera in the lower part of Unit (V). Simultaneously the sedimentation of medium packstone was replaced by accumulation of fine packstones, the large Lepidocyclinids in the lower part of Unit (V) may have arrived by mass transport during the Miocene transgressive. Renewed shallowing the upper of this unit is based on the increase of the average grain size and the massive return of the larger foraminifera and coral patches suggest that the carbonate build up remained far from any coast line.

The upper part of Unit (V) and Unit (VI) from a shallowing has been suggested. – upward sequence. Although the depth ranges of our taxonomical groups must have shown considerable overlap, some differentiation in their stratigraphical ranges are still visible.

Most of the packstone in Unit (VI) must have accumulated in shallower, marine environment, which is concluded from the presence of large size burrows and numerous clasts of organism living in the photic zone, In such an environment it may be expected that bioclasts were laterally displaced , as in lower part of Unit (VI), the dominated for the *Lepidocyclina* bearing floatstone and *Numulitidae (Hterostegina, Spiroclypeus)* which have subrounded shape.

Relative to unit (VI), the thin-section of Unit (VII) shows a higher diversity of the foraminiferal assemblages. Bryozoans and encrusting foraminifera are nearly absent, *Pararotalia* and the *Heterostegina* are restricted to shallowest basal part of Unit (VI), The deepening trend we suggested for the middle upper part of Unit (VI) is carbonated by relative peaks of *Amphistegina* and *Miogypsina s.s* followed by a *Lepidocyclina(Nephrolepidina)* maximum in the lower part of Unit (VII), judging that this unit accumulated in a shallow sublittoral open marine environment.

During the deposition of Unit (VIII), probably the presence of larger foraminifera such as *Miogypsinidae* and *Lepidocyclina(Nephrolepidina)* encrusting foraminifera, Crustose coralline algae, indicate the existence of a solid substrate. The hard grounds near the top of the carbonate sequence indicate that the deposition even ceased for a white or may represent the final expression of the shallowing trend during the deposition of Unit (VIII).

Chapter Three

BIOMETRIC ANALYSIS OF *LEPIDOCYCLINA (NEPHROLEPIDINA)*

3-1 Introduction

In this chapter the morphometric data of the *Lepidocyclina (Nephrolepidina)* are discussed. Most investigated *Lepidocyclina (Nephrolepidina)* associations are derived from the sections such as Kirkuk well-19, (Units I, II and III), Bai-Hassan well-4 (Units II, III and IV), Khabaz well-3 and Qarah Chauq Dagh (Units V,VI,VII and VIII) .

The samples are too strongly indurated and dolomitized for us to isolate individual larger foraminifera, therefore we sampled semi-weathered rock materials, from which the larger foraminifera could be gathered easily, and thin sections were made for each sample, especially for samples are too hard and rich in *Lepidocyclina (Nephrolepidina)* individuals.

3-2 Methods of investigation

Thin sections were made for each sample especially those sticks of sample which contain the oriented(equatorial) sections for the *Lepidocyclina (Nephrolepidina)*.Twelve slides were made for each sample to be sufficient for statistical analysis .

In this manner (404) oriented equatorial sections were prepared and are representative of *Lepidocyclina(Nephrolepidina)*, which has been drawn by means of digital camera with enlarging of (15-40X) for all specimens. The samples which are rich in the *Lepidicyclina(Nephrolepidina)* , minimum (9) observations were studied on each parameters. A_0, C, D_1, D_2, R, and α counts were made from the drawing using a plastic ruler and angle –protractor.

Counts and measurements on the early chambers of *Lepidocyclina(Nephrolepidina)* were performed according to the procedures described by Drooger(1952), Drooger and Freudenthal (1964), Van der Vlerk & Gloor, (1968); Meulenkamp & Amato (1972), De Mulder, (1975); Drooger and Rohlding, 1987; Drooger,(1993); Saraswati, (1994); and Saraswati and Kumar,(2000)

The parameters used by these authors are briefly reviewed and their stratigraphic valueare discussed.

3-3 **Parameters of *Lepidocyclina(Nephrolepidina)***

3-3-1 External features

The Lepidocyclinids generally possess a reasonably well preserved outer morphology. The diameters range from (1- 12) mm, and there is a relationship between diameter and internal features. The larger specimens proved for the greater part belonged to the subgenus *Eulepidina*, whereas amongst the smaller specimens the frequency of *Nephrolepidina* showed to be higher. Saddle forms and specimens which showed pillars at their surfaces also belonged to *Eulepidina*. Small forms with topography constellated test all proved to surfaces with more angular or a more rounded periphery, were more or less equally distributing among the two subgenera. Especially in forms with more angular periphery the center is relatively more thickened than in specimens with a rounded periphery , which show a more gradually center wards thickening .

3-3-2 Internal features

Figures (8.a,b) shows the internal features on which counts and measurements in median sections of *Lepidocyclina(Nephrolepidina)* specimens are based. The figure also gives the terminology of the peri-embryonic chambers. The definition of individual chambers are as follows:

Protoconch: initial chamber (1), deuteroconch: second chamber (2) formed from 1, nucleoconch(embryon): 1 and 2 together..

PAC: Principal auxiliary chamber formed from 2, and resting on 1 and 2.

AACI: accessory auxiliary chamber; formed from 1, **AACII** : ad-auxiliary chamber formed from 2.

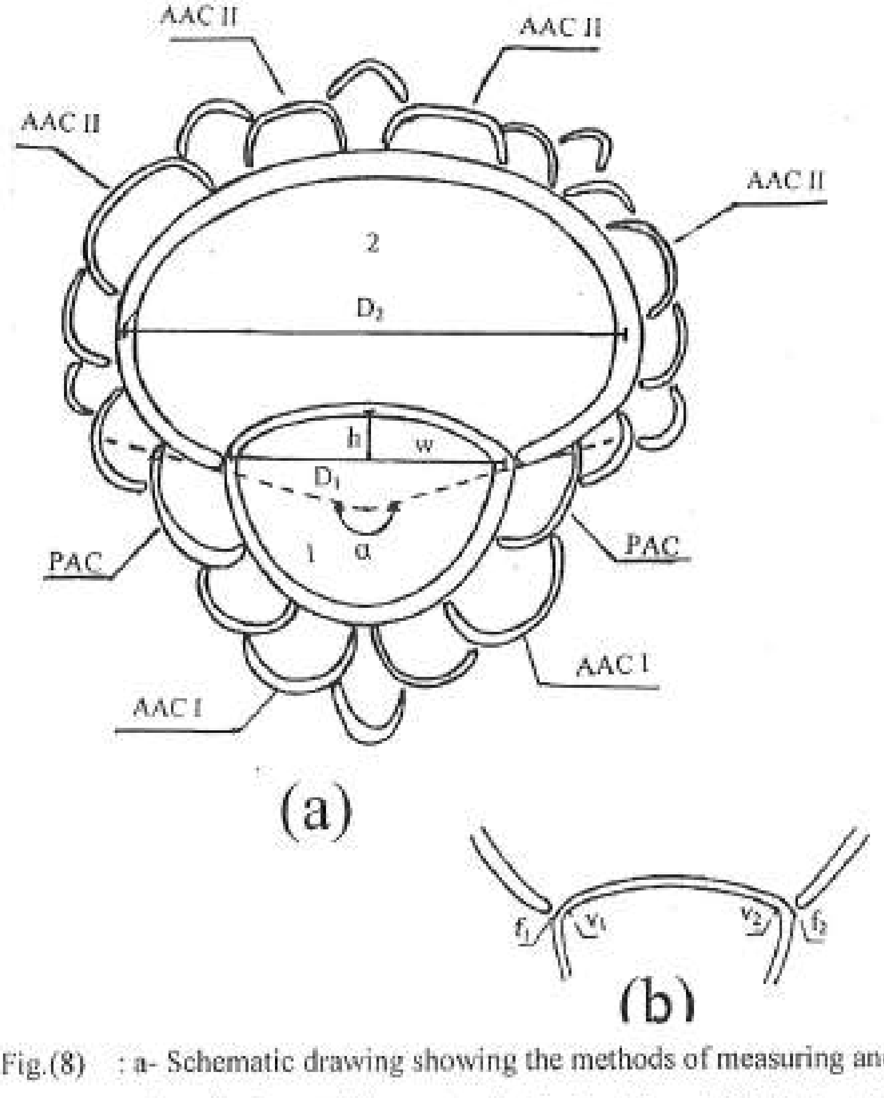


Fig.(8) : a- Schematic drawing showing the methods of measuring and counting the internal features in *Nephrolepidina*. b- Methods of measureing the degree of embracement in the embryonic chambers, A_I, the length of common wall is measured from v_1 to v_2, A_{II} from f_1 to f_2 (after De Mulder, 1975 and Drooger, 1993).

D_1: maximum diameter of the protoconch in µm, measured at right angles to a line connecting the centers of 1 and 2. Half of the thickness of the wall is included.

D_2 : maximum diameter of the deuteroconch, measured at right angles to the connection line between the centers of 1 and 2. Also in (D_2) values, half of thickness of the wall is included.

D_2/D_1: reflects the relative size of both embryonic chambers.

R: degree of curvature, calculated from the formula:-

R = 100 h/w. In this equation (w) is taken along the line connecting the attachment points of the deuteroconch to protoconch. Generally, (w) and (h) are measured along the maximum height of the protoconch that is inclosed by the deuoteroconch, measured at right angle to w.

α : introduced here. It reflects the degree of embracement of the protoconch by the deuteroconch, expressed by the protoconchal angle which is formed by the two hypothecal line from the center of the protoconch through the outer attachment points of the deuteroconchal walls with the protoconch (Fig.8_b, f_1 and f_2). α can be measured easier than A_i, but in not well-rounded protoconches the position of the center is rather arbitrary.

The mean number of accessory auxiliary chambers and the average degree of the embracement show sustained changes towards higher values from older to younger deposits. Therefore, these parameters have been used to define the stage of phylogenitic development and the relative age of Lepidocyclinid assemblages.

The mean of (D_1) and (D_2) from a stage pattern of increasing values. As a consequence, they can not be used for detailed correlations. The average degree of curvature (R) may offer possibility for biostratigraphic correlation, but the standard deviation for R appears to be considerably higher than those calculated for A. The same holds for parameter α, which is another form to express the degree of embracement of the protoconch by the deuteroconch.

In order to compare our results with those mentioned in the literature, our species assignments were primarily based upon (C) and (A_i)values. (A_i)and (A_o) in practice, both methods produced consistent results. Because Van Der Vlerk (1964) preferred A_i, whereas Drooger & Freudenthal (1964) used A_o.

3-3 Counts and measurements on the embryonic – nepionic stage and the relation between parameters

(396) megalospheric specimen, from (34) samples were subjected to biometric analysis in the studied area. The results of counts and measurements are recorded in tables (1- 4) . For Europian *Nephrolepidina*, (Freudenthal, 1964; Drooger and Freudenthal, 1964; Drooger and Socin,1959) reported an over all but shows an irregular increase in the average degree of embracement of the protoconch by the deuteroconch (A_i) and in the average number of accessory auxilliary chambers on the deuteroconch (C) in the course of time. The representative of *Lepidocyclina (Nephrolepidina)* in different sections is discussed below.

The names for the morphometrically defined species units have been selected from the older literature, in which a large number of species names were established on a purely typological basis and on the basis of characteristics that were never expressed numerically. Especially features of the exterior, such as size and shape of the test and pustules, were used by the earlier authors, such characteristics are considered nowadays to be largely environment-controlled and of subordinate taxonomic value.

The species designation of intermediate assemblage is ignored in De Mulder's (1975) classification in order to reduce the number of exemplum intercentrate determination.

In this study, the variation in the A—C- combination is rather wide along this road causes quite a few ex.interc. determinations as seen in (tables 1, 2, 3 and 4).

3-4-1 Kirkuk well-19 section

This section includes the Units (I, II and III) of the Oligocene carbonates, (Baba Formation). Seven samples of the section are rich in *Lepidocyclina (Nephrolepidina)* assemblages which show an increase in the (A_i) and (C) values when we introduce from the lower to the upper part of the section that may be indicated to the presence of different species. The scatter diagrams of the (A_i-C) and (D_2-C) are plotted in (Figs. 9 and 10) which show different style of correlations. In Unit I, the samples (1, 3 and 11) have weak positive correlation with a probability between 95-99%, the A_i and C values range between (Ai=35-40, C=1-3) respectively, which have the characteristics of *L(N.)praemarginata,*(Plate 5 , Figs.1-6, Plate 6, Fig. 12), While in Unit II, the samples (14, and 16) have a clear visible and strong correlation with the values (A_i= 39-41, C=2-4). They can be classified in the characteristics of *L.* ex. interc. *praemarginata-morgani* ,(Plate 6 , Figs 1-4.), but in Unit (III), of the upper part of the section which is represented by the samples(18 and 20), have a strong positive correlation with the values ranging between (Ai= 40-45,C=5-5.25) may be referred to *L.(N.) morgani*, (Plate 7, Figs.1-4) .

The scatter diagrams between (D_2) and (C) of the samples (1, 3, 11, 14, 16, 18 and 20) show a strong positive correlation. (Fig. 10) which indicates different species.

The scatter diagrams for the (C-α) show negative correlation.(Fig. 11). The lower part of the section which is represented by the samples (1, 3 and 11) reveal a weak negative correlation with values of the (C) and (α) range between (C = 1-3, α >208) respectively. While their values in the middle part in the samples (14 and 16) and ranged between (C= 2-4, α = 199-208), whereas the samples (18 and 20) contains the individuals their C and α values ranged

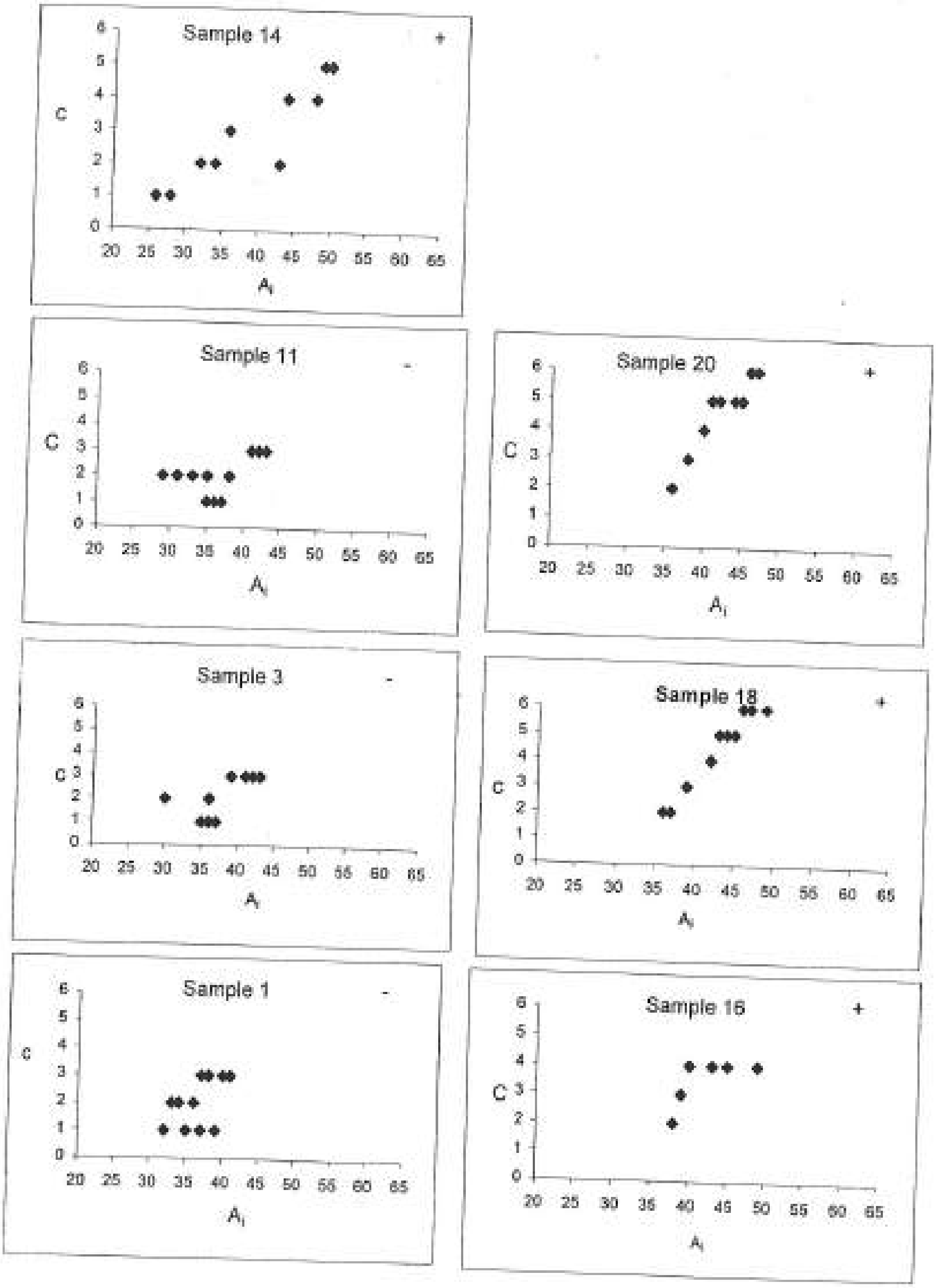


Fig.(9): Relation between C and A_i values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section.

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

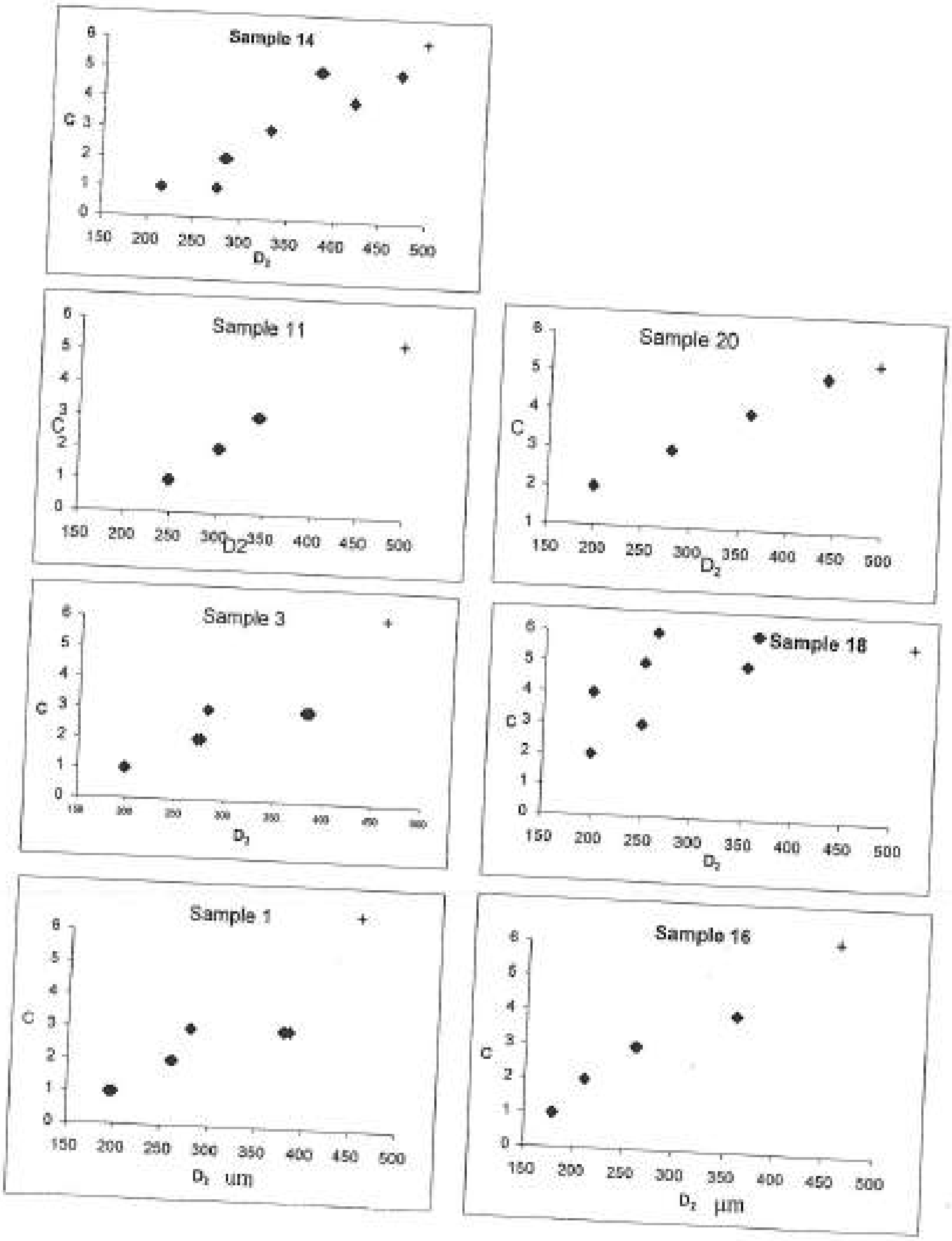


Fig.(10): Relation between C and D_2 values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

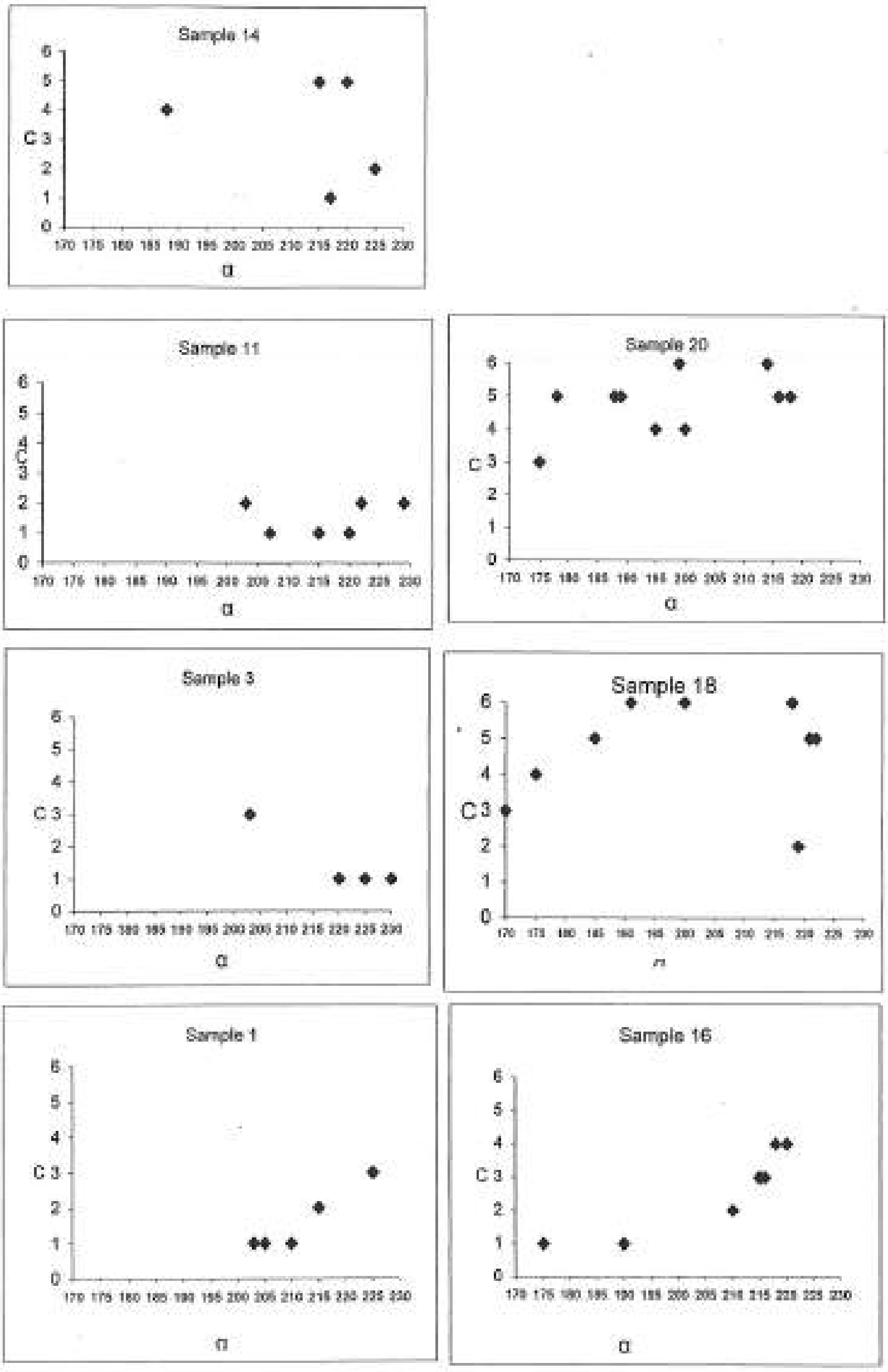


Fig.(11): Relation between C and α values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section between (C= 5-5.25 and α = 192.5-199). The values of (C^{-} - α-) relation indicate for species correspond on which resulted from the values of (C) and (A_i)

The means of (A_i-C) and (C-D_2) show a distinct positive correlation, (Figs. 12 and 13), no significant setback occur in the lower part of the section. In contrast with the relation between C and (α). (Fig. 15), shows the absence of significant positive correlation between the means of (C^{-}) and (α^{-}) per samples seems to be an arbitrary positive correlation. As to the relation between the seven assemblages showing that both parameters are positively correlated, with a probability of more than 99%. The observations suggest that the number of accessory auxiliary chambers can not be proved to be strongly dependent either on the degree of embracement or on the diameters of the deuteroconch. This conclusion is in fair agreement with the observations by De Mulder(1975) from Oligocene of the Jonian island, Greece.

The species in this section are distributed based on the (A^{-}_i) (C^{-}) and (α^{-})as the following :-

Species	A^{-}_i	C^{-}	α^{-}
L. praemarginata	$35<A^{-}_i<40$	$1<C^{-}<3$	$\alpha^{-}>208$
L.ex. interc.praemarginata-morgani	$39<A^{-}_i<41$	$2<C^{-}<4$	$199<\alpha^{-}<208$
L.morgani	$40<A^{-}_i<45$	$3<C^{-}<5.25$	$192.5<\alpha^{-}<199$

The histogram of A_i and C classes are plotted in (Fig.15), which shows the unimodal and fairly normal distributional patterns for most of the samples, The irregularities in the (C) histogram might be explained by the low number of observations in comparison to the wide variation and /or the inaccuracies in counting the number of accessory auxiliary chambers. However the wide variation and skewed character of the samples may as well be explained by

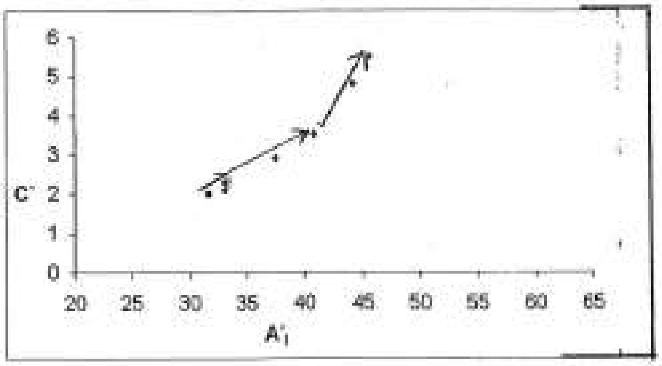


Fig.(12): Relation between C and A_i mean values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section arrows indicate their stratigraphic order

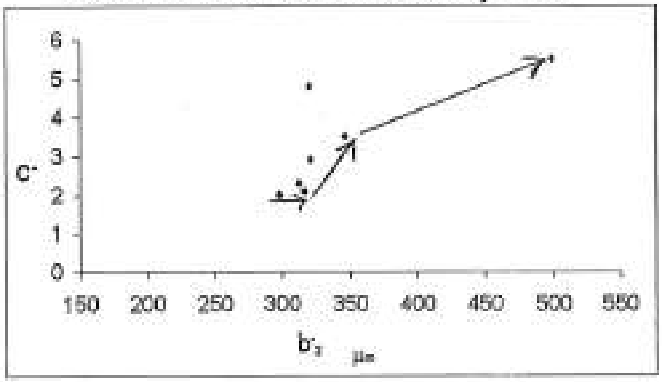


Fig.(13): Relation between C and D_2 mean values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section arrows indicate their stratigraphic order

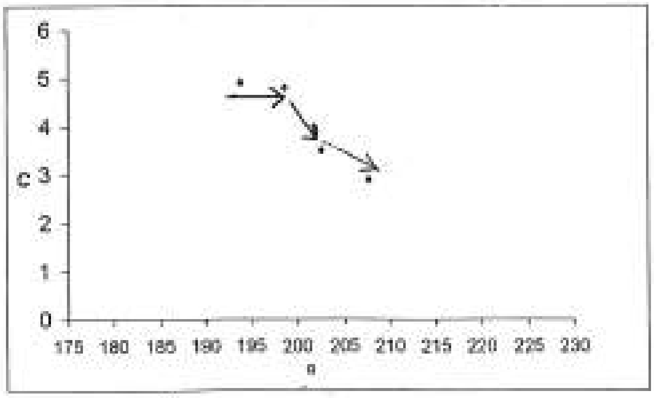


Fig.(14): Relation between C and α mean values for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section arrows indicate their stratigraphic order mixing of more positive and more highly developed assemblages. The discussion of histograms is listed below:

In the samples (1,3 and 11) of the Unit I, the histograms have the unimodal shape that the (A_i)and (C) values are ranging from (35-40) and (1-3) respectively may indicate to one type of species which is related to the *L.(N.) praemarginata*. The samples (14 and 16) of the Unit II, have the bimodal shape with the values of A_i and C ranging between (39-41) and (2-4) respectively, this indicates an intermediate position between two type of the species situated between *L(N.)Praemarginata* and *L(N.)morgani* that have both characters in A_i and C values which is named as *L.ex. interc. praemarginata-morgani*, but the upper part of the section represented by the samples (18 and 20) of the Unit III have the unimodal shape with (A_i=40-45, C=5-5.25) values corresponding to the values of the *L.(N.)morgani*.

Therefore the values of (A_i)and (C) in Kirkuk well-19 section are in fair agreement with the range of (A_{-i})and (C) values with the observation from all the world by(De Mulder,1975; Drooger and Rohling,1987;Drooger,1993; Saraswati and Arum Kumar,2000)

The average degree of embracement of the protoconch by the deuteroconch ($\bar{A}_i$) and the average number of the accessory auxiliary chambers on the deuteroconch ($\bar{C}$) show an increasing of the data from the lower part to the upper part of the section, and the species are located based on the C , A_i , also the mean of α and another parameters reflecting the degree of embracement of the embryonic chambers show a successive of decreasing values, for example the samples (7 and 15) of the Unit (II) which shows that the values of (α) are more than (208), which is related to the *L. praemarginata*, but from the samples (18, 19 and 20) of the Units (II and III), the values of (α)decreased and ranged between (199-208) which are close to *L. ex. interc. praemarginata-morgani*, whereas the upper part of the section especially the samples (22 and 23)

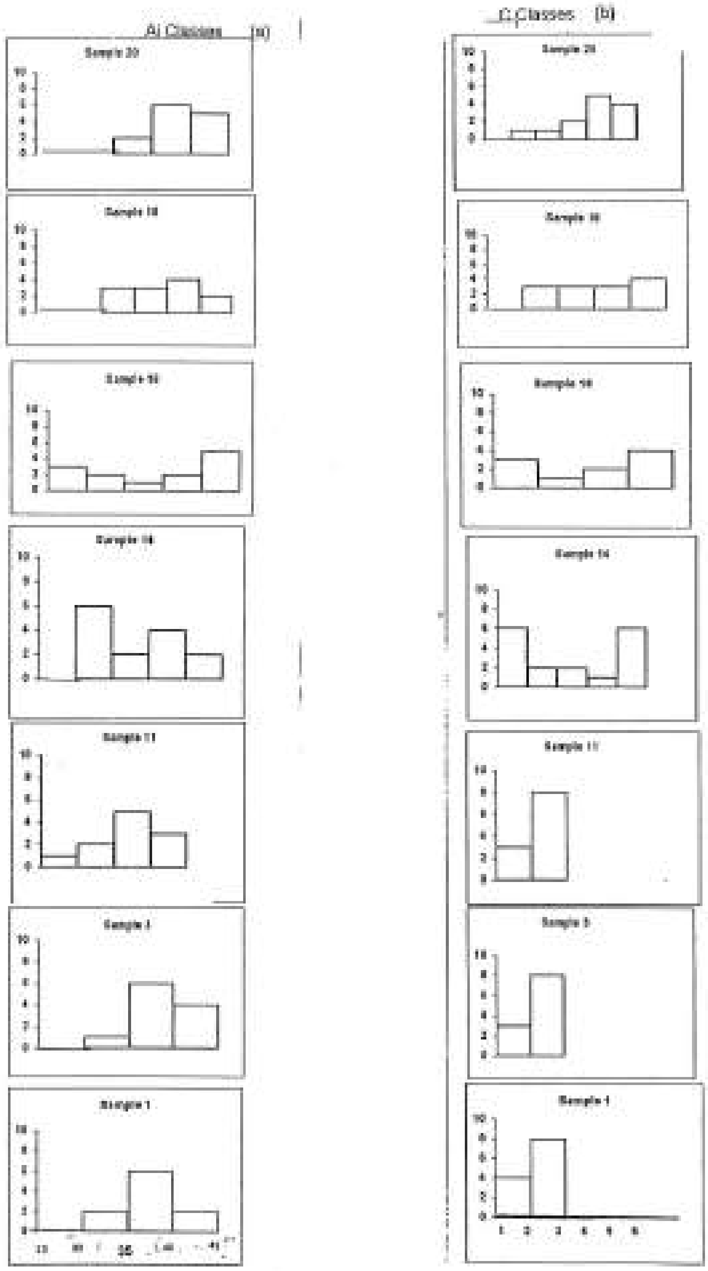


Fig.(15): Hisograms of A_i classes and of C classes for seven selected *Nephrolepidina* assemblages in Kirkuk well-19 section.

of the Units (III and IV) the decreasing of the α value was very clear and ranged between (192.5-199)which corresponds to the *L. morgani*. (Table- 1).

In contrast the average degree of curvature of the common wall between the protoconch and deuteroconch (R) has a less regular pattern of increasing values. No clear trend is observed in the average size of protoconch (D_1) and deuteroconch(D_2), (D_2/D_1)values are not actually changing in the lower part of the section, but in those obtained for the sample (20) is significantly higher.(Table1)

3-4-2 Bai-Hassan well-4 section

This section consists of the units (II,III and IV) of the Oligocene carbonates (Baba Formation), eight samples only are rich in *L.(N.)* , from the lower to the upper part of the section, which are subjected to biometric analyses by using the parameters values (A_i-C and D_2-C). In Unit II, the samples (7, 15 and 16) show a strong or a weak positive correlation (Figs. 16 and 17) the values of A_i and C range between (A_i=35-40, C=1-3) respectively which have the characteristics of the *L.(N.) praemarginata* (Plate5, Figs.7-12), while the individuals in the samples (18,19 and 20) of the Units (II and III) show the increasing of values of A_i and C range between (39-41, and 2-4) respectively which will be referred to *L.ex.interc. praemarginata-morgani* in this part of the section (Plate 6, Figs. 5-11). But the upper part of the section Units (III and IV) represented by the samples (22 and 23) have the means value of C about (5-5.25) and A_i (40-45) may be marked to the *L.(N.) morgani*. (Plate 7, Figs. 5-7).

(D_2) and (C) relations are plotted in (Fig. 17), their values correspond with the species that located in the relations between (A_i) and (C).

The scatter diagram for the (C-α) show negative correlation. Fig. (18). The lower part of the section represented by the samples (7, 15 and 16) reveal a strong negative correlation with values of the C and α range between (C=1-3, α>208) respectively. While their values in the middle part in the samples (18, 19 and 20)

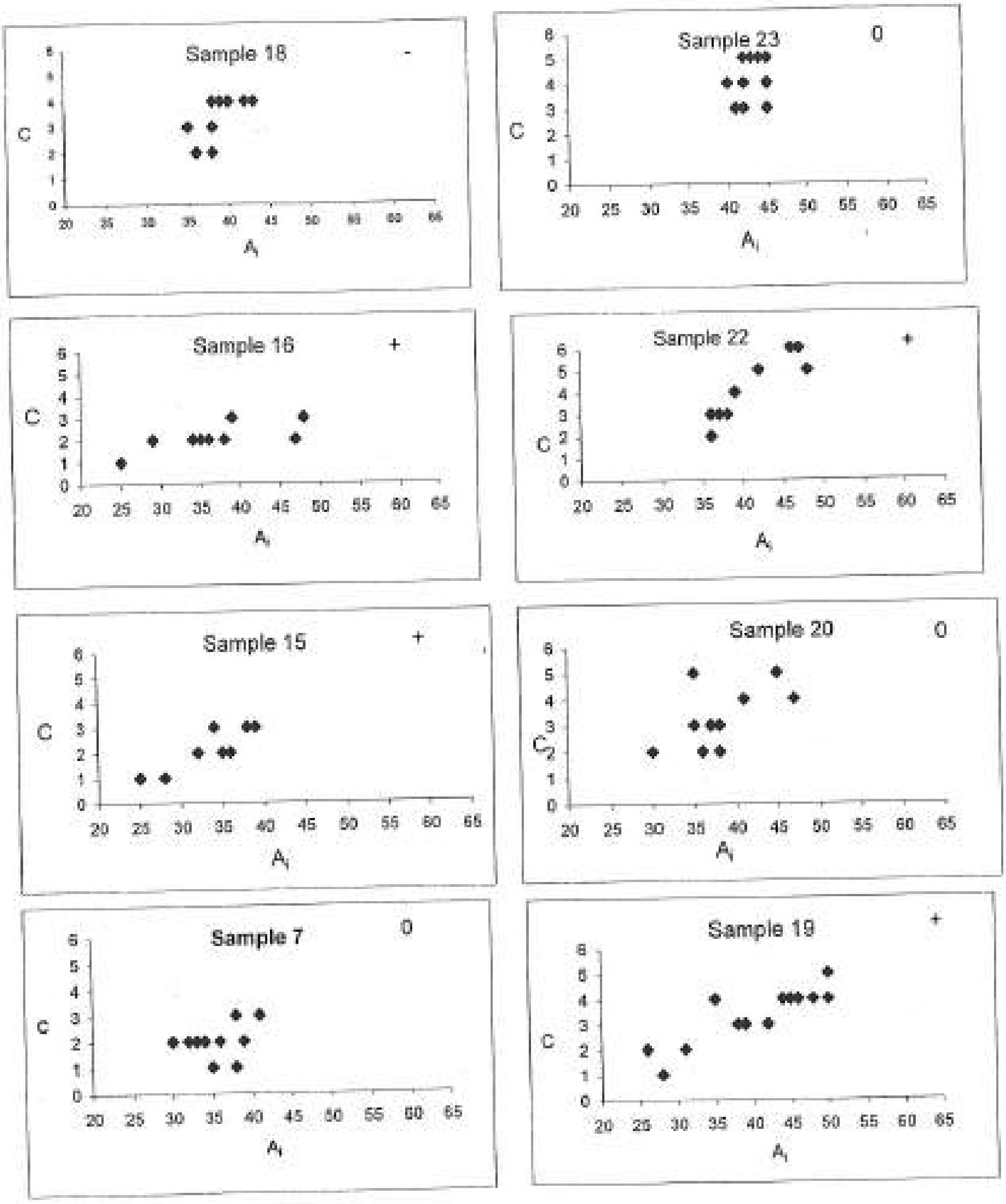


Fig.(16): Relation between C and A_i values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section.

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

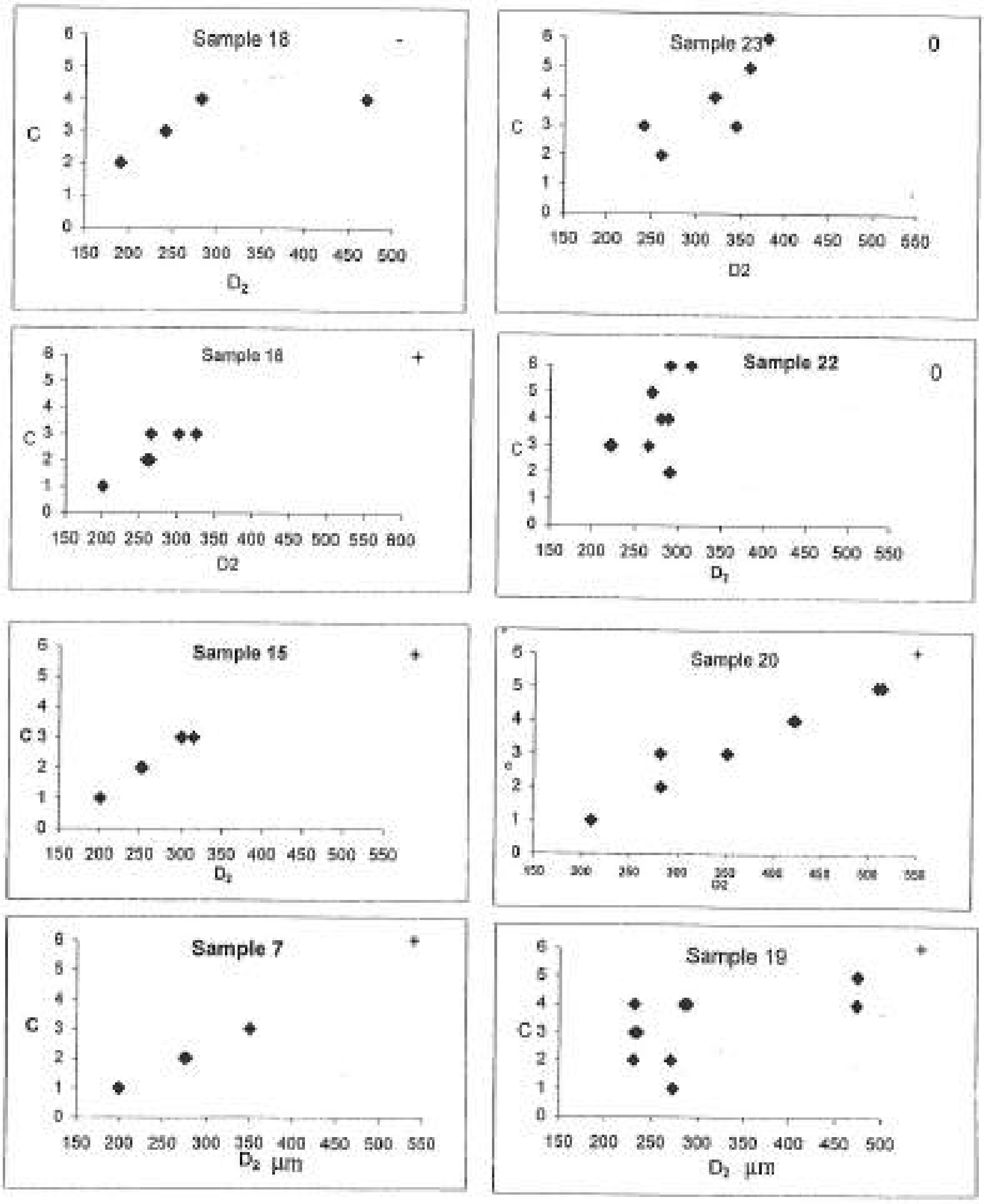


Fig.(17): Relation between C and D_2 values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section.

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

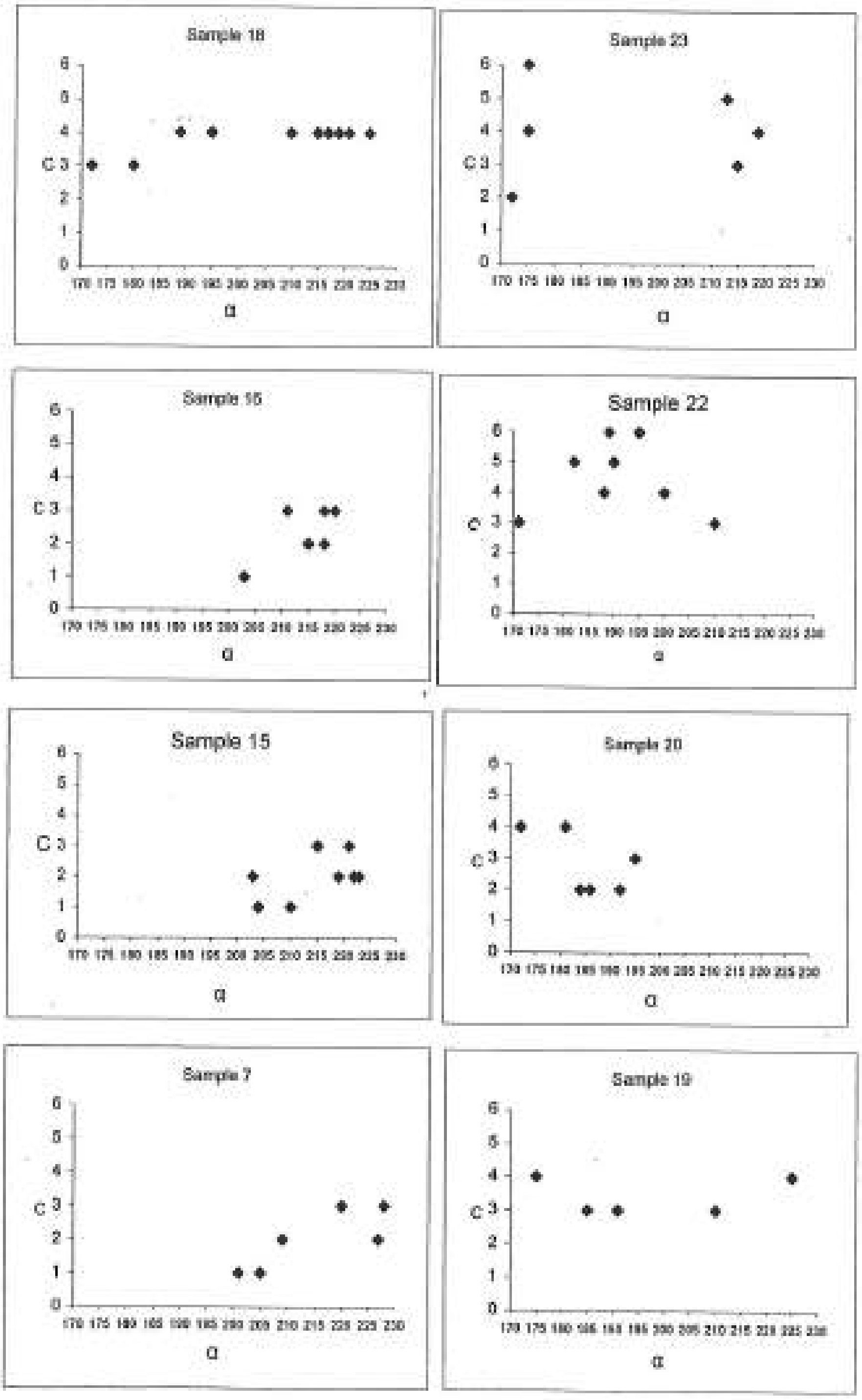


Fig.(18): Relation between C and α values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section.

Series	Stage	Unit	Thickness (m)	Sample Number		A_1°	C°	D_1°	D_2°	D_2/D_1°	R°	α°	Species
Oligocene	Chattian	III	9	20	M	42.5	4.9	297.3	324.6	1.09	29.4	193.9	*L. morgani*
					N	13							
				18	M	44.1	4.8	220.1	285.83	1.5	28.4	198.6	*L. morgani*
					N	12							
		II	8	16	M	40.7	2.9	272	330.0	1.2	25.5	207.7	*L. ex. interc praemarginata-morgani*
					N	10							
				14	M	40.8	3.5	283.3	345.8	1.2	23.5	202.5	*L. ex. interc praemarginata-morgani*
					N	12							
		I	18	11	M	36.4	2	260.7	298.1	1.1	17.4	229.1	*L. praemarginata*
					N	11							
				3	M	38.1	2.3	240.9	312.4	1.3	14.1	238.2	*L. praemarginata*
					N	11							
				1	M	36.8	2.1	219	315.9	1.4	15.3	238.8	*L. praemarginata*
					N	12							

Table(1): Results of Counts and measurements on Seven *Nephrolepidina* assemblages from the Oligocene Carbonates, (Baba Formation) in Kirkuk well-19 section M = Mean of the value, N = Number of observation.

ranged between (C =2-4, α= 199-208) whereas the samples (22 and 23) contains the individuals their C' and α' values range between (C =5-5.25 and α' = 192.5-199), the values of (C - α' relation indicate for species correspond on which resulted from the values of (C) and (A_i).

The average means of (A_i.C) and (D_2-C) shows a positive correlation. (Figs.19 and 20) respectively, while the average means of (C¯α') show a reverse correlation. (Fig.21)

In order to support the results, the histograms of (A_i) and (C) classes are plotted in (Fig.22), which show unimodal and fairly normal distributione pattern for most of the samples. The regularity in the (C) histogram might be explained by the low number of observations, in comparison with wide variation and for the inaccuracies in counting the number of accessory auxiliary chambers. However, the wide variation and skewed character of the (C) histograms of the same of the samples may as well be explained by mixing of more primitive and more highly developed assemblages. In the samples (7,15 and 16), there is an unimodal shape of the histogram in both values of A_i and C which are ranging from (35 to 40) and (1 to 3) respectively, these values correspond to the *L.(N.)praemarginata*, the samples (18,19 and 20) of the (unit II and III) have the bimodal shape with the values (A_i=39-41, 'C=2-4) that are related to the species, situated between *L.(N.) praemarginarta* and *L.(N.)morgani*, which are named as *L.ex.interc. praemartginata-morgani* ,but the upper part of the section (Samples 22 and 23) of the Unit (V), with the values of (A_i=40-45, C=5-5.25) which have the unimodal shape are close to the characteristics of the *L.(N.) morgani*.

Therefore the (A_i) and (C) values of this section in this study corresponds with the range of (A_i) and (C) values that mentioned by (De Mulder,1975; Drooger and Rohling,1987; Drooger, 1993; Saraswati and Arun Kumar,2000) from the different part of the world.

The average degree of embracement of the protoconch by the deuteroconch (A_i) and the average number of the accessory auxiliary chambers on the

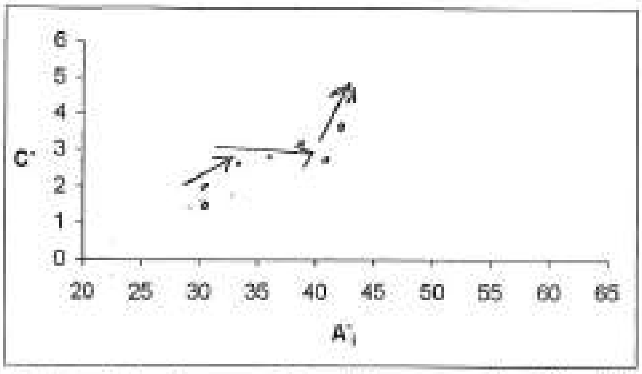


Fig.(19): Relation between C and A_i mean values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section.
arrows indicate their stratigraphic order.

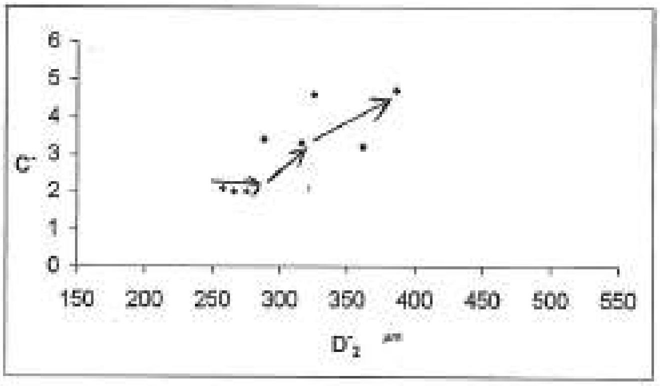


Fig.(20): Relation between C and D_2 mean values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section
arrows indicate their stratigrapgic order.

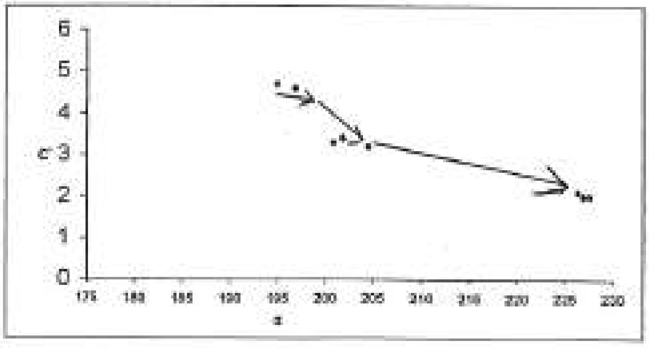


Fig.(21): Relation between C and α mean values for eight selected *Nephrolepidina* assemblages in Bai-Hassanwell-4 section
arrows indicate their stratigraphic order.

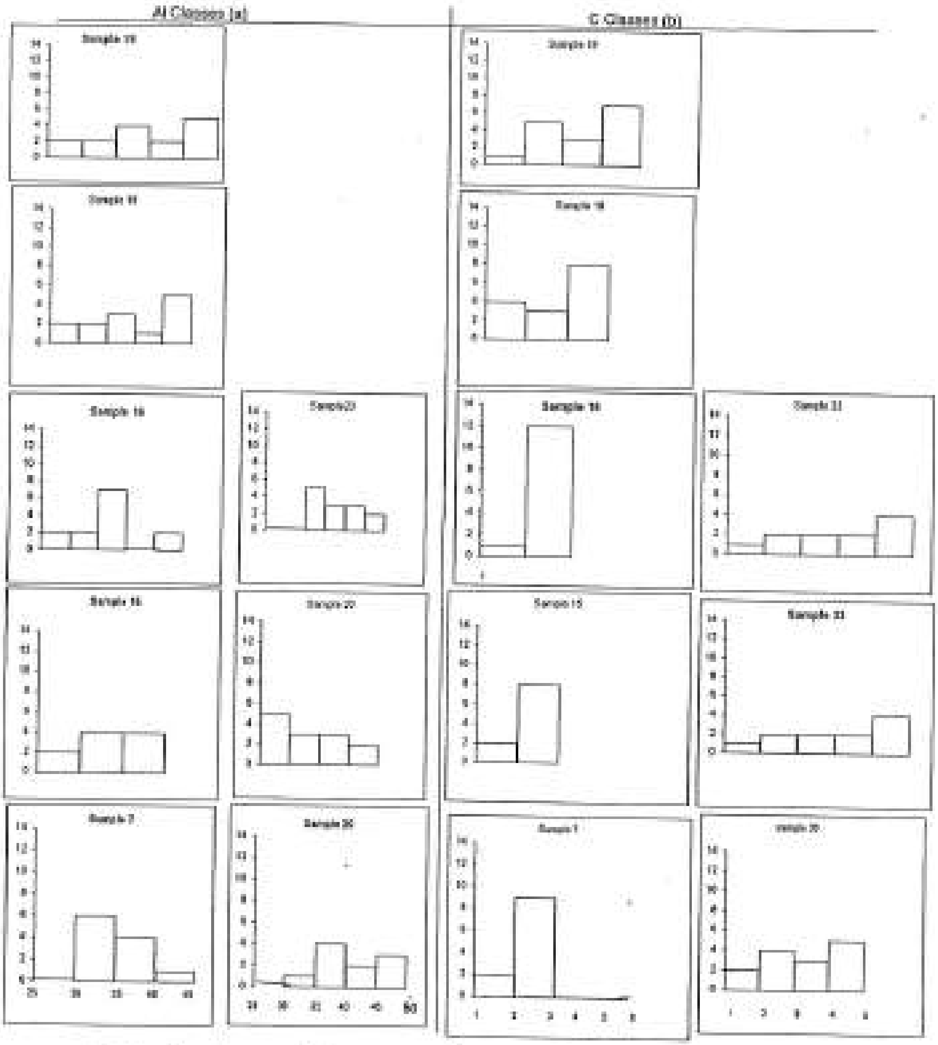


Fig.(22): Histograms of A_i classes and of C classes for eight selected *Nephrolepidina* assemblages in Bai-Hassan well-4 section deuteroconch (C) show an increasing of these data from the lower part to the upper part of the section, and the species are located based on the (C), (A_i) and (α) but the degree of embracement of the protoconch by the deuteroconch (α) values decreased from the lower to the upper part of the section.(Table 2)

The species of this section are distributed according to their mean values of (A_i, C and α)as the following :-

Species	$\bar{A}_i$	$\bar{C}$	$\bar{\alpha}$
L.praemarginata	$35<\bar{A}_i<40$	$1<\bar{C}<3$	$208<\bar{\alpha}$
L.ex. interc.praemarginata-morgani	$39<\bar{A}_i<41$	$2<\bar{C}<4$	$199<\bar{\alpha}<208$
L.morgani	$40<\bar{A}_i<45$	$5<\bar{C}<5.25$	$192.5<\bar{\alpha}<199$

For European *Nephrolepidina* that are reported on over all, showing an irregular increasing in the average degree of embracement of the protoconch by the deuteroconch (A_i) and in the average number of accessory auxiliary chambers on the deoteroconch (C) (Frendenthal, 1964; Drooger and freudenthal, 1964 ; Drooger and Socin, 1959) , but in this study there is a regular increasing of (A_i)and (C) values when introduced from the lower part to the upper part of the section.

Also the mean of α, shows a successive of decreasing values, from the lower to the upper part of the section, the values of α are ranging from (227.6) in the lower part of the section (sample 7) to (194.9) in the upper part (sample 23), these ranges may give indication to different species which are distributed from the lower part to the upper part of the section, represented by *L. praemarginata, L. ex. interc. praemarginata-morgani* to the *L. morgani.* In contrast the average degree of curvature of the common wall between the protoconch and deuteroconch (R) has a less regular pattern of increasing values. No clear trend is observed in the average size of protoconch (D_1) and deuteroconch(D_2), (D_2/D_1)values are not actually changing in the lower part of the section.(Table,2)

Series	Stage	Unit	Thickness (m)	Sample Number		A'₁	C'	D'₁	D'₂	D₂/D₁	R'	α'	Species
OLigocene	Chattian	IV	35	23	M	42.8	4.7	260.3	341	1.2	30.1	194.9	*L.morgani*
					N	14							
		III	11	22	M	42.4	4.6	206	274.9	1.4	25.4	196.8	*L.morgani*
					N	12							
				20	M	39.8	3.2	318.5	361.5	1.14	25	204.5	*L.ex.interc praemarginata-morgani*
					N	10							
		II	9	19	M	40.2	3.3	230.5	314.6	1.3	26.8	200.8	*L.ex.interc praemarginata-morgani*
					N	13							
				18	M	39.1	3.4	281.8	287.7	1.02	30.6	201.8	*L.ex.interc praemarginata-morgani*
					N	13							
				16	M	36.7	2	236.6	265.5	1.1	13.2	226.9	*L.praemarginata*
					N	13							
				15	M	36.7	2.1	213.2	257.7	1.2	16.2	226.3	*L.praemarginata*
					N	10							
				7	M	35.3	2	206.5	273	2.3	14.9	227.6	*L.praemarginata*
					N	11							

Table (2): Results of Counts and measurements on Eight *Nephrolepidina* assemblages From the Oligocene Carbonates , (Baba Formation) in Bai-Hassan well-4 section. M = Mean of the value. N = Number of observation.

3-4-3 Khabaz well-3 Section

The Units (V,VI,VII and VIII) are the subdivision of this section from the lower part to the upper part, the relations between (A_i , C) and (D_2,C) for *Nephrolepidina* individuals from (`12) samples are plotted in (Figs, 23 and 24) respectively, showing a weak or a strong positive correlation or no correlation. The individuals in the samples (7, 16 and 22) of the units (V and VI) have a strong positive correlation, in which the values of A_i range from (40 to 45), and C values from (5 to 5.25), these values will be referred to *L .morgani*(Plate 7 , Figs.8-9, Plate 8, Fig. 3), while the samples (28, 31, 32, 35 and 36) of the units (VI and VII) have individuals with the values of A_i and C, differ from that in the samples of the lower part of the section, ranging between (A_i=44-46, C=5-5.5), with no correlation or a weak positive correlation, these individuals are situated between *L .morgani* and *L .tournoueri*, which is named *L. ex. interc. morgani-tournoueri* ,(Plate 8 , Figs.4-9, Plate 9, Figs. 2-3), the upper part of the section (units VII and VIII) which is known by the samples (37, 42, 49 and 50), we recognized that the values of A_i and C have been increased (> 45, and >5.25) respectively, and show a strong positive correlation, in addition the relations between D_2 and C, and their values from the same samples may refer to *L .tournoueri*, (Plate 9, Figs.4-9).

The scatter diagram for the (C - α) show negative correlation (Fig.25). The lower part of the section which represented by the samples (7, 16 and 22) reveal a weak, a reverse correlation with values of the C and α range between (C 5-5.25-α 192.5-199) respectively. While their values in the middle part in the samples (28, 31, 32, 35, and 36) ranged between (C= 5-5.5, α 189.5-192.5) whereas the samples (37, 42, 49 and 50) contain the individuals their C and α, values ranging between (C > 5.25, α>189.5), The values of (C' - α') relation indicate for species correspond on which resulted from the values of C and (A_i).

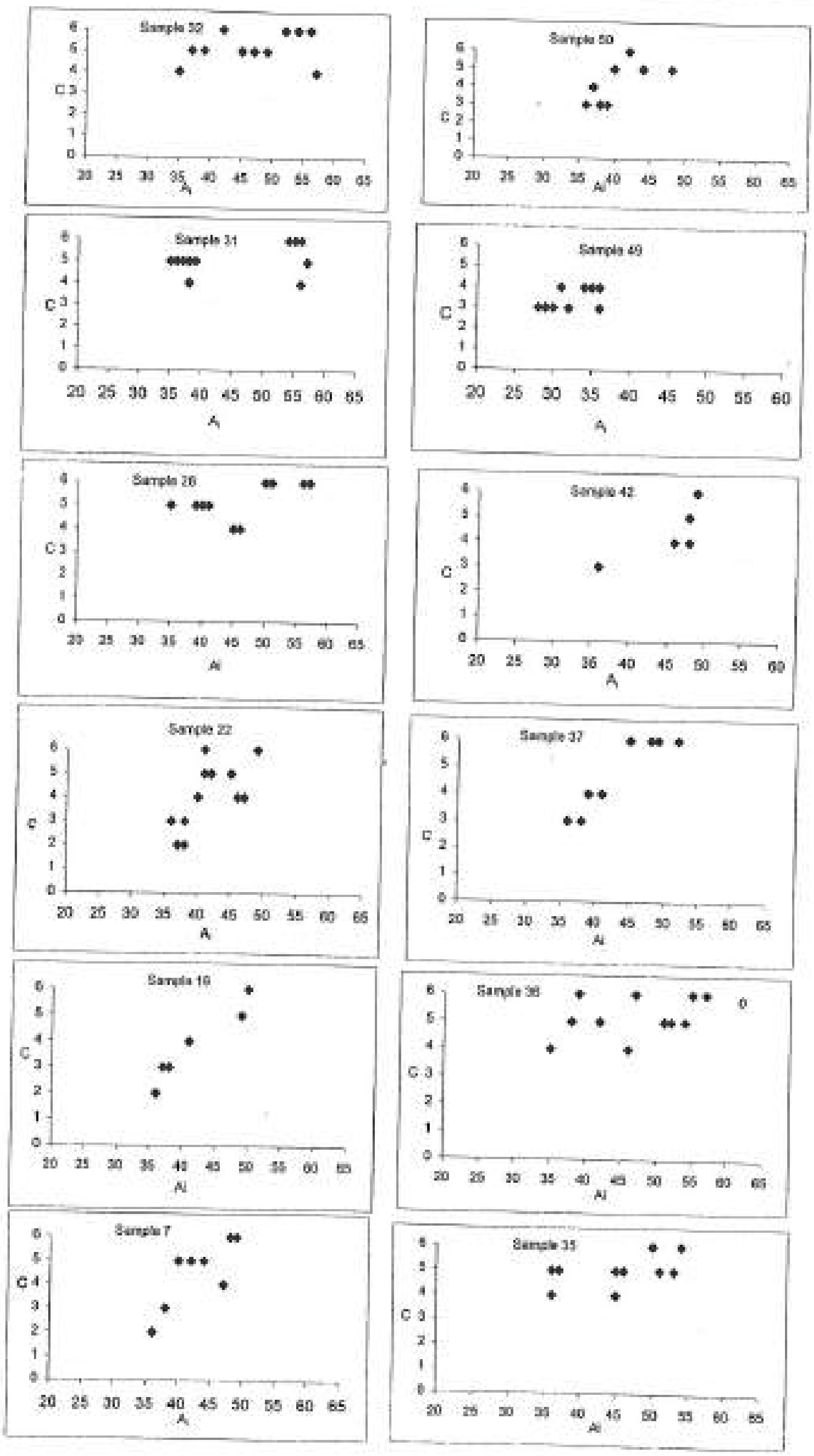


Fig.(23): Relation between C and A_i values for Twelve selected *Nephrolepidina* assemblages in Khabaz well-3 section. + refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation

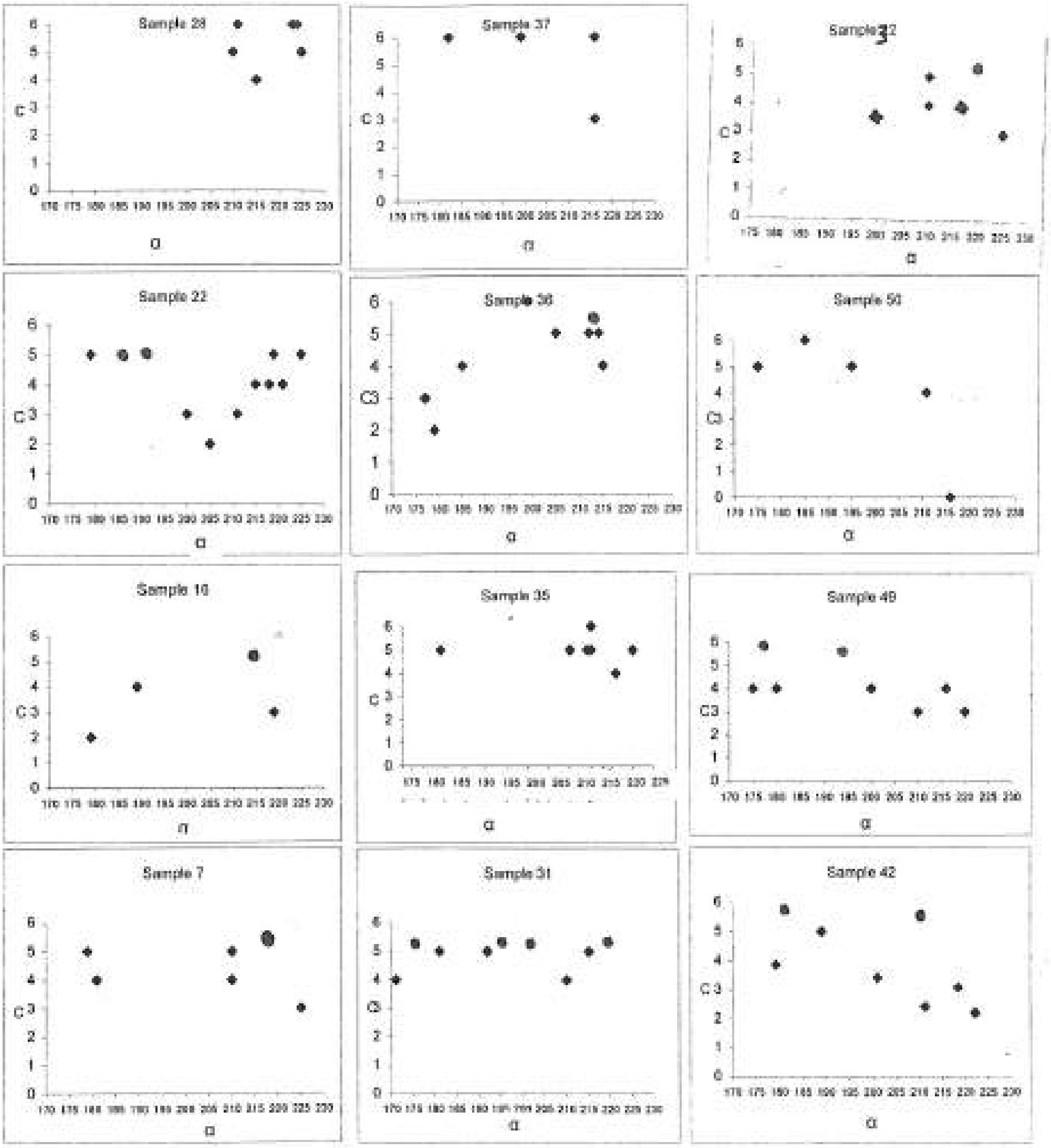


Fig.(25): Relation between C and α values for Twelve selected *Nephrolepidina* assemblagesin Khabaz well-3 section.

The mean values of ($C^{`}$-$A_i^{`}$) and ($D^{`}_2$- $C^{`}$) shows a distinct positive correlations. (Figs.26 and 27) respectively, while the means of (C-α) show a reverse correlation. (Fig. 28)

The histogram of (A_i) and (C) classes (Fig.29), have supported the results, which show unimodal and fairly normal distributional pattern for most of the samples. The regularizes in the (C) histogram (e.g. sample 16) might be explained by the low number of observations, in comparison with wide variation and for the inaccuracies in counting the number of accessory auxiliary chambers..

The average degree of embracement of the protoconch by the deuteroconch (A_i) and the average number of the accessory auxiliary chambers on the deuteroconch(C) show an increasing of the data from the lower part to the upper part of the section, and the species are located based on the C and A_i.

The histogram of this section possess unimodal and bimodal shapes(Fig. 29), the samples (7,16 and 22) of the units(V and VI) show the unimodal shape that the values of (A_i)and (C) vary between(40-45 and 5-5.25) respectively, these values are the characteristics of the *L .morgani*, while the samples (28,31,32,35 and 36) of the units(VI and VII) have been revealed bimodal shape and their values of (A_i)and (C) ranging between (44-46 and 5-5.5) respectively. These values correspond to the *L.ex. interc. morgani-tournoueri*, but in the upper part of the section samples (37,42,49 and 50) of the units (VII and VIII), there is an increase of (A_i)and (C) values that range between (36-56 and 3-9) respectively, will be referred to as the *L .tournoueri*.

Also the means of (α) , show a successive of decreasing values which give indications to the existence of different species of *L.(N.)*. for example the sample (7) of the lower part of the section, belongs to the *L. morgani*, which have the mean value of α about (199), while the middle part of the section represented by the samples (28, 31, 32, 35 and 36), it is clearly visible the decreasing of the mean values of the ($\alpha^{`}$)which range between (189.5-192.5), correspond to the *L. ex. interc. morgani-tournoueri*, but the upper part of the section, in sample (50),

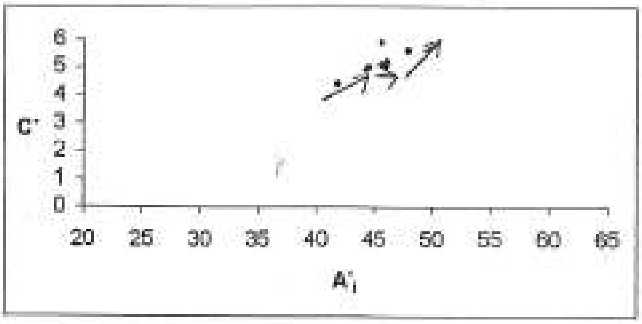


Fig.(26): Relation between C and A_1 mean values for Twelve selected *Nephrolepidina* assemblages inKhabaz well-3 section.

arrows indicate their stratigraphic order

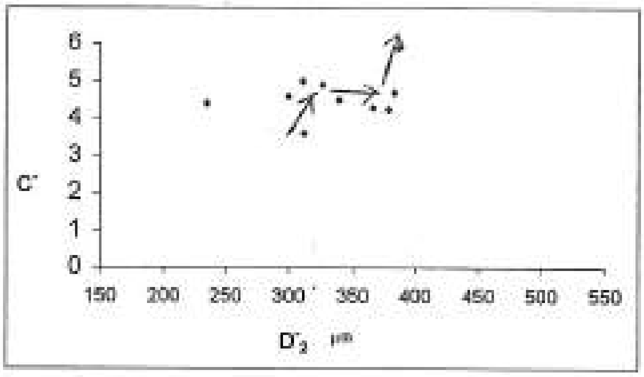


Fig.(27):Relation between C and D_2 mean values for Twelve selected *Nephrolepidina* assemblages in Khabaz well-3 section

arrows indicate their stratigraphic order.

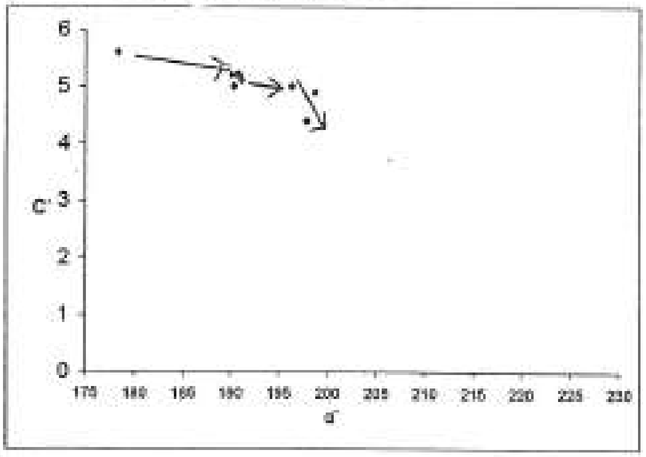
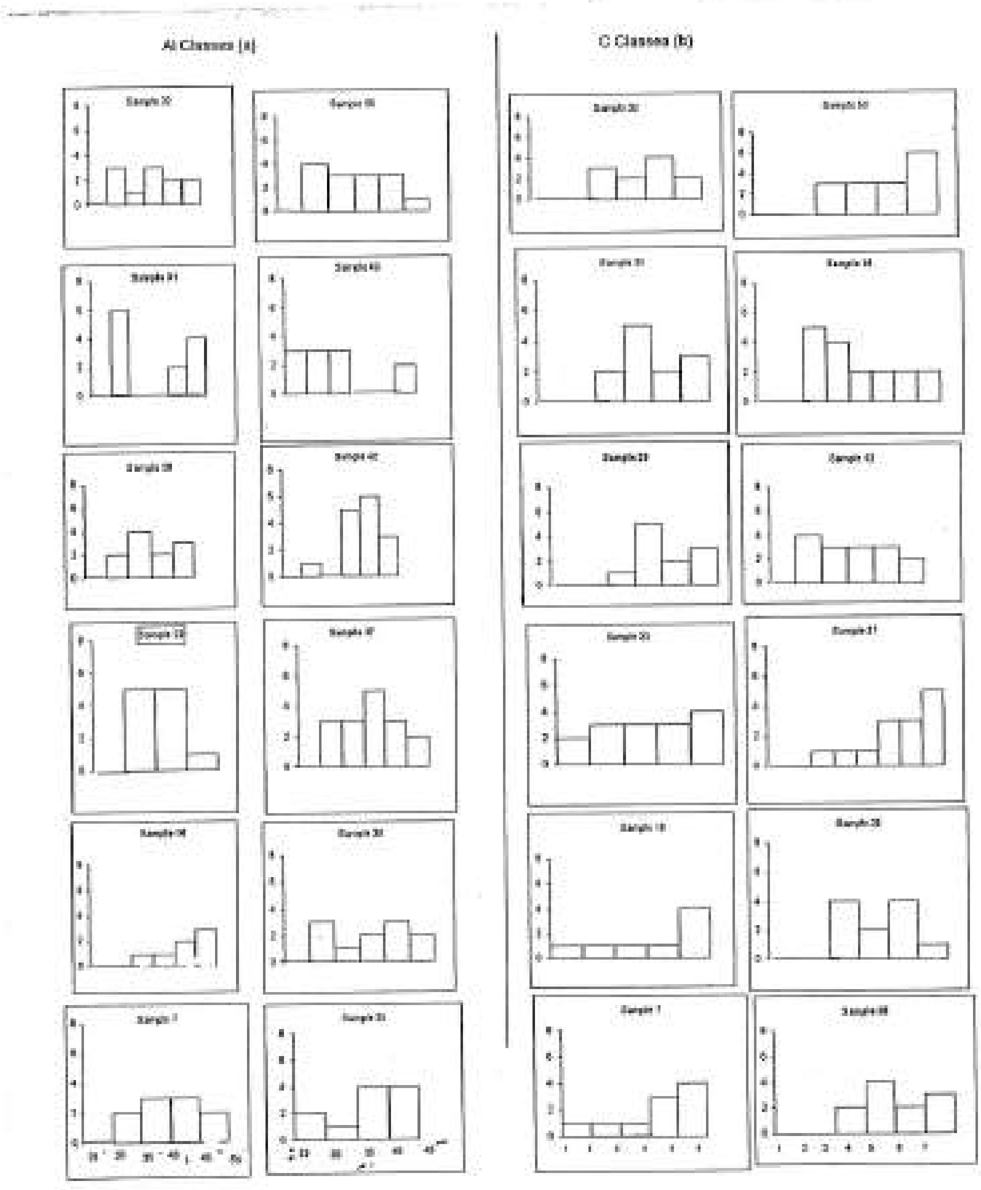


Fig.(28); Relation between C and α mean values for Twelve selected *Nephrolepidina* assemblages inKhabaz well-3 section

arrows indicate their stratigraphic order.



Fig(29):Histograms of A_i classes and of C classes for Twelve selected *Nephrolepidina* assemblages in Khabaz well-3 section which refer to *L. tournoueri* show the less mean value of ($\bar{\alpha}$=172.4), if compared with the mean values of the species from lower part of the section, In contrast the average degree of curvature of the common wall between the protoconch and deuteroconch (R) has a less regular pattern of increasing values. No clear trend is observed in the average size of protoconch (D_1) and deuteroconch (D_2). The values (D_2/D_1)are not actually changing in the lower to the upper part of the section. The mean of (A_i, C, D_1, D_2, D_2/D_1), R and α shows the distribution of the different species from the lower to the upper part of the section. (Table 3)

According to the mean values of ($\bar{A}_i$),($\bar{C}$) and ($\bar{\alpha}$) the species are distinguished as the following :

Species	$\bar{A}_i$	$\bar{C}$	$\bar{\alpha}$
L.morgani	$40<\bar{A}_i<45$	$5<\bar{C}<5.25$	$192.5<\bar{\alpha}<199$
L.ex.interc.morgani-tournoueri	$44<\bar{A}_i<46$	$5<\bar{C}<5.5$	$189.5<\bar{\alpha}<192.5$
L .tournoueri	$\bar{A}_i>45$	$\bar{C}>5.25$	$\bar{\alpha}<189.5$

3-4-4 Qarah Chauq Dagh Section

This section includes (V, VI, VII and VIII) units, distributed from the lower part to the upper part of the section. In the units (V, VI and VII), the samples (3,12,17.18 and 20) show a weak positive correlation in the relation between the scatter diagrams of the (A_i)- (C) , and (D_2 – C), (Figs.30 and 31) respectively, these characteristics are close to the *L .morgani* , (Plate 7, Figs.10-12, Plate 8, Figs. 1-2), but in unit (VII) the sample (21) shows a strong positive correlation that indicates to the *L.ex. interc. morgani-tournoueri* , (Plate 8, Figs.10-12), But the upper part of the section (sample 26) characterized by the presence of *L .tournoueri*, (Plate 9, Figs. 11-12) have the values of (A_i) between (35-56) and (C) between (2-6).

The scatter diagram of the (C - α) shows negative correlation Fig. (32). The samples (3,12, 17, 18 and 20) reveal a strong negative correlation with values of

Series	Stage	Unit	Thickness (m)	Sample Number		A'₁	C'	D'₁	D'₂	D_2/D_1	R'	α'	Species
Miocene	Aquitanian	VIII	34	50	M	45.6	5.9	318.1	386.1	1.2	35.5	172.4	*L.tournouari*
					N	14							
				49	M	47.9	5.6	264.1	320.4	1.3	34.9	178.2	*L.tournouari*
					N	12							
		VII	15	42	M	50.5	6.9	335.7	403.9	1.2	40.9	178.4	*L.tournouari*
					N	15							
				37	M	46.7	6.3	329.3	409	1.2	44.9	189.2	*L.tournouari*
					N	14							
				36	M	46	5.2	285.9	371.24	1.3	32.3	190.1	*L.ex.interc-morgani-tournouari*
					N	11							
				35	M	45.9	5	232.8	311.8	1.3	36	190.3	*L.ex.interc-morgani-tournouari*
					N	11							
				32	M	46	5.2	311.5	365.9	1.2	31.3	190.6	*L.ex.interc-morgani-tournouari*
					N	11							
		VI	13	31	M	46	5.2	271.4	378.78	1.4	31.2	190.8	*L.ex.interc-morgani-tournouari*
					N	12							
				28	M	45.5	5.1	300	339.2	1.13	28.5	191.1	*L.ex.interc-morgani-tournouari*
					N	11							
OLigocene	Chattian			22	M	41.8	4.4	213.5	280.3	1.3	27.4	197.8	*L.morgani*
					N	15							
				16	M	44.2	4.9	248.9	326.3	1.3	25.6	198.7	*L.morgani*
					N	9							
		V	36	7	M	44.5	5	233.6	320.7	1.4	26.3	196.3	*L.morgani*
					N	10							

Table (3) : Results of Counts and measurements on Twelve *Nephrolepidina* assemblages From the Miocene Carbonates, (Azkand Formation). in Khabaz well-3 Section. M = Mean of the value. N = Number of observation.

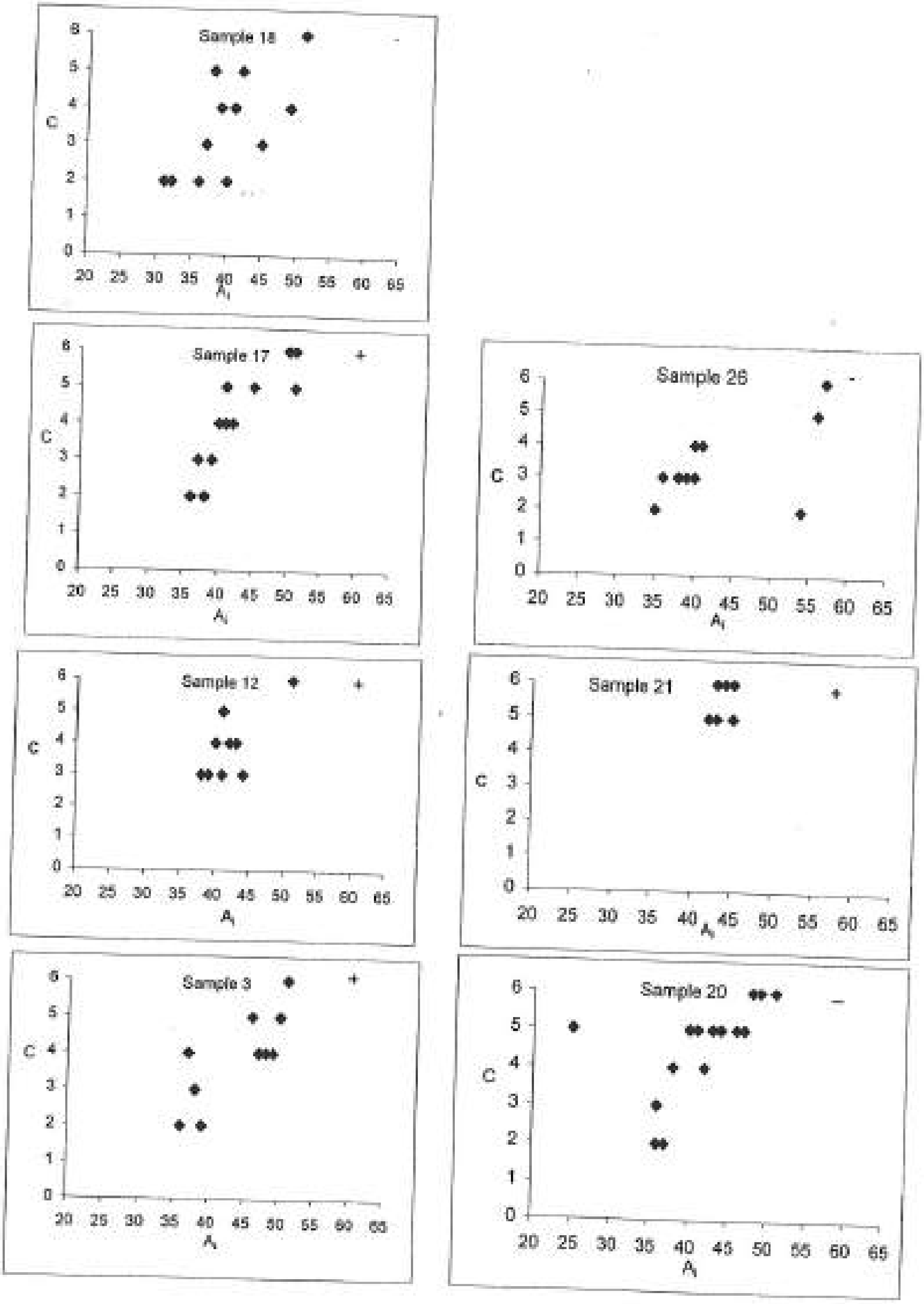


Fig.(30): Relation between A_i and C values for seven selected *Nephrolepidina* assemblages from Qarah Chauq Dagh section

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

(C) and (α) range between (C= 5-5.25, α = 192.5-199) respectively. While their values in the sample (21) ranged between (C = 5-5.5, α = 189.5-192.5), whereas the sample (26) contain the individuals, their (C) and (α) values range between(C > 5.25, α >189.5), The values of (C - α) relation indicate for species correspond on which resulted from the values of (C) and (A_i).

The mean values of (A_i-C) and (C-D_2) show positive correlations. (Figs.33 and 34), but the values of (C-α) show a negative correlation, (Fig.35)

In the (Fig. 36) which shows the histograms of A_i and C classes of this section from the lower part to the upper part of the section, the samples (3,12,17,18 and 20) of the units (V,VI, and VII) show a unimodal shape of the histogram with the values of A_i and C range between (40-45 and 5-5.25) respectively, which correspond to the characteristics of the *L.morgani*, the sample (21) of the unit (VII) shows an increase of the values of (A_i) and (C) (A_i = 44-46, C = 5-5.5) which indicates to an intermediate position between two species that have the characteristics of *L.morgani* and *L .tournoueri* which is known as *L.ex. interc morgani –tournoueri* .but the upper part of the section (sample 26) of the unit(VIII)shows the unimodal shape of A_i and C more than (45 and 5.25) respectively that is indicated to the *L. tournoueri.*

The average degree of embracement of the protoconch by the deuteroconch (A_i) and the average number of the accessory auxiliary chambers on the deuteroconch(C) show an increasing of the data from the lower part to the upper part of the section, and the species are located based on the (C) and (A_i).

Also the mean value of α reflected to different species if we see the mean value of α from the lower to the upper part of the section that appears variation between (198) to (193.9), for example; the samples (3,12,17 and 18) of the Units (V,VI and VII) have nearly the same values ranging between (196-198) which refer to the *L. morgani*, while the sample (21) of the unit(VII) have a value of α about (192,1) which belongs to *L. ex. interc. morgani-tournoueri*, whereas the upper part of the section , the decreasing of the mean value of α was very clear about

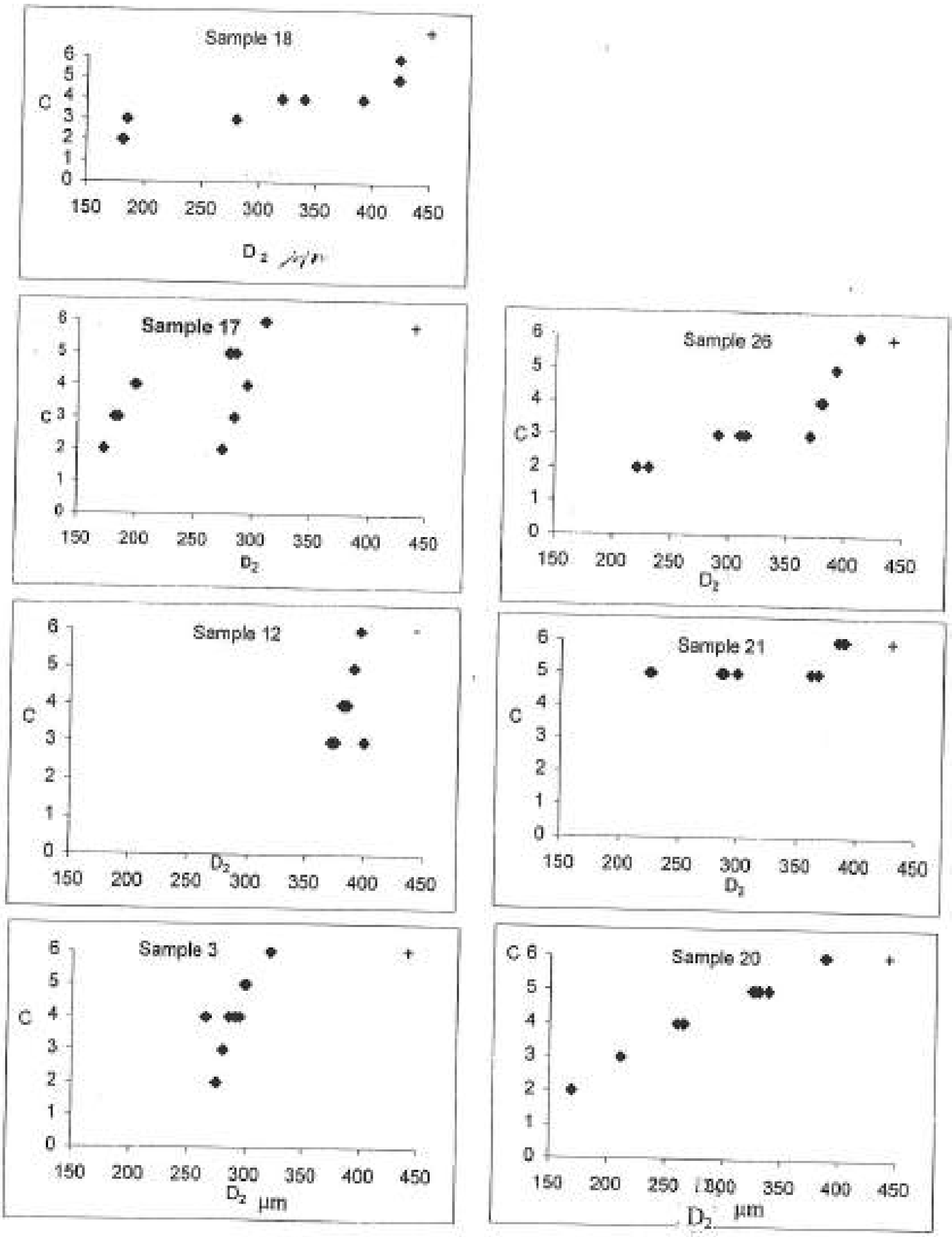


Fig.(31): Relation between C and D_2 values for seven selected *Nephrolepidina* assemblages from Qarah Chauq Dagh section

+ refers to a strong positive correlation with probability more than 99%, - refers to a weak positive correlation with a probability between 90-99%, 0 means no correlation.

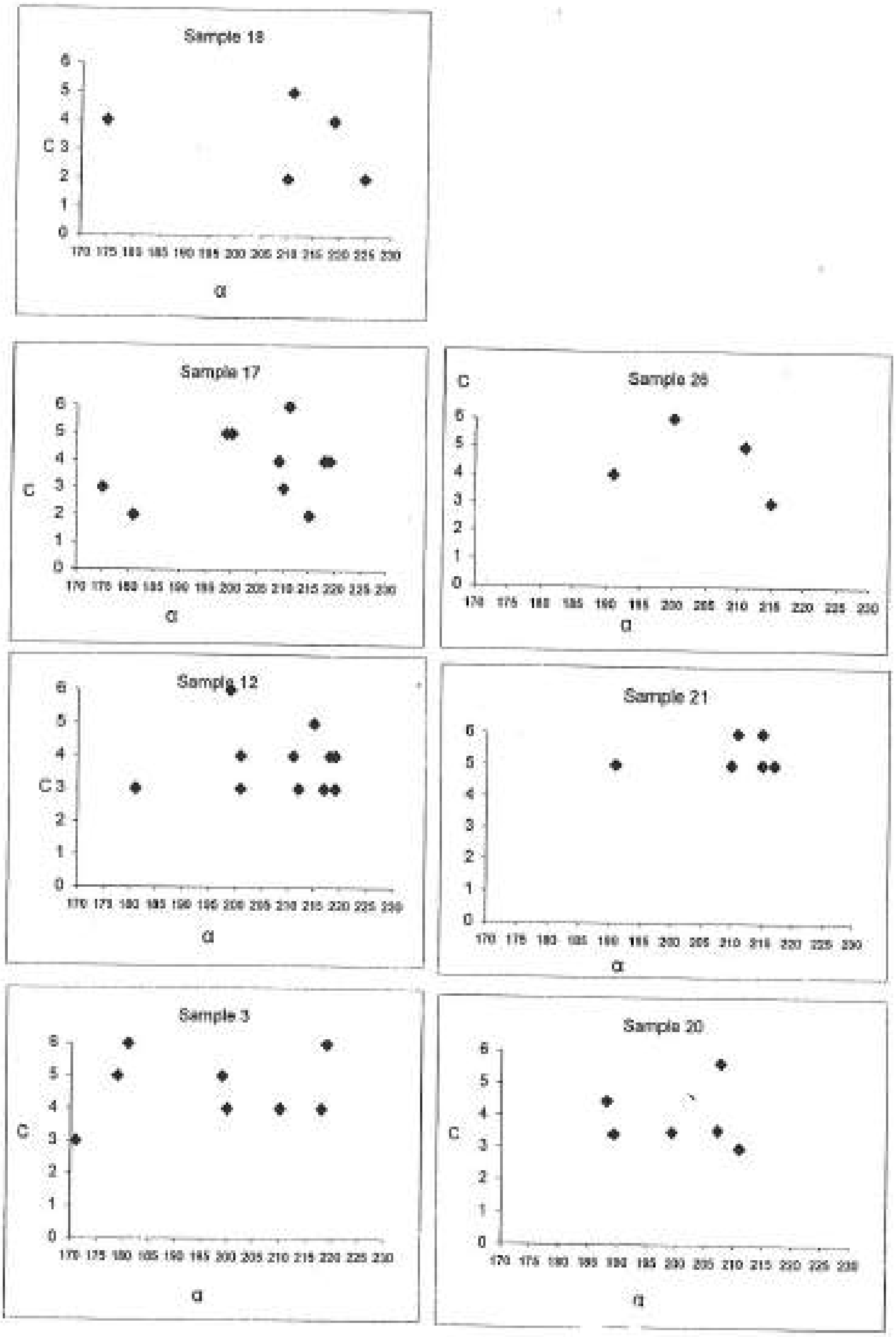


Fig.(32): Relation between C and α values for seven selected *Nephrolepidina* assemblages from Qarah Chauq Dagh section.

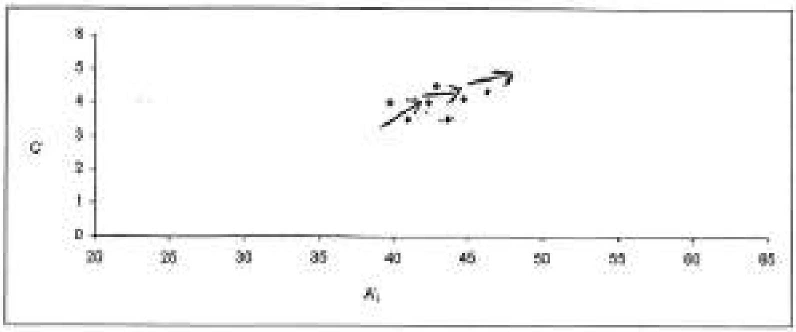


Fig.(33): Relation between A_1 and C mean values for seven selected *Nephrolepidina* assemblages in Qarah Chauq Dagh section
arrows indicate their stratigraphic order

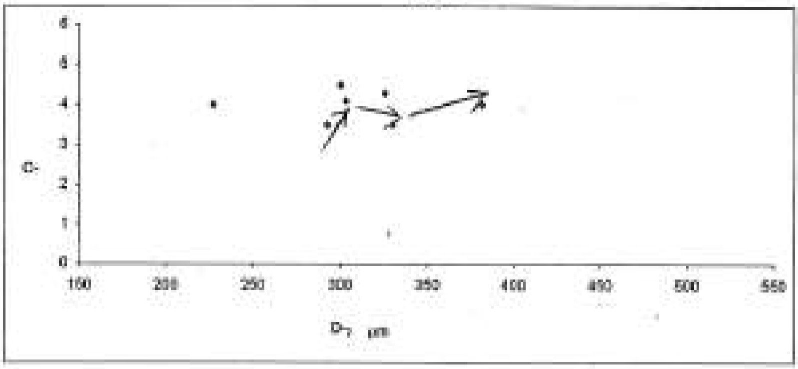


Fig.(34): Relation between C and D_2 mean values for seven selected *Nephrolepidina* assemblages for Qarah Chauq Dagh section
arrows indicate their stratigraphic order

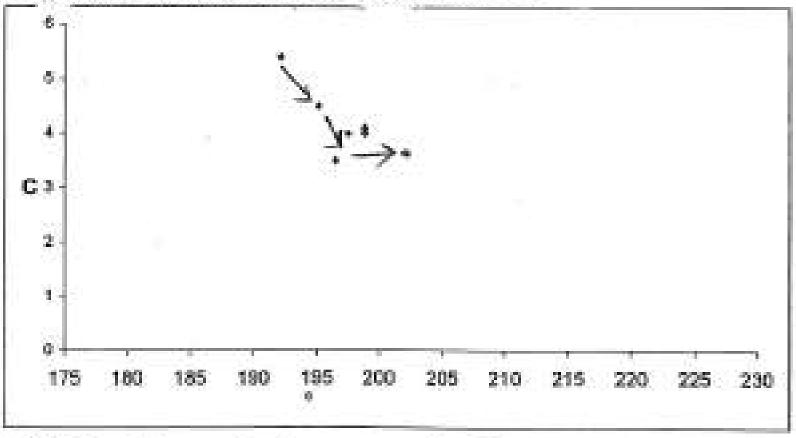


Fig.(35): Relation between C and α mean values for seven selected *Nephrolepidina* assemblages for Qarah Chauq Dagh section
arrows indicate their stratigraphic order

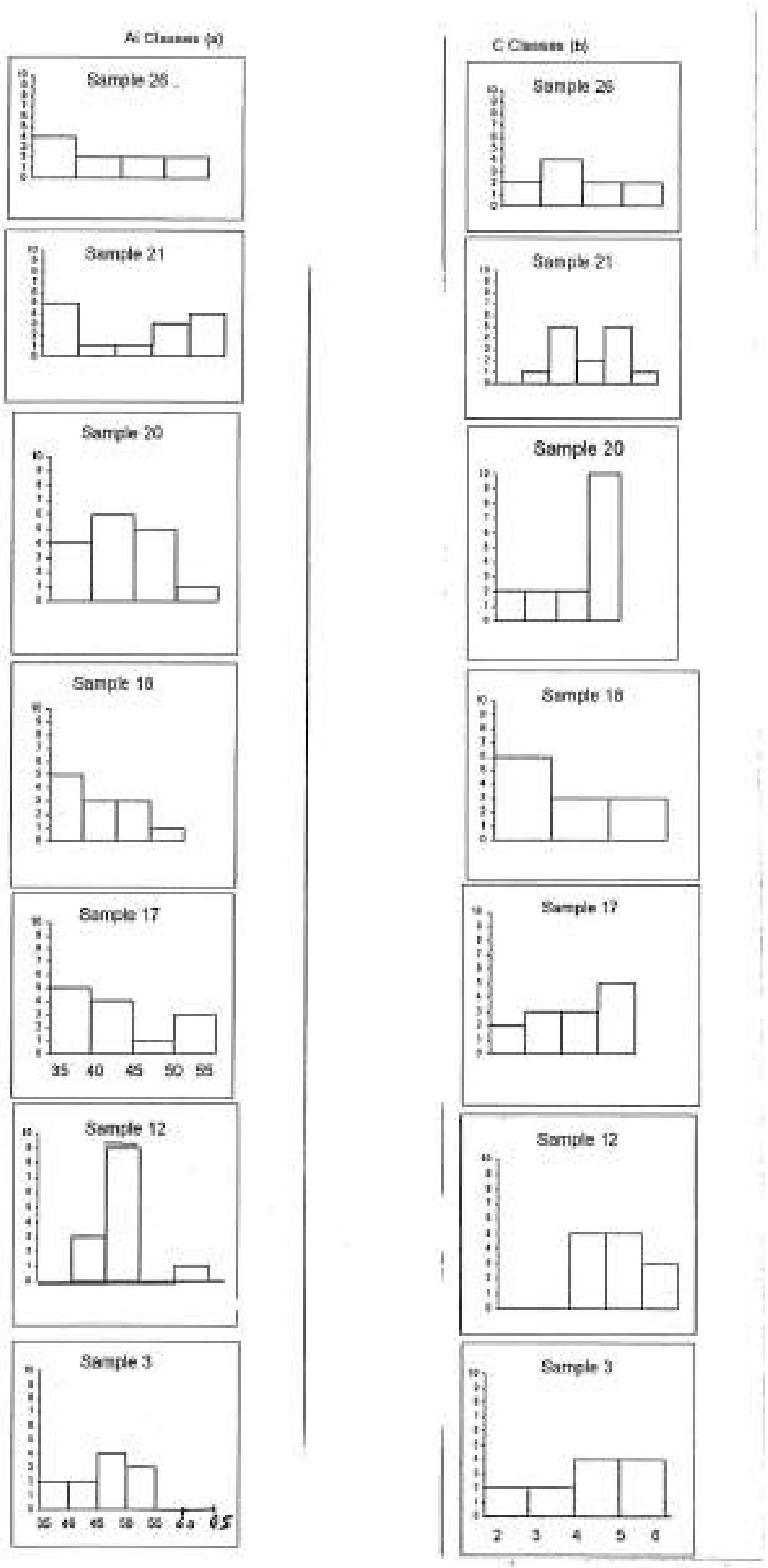


Fig.(36):Histograms of A_i classes and of C classes for seven selected *Nephrolepidina* assemblages in Qarah Chauq Dagh section

(182.3) that refers to *L. tournoueri* , In contrast the average degree of curvature of the common wall between the protoconch and deuteroconch (R) has a less regular pattern of increasing values especially in sample (26). No clear trend is observed in the average size of protoconch (D_1) and deuteroconch(D_2), (D_2/D_1)values are not actually changing in the lower part of the section.(Table,4)

The species of this section are distributed based on the mean values of (A^{-}_{i}),(C^{-}) and (α^{-})as the following :

Species	A^{-}_{i}	C^{-}	α^{-}
L. morgani	$40<A^{-}_{i}<45$	$3<C^{-}<5.25$	$192.5<\alpha^{-}<199$
L.ex.interc.morgani-tournoueri	$44<A^{-}_{i}<46$	$5<C^{-}<5.5$	$189.5<\alpha^{-}<192.5$
L. tournoueri	$A^{-}_{i}>45$	$C^{-}>5.25$	$\alpha^{-}<189.5$

3-3 Comparison of various biometric species in units

As mentioned previously, there is seldom to obtain carbonate sequence which shows the Miocene carbonate facies (Azkand Formation) overlies directly the Oligocene carbonate facies (Baba Formation), if it gained, the later would represent only one of the facies partially.

Therefore many sections are adopted to recover the contemporaneous of Oligocene-Miocene sequence. The Oligocene carbonate (Baba Formation) in Kirkuk well-19 and Bai-Hassan well-4 sections subdivided into (I, II, III and IV) Units. The lower part of the Baba Limestone represented by Unit (I) in Kirkuk well-19 and lower part of Unit (II) in Bai-Hassan well-4 sections, characterized by the occurrence the first primitive type of *L.(Nephrolepidina) praemarginata* depending upon the mean values of the ($C - A_i$, $C - D_2$ and $C- \alpha^{-}$) relation (Table1 and 2). From Unit (II) and lower part of the Unit III which represent the

Series	Stage	Unit	Thicknes (m)	Sample Number		A'_1	C'	D'_1	D'_2	D_2/D_1	R'	α'	Species
Miocene	Aquitanian	VIII	15	26	M	47.6	5.6	260	330.2	1.27	36.3	172.7	*L.tourenouri*
					N	10							
		VII	12	21	M	46.3	5.4	269.9	325.9	1.2	28.9	192.1	*L.ex.interc.morgani ,tourenouri*
					N	14							
				20	M	42.8	4.5	255.8	300.5	1.17	24.7	195.125	*L.-morgani*
					N	16							
				18	M	40.9	3.5	236	292.3	1.2	28.5	196.5	*L.-morgani*
					N	12							
				17	M	42.3	4	293	371.5	1.3	27.5	197.5	*L.morgani*
					N	13							
		VI	10	12	M	41.4	4	301.9	381.9	1.3	29.2	198.8	*L.morgani*
					N	13							
Oligocene	Chattian	V	24	3	M	44.7	4.1	253.4	303.3	1.2	27.1	198.8	*L.morgani*
					N	11							

Table(4): Results of Counts and measurements on Seven *Nephrolepidina* assemblage from the Miocene Carbonates (Azkand Formation) in Qarah Chauq Dagh section.

M = Mean of the value. N = Number of observation.

middle part of Baba Formation, Another species is distinguished that situated in their character between *L.praemarginata* and *L.morgani* which is represented by *L.ex.interc. praemarginata-morgani*. The mean values of the ($C^{`}$ , $A^{`}_{i}$) and ($\alpha^{`}$) for the individuals from Unit (IV) and the upper part of Unit III. The *L.(N.)morgani* shows an increase in these parameters in comparing with the previous species, and this species is continued to the units (V and VI), represented as the lower part of Azkand Formation (Miocene).

Whereas in Unit VII, the biometric analysis shows an increasing in the values of (C, A_i) and decreasing the ($\alpha^{`}$)values that distinguished another species situated in mide position in their character *between L.morgani* and *L .tournoueri* which is named as *L.ex.interc .morgani- tournoueri*, the lower part of Unit (VII)and Unit (VIII) characterized by the presence of *L.(N.) tournoueri* which have the largest value of the (C, A_i)and minimum values for the ($\alpha^{`}$). (Tables 3 and 4).

Summarizing, it can be stated that mean values of the (C) and (A_i)show successive increasing but the ($\alpha^{`}$)values decreased from Unit I (Lower part of Baba Formation) toward Unit (VIII) (Upper part of Azkand Formation), while no clear trend is observed in the average size of protoconch (D_1) and deuteroconch (D_2) from the lower to the upper part of the sequence.

The species are distributed in the Oligocene- Miocene carbonate sequence based on the mean values of ($C^{`}$, $A_i$ and $\alpha^{`}$) as the following:

Species	$A^{`}_{i}$	$C^{`}$	$\alpha^{`}$
L .tournoueri	$A^{`}_{i}$ >45	C- >5.25	$\alpha^{`}$ < 189.5
L. ex.interc.morgani-tournoueri	44<$A^{`}_{i}$<46	5 < $C^{`}$ < 5.5	189.5< $\alpha^{`}$ <192.5
L .morgani	40, A`i <45	3 <$C^{`}$ <5.25	192.5 < $\alpha^{`}$ <199
L.ex.interc. praemarginata-morgani	39 < A`i < 41	2 < $C^{`}$ < 4	199 < $\alpha^{`}$ < 208
L.praemarginata	35 < A`i < 40	1 < $C^{`}$ < 3	208 < $\alpha^{`}$

The species of *Nephrolepidina* are distributed from the lower part of the Unit (I) of the Baba Formation, to the Unit (VIII) of the upper part of the Azkand Formation. (Fig.37)

Series	**Stage**	**Unit**	**Formation**	**Species/*Lepidocyclina(Nephrolepidina)* /*L.ex. interc.***
Miocene	Aquitanian	VIII	Azkand	*L.(N.) tournoueri*
		VII		*L. ex. interc. morgani-tournoueri*
		VI		
Oligncene	Chattian	V		*L.morgani*
		IV	Baba	
		III		*L. ex. interc. praemarginata-morgani*
		II		*L.praemarginata*
		I		

Fig. (37): Species list of *Lepidocyclina (Nephrolepidina)*, distributed from the studied area based on the biometric data.

Chapter Four

BIOMETRIC ANALYSIS OF MIOGYPSINIDAE

4-1 Introduction

In this chapter the morphometric data of the Miogypsinidae are discussed from the Oligocene-Miocene carbonates. Most investigated Miogypsinid associations were derived from the Khabaz well -3, and Qarah Chauq Dagh sections (Units V, VI, VII and VIII) (Figs. 39 and 40)

At many levels the sediments are too strongly indurated for us to isolate individual larger foraminifera, and some of them are dolomitized, therefore, we sampled semi-weathered rock material especially from Qarah Chauq Dagh section, from which the larger foraminifera could be gathered easily. Although collecting of such material was carried out with the greatest care.

4-2 Methods of investigation

Whenever possible, we identified minimum number of (12) specimens from each sample. If two subgenera of *Miogypsina* were found to be present in one sample, we doubled the number of collected individuals. Sometimes the lack of material forced us to be content with fewer specimens. But in hard samples, we obtained the median sections of individuals by preparing about (15) slides from each sample especially from sticks that contains equatorial sections. For the execution of our measurements we have to prepare median sections.

For biometric studies of Miogypsinids (180) oriented equatorial sections were prepared, representative of *Miogypsina s.s. and Miogypsinoides* have been drawn by means of digital camera with enlargement of (10-40X) for all specimens. (D_1, D_2, X,y, α, β and V) counts were made from the drawing using a plastic ruler, and angle protractor.

Counts and measurements on the early chambers of Miogypsinidae were performed according to the procedures described by Drooger (1952); Drooger and Freudenthal (1964); De Mulder (1975); Drooger, (1993)

4-3 *Miogypsinid* parameters

The linear variables were measured in micrometers are limited to micron (μm)

The variables and their definition are listed below: - (Fig.38)

(X): The total number of nepionic chambers in the initial spiral excluding the two embryonic chambers and including the closing chamber, if present.

(γ): This angular parameter is quantitative measure of the orientation of the nepiont in the foraminiferal test. A detailed description of the way of measuring γ was given by Amato & Drooger (1969).

Two line segments determine this variable. The first one starts at the center of the protoconch and passes through the center of the protoconch and continues through the apex of the test, coinciding with the apical –frontal line. The zero of the γ-scale has been arbitrarily fixed at the configuration where both line segments coincide in individuals with one whorl or less.

γ is positive if the first principal auxiliary chamber points to the frontal margin of the test. Otherwise γ is negative. In the later case it is measured by rotating the embryonic line segment in the direction of coiling towards the apical frontal line segments.

(α): The arc length of the circumference of the protoconch underlying the shorter spiral.

(β): The arc length of the circumference of the protoconch underlying both protoconchal spirals .

(V): This parameter depends on two angular variables,γ, and β, in the following way:

$V = 100\ \alpha / 0.5\beta = 200\alpha/\beta$.

The dimensionless ratio, which scale ranges from 0 to 100 indicates the degree of symmetry of the protoconchal spirals.

(D_1): The maximum diameter of the protoconch is measured perpendicular to the embryonic line (see γ) and includes half of the thickness of the walls.

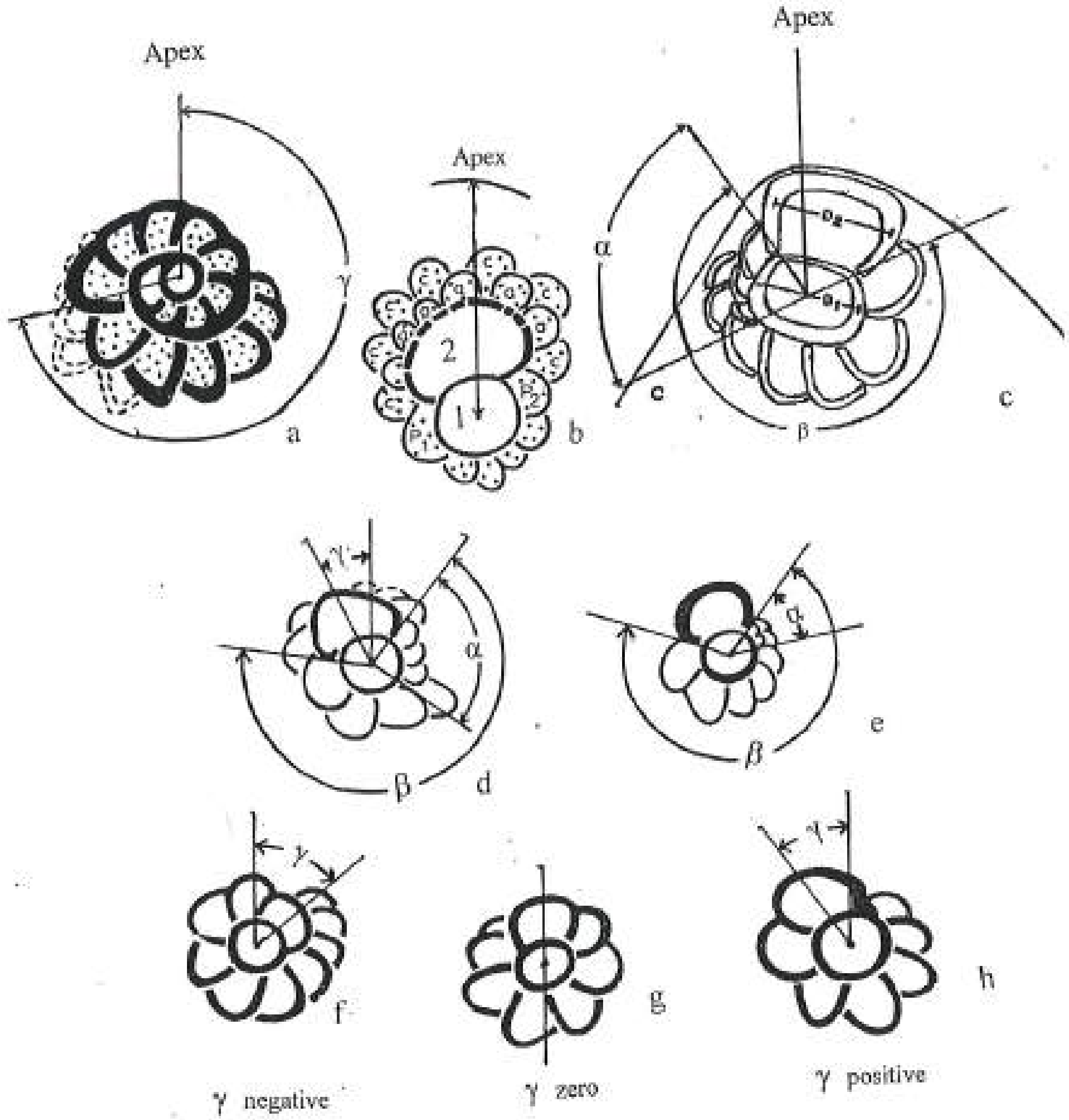


Fig.(38):- Schematic drawing the median sections of the embryonic-nepionic stage Miogypsiniodae illustrating the derivation of (α, β andγ). 1=protoconch, 2=deuteroconch. 1 and 2 constitute the embryonic stage; chambers around the embryonic stage(doted in figs. a, b) constitute the nepionic stage. P1=first principal auxiliary chamber, p2=second principal auxiliary chamber; a=accessory auxiliary chamber, c=closing chamber.
(after Raju, 1974 & Drooger,1993)

(D_2): These parameters represent the largest diameter of the deuteroconch, determined parallel to the measurement line of D_1

(P): Percentage of specimens with two principle auxiliary chambers.

The estimate of the exact number of chambers in the primary spiral(X) is rather difficult in individuals with long spirals. (X) may be estimated too low, because the ultimate chambers, which are very small, were not cut in thin section or half section. On the other hand (X) may be estimated too high, because a lateral chamber was identified as the ultimate or penultimate spiral chamber. Furthermore, observation on (X) is hampered by a bad preservational state of the specimen.

The parameter (V) is not totally unambiguous with respect to the degree of symmetry of the protoconchal spirals. This small imperfection is caused by the absence or presence of a closing chamber between the protoconchal spirals. In the specimen without a closing chamber the longer spiral overrides the shorter spiral. β in particular, does not take into account the part of the primary spiral, which overlies the chambers starting from the second principal auxiliary chamber (Fig.38c).

4-4 Heterogenity of the assemblages

The lower most associations of *Miogypsina s.s* in Unit (VII), samples (42) of Khabaz well-3 section, and sample (18)of Qarah Chauq Dagh section, marked by the joint presence of types with lateral chambers and types without such chambers. The two groups correspond with the subgenera *Miogypsina s.s.* and *Miogypsinoides* respectively. The larger part of the Khabaz well-3 section in Units (V, VI, VII and VIII) and the Qarah Chauq Dagh section in Units (V,VI,VII and VIII) consist entirely of individuals with massive sides, they all belong to the subgenus *Miogypsinoides*.

The subgeneric identification of the Miogypsinids, which was carried out during the grinding process was not successful for small number of specimen, probably due to their bad state of preservation and dolomitization .

We might wonder whether the presence of both subgeneric groups can also be recognized in their biometric properties. The ranges of parameter values found for the *Miogypsina s.s.* and *Miogypsinoides* individuals show a wide overlap in all parameters of the Khabaz well-3 and Qarah Chauq Dagh sections, (Figs. 39 and 40). Apparently both taxa are not mutually exclusive on the basis of individual, morphometric characteristics. Theoretically the presence of more than one biometric group might be recognized from the bimodal shape of the frequency distribution, from the large coefficient of variability for one or more parameters or from the patchiness of clusters in the scatter diagrams. However the low relative frequencies of *Miogypsinoides* in most samples seriously hamper the chance to recognize such mixture phenomena. The sample (42) from the Khabaz well-3 section and (18) from the Qarah Chauq Dagh section, they are only, one in which both subgenera are frequent.

In this association *Miogypsina s.s.* and *Miogypsinoides* show distinctly different modal classes in the frequency distributions of the embryonic size parameters.(Figs.39, and 40)). The heterogeneity is also visible from the nepionic parameters., *Miogypsinoides* being more primitive in both X and γ.

	V_{D1}	V_{D2}	V_X
Miogypsina s.s	36.7	31.42	13.9
Miogypsinoides I	28.7	28.06	10.55
Miogypsinoides II	10.04	08.09	11.66

Table (5): Coefficient of variability for *Miogypsina* in sample (42) of Khabaz well-3 section

	V_{D1}	V_{D2}	V_X
Miogypsinas.s.	35.58	29.9	11.07
Miogypsinoides I	29.79	29.5	11.19
Miogypsuinoides II	9.89	09.75	11.63

Table (6):- Coefficient of variability for *Miogypsina* in sample (18) of Qarah Chauq Dagh section.

Coefficient of variability for *Miogypsina s.s. and Miogypsinoides* in sample (42) in the Khabaz well-3 section, and sample (18) from the Qarah Chauq Dagh section,

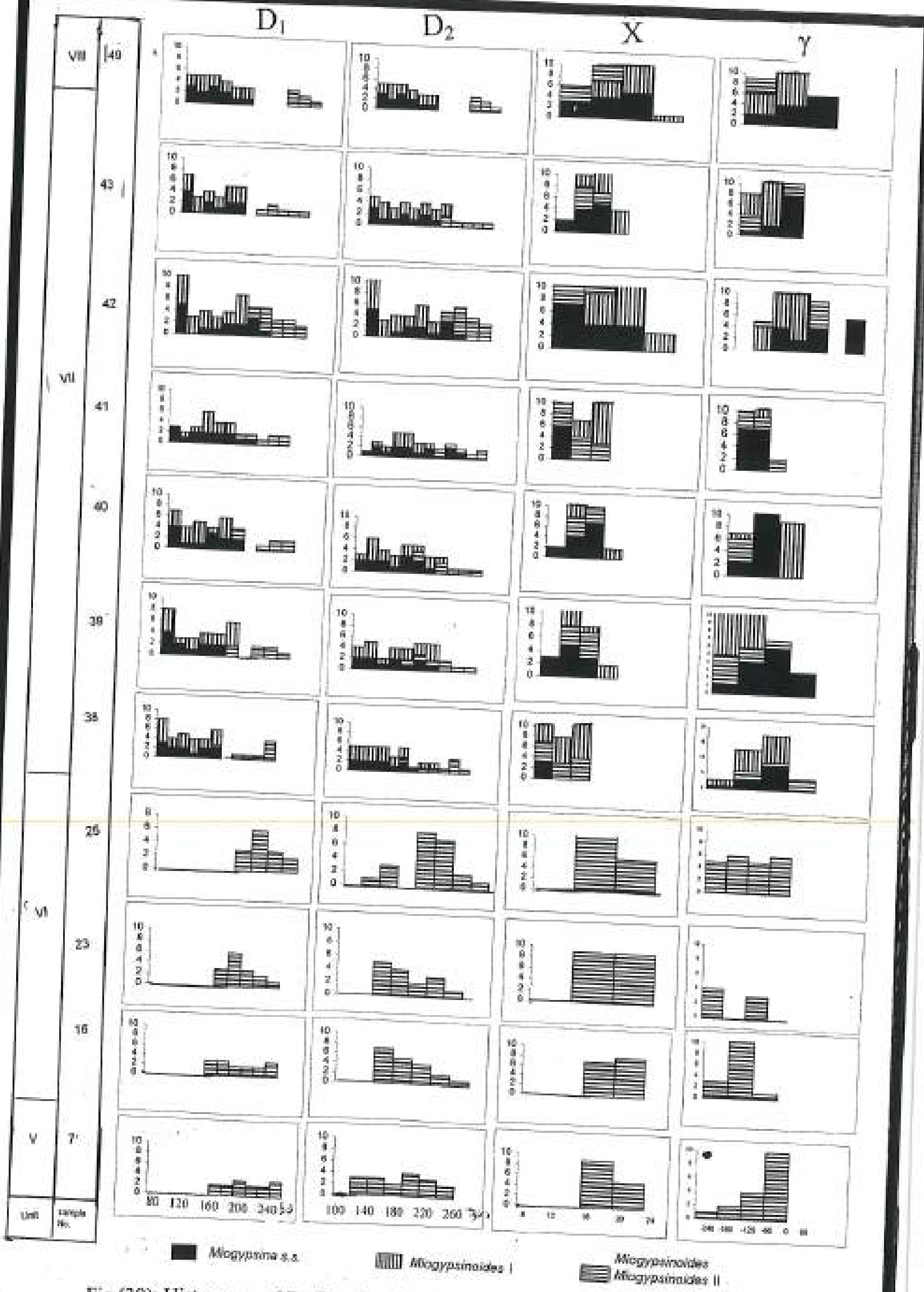


Fig.(39): Histograms of D_1, D_2, X and γ of *Miogypsina s.s.* and *Miogypsinoides* I and II in the Khabaz well-3 section. Miocene carbonates Azkand Formation.

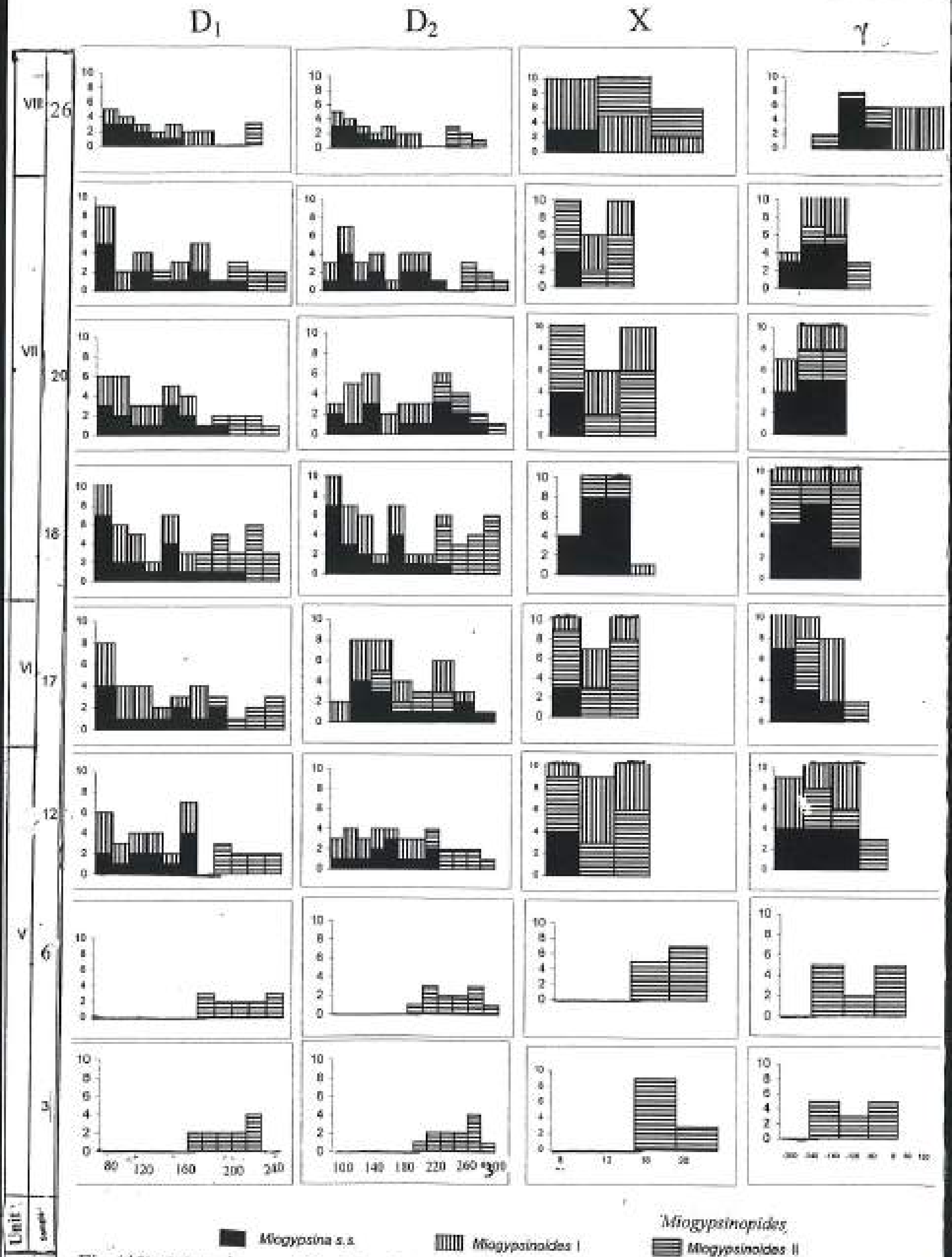


Fig.(40): Histograms of D_1, D_2, X and γ of *Miogypsina s.s.* and *Miogypsinoides* I and II in the Qarah Chauq Dagh section. Oligocene carbonates Babb Formation which are shown in (tables 1 and 2), in a way which support the inhomogenity of the assemblage. V_{D1} for *Miogypsina s.s.* is high (V_{D1} = 36.7 and 35.58 in samples 42 and 18 respectively), But (V_{D1}) for *Miogypsinoides* in the same samples remain unacceptably high.

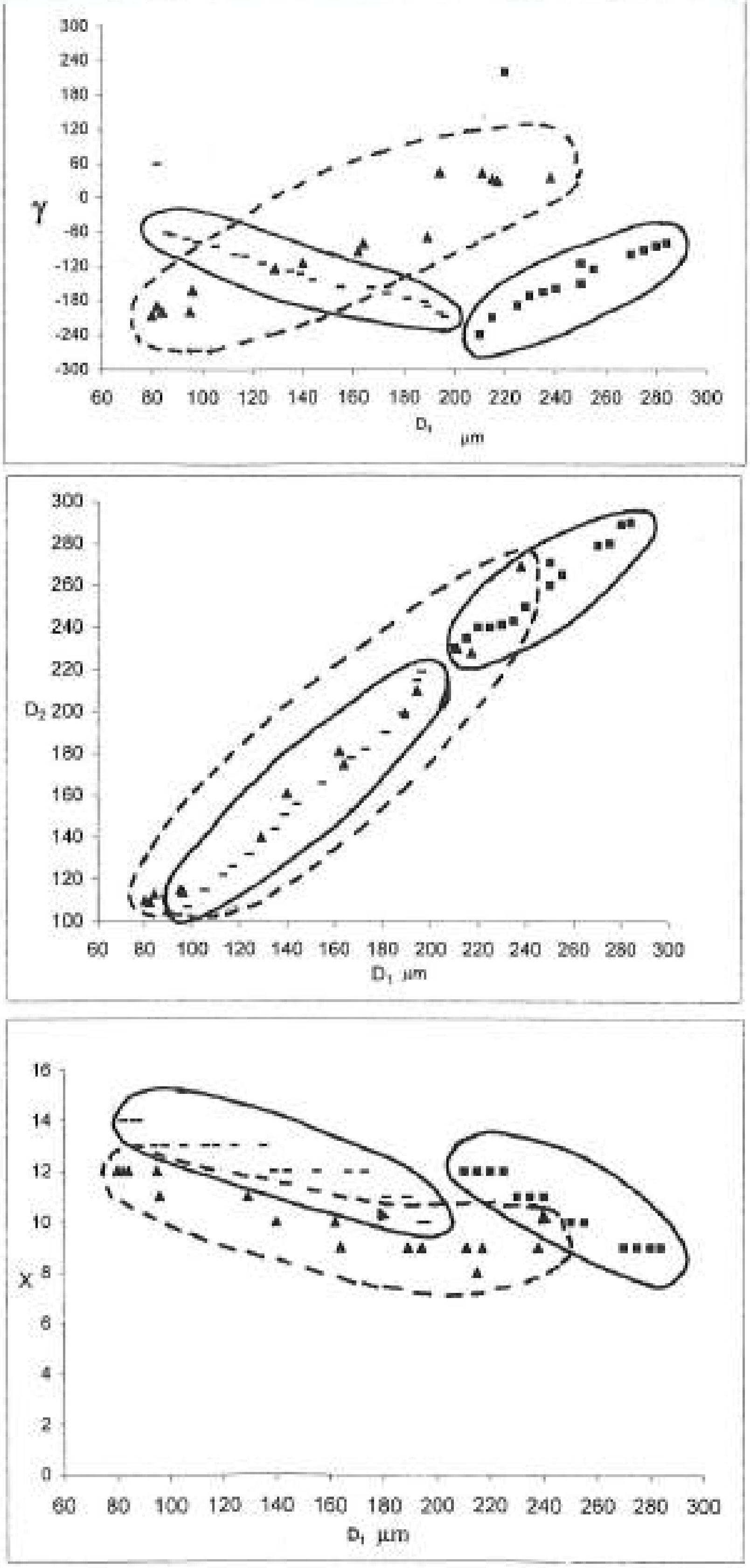
This anomalous value of the coefficient of variability which are seen in (tables 5 and 6) is understandable from the investigation of the scatter diagrams for the samples (Figs. 41, and 42), in which (D_1) is plotted against (X, D_2 and γ) respectively. In the D_1-γ scatter diagram in both samples, it is clearly visible that the individuals of *Miogypsinoides* fall apart in two clusters. But this division is not reflected in the other two diagrams. It refers to that we are investigating with two different associations for *Miogypsinoides* in samples (42 and 18).

Two groups of *Miogypsinoides* are distinguished depend on the protoconchal diameter Group I consists of individuals with small protoconches and group II comprises individuals with large protoconches.

In the scatter diagram of (D_1 andy), it can be noted that group II is completely separated from *Miogypsina s.s.* cluster, whereas group I shows an overlap with the later (Figs. 41 and 42). In contrast, the D_1- X and D_1-D_2 scatter diagrams show the overlap of *Miogypsinas.s.s.* with both groups of *Miogypsinoides*.

Because of the scarcity of *Miogypsinoides* in most individual's samples we compiled all data on this subgenus in Unit VII in some scatter diagrams (Figs. 43 and 44). The resulting scatters are again interpreted in terms of two types of *Miogypsinoides*, which has been distinguished in samples (42 and 18).

The association of individuals with the smaller embryons will be referred to as *Miogypsinoides* I; the other will be named *Miogypsinoides* II. The critical value of (D_1) to discriminate between both groups appeared to be (200) μm. It is clear from the scatter diagrams that both *Miogypsinoides* taxa can not be separated on the basis of X and γ ; not withstanding the modal differences. Solid proof for the existence of more than one biometric *Miogypsinoides* group is not furnished by most samples individually, because of the low relative frequencies.



- *Miogypsinoides* I ■ *Miogypsinoides* II ▲ *Miogypsina s.s.*

Miogypsinoides

Fig.(41): D_1-X, D_1-D_2 and D_1-γ scatter diagrams of *Miogypsinoides* and *Miogypsina s.s.* in sample (42) of the Khabaz well-3 section.

Dashed line is scatter periphery of the accompanying *Miogypsina s.s.* individuales, soild lines scatter peropheries of *Miogypsinoides*

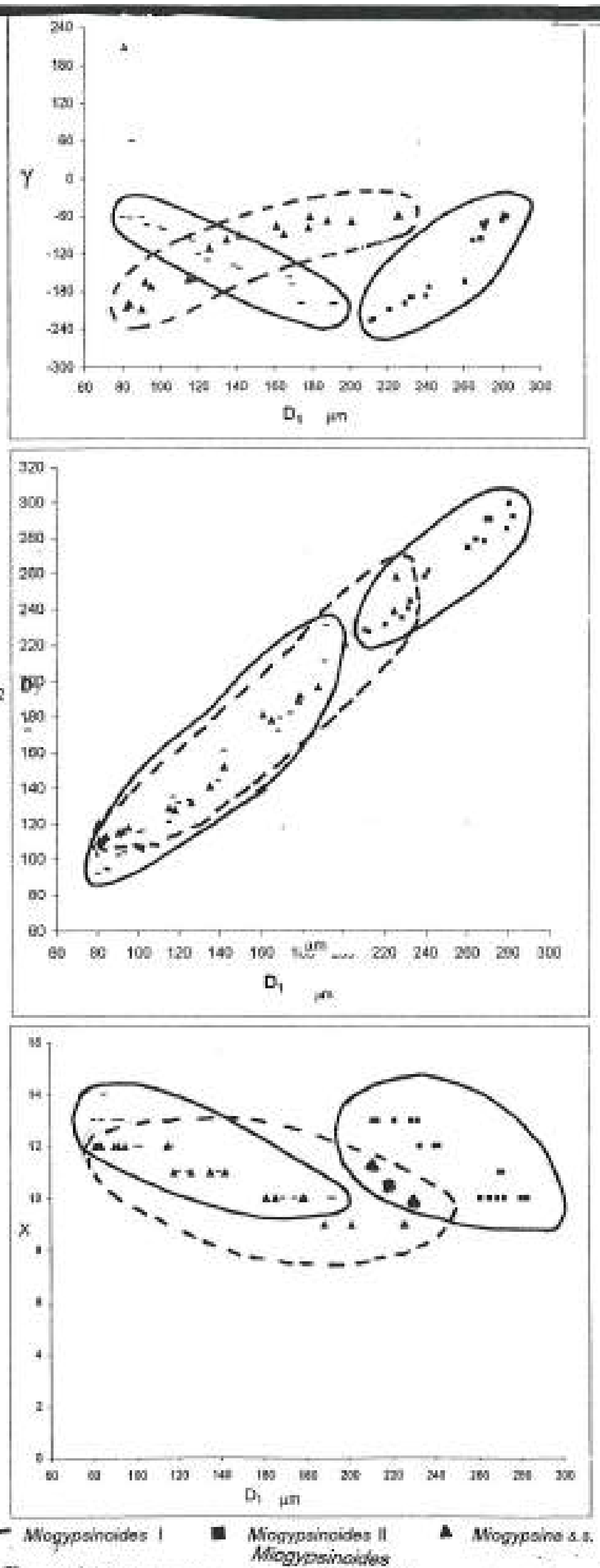


Fig.(42): D_1-X, D_1-D_2 and D_1-γ scatter diagrams of *Miogypsinoides* and *Miogypsina s.s.* in sample (18) of the Qarah Chauq Dagh section, Dashed line is scatter periphery of the companying *Miogypsina s.s.* individuals, solid lines is scatter peripheries of *Miogypsinoides* I and II individuals.

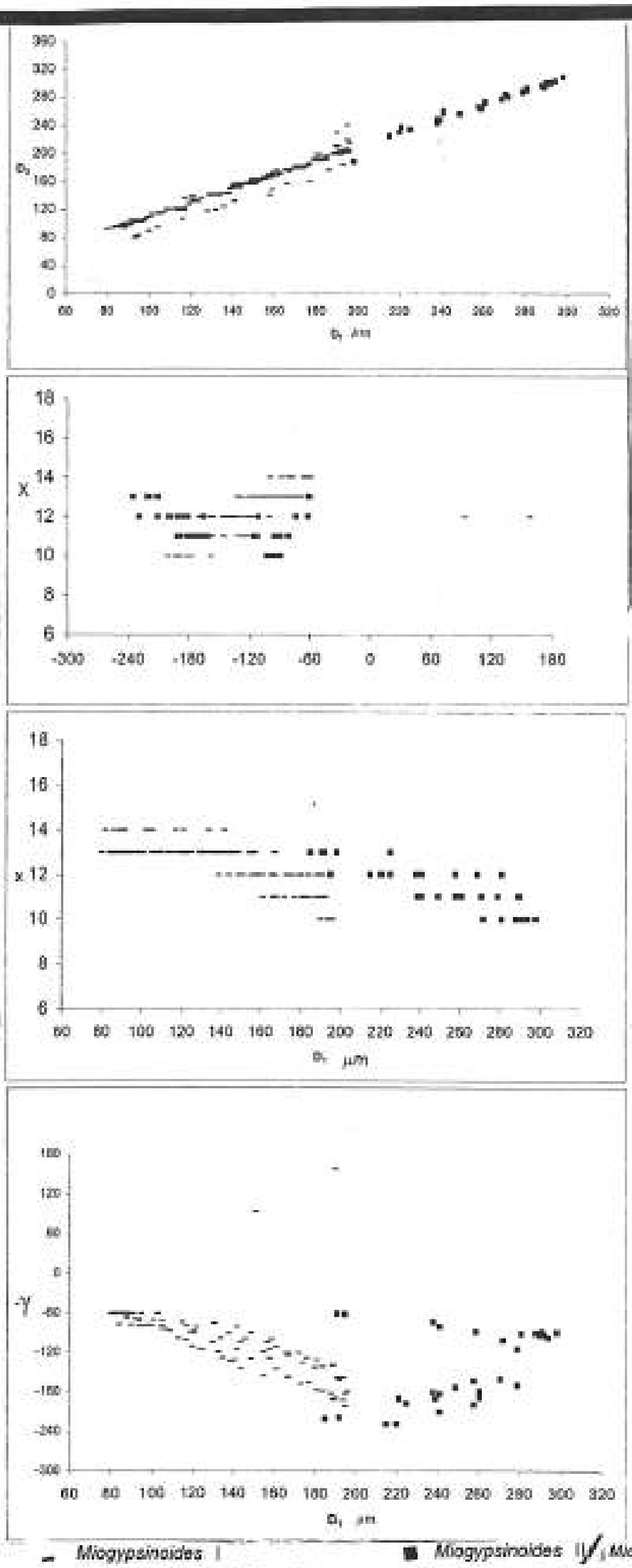
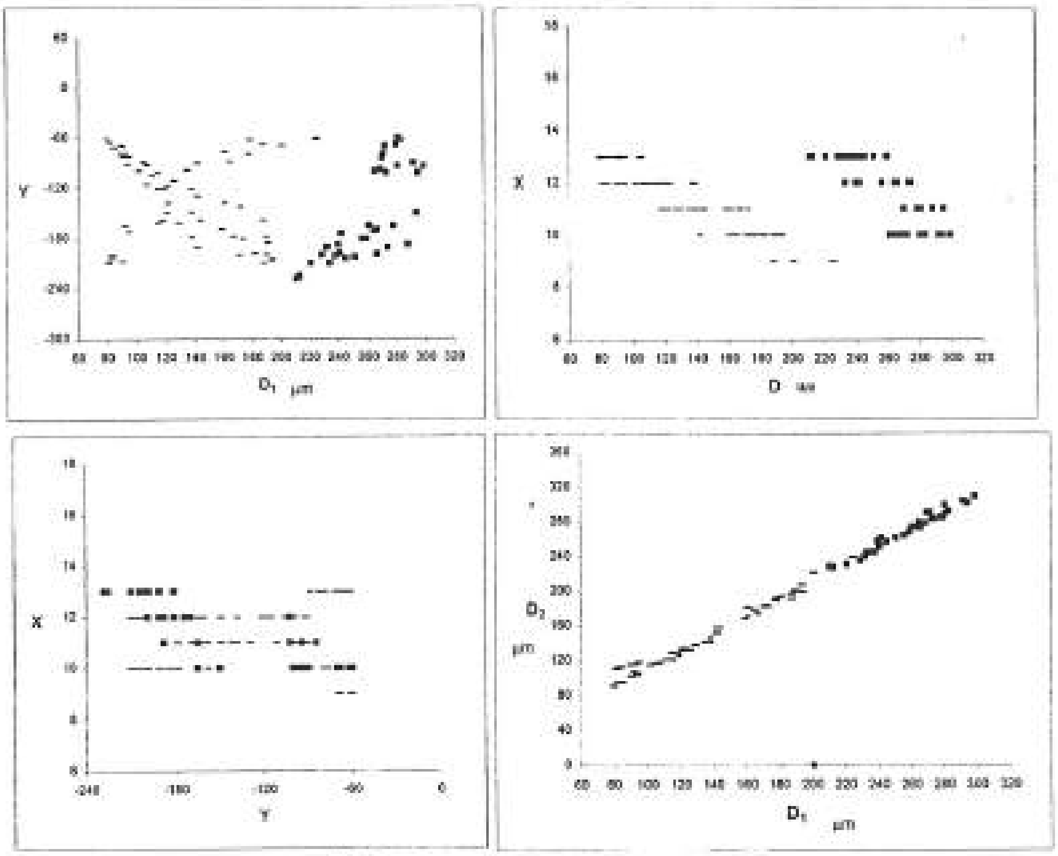


Fig.(43): γ-D_1, X-D_1, X-γ and D_1-D_2 scatter diagrams of the *Miogypsinoides* specimens in the samples (38, 39, 40, 41, 42 and 43) of unit (VII), Khabaz well-3 section.



- *Miogypsinoides* I

■ *Miogypsinoides* II
Miogypsuinoides

Fig.(44): γ-D_1, X-D_1, X-γ and D_1-D_2 scatter diagrams of the *Miogypsinoides* specimens in the samples (17, 18, 20 and 26) of unit (VII), Qarah Chauq Dagh section

4-5 Preliminary notes on analysis of individual lineages.

With regard to the changes in the Miogypsinid time sequence, we have to comment on the spatial relationship of the investigated samples. The coverage with samples for Units (V, VI, VII and VIII) was accomplished in two sections, Khabaz well-3 and the Qarah Chauq Dagh.

However some lithological and micropaleontological changes were observed during the microscopical investigation of the thin sections, which have some correlation value. In both sections a distinct negative shift was observed in the relative frequencies of the larger foraminifera. Fig. (7). The small scale shifts and trends in the sample means will be termed positive when they are in line with the literature data in the Miogypsinidae (e.g. Drooger, 1963 Raju, 1974, Wildenborg, 1991)). The outcomes of the tests will be labeled negative when they are against the trend of overall changes, known from the earlier investigations. The tendencies, which we will consider in particular, are the principle of nepionic acceleration and the size increase of the embryon. The differences between the sample means were checked with the t-test or with the Kay square test, the degree of deviation was in turn tested with the help of the χ^2 –test. Only the parameter (X) needed testing with the Kay square test, because its data frequency appeared to be too skewed for the hypothesis of normal distributions.

Pairs of samples means were selected for the Kay square and the t test, to provide as with a good, overall picture of the small scale changes, present in the series of *Miogypsina*. The differences between samples at large stratigraphical distances were not given special attention, because the direction of the change is probably the same as the direction of the overall trend. If significant shifts were suspected to be present in more variable, all parameters of the sample couplet under consideration were tested. On the other hand no tests were applied to sample pairs, which do not show marked, visual differences in any variable.

4-6 *Miogypsinoides.*

4-6-1 Changes in the samples means

The basal assemblages of *Miogypsinoides* which are not yet associated with *Miogypsina s.s.*, was observed from the samples (7.16,23 and 25) in Khabaz well-3 section and(3 and 6) in Qarah Chauq Dagh section, show a distinct, positive shift in the nepionic and in the embryonic parameters. The results of the t-test and the Kay square test of the observed differences between the samples of *Miogypsinoides* from two section (Khabaz well-3 and Qarah Chauq Dagh) are seen in (table-7)

Sample couple	Kay square-Test			t-test			
	X^{-}	γ^{-}	df	D_1^{-}	df	D_2^{-}	df
Khabaz well-3 section							
38-42 (Type II)	0.454	0.78	20-	2.412	20-	2.57	20-
38-42 (Type I)	0.371	0.78	34-	2.001	34-	1.79	34-
7-25	0.349	1.34	31	3.314	31-	3.204	31-
Qarah Chauq Dagh section							
12-18 (type II)	0.513	1.303	24	2.755	24-	-3.300	24
12-18 (type I)	0.418	0.849	30	0.078	30	-2.77	30
3-6	0.449	1.211	22	2.110	22-	2.301	22-

Table (7): Results of the t-test and the Kay square test of the observed differences between the samples of *Miogypsinoides*, levels of significance, p=0.01(++/--), p=0.05(+/-) degree of freedom in t-test, df=N_1+N_2 -2, N_1+N_2= sum of observations in both sample.

These changes are not unequivocally continued in the younger series of *Miogypsinoides* (Figs. 45 and 46). Concerning in the statistic (X¯), type I and II in samples (18) and (42) upwards seem to represent a more advanced stage of *Miogypsinoides* with respect to the associations in basal samples (3 and 6) and (7, 16, 23 and 25) in both sections. The mean embryon diameters of the two types of *Miogypsinoides* in the younger samples show opposed changes with relative to the assemblages in sample (6) and (25), *Miogypsinoides* I is marked by a drop in (D_1) and (D_2) whereas these means increase significantly towards *Miogypsinoides* II (Figs. 45 and 46, table 7).

In the sequence of *Miogypsinoides* assemblages co-occurring with *Miogypsina s.s.*, no distinct further changes are apparent, both in type I and type II, the difference between the parameters mean are too small relative to the values their standard errors(figs. 45 and 46). Care must be taken in evaluating the above statements on the two *Miogypsinoides* types, because they may be biased by too low frequencies.

4-6-2 Qualitative shifts in the morphotype composition

Before entering into details of the morphotype shifts in *Miogypsinoides*, we must point out a general aspect of the qualitative changes in the frequency distributions, which is of importance for our *Miogypsina* assemblages in general. The frequency of a morphotype just after its appearance in the biostratigraphical record is very low. The chance of an erratic loss of such a low frequency type by sampling hazards is relatively large and consequently there is an influence on the precise determination of the entry or exist level of a specific morphotype.

Alternative in the morphotype ranges are distinctly present in the nepionic variables. (table-8) which corresponds to the changes in the sample means, (Figs. 45 and 46). The changes in the ranges of the embryon diameters are much vaguer with respect to the lower most sample (7, 16, 23 and 25) from Khabaz well-3 section and (3 and 6) from Qarah Chauq Dagh section. The total range of morphotype in D_1 seems to expand both at the lower and at the upper end of the variation, with one

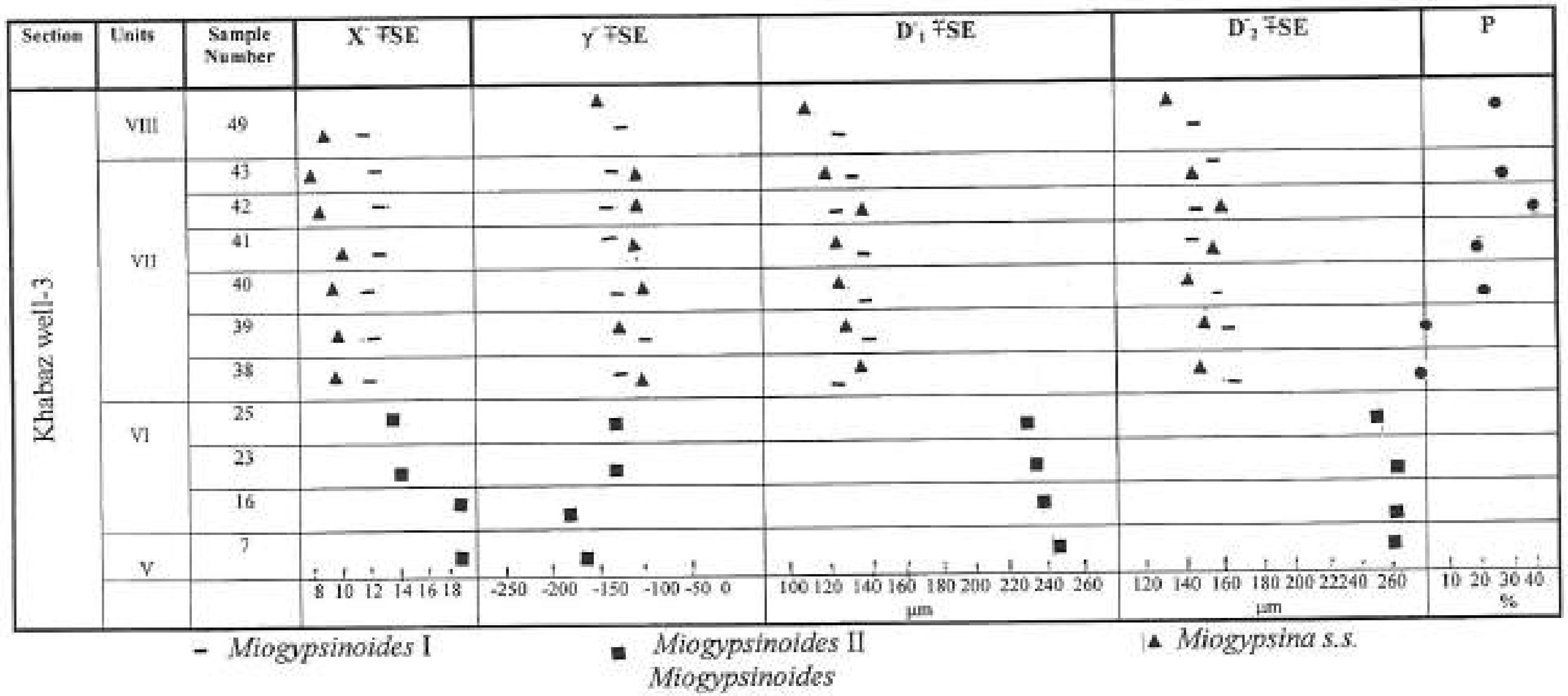


Fig. (45): X̄, γ̄, D̄'1, D̄'2 and P of *Miogypsina* in the samples of Units (V, VI, VII and VIII) of Khabaz well-3 section.

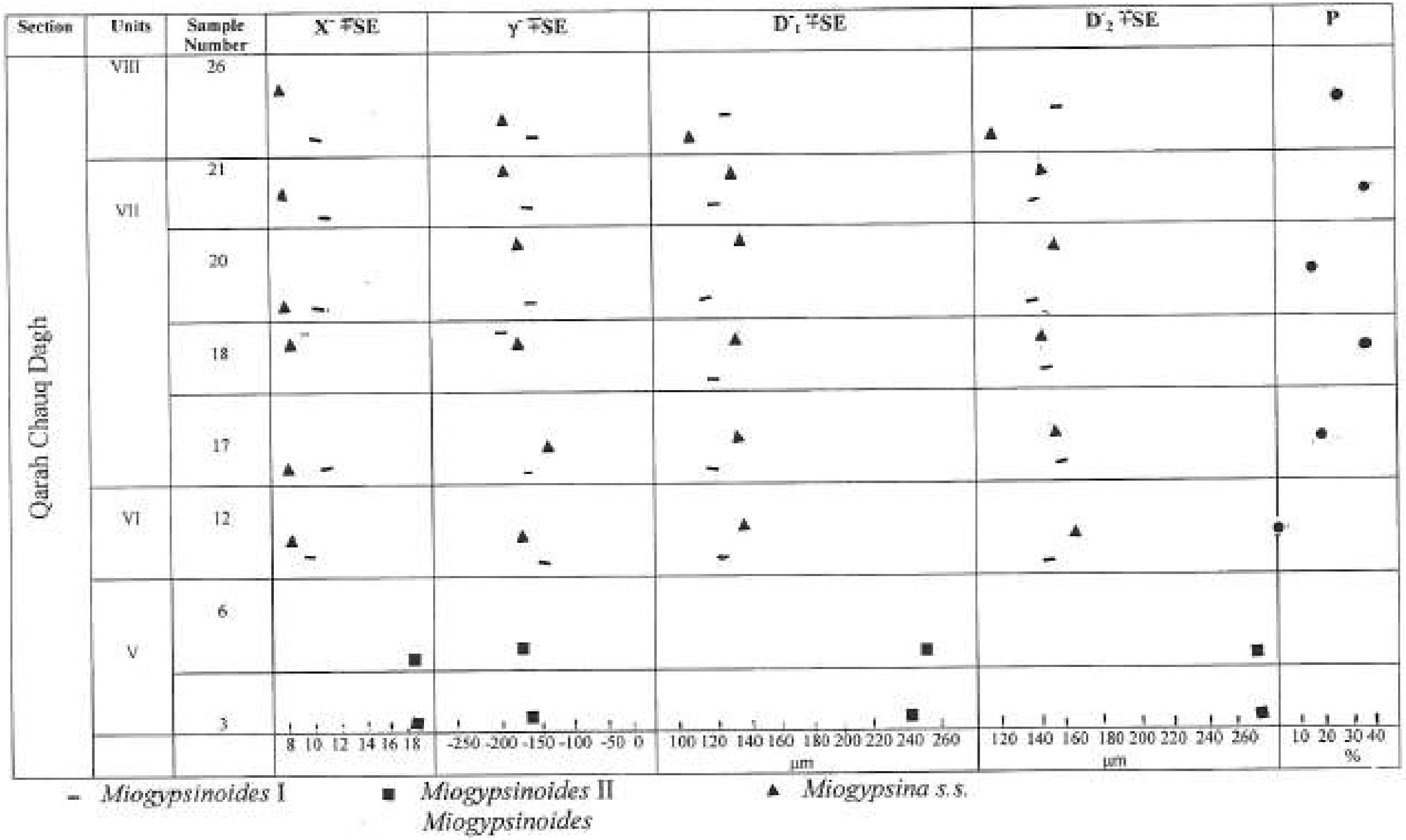


Fig. (46): X^{-}, γ^{-}, D^{-}_1, D^{-}_2 and P of *Miogypsina* in the samples of Units (V, VI, VII and VIII) of Qarah Chauq Dagh section .

or three classes respectively but there is very little change above the lower most from both sections.

	X	γ
Khabaz well-3 section		
Exits	23-18	-238 - -177
Entities	10-8	-84 - 0
Qarah Chauq Dagh section		
Exits	22-17	-221 - -66
Entities	10-8	-60- - 0

Table (8): Entries and exits of X and γ morphotype of *Miogypsinoides* of the Units (V and VI), of Khabaz well-3 section and Unit (V) of Qarah Chauq Dagh section.

4-6-3 Distribution of *Miogypsinoides* individuals in Units(V,VI,VII and VIII)

The lower most samples of Units (V,VI) of the Khabaz well-3 section and (V) of the Qarah Chauq Dagh section were characterized by the presence of two group of *Miogypsinoides* as mentioned in paragraph 4-3. Group I consists of individuals with small protoconches and group II comprises individuals with large protoconches.

Theoretically the presence of more than one biometric group in the middle and upper most samples of Units (VI, VII, and VIII) in both sections might be recognized from the bimodal sections of the frequency distribution or from the patchiness of clusters in the scatter diagrams.

The histograms of (X,γ, D_1 and D_2) are plotted in the samples of Units (VII,VIII) of the Khabaz well-3 section and Units (VI, VII and VIII) of the Qarah Chauq Dagh section in (Figs. 47 and 48) which possess bimodal shape of histograms. It was clearly visible that the individuals of *Miogypainoides* fall apart in two groups especially in the histograms of (D_1) and (D_2), but the ranges of another parameters X and γ values show a wide overlap in all samples.

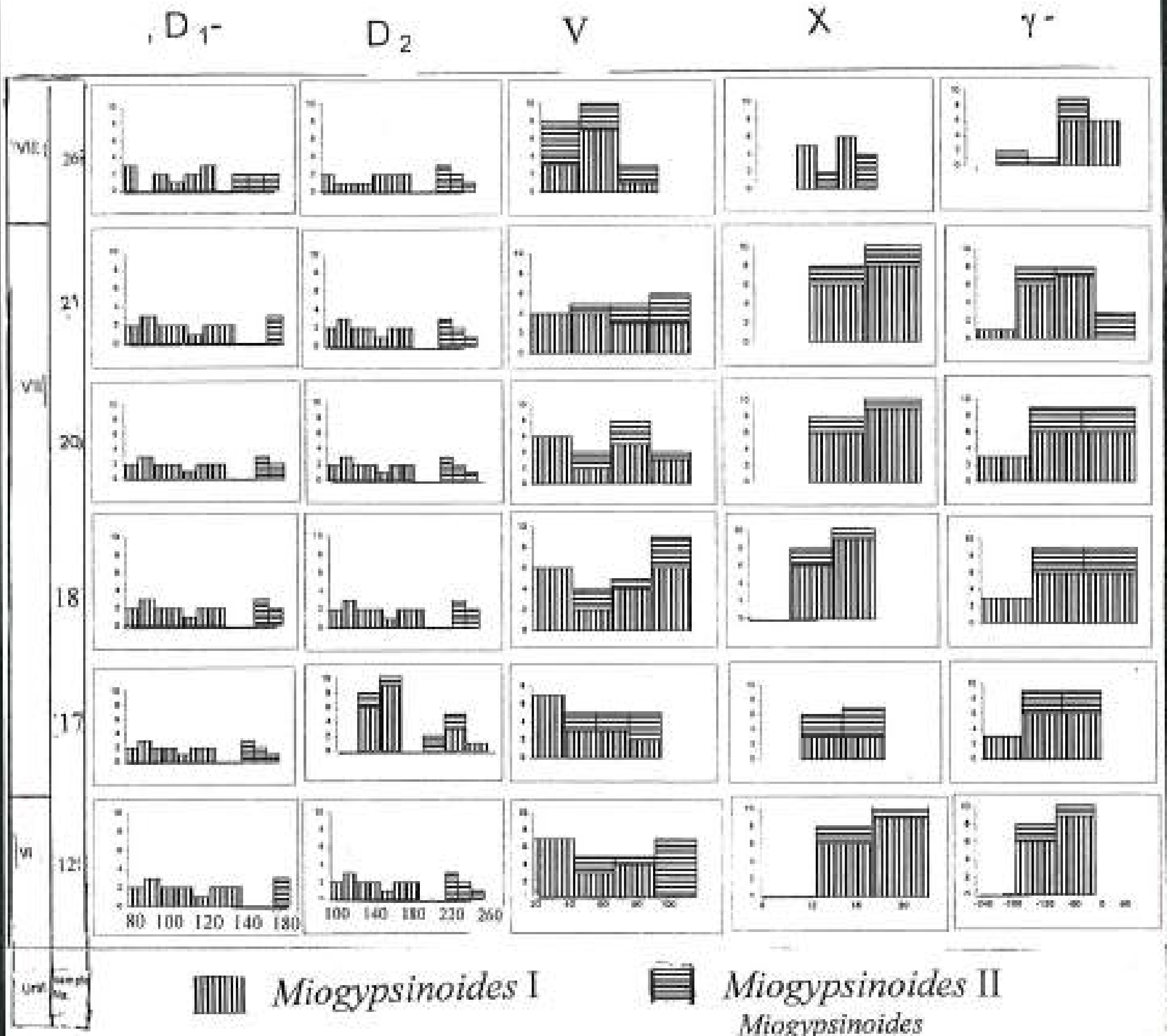


Fig.(48); Histograms of X, γ, D_1 and D_2 for *Miogypsinoides* in the samples of Units (VI, VII and VIII) of the Qarah Chauq Dagh section

The scatter diagrams for the same samples in both sections pointed out previously in (Figs. 49 and 50) in which (D_1) is plotted against (X, D_2 and γ) respectively, and (γ) against (X). In the (D_1-D_2) and (D_1-γ) scatter diagrams of the all samples (Figs. 49 and 50) show clearly that the individuals of *Miogypsinoides* fall apart in two clusters. It can be noted that group II cluster is completely separated from *Miogypsinoides* group I, whereas this division is not reflected in the (D_1-X , and γ-X,) diagrams, (Figs. 49 and 50).

4-6-4 Biometric Taxonomical classification.

For the classification scheme we refer to the compilation of Drooger (1993). The biometric species, we identified are listed in table (9), together with the necessary data for the determinations. The oldest association of *Miogypsinoides* was identified as *M. complanata*,(Plate 10, Figs. 1-8, Plate 11, Figs. 1-8), which is succeeded by *Miogypsinoides formosensis*, (Plate 12, Figs. 1-8, Plate 13, Figs. 1-2) in the lower most samples in sections, the determination of the assemblages, co-occurring with *Miogypsina*, center around *Miogypsinoides bantamensis*. (Plate 13, Figs. 3-6).

Type II assemblages are classified as *M. ex. interc. bantamensis-dehaartii* and types I assemblages are named as *M.ex. interc. formosensis-bantonensis*.

Section	Sample	X̄	SE	N	*Miogypsinoides* Ex. interc.
Khabaz well-3					
	49	12.3	0.35	13	*bantamensis*
	43	12.3	0.30	15	*bantamensis*
	42 (Type II)	10.5	0.23	14	*bantamensis-dehaartii*
	42 (Type I)	12.3	0.23	18	*formosensis-bantamensis*
	41	12.3	0.36	12	*bantamensis*
	40	12.6	0.27	15	*bantamensis*
	39	12.4	0.26	15	*bantamensis*
	38	12.3	0.27	18	*bantamensis*
	25	15.1	0.25	17	*formosensis*
	23	15.3	0.27	15	*formosensis*
	16	19.3	0.27	15	*complanata*
	7	18	0.32	14	*complanata*

Qarah Chauq Dagh

26				
21	11.6	0.31	14	*bantamensis*
20	11.7	0.29	14	*banatamensis*
18(Type II)	10.4	0.31	18	*bantamensis-dehaarti*
18(Type I)	11.4	0.27	17	*formosensis-bantamensis*
17	11.9	0.30	15	*bantamensis*
12	12.6	0.33	15	*formosensis*
6	19.8	0.34	12	*complanata*
3	19.1	0.31	12	*complanata*

Table (9); Species list of *Miogypsinoides* and pertinent, biometric data; N=Number of observations on X in a sample or a sample suite; if N<11, then the name is presented in parentheses.

4-6-5 Correlations in separate assemblages

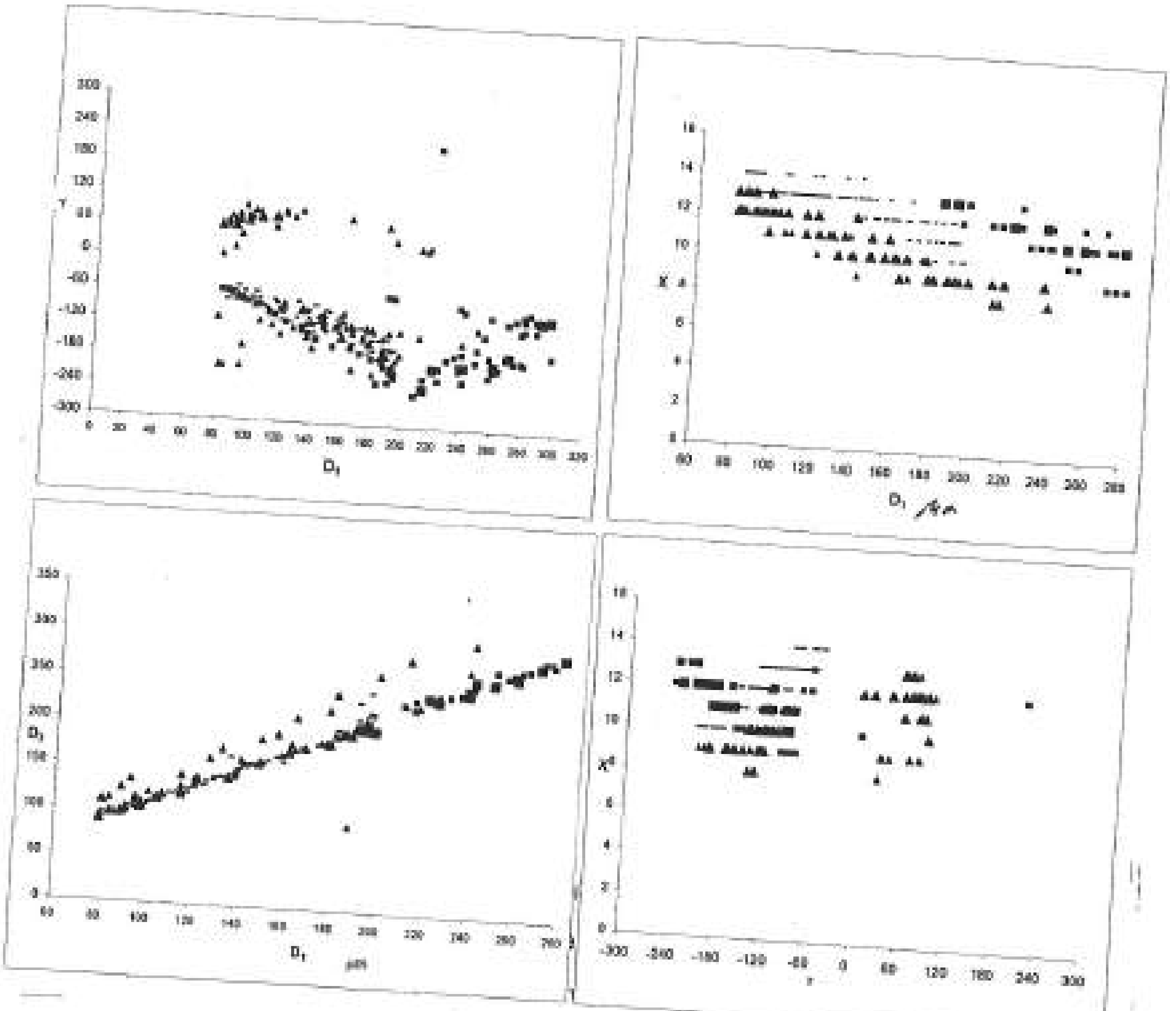
The oldest assemblage of *Miogypsinoides* samples (7, 16, 23 and 25) of the Khabaz well-3 and (3, 6) of the Qarah Chauq Dagh sections, reveal significance correlation (P=0.001) for all combinations of the parameters. (Figs. 51 and 52, table 10).

Usually the numbers of *Miogypsinoides* specimen in the samples of Unit (VII) in both sections are too low to provide meaningful coefficients of relation. Only *Miogypsinoides* I from sample (42) of the Khabaz well-3 section and the sample (18) of the Qarah Chauq Dagh section, represent in which sufficient individuals of this type are present, show well correlated variables. (Table 10)

Samples		X-γ	X-D_1	X-D_2	γ-D_1	γ-D_2	D_1-D_2
Khabaz well-3 section							
7	r N =14	-0.78	-0.806	-0.812	0969	0.9774	0.9977
		++	++	++	++	++	++
16	r N=15	-0.950	-9659	-949	0.9368	0.9711	0.9702
23	r N=18	-0.96	-0.976	-0.9556	0.9846	0.988	0.981
		+	+	+	+	+	+
25	r N= 17	-0.923	-0.934	- 0.9299	0.9624	0.9432	0.9945
		+	+	+	+	+	+
42 (Type I)	r N=20	-0.8795	-9451	-0.9595	0.9165	0.9055	0.9967
		++	++	++	++	++	++
42 (Type II)	r N=14	-0.0854	-0.9761	-0.9637	0.4679	0.6060	0.9966
			++	++	--	-	++
Qarah Chauq Dagh section							
3	r N=12	-0.7887	-0.8329	-0.83.28	0.9281	0.9312	0.9961
		++	++	++	++	++	++
6	r N=12	-0.7724	-0.8278	-0.8194	0.9491	0.9467	0.9964
		++	++	++	++	++	++
18 (Type I)	r N=18	-0.9463	-0.9385	-0.9026	0.8929	0.8847	0.9836
		++	++	++	++	++	++
18 (Type II)	r N =17	-0.8774	-0.9366	-0.9190	0.9679	0.9656	0.9809
		++	++	++	++	++	++

Table (10): Correlation of the parameters in single samples, df=N-2;N=pairs of observations; r-test is one sides; P= 0.01(++/--), P=0.05(+/-).

To have some notation of the association of various couples of parameters in *Miogypsinoides* I and II of the two sections. We show several scatter diagrams in which all specimens of both groups are presented. (Figs. 49 and 50). As usual we see that (γ-X and D_1-D_2) are well correlated. The correlation between the nepionic and the embryonic parameters are not that obvious; types I show weak covariations for various combinations of nepionic and embryonic variables, whereas, no such association is apparent for type II.



- *Miogypsinpoides* I ■ *Miogypsinoides* II ▲ *Miopgypsina s.s.*

Miogypsinoides

Fig.(49): γ-D_1, X-D_1-D_2 and X-γ scatter diagrams of the Miogypsina in the samples (38, 39, 40, 41, 42, 43 and 49) in the Khabaz well-3 section.

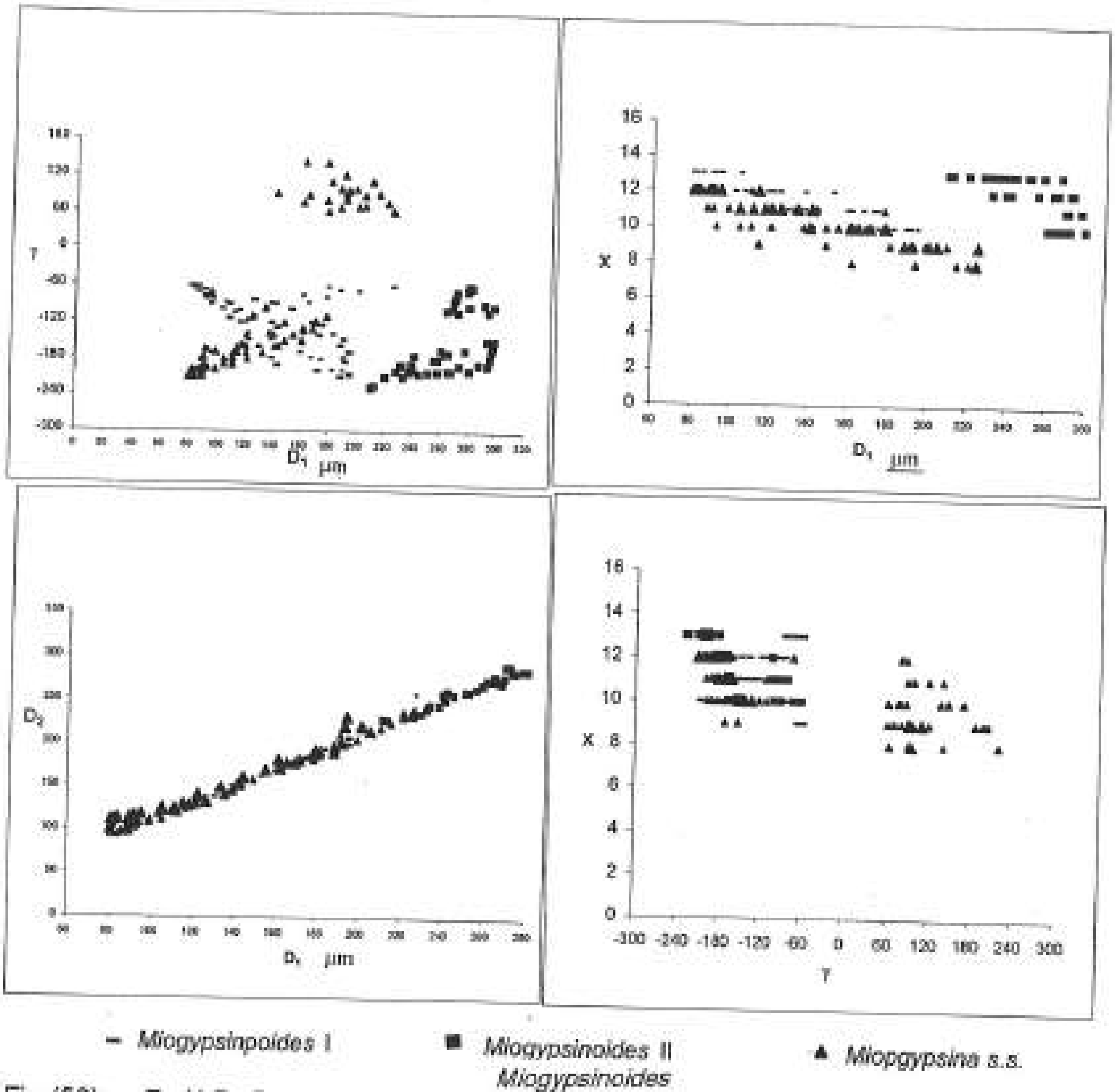


Fig.(50): γ-D_1, X-D_1-D_2 and X-γ scatter diagrams of the Miogypsina in the samples (12, 17, 18, 20, 21 and 26) in the Qarah Chauq Dagh section.

4-7 *Miogypsina s.s*

4-7-1 Trends

Overall changes in the parameters of *Miogypsina s.s.* in Units (VI, VII and VIII), (Figs.45 and 46) in both section were determined by testing the correlation between the parameter means and the ranking numbers of samples (cf. M.M. Drooger et. al., 1979). The result of the r-test are listed in table (11). The parameters show weakly significant and some of them significant, positive trends which means they are in line with the classical tendencies in the *Miogypsinoides* nepionic acceleration and embryonic size increase for example D_2 is highly significant correlated with the ranking number of a significant level of 0.01.

The overall changes in the values of P, the relative frequency of individuals with two principal auxiliary chambers was not tested statistically. From the graph of P in (Figs. 45 and 46) we infer that this variable tends to increase upward. The two lower assemblages of *Miogypsina s.s.* do not yet contain specimen with two P.A.C., whereas P attains values ranging from 20% to 35% in the upper part of the Unit (VII).

Stratigraphical interval	N	X^{-}	γ^{-}	D^{-}_1	D^{-}_2
Total Unit	12				
Khabaz well-3 Section	7	- 0.91	- 0.92	- 0.93	++ 0.94
Qarah Chauq Dagh Section	5	- 0.57	+ 0.65	- 0.41	++ 0.42

Table(11): Trends in the various mean of *Miogypsina s .s.* in Units (VI,VII and VIII)) tested with the r-test, df=N-2, N=number of samples; test carried out one sided; tested levels of significance: p=0.01(+ + /- -), p=(+ /-)

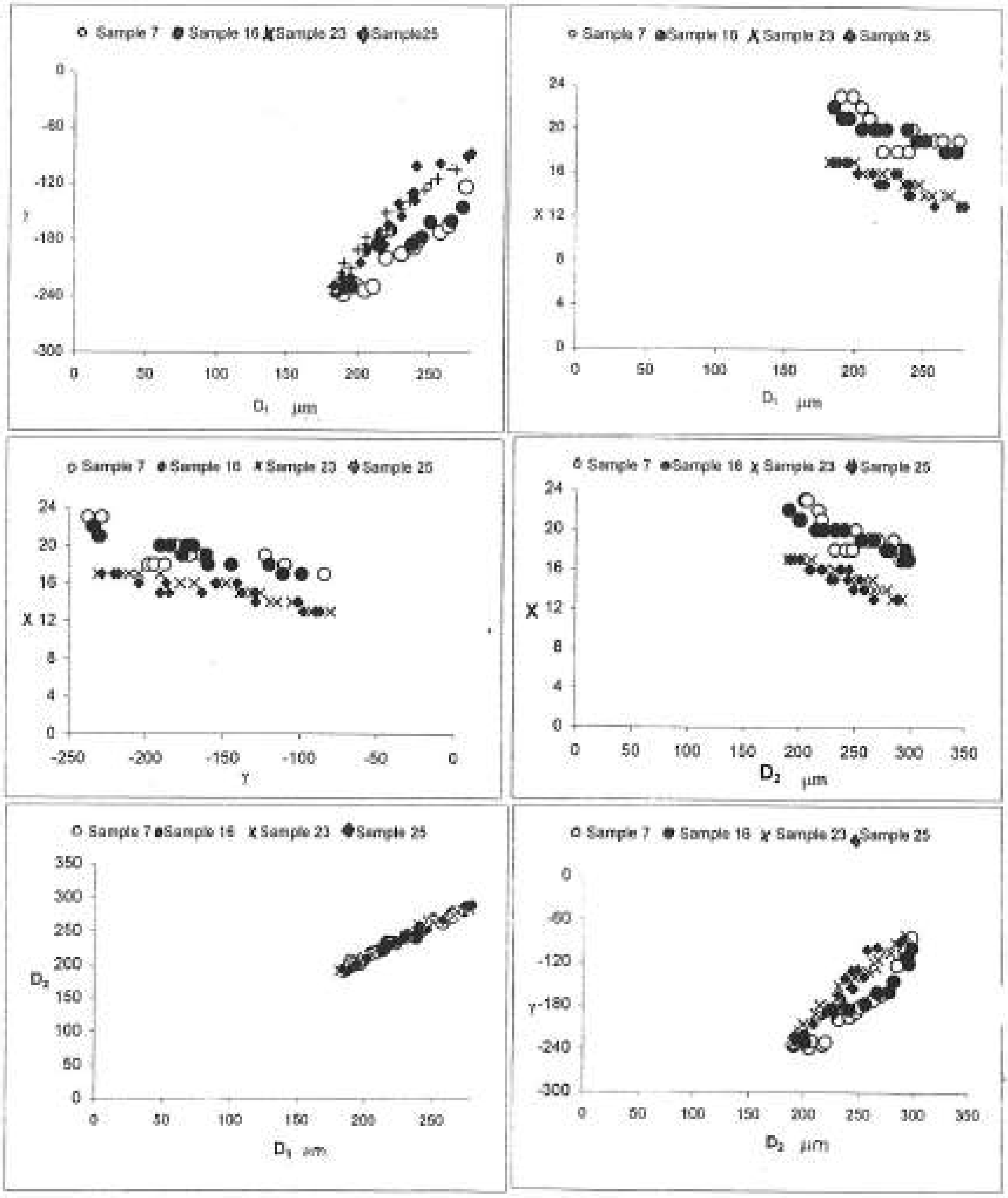


Fig.(51): Scatter diagrams of (γ-D_1, X-D_1, X-γ, X-D_2, D_1-D_2 and γ-D_1) for *Miogypsinoides* in the lower most samples (7. 16, 23 and 25) in Khabaz well-3 section.

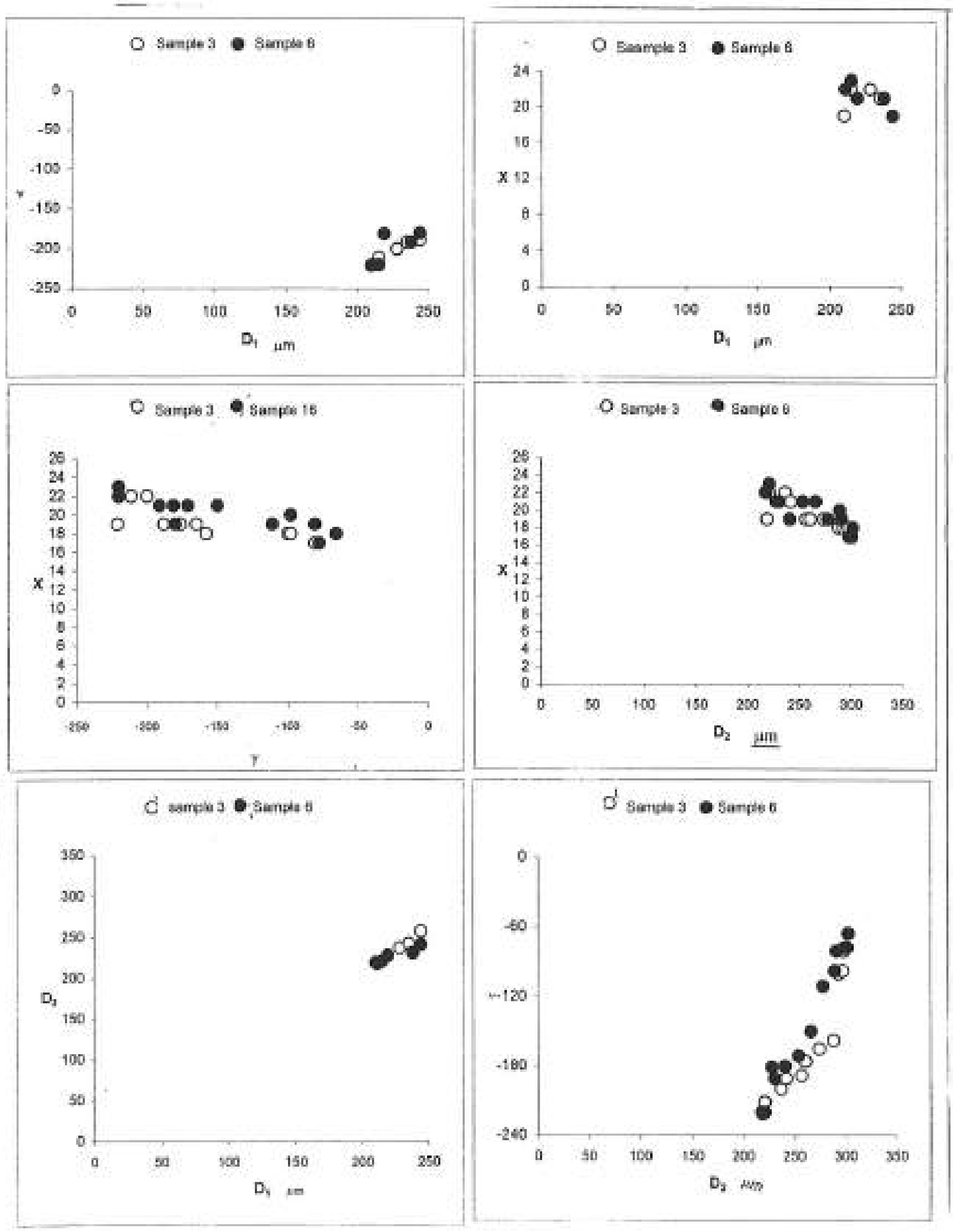


Fig.(52): Scatter diagrams of (γ-D_1, X-D_1, X-γ, X-D_2, D_1-D_2 and γ-D_1) for *Miogypsinoides* in the lower most samples (3 and 6) in Qarah Chauq Dagh section.

4-7-2 Small scale changes

In table (12) the resultof the statistical tests are presented for the *Miogypsina s.s.* in the Units (VI, VII and VIII) with the samples (38, 39, 40, 41, 42, 43, and 49) and (12, 17, 18,20, 21 and 26) of the Khabaz well-3 and Qarah Chauq Dagh section respectively. All parameters are subjected to positive shifts which are most frequently shown by (y), namely in the upper part of Unit (VII). Sometimes setbacks occur as well, only for the embryonic size parameters the changes opposite to the overall trend attain high significance level (P= 0.001). A significant change in a parameter is usually not accompanied by a significant shift in the other three variables of the same sample pair (table12).

Sample couple	Chi square test X^-	γ^-	df	t-test D_1^-	df	D_2^-	df
Khabaz well-3 section							
43-49	0.423	0.12	21	-1.99	21	0.143	21
41-49	0.353	-0.139	24	0.78	24	-0.56	24
41-43	0.352	-4.6	23	3.43	23	-.0.04	23
39-42	0.361	-1.57	24	1.27	24	-2.54	24
39-41	0.352	-1.69	15	-1.47	15	-0.84	15
38-40	0.371	0.73	23	0.800	23	2.14	23
38-39	0.442	0.43	21	1.32	21	2.34	21
Qarah Chauq Dagh section							
21-26	0.361	-0.73	21	-2.18	21	-1.192	21
20-26	0.349	-7.8	22	-0.44	22	-0.013	22
17-21	0.37	0.59	23	0.09	23	-0.07	23
17-20	0.35	0.97	25	3.35	25	-2.16	25
12-18	0.44	0.991	29	-1.01	29	-4.30	29
12-17	0.37	-1.74	22	4.09	22	2.877	22

Table (12): Significance of the observed differences between the sample means of *Miogypsina s.s.* in Units(VII and VIII) tested by one sided t-test or Chi square test $=N_1+N_2-2;N_1+N_2=$Sum of observations in both samples; significance levels=0.01(+ +/ - -), p=0.05(+/-); no significant result(o).

4-7-3 Qualitative shifts in the morphotype composition

For a general remark on changes in the morphotype composition we refer to the previous description of *Miogypsinoides*. The ranges of morphotyopes in *Miogypsina s.s.* were deduced from the histogram in (figs 39, 40, 53, 54 and 55). It is supported by a number of scatter diagrams in (Figs. 56 and 57) which illustrate the intensity of the covariation between (D_1-X, D_1-γ and D_1-D_2) of the *Miogypsina s.s.* in the Units (VI, VII and VIII) of the Khabaz well-3 and Qarah Chauq Dagh sections.

4-7-4 Qualitative changes in the frequency distribution

All frequency distributions of (V) in Fig.(55) represent samples from the Units (VII and VIII) of the Khabaz well-3 and Qarah Chauq Dagh sections. In the lower part of the Unit (VII) there are very few individuals with a second nepionic spirals, viz, one per sample at a maximum. Despite these low frequencies the variation in the observational values is relatively large in the lower interval. In the associations up to the samples (42) in Khabaz well-3 section and (18) from Qarah Chauq Dagh section, the classes is ranging from (40-60) are present. The next higher classes (80-100), appear in samples (43 and 20) from both sections while the range of (V) is large in Unit (VIII) the relative frequencies of various morphotypes remain low.

4-7-5 Biometric taxonomical classification

The biometric classification scheme of the *Miogypsinoides* of Drooger (1963) will be used to identify the assemblages of *Miogypsina*. A review of determinations is provided in table (13), which include also the relevant statistical data of the *Miogypsina* associations. The dominant species of *Miogypsina* in the lower part of the sections (Khabaz well-3 and Qarah Chauq Dagh) is *Miogypsina gunteri*,(Plate 14, Figs. 1,5,6, Plate 15, Figs. 1,3, 4-6, Plate 16, Figs. 1, 3-6) which is changed to another species, situated in their character between *Miogypsina gunteri* and *Miogypsina tani*, especially in the upper part of the sections which is in transitional state to *Miogypsina tani* may be called *Miogypsina gunteri-tani*.(Plate, 14, Figs. 2-4, Plate 15, Fig. 2, Plate 16, Fig.2).

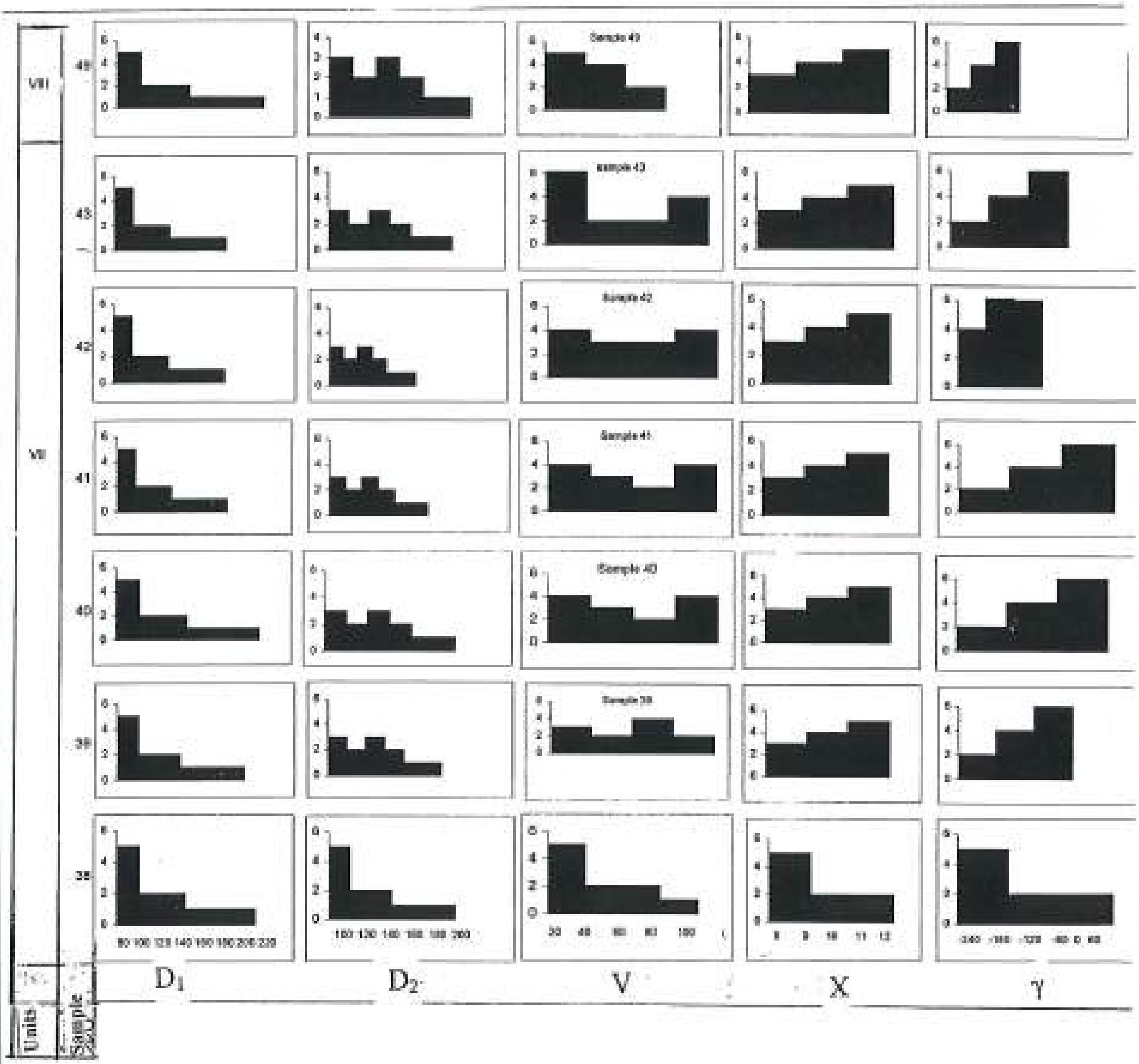


Fig.(53): D_1, D_2, V and γ histograms of *Miogypsina s.s.* of the unit (VII and VIII) of the Khabaz well-3 section.

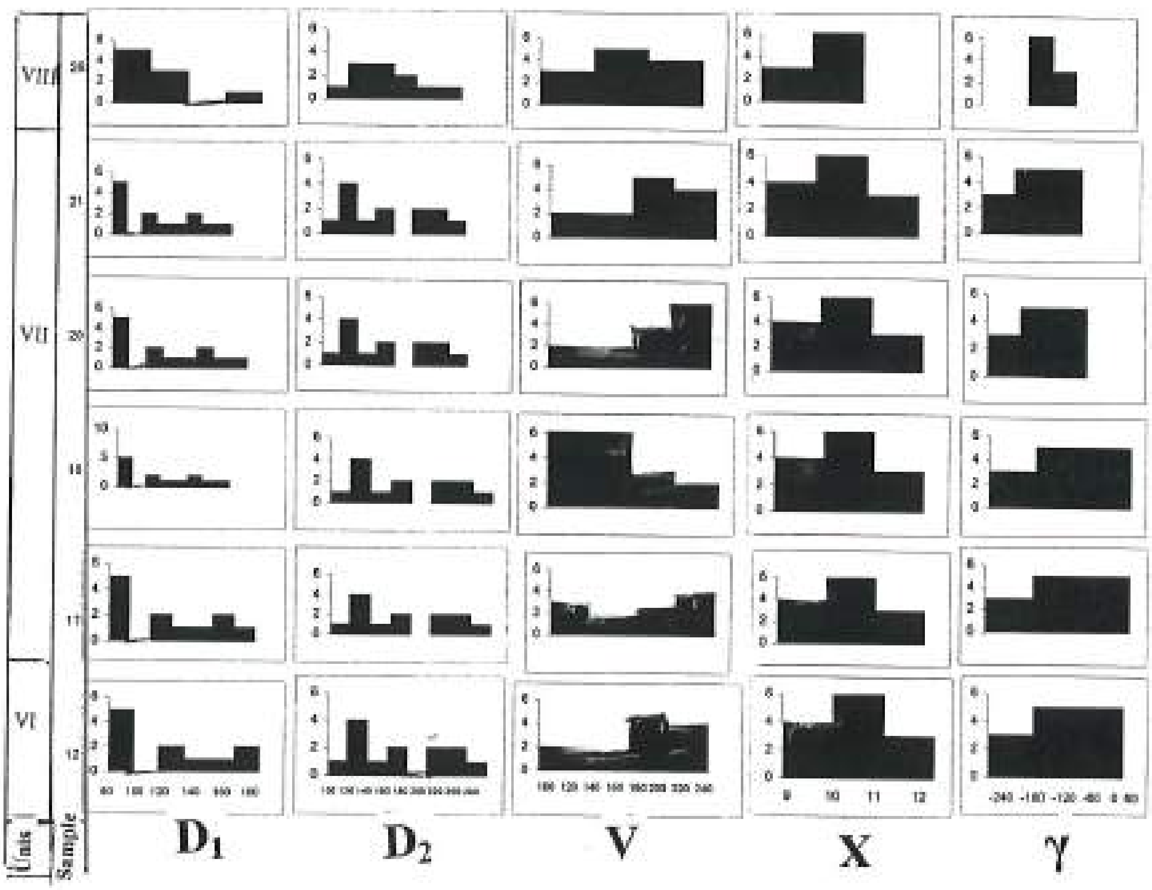


Fig.(54): D_1,D_2,V and γ histograms of *Miogypsina s.s.* of the Units (VI, VII and VIII) of the Qarah Chauq Dagh section.

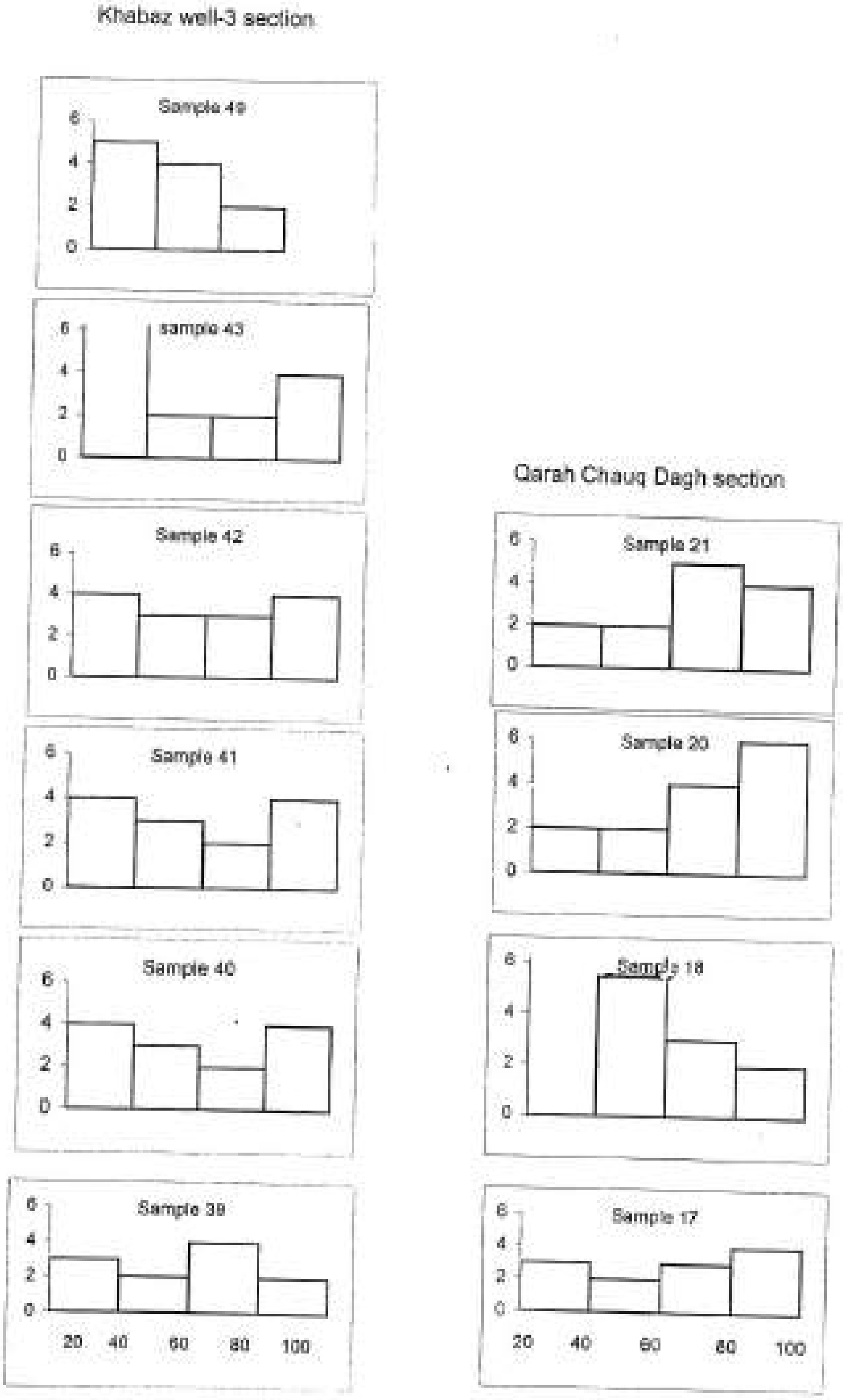


Fig.(55): Histograms of V for some samples of *Miogypsina s.s.* in unit (VII) and of the Khabaz well-3 and Qarah Chauq Dagh sections.

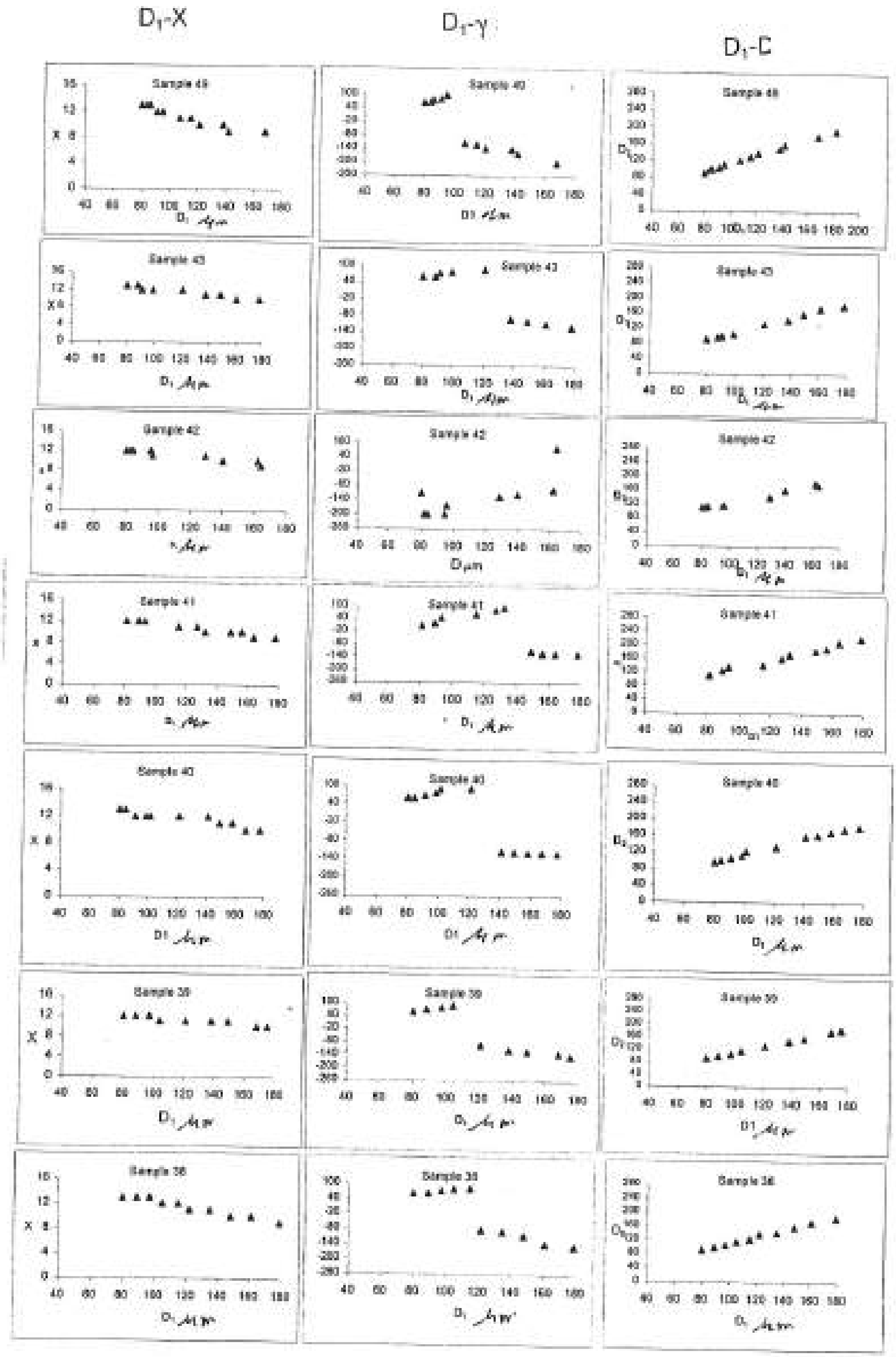


Fig.(56): Scatter diagrams of X-D_1, γ-D_1 and D_1-D_2 for various samples of *Miogypsina s.s.* in the unit (VII and VIII) of the Khabaz well-3 section.

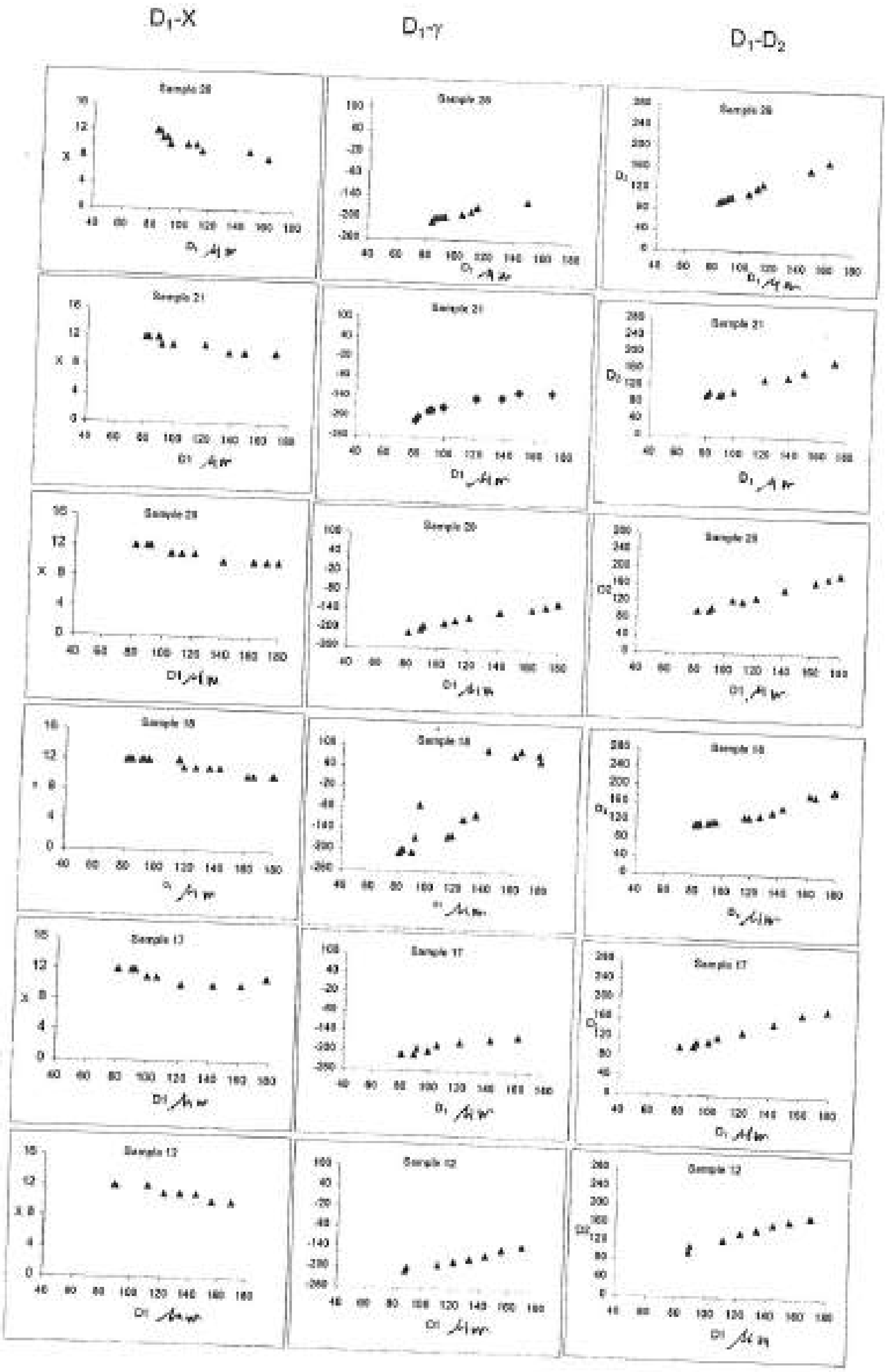


Fig.(57): Scatter diagrams of X-D_1, γ-D_1 and D_1-D_2 for various samples of *Miogypsina s.s.* in the unit (VII and VIII) of the Qarah Chauq Dagh section.

Section	Sample	X	SE	N	P%	бp	*Miogypsina/ M.ex. interc.*
Khabaz well-3							
	49	9.51	0.46	12	25	1.6	*gunteri-tani*
	43	9.4	0.44	11	28	1.45	*gunteri-tani*
	42	10.1	0.36	15	35	1.41	*gunteri*
	41	10	0.35	14	21	1.41	*gunteri*
	40	10.8	0.41	13	23	1.36	*gunteri*
	39	10.5	0.37	11	0	1.1	*gunteri*
	38	11	0.48	12	0	1.54	*gunteri*
Qarah Chauq Dagh							
	26	9.1	0.35	12	25	1.32	*gunteri-tani*
	21	9.7	0.37	13	24	1.32	*gunteri-tani*
	20	10.3	0.36	14	15	1.27	*gunteri*
	18	10.4	0.38	13	34	1.15	*gunteri*
	17	10.3	0.3	12	17	1.31	gunteri
	12	10.3	0.40	12	0	1.37	*gunteri*

Table (13): List of identified, biometric species of *Miogypsina* s.s. and relevant, statistical data, N = number of observations on X in one sample; σ p standard deviation of p.

4-7-6 Correlation

Both the (X-γ) and (D_1-D_2) combinations of the *Miogypsina s.s.* are distinctly correlated in about 30% and 100% of the total number of associations, negative and positive respectively. (Fig.58). Less evident are the links between the nepionic and embryonic variables. A significant negative result of the r-test (p=0.001) for (X and D_1 or X and D_2) occurs in about 40% of the samples and about 50% of the associations have a distinct positive correlation between (γ) and the diameters of the embryonic chambers.

P=0.0 / P=0.01	X	γ	D_1	D_2
X		-30	-30	-75
γ	-30		+50	+65
D_1	-40	+50		+100
D_2	-40	+60	+100	

Fig. (58): Percentage of significance correlations values (p= 0.05or p= 0.01) of Miogypsina s.s. assemblages in Units (VII and VIII), +50 means positive correlation in 50% of the samples N= Number of samples.

The correlation data from the Khabaz and Qarah Chauq Dagh sections were also considered separately. (Table 14)

Section	N	D'_1-D'_2	X'-γ'	X'-D'_1	X'-D'_2	γ'-D'_1	γ-D_2
Khabaz well-3	7	++	-	0	-	++	++
Qarah Chauq Dagh	6	+	- -	0	+	-	+

Table (14): Number of samples with a significant correlation (P=0.05) for specific pairs of variables of *Miogypsina s.s.* in Units (VI, VII and VIII) of the sections Khabaz well-3 and Qarah Chauq Dagh.

The relative number of significant correlations (p= 0.05) tends to be smaller in both sections, except for D_1-D_2 in Khabazwell-3 section.

The sample means are without exception distinctly correlated at a significant level of 0.01. (Fig. 59).

γ'	D'_1	D'_2	P=0.01 N=12
-	-	-	X'
	+	+	γ'
		+	D'_1

Fig. (59): Diagram showing the correlation between the various sample means of *Miogypsina s.s.* in Units (VII and VIII), 0f the Khabaz well-3 and Qarah Chauq Dagh section.

A graphical presentation of the covariation between the means is provided in (Figs. 60 and 61).

The individual correlation tests for the Khabaz well-3 and Qarah Chauq Dagh sections did not reveal largely different results, except for the couples X'-D'_1 and X' -, which are not correlated in both sections.(Table 15).

Section	N	X'-γ'	X'-D'_1	X'	D'_2	γ'-D'_2	D'_1-D'_2
Khabaz well-3	7	-	0	0	+ +	++	+ +
Qarah Chauq Dagh	6	-	-	-	+ +	+ +	++

Table (15): correlation between the samples means of *Miogypsina s. s.* in Units (VII and VIII) of the Khabaz well-3 and in the Qarah Chauq Dagh sections ; P= 0.01(+ +/- -), P=0.05(+/-); r-test was executed one sided; no significant correlation: (o).

4-7 <u>Comparison of the various biometric species units</u>

Reviewing the analyses of samples means, it becomes clear that the principle of nepionic acceleration is applicable to the total data set of units (VI, VII and VIII).

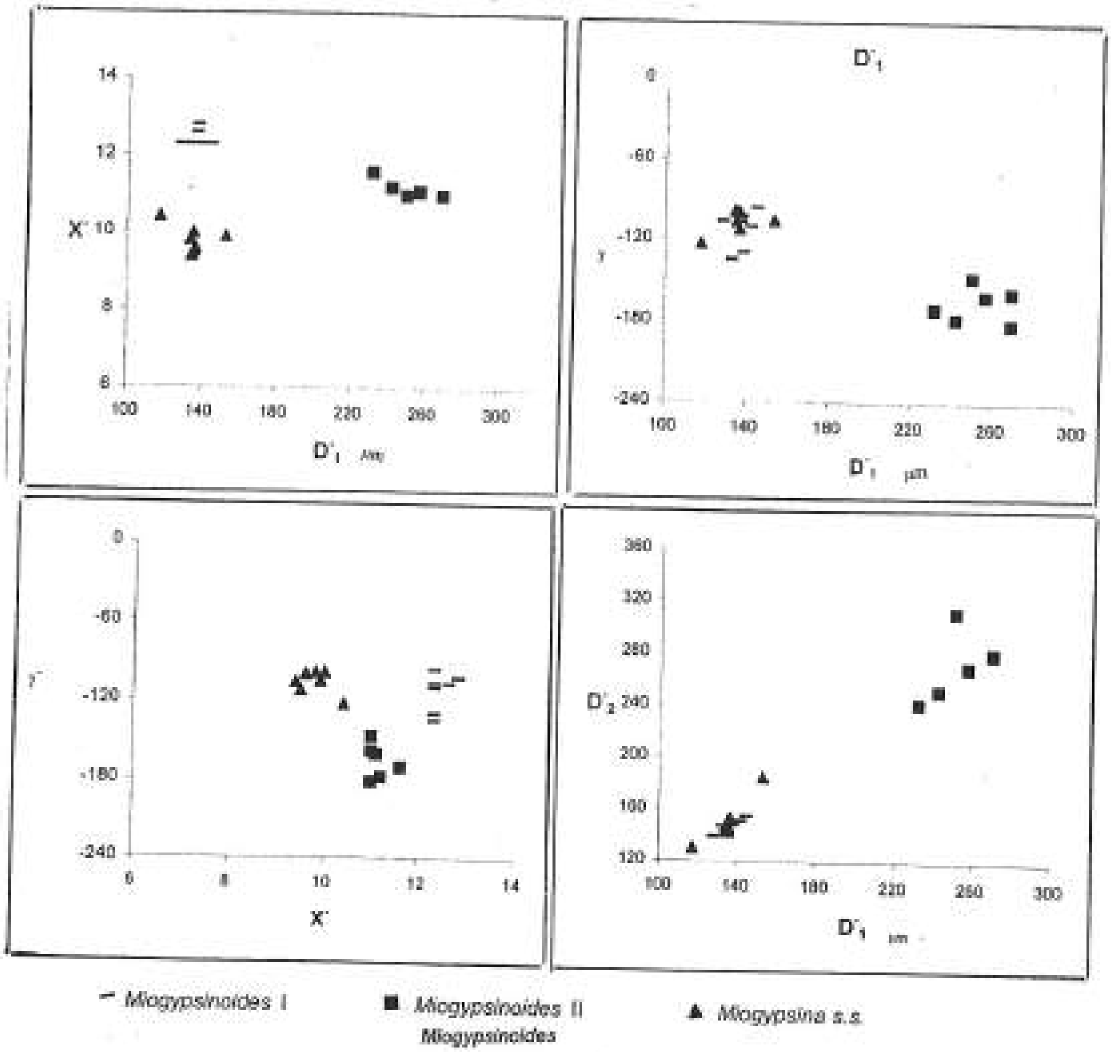


Fig.(60): X'-D'1,γ'-D'1,D'1-D'2, and γ'-D'1 scatter diagrams of all *Miogypsina* assemblages of units (VI, VII and VIII) of the Khabaz well-3 section.

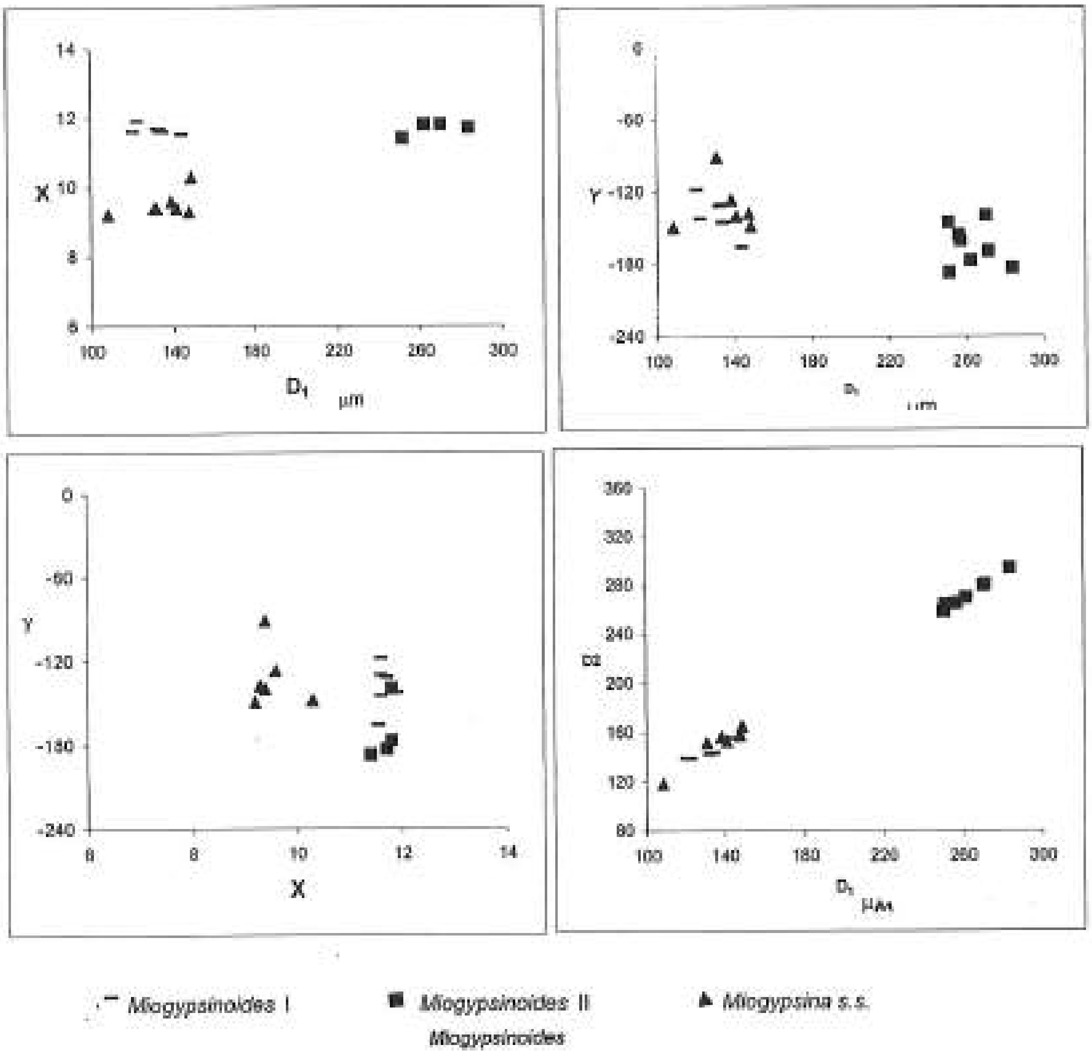


Fig.(61): X'-D'_1, γ'-D'_1, D'_1-D'_2, and γ'-D'_1 scatter diagrams of all *Miogypsina* assemblages of units (VI, VII and VIII) of the Qarah Chauq Dagh section.

The positive tendencies in (D'$_1$) and (D'$_2$) are not straightforward as in (X') and (γ'). The embryonic diameters of *Miogypsina s.s.* in their lower most associations and of *Miogypsinoides* I, show significant shift with respect to *Miogypsinoides formosensis* by contrast, *Miogypsinoides* II, is marked by a positive change in these statistics. No distinct differences are apparent between (D_1') and (D_2') of *Miogypsinoide* I, and of *Miogypsina s.s.* from the lower part of both sections.

The possibility of different development rates of X' and γ' is the co-occurring *Miogypsina s.s* and *Miogypsinoides,* which is difficult to evaluate, because of too scanty information on the later subgenus. Both (X') and (γ') of *Miogypsina* show a progressive trend, while the few data of *Miogypsinoides* I, and II suggest stability for both in the same interval, *Miogypsinoides* I, is always more primitive at a comparable stratigraphical levels, whereas *Miogypsinoides* II seems to shift from relatively somewhat more advanced than *Miogypsina s.,s.*. To gain more insight in the possible relationships between the three biometric entities, i.e. the primitive *Miogypsinoides* I, and II band the co-occurring *Miogypsina s.s.*, we made two scatter diagrams of (X-D_1) and (γ-D_1), (Figs.62 and 63). In which the variation of the three groups is illustrated by the individuals of selected samples.

The scatter diagrams of the means (Figs. 60 and 61) show that all three taxa fit in with a single line for the embryonic (D_1-D_2) and the nepionic (X-γ) features. In the combinations (X-D_1 and γ-D_2) the two groups are apparent again. *Miogypsinoides* II could well be the regular continuation of *Miogypsinoides complanata* and *M.formosensis*. Whereas the other two groups could have originated from such a line after a rapid drop in embryonic sizes, each of the two following its own line of development afterwards.

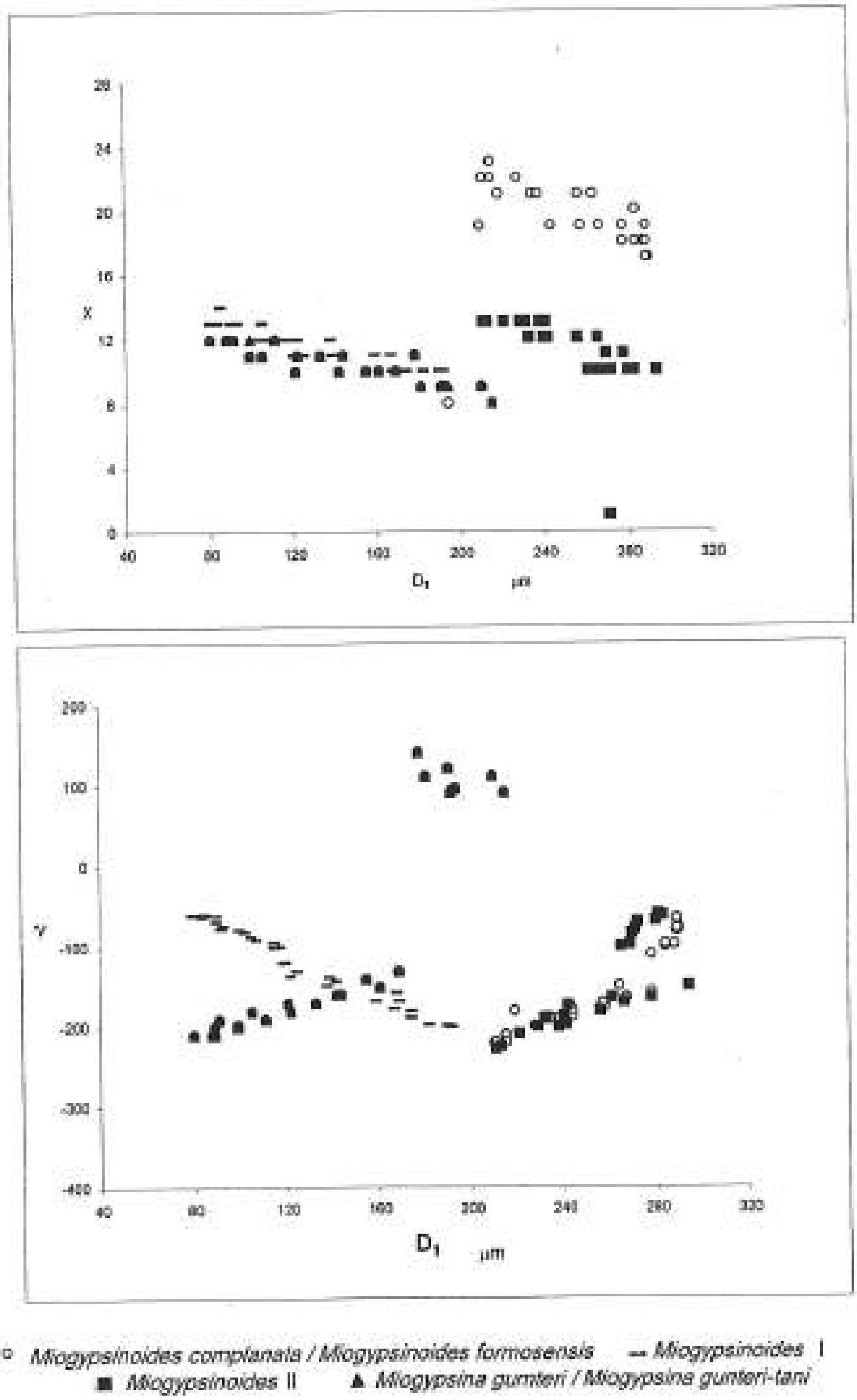


Fig.(62):X-D_1 and γ-D_1 scatter diagrams for selected samples of *Miogypsinoides complanata-formosensis, Miogypsinoides* I and II and *Miogypsina gunteri*, of the Khabaz well-3 section.

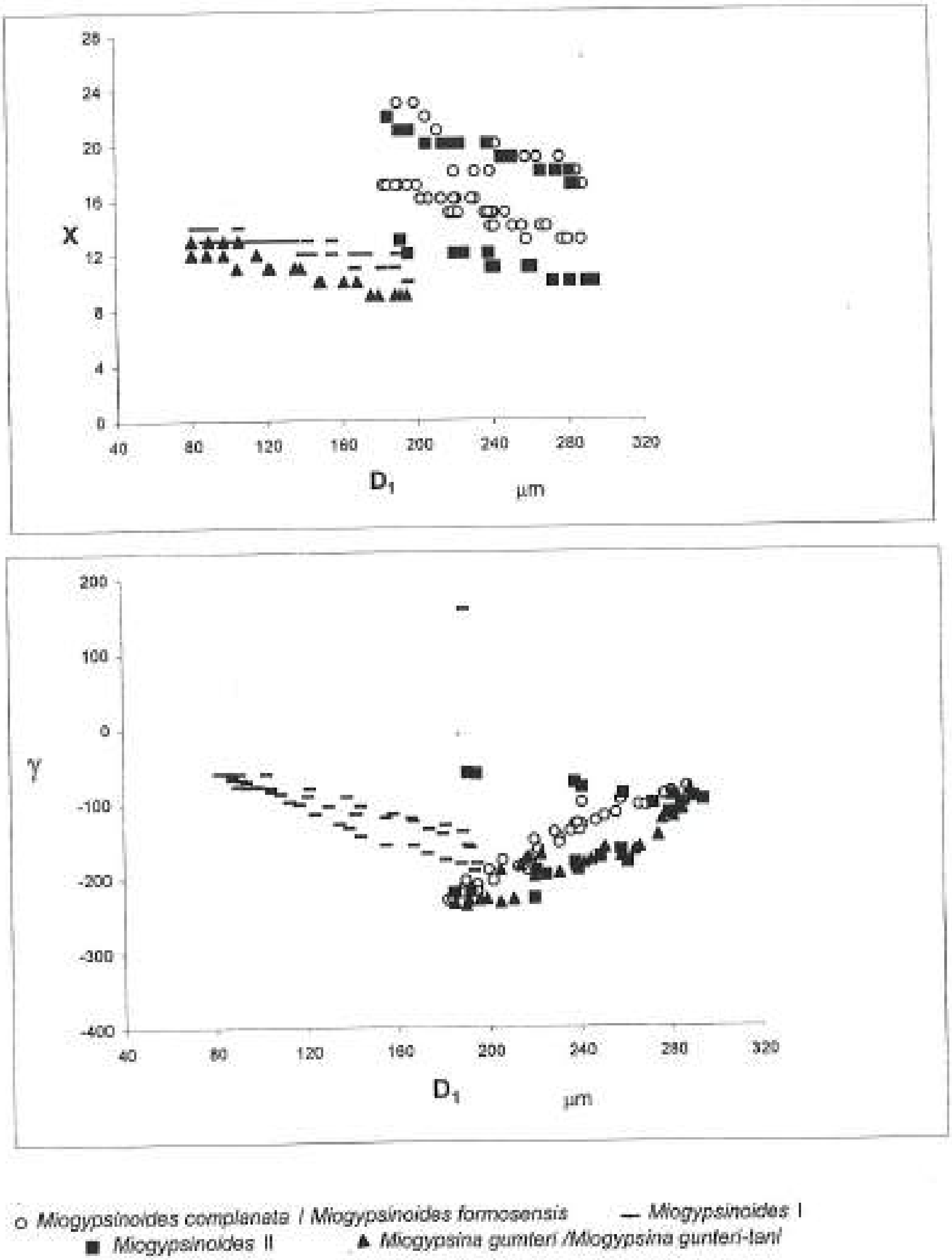


Fig.(63): X-D_1 and γ-D_1scatter diagrams for selected samples of *Miogypsinoides complanata-formosensis, Miogypsinoides* I and II and *Miogypsina gunteri*, of Qarah Chauq Dagh section.

Chapter Five

EVOLUTIONARY ASPECTS OF THE *LEPIDOCYCLINA(NEPHROLEPIDINA)* AND MIOGYPSINIDAE

5-1 Introduction.

The succession of *Lepidocyclina(Nephrolepidina)* and *Miogypsina* species in Baba and Azkand Formations(Oligocene –Miocene) carbonates of Kirkuk well-19 ; Bai-Hassan well-4; Khabaz well-3, and Qarah chauq Dagh sections, provides us with unique proof for the general validity of the principle of nepionic acceleration(Tan Sin Hok, 1936), in the evolution of the *Lepidocyclina(Nephrolepidina)* and *Miogypsina.*

The evolutionary patterns in our *Lepidocyclina(Nephrolepidina)* and *Miogypsina* lineages will be dealt with in more detail, which was actually the main purpose of our investigation .The morphometric series will be the results of earlier published detailed studies on other Orbitoidal Foraminifera and with current evolutionary theories.

A major deviation from the earlier established evolution pattern in the Khabaz well-3 and Qarah Chauq Dagh sections consist of the contemporaneous, Aquitanian occurrences of two morphometric units close to *M. bantamensis*, instead of only one, they were named *Miogypsinoides* I, and II. This divergence from the overall line of evolution will be discussed in paragraph 5-4-2

5-2 Evolution in *Lepidocyclina(Nephrolepidina)*

Biometric investigations of the megalospheric individuals of *Nephrolepidina* assemblages from several places in Europe by Van der Vlerk, 1959; Drooger and Socin, 1959; Drooger and Freudenthal, 1964) led to De Mulders' classification (1975), in which three morphometrically defined species are recognized by the combination of two parameters: the degree of embracement of protoconch by the deuteroconch (factor A_i) and the number of accessory auxiliary chambers (Factor C). On the basis of general theories which are called embryonic and nepionic acceleration, depending on the combinations of (A') and (C') values:

The names and morphometric delimitation of the species are:

Lepidocyclina praemarginata	$1 < C' < 3$	$35 < A' < 40$
Lepidocyclina morgani	$3 < C' < 5.25$	$40 < A' < 45$
Lepidocyclina tournoueri	$C' > 5.25$	$A' > 45$

The overall acceleration trends appear to be in accordance with the stratigraphic order of these three species, but the rate of evolution must have been very low, if one takes into account that the development lasted throughout the entire second half of the Oligocene (Chattian) and well into the Miocene. The latest published review paper (Drooger and Rohling, 1987) on all morphometrically determined *Nephrolepidina* associations of the European regions shows that all data fit in with a single lineage that shows a development a long a broad band in the (A' - C').

5-2-1 Evolutionary lineage in *Lepidocyclina (Nephrolepidina)* In Iraq.

The evolutionary trend in this study (Northeast Iraq) from Oligocene-Miocene carbonate sequence based on biometric investigations of the megalospheric individuals of *Nephrolepidina* assemblages from several sections (Kirkuk well-19; Bai-Hassan well-4; Khabaz well-3 and Qarah Chauq Dagh) in which several morphometric species are recognized on combination of (A'_i)and (C') values, in addition, the third factor (α) is used which shows a clear decreasing from the lower part to upper part of the sections (Tables 1, 2, 3, 4 and Fig. 64).

In the scatter diagrams of (C') versus (A'_i) values for Iraqian *Lepidocyclina (Nephrolepidina)* assemblage (Fig.64), in which Europian and African assemblages are entered, shows that all data fit in with a single lineage that shows a development along a broad band in the (A' - C') relation, the fairly wide variation along this road causes quite a few ex. interc. determinations as mentioned in (paragraph 3-4), which is advisable in the species designation of the De Mulder's classification. It is also clear that the associations of the lineage fit to one end the same, general trend of increase in the diameters of both embryonic chambers (Tables, 1, 2, 3, 4 and 16).

The evolutionary and morphometric delimitation of the species with corresponding age are plotted in Fig. (65) and pointed out in below:

Formation	Stage	Species	C'	A'_i	α'
Azkand	Aquitanian	*L .tournoueri*	$C'>5.25$	$A'_i>45$	$\alpha'<189.5$
		L.ex.interc.morgani-tournoueri	$5<C'<5.5$	$44<A'_i<46$	$189.5<\alpha<1925$
Azkand / Baba	Chattian	*L.morgani*	$3<C'<5.25$	$40<A'_i<45$	$192.5<\alpha<199$
		L.ex.interc.praemarginata-morgani	$2<C'<4$	$39<A'_i<41$	$199<\alpha<208$
		L.praemarginata	$1<C'>3$	$30<A_i<40$	$208<\alpha'$

Table (16): Distribution of *Lepidocyclina (Nephrolepidina)* species of the studied area, based on the mean values of (C, A_i and α)

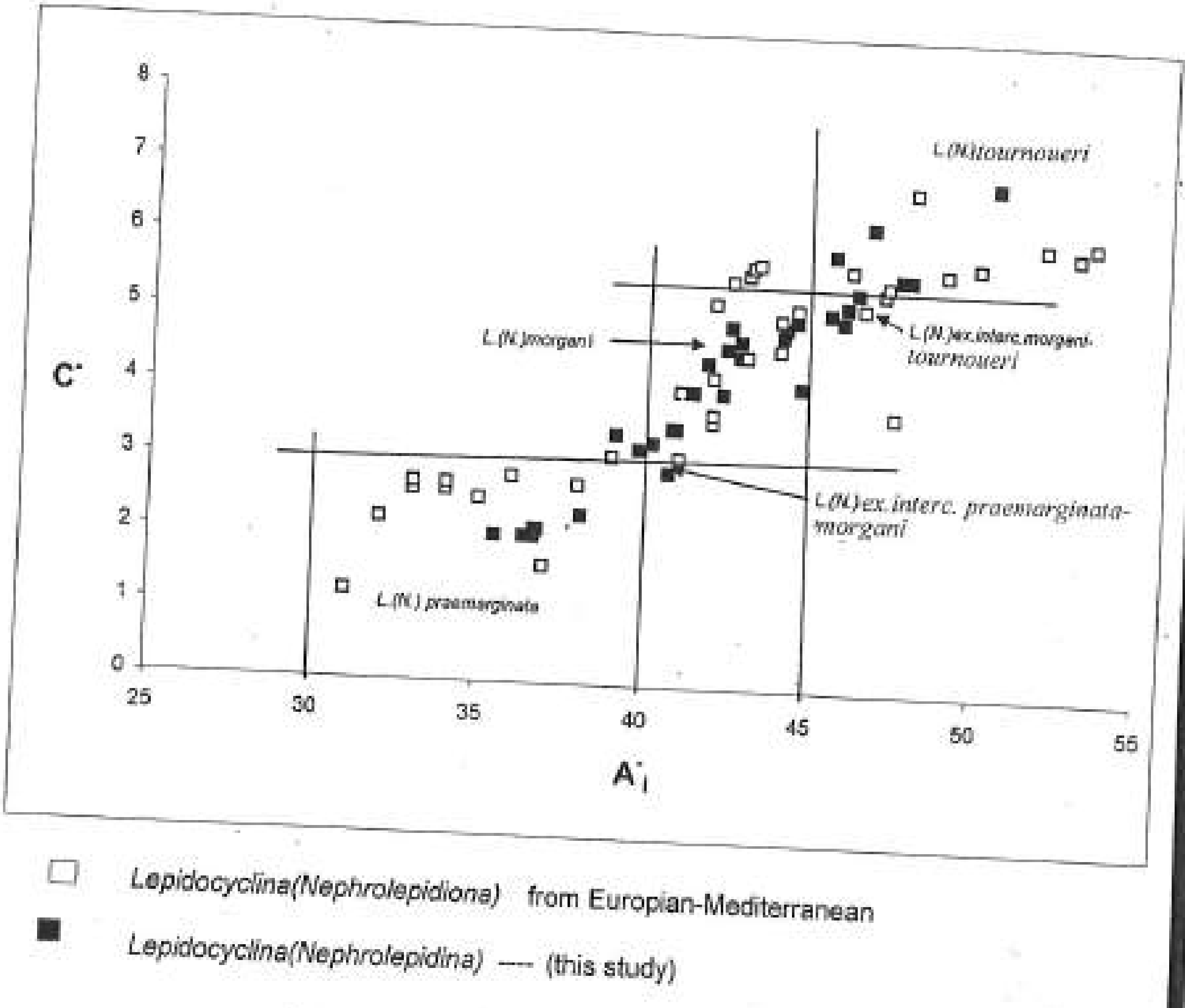


Fig.(64):Scatter diagram of C- versus A_i values for Iraqi *Lepidocyclina(Neph.* assemblageswith Europian-Mediterranean *Lepidocyclina* Mediterranean *Lepidocyclina* ,
(Litreture data from Drooger and Rohling, 1987 and Drooger,1993)

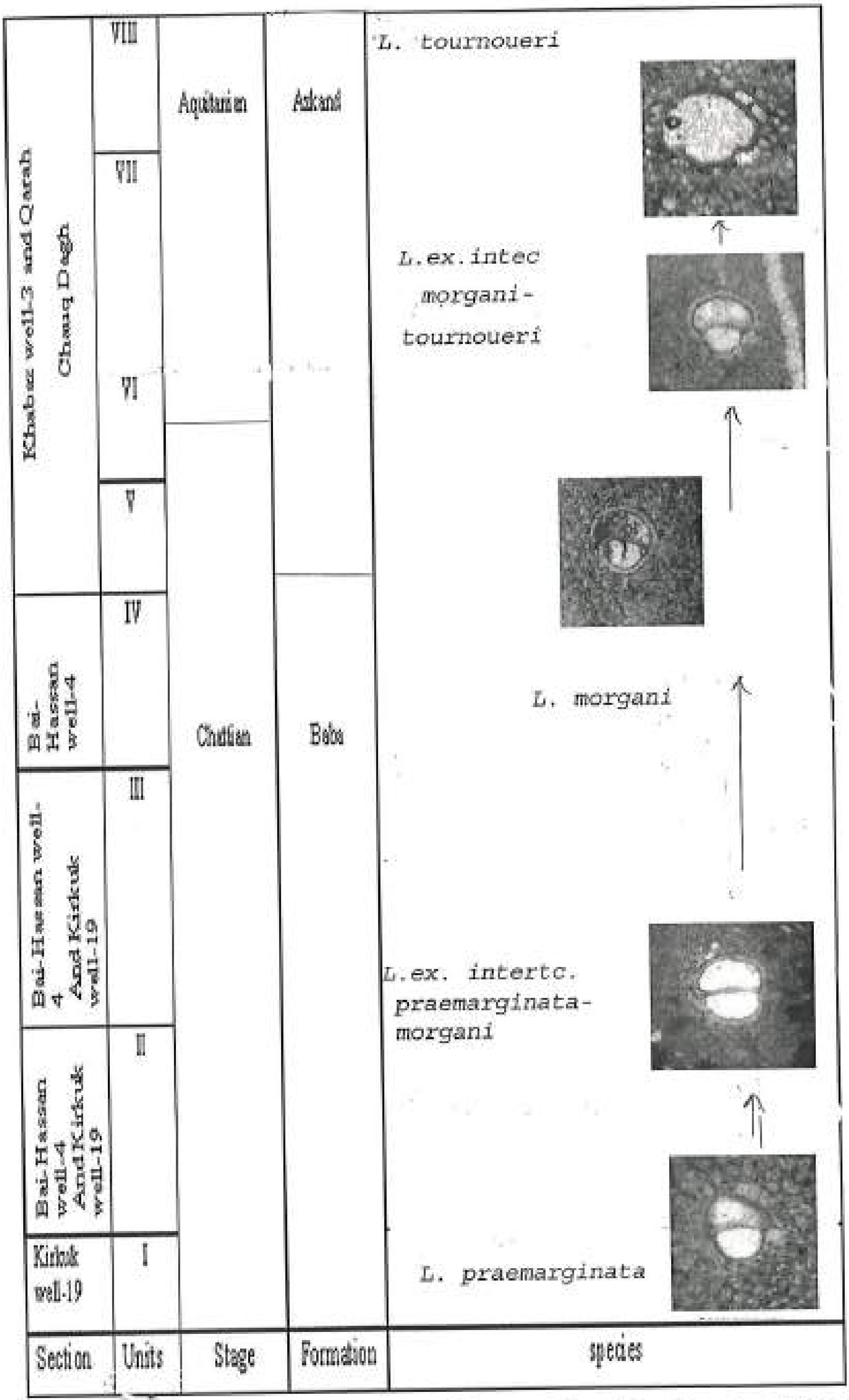


Fig.(65): Evolution of *Lepidocyclina (Nephrolepidina)* of the Units (I, II, III, IV, V, VI, VII and VIII) from the sections Kirkuk well-19; Bai-Hassan well-4; Khabaz well-3 and Qarah Chauq Dagh

The succession of these species corresponds to the lineage in the Europe –Mediterranean area which started at some level in the phylogenitic middle part of the Oligocene continued upwards into the early Miocene.

The lineage shows progressive complication in preimbryonic chambers , ranges from Chattian, Aquitanian within that time an increasing is recorded in number of accessory auxiliary chambers on the deuteroconch (factor C) and in grade of embracement of the proptoconch by the deuteroconch (factor A), in contrast, decreasing is recorded in (Factor α).

Butterlin, (1987) follows the suggestion of Bronnimann (1940) normally the Europioan-Mideterranean *praemarginata-morgani –tournoueri* lineage the endemic evolutionary continuation of the *L. muretanica/pustulosa*, but we think this lineage in Iraq and surrounded areas originated independently from primitive *Nephrolepidina* represented by *L(N.) praemarginata* and the *L.morgani* which distinguished from Morocco، is a variation of the praemarginata because of having the same (factor C) while the factor (A_i) is lesser than as in *praemarginata*.

5-2 The deviation from the general development pattern in *Miogypsina*.

As has been shown in paragraph (4-4) two groups of *Miogypsinoides* specimens, both close to *M. bantamensis* are found to a company *M.gunteri*-tani in the Aquitanian carbonates of the Azkand Formation in Khabaz well-3 and Qarah Chauq Dagh sections. The two biometric units, *Miogypsinoides* I, and II, differ primarily in embryonic size and show relatively minor morphometric differences in nepionic configuration. The mean protoconch diameter of *Miogypsinoides* I varies from about (100-120μm), whereas *Miogypsinoides* II is marked by a mean diameter of the protoconch of about (210-220μm). The chronostratigraphic range *of Miogypsinoides* I continues into the Late Aquitanian, where it associates the successive species *Miogypsina gunteri,Miogypsina* tani. The Late

Aquitanian *Miogypsinoides* I displays small shift in its nepionc variables with respect to its early Aquitanian ancestor; (X) decreases from about (13 to 14) in the early Aquitanian to about (11 to 12) in the Late Aquitanian . A part from this shift that occurs close to the chronostratigraphical boundary, neither *Miogypsinoides* I nor *Miogypsinoides* II shows a significant net change in their nepionic variables. In both nepionic and embryonic characteristics *Miogypsinoides* I is very close to primitive *Miogypsina gunteri*, *Miogypsinoides* II display distinct morphological overlap with the other older *Miogypsinoides complanata* and with the *Miogypsinoides formosensis* . So far, the simultaneous existence of the type of *Miogypsinoides* in the Aquitanian is not known in the literature. Three hypotheses will be offered to explain the co-occurrences, first of all some remarks will be made on the habitats of both types on the basis of our own observations, the *Miogypsinoides bantamensis* probably preferred a hard substrate and some what shallower depth relative to *Miogypsina s.s.* as discussed in paragraph (2-4) Unit (VIII) for both Aquitanian *Miogypsinoides* the whole rock thin sections gave no reliable indication on the paleoenvironment, especially because of the low frequencies in this interval. The biometric data on *Miogypsinoides* I, and II give possibly a clue to the relative position of the habitats of both units (VII and VIII) (Paragraph 4-4, Figs. 39 and 40).

In the successive samples of the Units (V and VI) in both sections, the frequency of type II, relative to type I is the largest in the upper part of this unit which has been thought to represent the deeper facies of this interval, Thus, *Miogypsinoides* II seems to prefer shallower habitats with respect to *Miogypsinoides* I and also with respect to *Miogypsina* s.s. In contrast the low frequency distributions of *Miogypsinoides* II will be shown and clear in the units (VII and VIII) as compared to *Miogypsinoides* I which shows highly distribution.

According to (Wildenborg, 1991) the Chattian and early Aquitanian shows an excellent analogue of the differentiation in the *Miogypsinoides* and *Miogypsina s.s* ., as in the studied area early *Miogypsinoides* possibly split into two branches one with lateral chamber complexes *(Miogypsina s.s.)* and the other preserving the massive side walls of *Miogypsinoides* . Simultaneously, the *Miogypsina s.s.* branch underwent a reduction of the mean embryon size with respect to *Miogypsinoides* II, rather later still showing distinct increase of embryonic size with respect to the supposedly ancestral *Miogypsinoides complanata* and *Miogypsinoides formosensis* . This splitting into two branches could well represent the adaption to specific habitats deeper than those of *Miogypsinoides* II. There is close resemblance between the embryons and nepionics of *Miogypsinoides* I the most primitive *Miogypsina s.s. (Miogypsina gunteri)* . This brings us to explain the existence of *Miogypsinoides* I in the regions of the studied sections. Both taxa with small embryons would belong to one monophylogenitic group. Taking into account the probable difference in preference for the type of substrate, and may assume a case of different adaptive evolution, *Miogypsinoides* I would have adapted to hard substrate of some what greater depth, and this corresponds to the hypothesis proved by (Wildenborg,1991). The (D'_1-X') and (D'_1-V') scatter diagrams in Figures (66 and 67) illustrate that our associations of early *Miogypsinoides* and *Miogypsina s.s.* fit rather well within the range of the *Miogypsina* data from French, Italian and Sicily localities. They differ from the more southern occurrence in having in the whole larger mean protoconch sizes. However the Aquitanian , *Miogypsinoides* I is close to the *Miogypsinoides* associations from localities in Africa., viz Egypt (Souaya,1961); Morocco (Brönnimann,1940); Drooger,1954b.

In the preceding discussion, it has been presented to explain the presence of types of *Miogypsinoides* in addition to *Miogypsina s.s.* . in the studied sections of Aquitanian. A local region of all taxa would invoke a rather complicated evolutionary exceeds or series of events in a time interval close to the chattian-Aquitanian boundary , Unfortunately , our record for this period is far from complete.

As seen in Figs (66 and 67), we prefer the hypothesis of immigration of *Miogypsinoides* I from a southern subprovince. There are good agreements to defend the postulate that the studied section was split into a northern and southern sub province. The studied area that was part of the Africa realm with its specific evolution of *Miogypsina*. At some time during the early Aquitanian, *Miogypsinoides* I a typical form of the African sub province, migrated into the studied area.

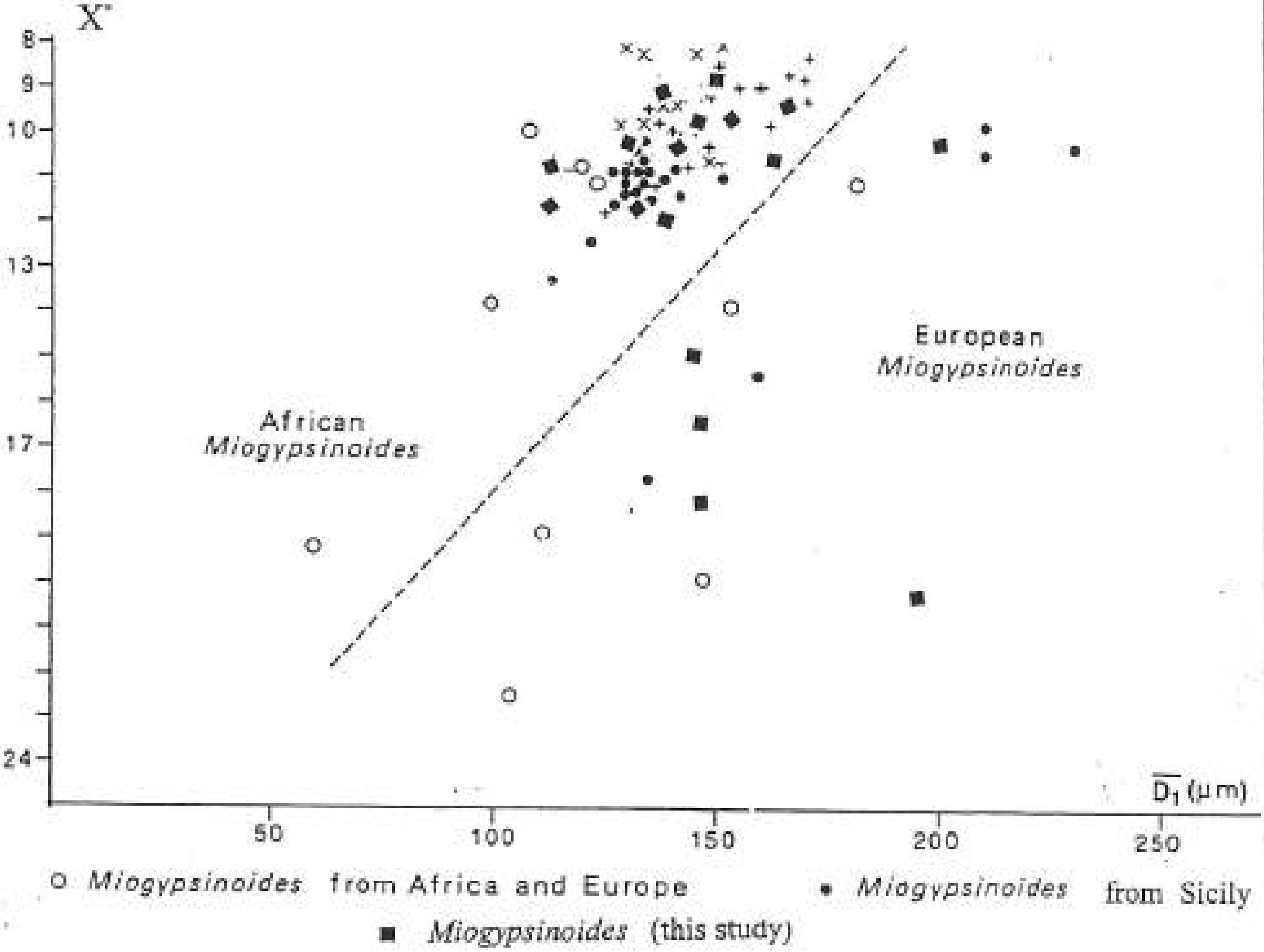


Figure (66): D'1-X' diagram of *Miogypsinoides* in the Khabaz well-3 and Qarah Dagh sections, Dashed lines separate European assemblages of *Miogypsinoides* from assemblages of African origin and assemblages of Sicily.(Literature data from Drooger & Raju, 1973; Brun & Wong, 1974; De Mulder, 1975 and Wildenborg, 1991)

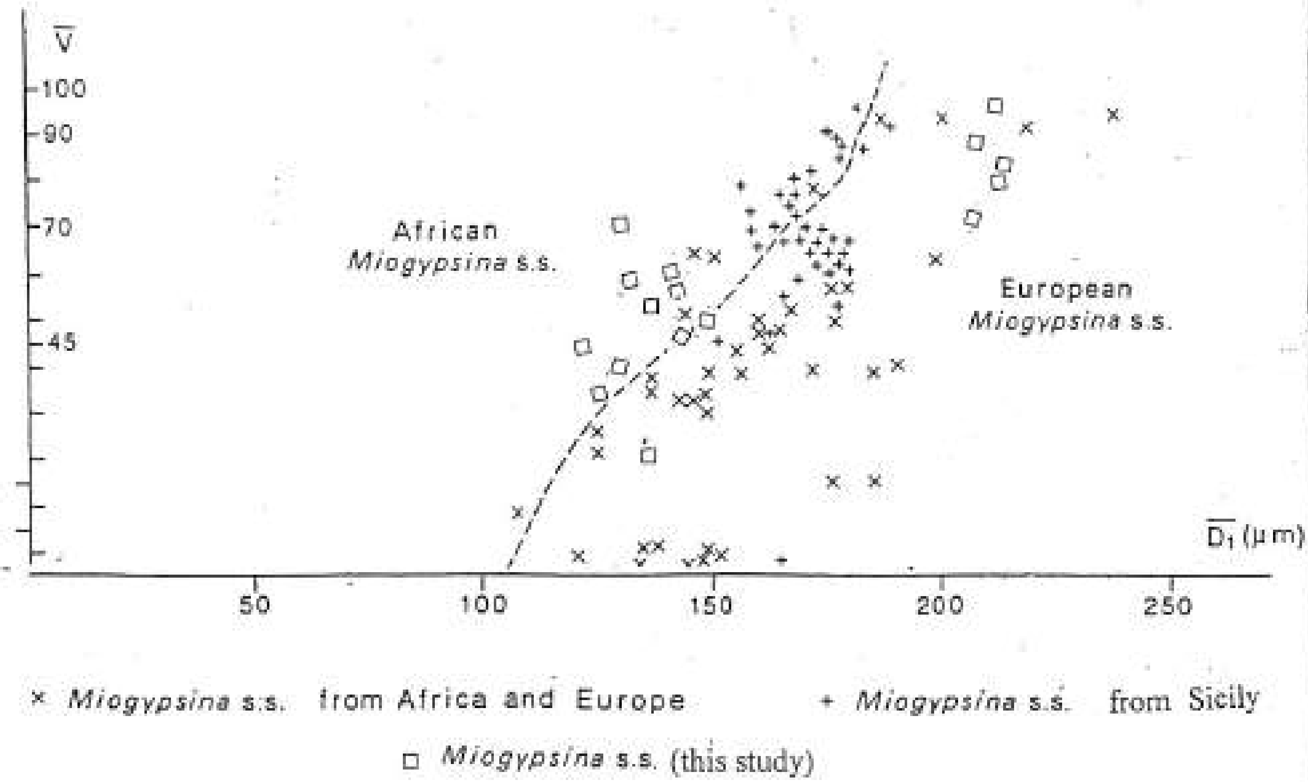


Figure 16.7 D'₁-V' diagram of *Miogypsna s.s.* in the Khabaz well-3 and Qarah Dagh sections, Dashed lines separate European assemblages of *Miogypsina s.s.* from assemblages of African origin and assemblages of Sicily.(Literature data from Drooger & Raju, 1973; Brun & Wong, 1974; De Mulder, 1975 and Wildenborg, 1991)

5-3-1 Evolution in *Miogypsinoides*

Tan Sin Hock, 1936a, 1937; Barler & Grimsdale, 1937; Drooger, 1963) agree that *Miogypsinoides* evolved from a Rotalia-like ancestor (*Pararotalia or Neorotalia*), because of certain similarities between the individuals of *M.complanata* and associated *Pararotalia*. Raju, (1974) recorded that the Indian material for small individuals of both *M.cf. bermudezi* and *M.complanata* show several morphological characteristics-ornamentation, trochospiral stage, umbilical plug-similar to those associated individuals of *Parararotalia*. These data leave little doubt that early *Miogypsinoides* evolved from a *Pararotalia* ancestor.

Drooger, (1984) discussed in detail the evolutionary patterns in Orbitoidal Foraminifera, in which he included Miogypsinidae with an available data and has attempted to explain evolutionary processes with reference to pulsating, this later term was used by Drooger and Raju, (1987), in explaining the succession of Miogypsinidae, in depending on the mean values of (X) in encompassing the species. In the preceding discussion and as discussed in table (9), it is clearly visible the gradual change in the mean values of (X) progressively from the lower part to upper part of the Azkand Formation in Khabaz well-3 and Qarah Chauq Dagh sections, in the lower most Units (V and VI) reflect individuals with large embryon size with mean values of (X) ranging between (19-13) which indicate to *Miogypsinoides complanata* and *Miogypsinoides formosensis* respectively. The occurrence of these species with other associated foraminifera includes *Lepidocyclina. morgani* which is an indication for Late Oligocene (Chattian) (Drooger and Ragu, 1987) in Unit (VII), consists two groups of *Miogypsinoides* individuals, the two biometric units, *Miogypsinoides* I and II, differ primarily in embryonic size, the mean protoconch diameter of *Miogypsinoides* I varies from about (110 to 120 μm) whereas *Miogypsinoides* II is marked by (210 to 230 μm) and their mean values of X varies between (13-10), both of species close to *Miogypsinoides* *bantamensis*, type II assemblages are classified as *M.ex. interc. bantamensis -dehaartii* and those of type I are named *M.ex.interc. formosensis-bantamensis*, co-occurring with *Miogypsina gunteri-tani*, the appereance of these species give indication to the Early Aquitanian. The *Miogypsinoides* types I range up into the unit (VIII) with mean values of (X) differ between (11-13) are mainly close to *Miogypsinoides bantamensis*. (Table 9, Fig, 68).

5-3-2 Evolution in *Miogypsina s.s.*

In this and many earlier investigation it is the variable (V') that has been used to describe the nepionic evolution of Aquitanian *Miogysina s.s.* and to identify the successive biometric species (Wildenborg, 1991). Fig.(69)

It has been suggested that the diameter of the protoconch may change in relation to water depth or some depth linked factor. According to theory (Drooger & Raju, 1973) protoconch diameter would increase toward greater depth. If, furthermore some correlation would exist between embryonic size and nepionic parameters, such ecological factors could indirectly have affected the values of (V) and (V'). An examination of the intra – and inters ample correlations between the embryonic and nepionic variables is needed to evaluate this constraint.

Our discussion is that the positive correlation between (V' and D_1) probably is not the result of functional relations between both statistics. If the mean size of the embryon was some how determined by a depth linked ecological factors, this effect probably was not reflected in parameter (V'). On the contrary the supposed shallowing during the deposit of unit (VI) would theoretically have caused a decrease in (D'_1) instead of the general increase that we found. We think that we can role out the effects of environment on the succession of (V ") values. This inclusion is in good

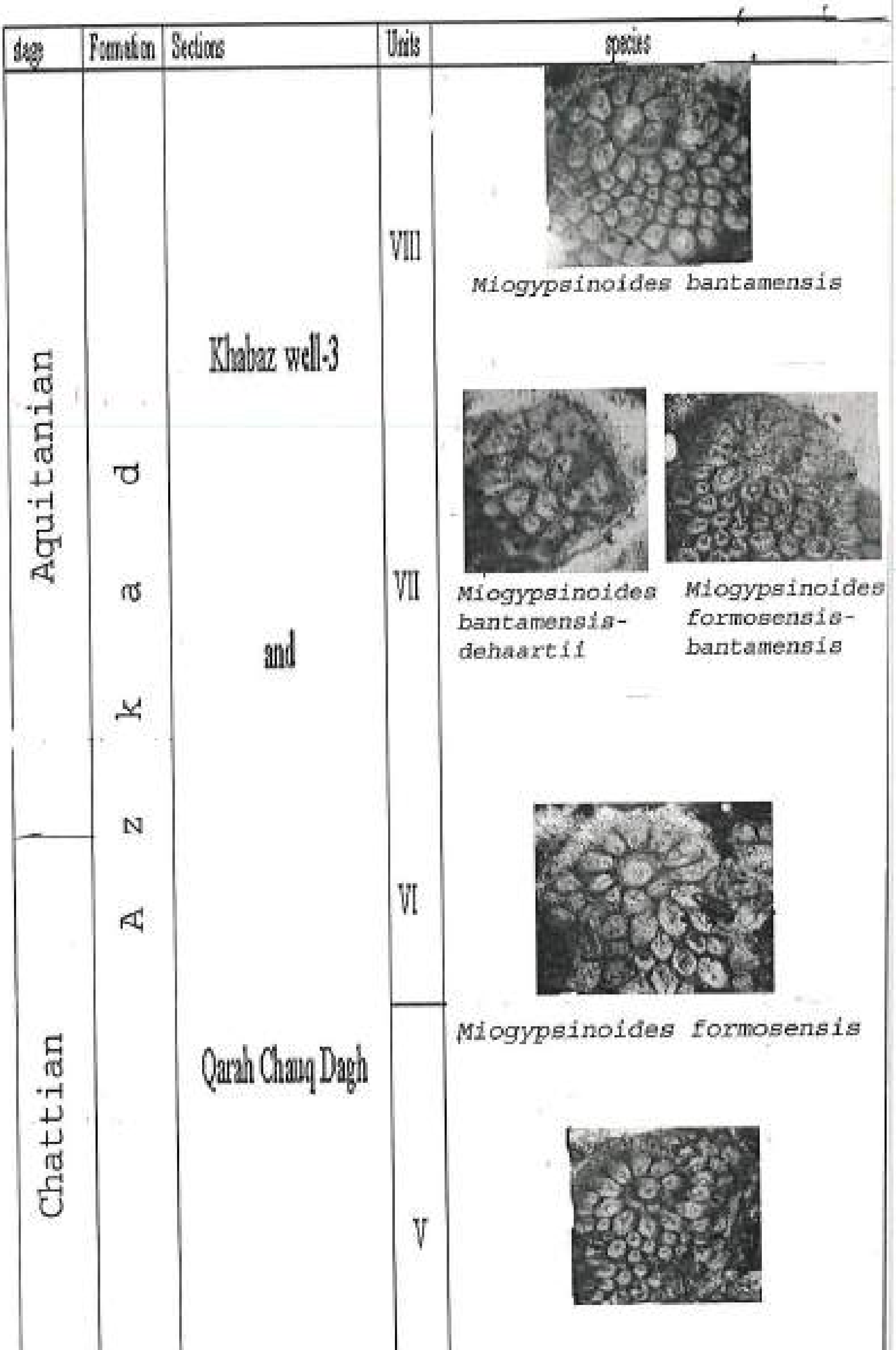


Fig. (68): Evolution of *Miogypsinoides* from the Units (V, VI, VII and VIII) of the sections Khabaz well-3 and Qarah Chauq Dagh.

harmony with the fact that intrasample ($V^{'}$ - $D^{'}_1$) correlations are hardly ever of statistical significance.

According to certain evolutionary theories, we need low frequency populations for rapid changes in morphology. As a check on such a possible relation we plotted the relative frequency of *Miogypsina s.s.* in the Fig.(69)

In Fig. (69) which shows two low frequency zones of *Miogypsina s.s.* have been entered the lowest ($V^{'}$) in Unit (VI) are found in the low frequency interval between level 3 and 4 and correspond to a negative change followed by a leap forward at the top. We can not exclude the possibilities that the reworking of older *Miogypsina s.s.* must be held responsible for the negative shift. Also (D_1) shows a set back have way this lower most zone of low relative numbers. With increasing frequencies of *Miogysina s.s.* across level 4 is shown a notable increase, decrease and weak increase again into the middle low frequency zone followed by a staggered increase across level (6) toward the top, of unit (VII). And the second low frequency interval is noted after level (6) toward the upper part of Unit (VII).

The early frequency of *Miogypsina s.s.* has been seen across between levels 1 and 2 in units (VI) of Azkand Formation in Khabaz well-3 and Qarah Chauq Dagh sections correspond to the primitive type of *Miogypsina* associations with old Chattian *Miogypsinoides complanata* and *Miogypsinoides formosensis* with mean (X) values of these species range between (9-12).

The other increasing infrequency of *Miogypsina s.s.* has been seen across the level (6), especially in the top of Unit (VII), which is characterized by the simultaneous occurrence of *Miogypsinoides* and *Miogypsina s.s.* in samples of Unit (VII) as mentioned in paragraph (4-4), and these species possess the mean values of X varies between (9-11). This frequency of *Miogypsina s.s.* are chosen to *Miogypsina gunteri-tani* according to (Drooger, 1963). (Fig. 70, Table 13).

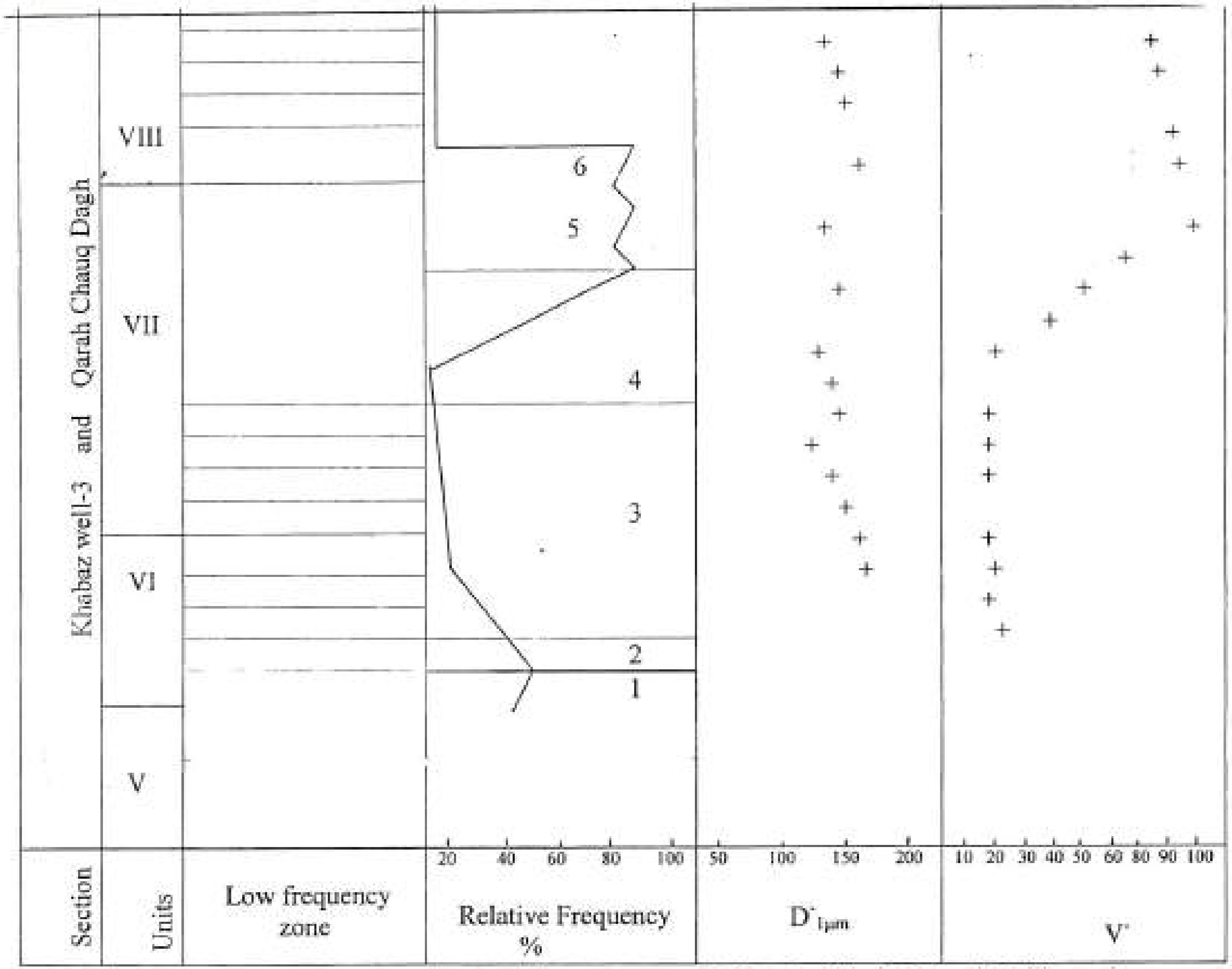


Fig.(69): Frequency of Miogypsina s.s. in Units (VI, VII and VII) and shifts in V' and D'1 illustrating the supposed relation between low frequency zones and evolutionary change The lines (1-6) change in faunal composition.

In summary, we may suggest that there was some link in the evolution of our Chattian, Aquitanian, *Miogysina* s.s., to episodes with low frequencies of this subgenus. Evolutionary changes seem to be of subordinate importance in the periods in between, when *Miogypsina* was relatively more frequent.

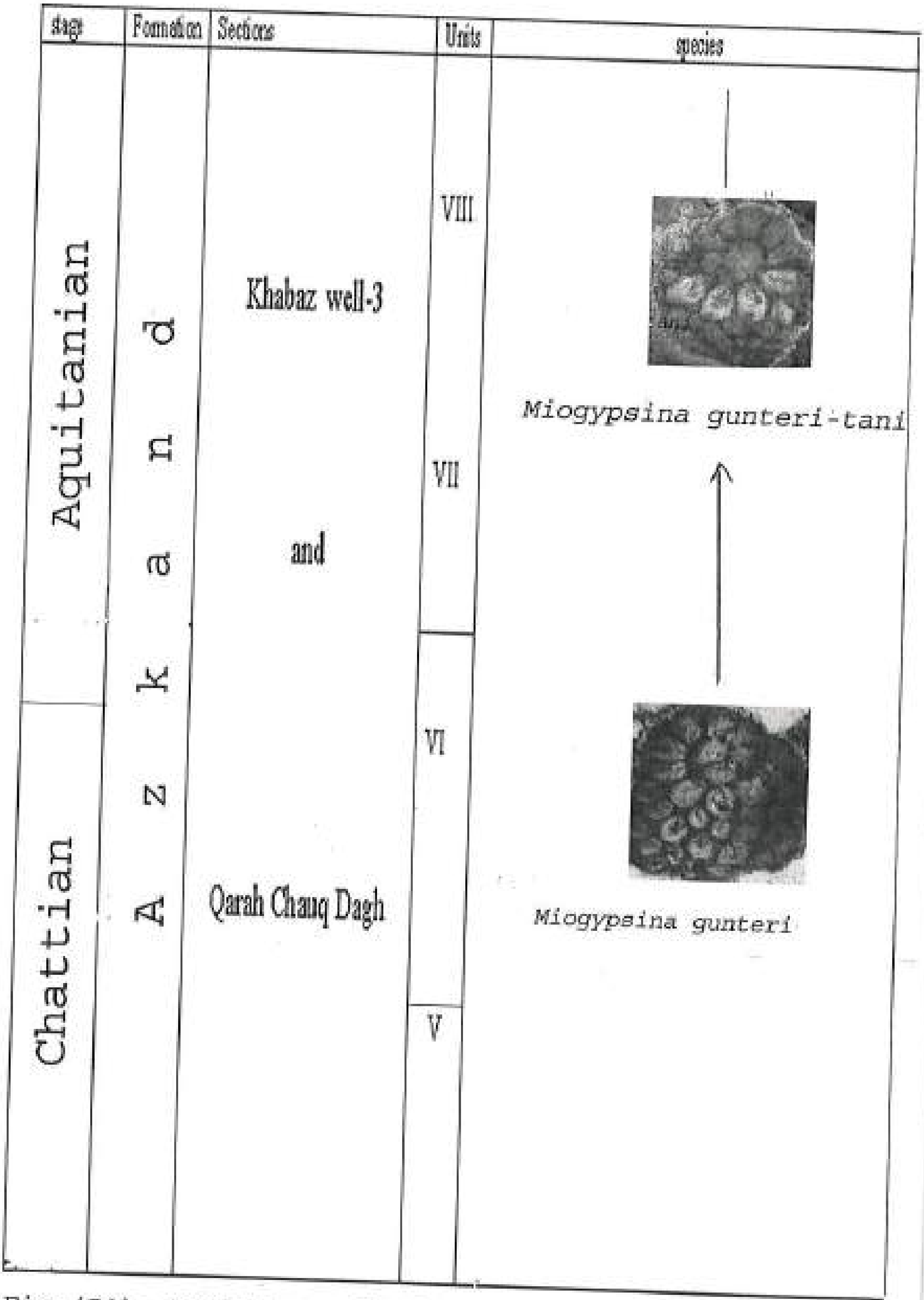


Fig.(70): Evolution of *Miogypsina s.s.* from the Units (VI, VII and VIII) of the sections Khabaz well-3 and Qarah Cjhauq Dagh.

Chapter Six

6-1 REMARKS ON TAXONOMY

6-1-1 Introduction

The taxonomical identification of the larger foraminifera is based on biometric criteria, the principles of which were defended by Drooger (1952). Additional taxonomical and morphological remarks will be presented below for the species of *Lepidocyclina* and *Miogypsina*.

6-1-2 FAMILY LEPIDOCYCLINIDAE

Family LEPIDOCYCLINIDAE Scheffen, 1932
Subfamily Lepidocyclininae, Scheffen, 1932
Genus ***Lepidocyclina*** Gümbel (1870)
Subgenus ***Nephrolepidina*** H. Douvillé 1911

Lepidocyclina (Nephrolepidina) praemarginata R. Douvillé
Pl.5, figs. (1-12), Pl.6, fig. 12

Lepidocyclina praemarginata R. Douvillé, 1908, Bull. Soc. Géol. France, ser. 4, vol. 8, p. 91, figs. 1, 2, 4

Lepidocyclina(Nephrolepidina) praemarginata R. Douvillé, Vervloet, 1966, Strat. Pal. Data Tert. Southern Piemount, p.59, fig. 5, pl. 12, figs. 1-4.

Nephrolepidina praetournoueri (H. Douvillé), Lange, 1968, Thesis Univ. München, Bamberger Fotodruck, p. 57, pl. 1, fig. 1.

L epidocyclina praemarginata R. Douvillé, 1908, Drooger and Rohling,1988, Akademic.Van.wet. vol.91,p.39-52.

Lepidocyclina praemarginata R. Douvillé,Drooger, 1993,Verhamd, Kon,Ned.Akad.Wetensch,Amsterdam et.p.1- 241.

Lepidocyclina praemarginata R. Douvillé , Saraswati,P.K., and Kumar, A ,1994

Lepidocyclina praemarginata R. Douvillé, 1908, Saraswati,P.K., and Kumar, A ,2000,Hindistan publishing Cor., New Delhi, N.3.

L.(N.)praemarginata is marked by values of (A_i) ranging about (35-40) , (C) about (1-3) and (α) more than 208.

Distinct *L.praemarginata* has been identified in the samples (1,3 and 11) in Unit (I) of the Kirkuk well-19 section and the samples (7,15 and 16) in Unit(VII) of the Bai-Hassan well-4 section.

Our assemblages resemblance with *L.(N.) praemarginata* from Europe and India.

Lepidocyclina (Nephrolepidina) morgani Lemoine and R. Douvillé
pl.7, figs. 1-2, Pl.8, figs. 1-3

Lepidocyclina morgani Lemoine & R. Douvillé, 1904, Mém. Soc. Géol. France, vol. 12, pt. 2, p.17, 18, pl. 2, fig. 4; pl. 3, fig.2.
Lepidocyclina(Nephrolepidina)morgani Lemoine & R. Douvillé, Drooger & Socin, 1959, Micropal., vol.5, pt. 4.
Lepidocyclina(Nephrolepidina)morgani Lemoine & R. Douvillé, Drooger & Freudenthal, 1964, Ecl. Geol.Helv.Vol. 57, pt. 2, p. 515.
Nephrolepidina morgani (Lemoine & R. Douvillé), Lange, 1968, Thesis Univ. München; Bamberger fotodruck, p. 63, pl. 1, fig. 2.
Lepidocyclina morgani Lemoine & R. Douvillé, 1904, Drooger and Rohling, 1988, Akademic.Van.wet.vol.91,p.39-52.
Lepidocyclina morgani Lemoine & R. Douvillé, 1904, Drooger, 1993,Verhand Kn , Ned Akad . W e t e n sc h ,Amsterdam et p.1- 241.
Lepidocyclina praemarginata R. Douvillé , Saraswati,P.K., and Kumar, A ,1994
Lepidocyclina praemarginata R. Douvillé, 1908, Saraswati,P.K., and Kumar, A ,2000,Hindistan publishing Cor. ,New Delhi, N.3.

Assemblages of the *L.(N.)morgani* characterized by the values of (A_i) and (C) ranging between (40-45 and 5-5.25) respectively, and (α) varies between (192.5-199).

Typical assemblages of this species have been found in the samples (18 and 20) in Unit (III) of the Kirkuk well-19 section, and samples (22 and 23) in Units (III and IV) of the Bai-Hassan well-4 section, (7,16 and 22) in Unit (VI) of the Khabazwell-3 section and samples (3,12,17,18 and 20) in Units (V,VI,and VII) of the Qarah Chauq Dagh section.

Our assemblages correspond to that specimens of *L.(N.).morgani* described from Europe and India..

Lepidocyclina (Nephrolepidina) tournoueri Lemoine and R. Douvillé
Pl.9, figs. 4-12

Lepidocyclina tournoueri Lemoine and R. Douvillé, 1904, Mém. Soc. Géol. Friance, vol. 12, pt. 2, p.19, pl. 1, fig. 5. p.
Lepidocyclina tournoueri Lemoine and R. Douvillé, Drooger & Socin, 1959, Micropal., vol. 5, pp. 415-426. Lepidocyclina (*Nephrolepidina) tournoueri* Lemoine and R. Douvillé, Drooger & Freudenthal, 1964, Ecl. Geol. Helv.,vol.57, pt. 2, p. 522.
Nephrolepidina tournoueri (Lemoine and R. Douvillé) Lange (pars), 1968, Thesis Univ. München,BambergerFotodruck,p.59,pl,1,figs.3.
.*Lepidocyclina tournoueri* Lemoine and R. Douvillé,1904,Drooger and Rohling,1988,Akademic.Van.wet.vol.91,p.39-52.
Nephrolepidina tournoueri (Lemoine and R. Douvillé), 1904, schivinotto,F.,1992, Bull. Della, Soci. Paleos. Italian, Vol.31(2), p. 189-206,.
*Lepidocyclinatournoueri*LemoineandR.Douvillé,1904,Drooger,1993,VerhandKon,Ned.Akad.Wetensch,Amsterdam et p.1- 241.
Lepidocyclina praemarginata R. Douvillé , Saraswati,P.K., and Kumar, A ,1994
Lepidocyclina praemarginata R. Douvillé, 1908, Saraswati,P.K., and Kumar, A ,2000,Hindistan publishing Co r ., New Delhi, N.3.

Population of *L(N.).tournoueri* in our assemblages have a value of (A_0) more than 45 , (C) values more than 5.25, and (α) values less than 189.5, this species has been identified in the samples (37,42, 49 and 50) in Units (VII and VIII) of the Khabaz well-3 section and the sample (26) in unit (VIII) of the Qarah Chauq Dagh section. Assemblages of *L.(N.) tournoueri* resembles with the species distinguished from Europe and India.

6-1- 3 <u>Family MIOGYPSINIDAE</u>

Family MIOGYPSNIDAE, Vaughan,1928
Genus ***Miogypsina*** Sacco, 1893
Subgenus ***Miogypsinoides*** Yabe & Hanzawa

Miogypsina (Miogypsinoides) complanata Schlumberger
Pl.10, figs.1-8, Pl.11, figs. 1-8

Miogypsina complanata Schlumberger, 1900, p. 330, pl. 2, figs. 13-16; pl. 3, figs. 18-21

Miogypsina (Miogypsinoides) complanata Schlumberger, Drogger, 1954a, pp. 230-232, only the assemblages from his locality 1: Villa Giuseppina

Miogypsina complanata Schlumberger,Wildenborg,1991, P.111. pl. 2, figs .,pl.3, figs.12, tab. 5 4,II.

Miogypsina complanata Schlumberger, 1900,Raju,D.S.N. 1991,Geosc.Jou.vol.XII,No.1,pp.53-65.

Miogypsina complanata Schlumberger, 1900,Drooger, 1993, verhamed, Kon.Ned.akad.Wetensch.ameteddam,p.1-241

Assemblages of this species are characterized by X˙ values larger than 17 (Drooger, 1963; Raju, 1974;Wildenborg, 1991).

The trochoid character of the primary spiral is well recognizable in the specimens of the Khabaz well-3 and Qarah chugh Dagh assemblages in unit (V), in samples (7 and 16) and (3 and 6) respectively. Y˙, the mean number of spiral chambers with only one stolon, has the relatively high value of 9.5. as to the mean embryon size, The Khabaz well-3 and Qarah chauq Dagh association is well comparable to those of the nominate species from Iran; north Italian ,French and Sicily localities .

Miogypsina (Miogypsinoides) formosensis Yabe & Hanzawa
Pl.12, figs. 1-8, Pl.13, figs. 1-2

Miogypsina(Miogypsinoides) debaartii Van der Vlerk var. formosensis Yabe & Hanzawa, 1928, p. 534, figs. 1a-b.

Miogypsina(Miogypsinoides) formosensis Yabe & Hanzawa, De Bock, 1976, p. 15

Miogypsina(Miogypsinoides) formosensis Yabe & Hanzawa, Wildborg,1991, P.111, pl.2, fig.10, pl.3, fig. 13, tabs.

Miogypsina(Miogypsinoides) debaartii Van der Vlerk var. formosensis Yabe & Hanzawa, 1928, Ragu,D.S.N. 1991,Geosc.Jou.vol.XII,No.1,pp.53-65

Miogypsina(Miogypsinoides) debaartii Van der Vlerk var. formosensis Yabe & Hanzawa, 1928, Drooger, 1993, verhamed, Kon.Ned.akad.Wetensch.ameteddam,p.1-241.

The assemblages of this species have X˙ values between 17 and 13 (Drooger, 1963; Raju, 1974; Wildenborg,1991).

In the Khabaz 3 and Qarah chug Dagh assemblages in units (V, and VI) in the samples (6 and 12)(23,25) and (12,17) respectiovely mean number of spiral chambers with only one stolon (Y') is 6. Considering the mean embryon size, this association shows some resemblance with *M. formosensis* reported from North Italian, Iran, French and Silicily localities

Miogypsina(Miogypsinoides) bantamensis (Tan Sin Hok)
Pl. 12, figs. 3-6

Miogypsinoides complanata forma bantamensis Tan Sin Hok, 1936, pp. 48-50, pl. 1, fig. 13.

Miogypsina(Miogypsinopides)complanata Schlumberger, Drooger, 1954a, pp.230-232,only assemblages from his locality 2.

Miogypsina (Miogypsinoides) complanata Schlumberger mauretanica Bronnimann, Souaya, 1961,pp.672-676, pl.1, figs. 1-10, pl. 2, figs. 1-13.

Miogypsina (Miogypsinoides) bantamensis Tan Sin Hok, De Bock, 1976, p. 15, pl. 1-4, pl. 5, fig. 1, pl. 6-14 , 33, 41

Miogypsina (Miogypsinoides) bantamensis Tan Sin Hok, Wildenborg,1991, p.111,pl.2, figs. 5-7, pls. figs.1-11, tab. 4, 14, 11, IV.

Miogypsina(Miogypsinoides)bantamensis,TanSinHok,Raju,D.S.N.1991,Geosc.Jou.vol.XII,No.1, pp.53-65.

*Miogypsina(Miogypsinoides)bantamensis*TanSinHok,Drooger,1993,verhamed,Kon.Ned.akad.Wetensch. Amsteddam,p.1-241

Populations of *Miogypsinoides* with values of X' between 13 and 10 are determined as *M. bantamensis* (Drooger, 1963; Raju,1974;Wildenborg,1991).

On the basis of embryon size, two groups of assemblages of *Miogypsinoides* close to *M. bantamensis* can be recognized in Units (VII). The Khabaz well-3 and Qarah Chauq Dagh assemblages that are marked by specimens with a relatively large embryon (type II), are infact intermediates between *M.bantamensis and M.dehaartii*. The mean protoconch diameter in type II assemblage from (210-220 μm). Y', the mean number of chambers in the primary spiral with only one stolon, is about(2.5) in our samples. Type II assemblages are well comparable to the associations of *Miogypsinoides* of European origin.

The associatiations of *Miogypsinoides* that are marked by a relatively small embryon (type I), have a mean protoconch diameter of about (110-120 μm). The associatios in Units (VII) are intermediate between *M.. formosensis* and *M.bantamensis*. Their mean number of spiral chambers with one stolon (Y¯) is about (5) and D^{-}_{1} varies between 125 and 150 μm. Type I shows a distinct resemblance with African (Egypt) and Sicily assemblages.

Subgenus ***Miogypsina*** Sacco

Miogypsina (Miogypsina) gunteri Cole

Pl. 14, figs. 1, 5-6, Pl.15, figs. 1, 3-6, Pl. 16, figs. 1, 3-6

Miogypsina gunteri Cole, 1938, p. 42, pl. 6, figs. 10-12, 14; pl. 8, figs. 1-9.

Miogypsina (Miogypsina) gunteri Cole, Drooger, 1954a, pp. 232-233, pl. 2, figs. 25-27; De Bock, 1976, p. 17, pl. 5, fig. 2.

Miogypsina (Miogypsina) gunteri Cole, Wildenborg, 1991, p.112, pl.2, fig. 8, pl.4, figs. 6-9,tab 19,1

M iogypsina gunteri Cole, Raju,D.S.N. 1991,Geosc.Jou.vol.XII,No.1,pp.53-65.

Populations of *Miogypsina* with lateral chambers and values of X¯ between 12.5 and 9 are *named* *M. gunteri*(Drooger, 1952, Wildenborg, 1991).

Typical assemblages of this species have been encountered in the lower Unit (VI) of the Khabaz well-3 Section, and in the lower part of unit (VII) of both sections, populations of *Miogypsina s.s.* are intermediate between *M. gunteri* and *M. tani*. Part of the specimen in the assemblages *M. gunteri* have a second principal auxiliary chamber. The morphology of the sidewalls in of *Miogypsina s.s.* may range in one rock sample from partly massive with only a few lateral chambers to a fully developed of lateral chambers.

6-2 Conclusions

1- The Oligocene carbonate of the Baba Formation and the correspond overlying Miocene carbonate of the Azkand Formation were subdivided into the following eight units from bottom to the top:

Baba Formation

Unit I: Fine to very coarse bioclastic larger foraminiferal packstone grading to grainstone.

Unit II: Fine to very coarse bioclastic larger foraminiferal packstone

Unit III: Fine bioclastic smaller Foraminiferidal packstones .

Unit IV: Fine bioclastic smaller foraminiferal wackstones to dolostones.

Azkand Formation

Unit V: Fine bioclastic smaller Foraminiferal packstone.

Unit VI: Fine to very coarse bioclastic larger Foraminiferal packstone

Unit VII: Very fine to coarse bioclastic larger foraminifedral packstones to grainstone

Unit VIII : Fine to coarse bioclastics packstone to boundstone.

2- The Oligocene –Miocene carbonate are deposited in open shallow marine environment.

3- Many morphometric series of *Lepidocyclina (Nephrolepidina)* were distinguished for the first time from Iraq by using biometric analysis of *Lepidocyclina (Nephrolepidina)* individuals, based on the mean values of (C, A_i and α) as following :-

Species	$A^{'}_{i}$	$C^{'}$	$\alpha^{'}$
L .tournoueri	$A^{'}_{i} > 45$	$C^{-} > 5.25$	$\alpha^{'} < 189.5$
L. ex.interc.morgani-tournoueri	$44 < A^{'}_{i} < 46$	$5 < C^{'} < 5.5$	$189.5 < \alpha^{'} < 192.5$
L.morgani	$40, A^{'}i < 45$	$3 < C^{'} < 5.25$	$192.5 < \alpha^{'} < 199$
L.ex.interc. praemarginata-morgani	$39 < A^{'}i < 41$	$2 < C^{'} < 4$	$199 < \alpha^{'} < 208$
L.praemarginata	$35 < A^{'}i < 40$	$1 < C^{'} < 3$	$208 < \alpha^{'}$

4- It is clear that the principle of nepionic acceleration as defined by Tan Sin Hok is applicable by analyses of carbonate sample means. On the basis of the mean embryon size two types of assemblages could be distinguished in the Early Aquitanian sediments. Type I with the smaller embryon and type II with the larger embryon.

5- Biometric analyses on *Miogypsina* reveals that the oldest species of *Miogypsinoides* represented by *Miogypsinoides complanata* and *Miogypsinoides formosensis* accompanied by the association *Miogypsina gunteri* that are present in the lower part of the Azkand Formation of Late Oligocene age (Chattian).

6- The Early Miocene association of *Miogypsina s.s.* represented by *Miogypsina-gunteri-tani* are often accompanied by *Miogypsinoides* . Most of these are close to *Miogypsinoides bantamensis.*

7- The evolutionary trend in *Lepidocyclina(Nephrolepidina)* shows progressive complication in preimbryonic chamber represented by an increasing in factor (C^{-} and A'_{i}) and decreasing in (α) factor in grading from Chattian (Baba Formation) upward into Early Aquitanian (Azkand Formation).

8- The evolutionary trend in *Miogypsina* based on the gradual change in the mean values of (X). The early frequency of *Miogypsina gunteri* with mean values (X= 9-12) recorded from the lower part of the Azkand Formation in both sections associated with old Chattian *Miogypsinoides complanata* and *Miogypsinoides formosensis* with their mean values of (X) between (10-13), but the *Miogypsina gunteri-tani* with their (X^{-}) values about (9-11) has occurred in the upper part of Azkand Formation (Early Aquitanian), simultaneously with *Miogypsinoides bantamensis* with their mean values of (X) about (13-10).

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Plate -1-

Figure (1): Coarse Foraminiferal packstone, Unit (V), Sample (7), Khabaz well-3 section, Azkand Formation. (15X)

Figure (2): Fine bioclastic smaller Foraminiferal packstone, Unit (II), Sample (14), Kirkuk Well-19 section, Baba Formation. (15X)

Plate -1-

1

2

Plate -2-

Figure (1): Smaller Foraminiferal packstone, Unit (VIII), Sample (26), Qarah Chauq Dagh section, Azkand Formation. (15X)

Figure (2):Coarse grainstone into packstone with *Amphistegina* and *Lepidocyclina (Nephrolepidina)*, Unit (VII) Sample (18), Qarah Chauq Dagh section, Azkand Formation, (15X).

Plate -2-

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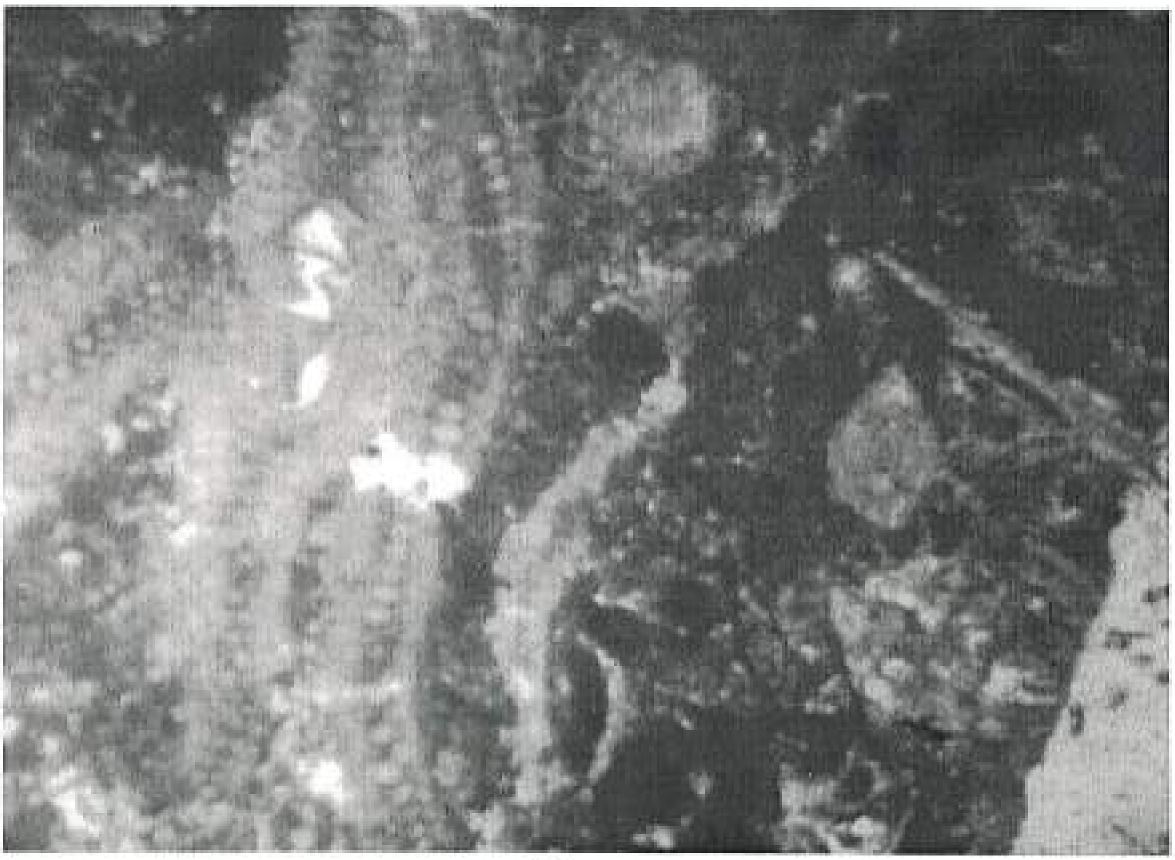

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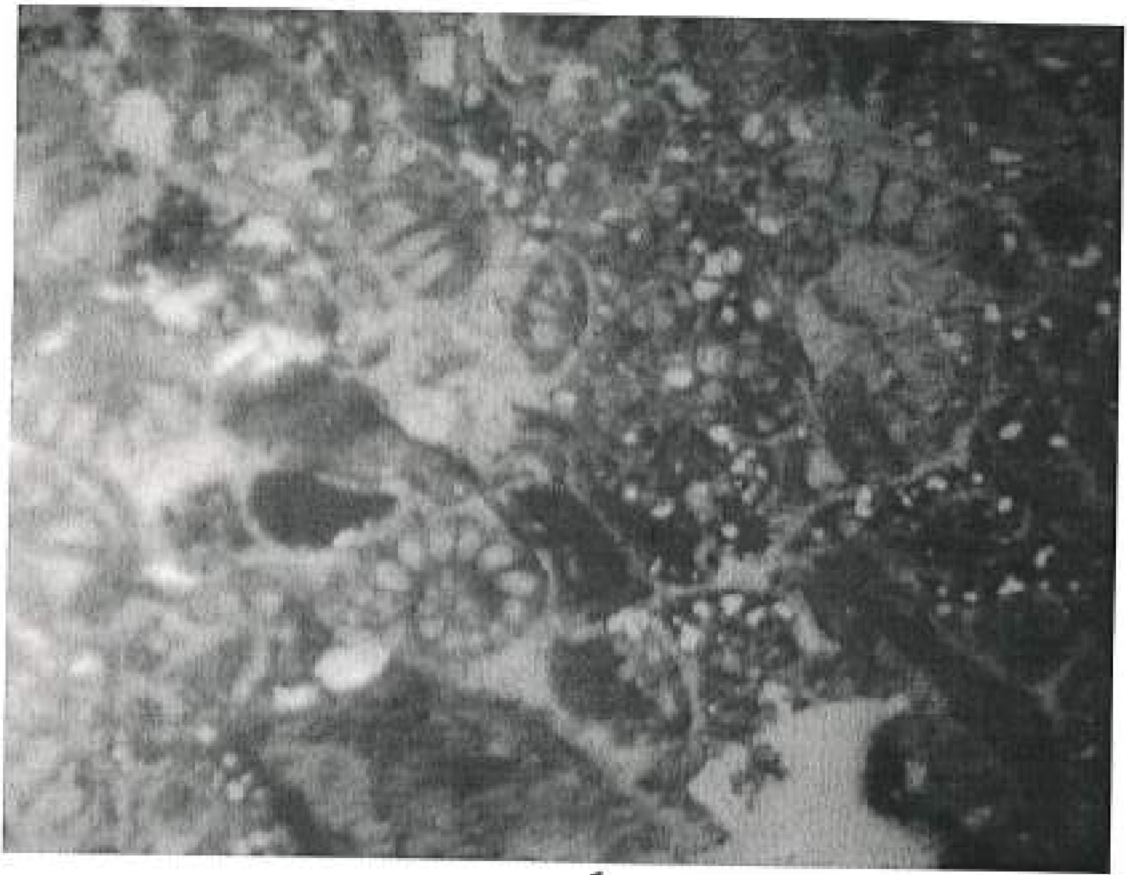
Plate -3-

Figure (1):- Foraminiferal packstone, Unit (III), Sample (20), Bai-Hassan well-4 section, Baba Formation. (15X)

Figure (2):Foraminiferal wackstone to dolostone, Unit (IV), Sample (23), Bai-Hassanwell-4 section , Baba Formation. (15X)

Plate -3-



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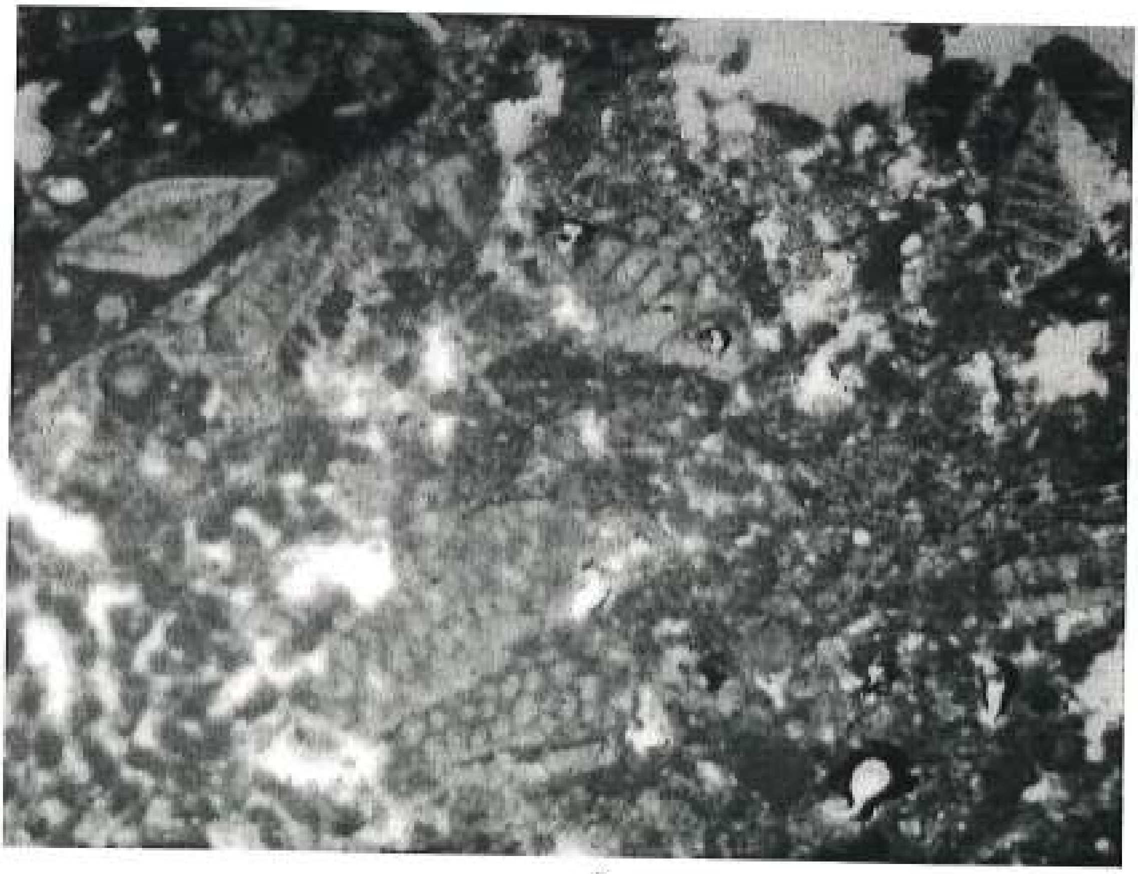

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Plate -4-

Figure (1): Foraminiferal bioclastic packstone, Unit (I), Sample (3), Kirkuk well-19 section, Baba Formation. (15X)

Figure (2):- Foraminiferal packstone to grainstone, Unit (VI), Sample (22), Khabaz well-3 section, Azkand Formation. (15X)

Plate -4-

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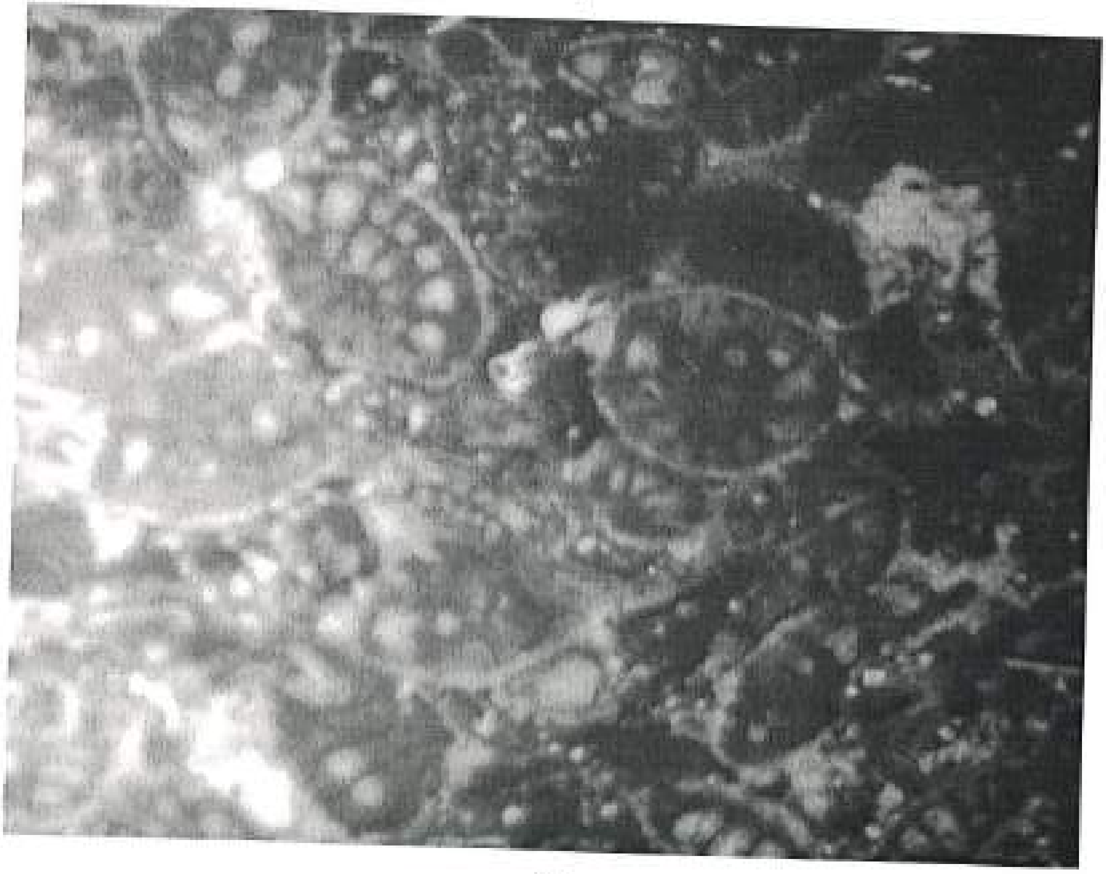

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Plate -5-

Figure (1):- *Lepidocyclina (Nephrolepidina) praemarginata*, Unit (I),sample(1), Kirkuk well-19 section, Baba Formation , (40X)

Figure (2):- *Lepidocyclina (Nephrolepidina) praemarginata*, Unit (I), sample (3), Kirkuk well-19 section, Baba Formation , (45X)

Figures (3-4):- *Lepidocyclina (Nephrolepidina) praemarginata*, Unit (I), samples (11), Kirkuk well-19 section, Baba Formation, (40X).

Figure (5):-*Lepidocyclina (Nephrolepidina)praemarginata*,Unit(I),sample(11) Kirkuk well-19 section, Baba Formation, (40X).

Figure (6):-):- *Lepidocyclina (Nephrolepidina) praemarginata*,Unit (I), sample (3), Kirkuk well-19 section, Baba Formation, (40X).

Figure (7):- *Lepidocyclina (Nephrolepidina) praemarginata*,Unit (II), sample(7) Bai-Hassan well-4 section, Baba Formation.(40X)

Figure (8):- *Lepidocyclina (Nephrolepidina) praemarginata*,Unit (II), sample(7) Bai-Hassan well-4 section, Baba Formation.(35X)

Figures (9-10):*Lepidocyclina (Nephrolepidina)praemarginata*,Unit(II),sample (15),Bai-Hassan well-4 section, Baba Formation.(35X)

Figure (11):- *Lepidocyclina (Nephrolepidina) praemarginata*,Unit (II),sample(16) Bai-Hassan well-4 section, Baba Formation.(40X)

Figure (12):- *Lepidocyclina (Nephrolepidina) praemarginata*,Unit (II),sample(16) Bai-Hassan well-4 section, Baba Formation.

Plate -5-

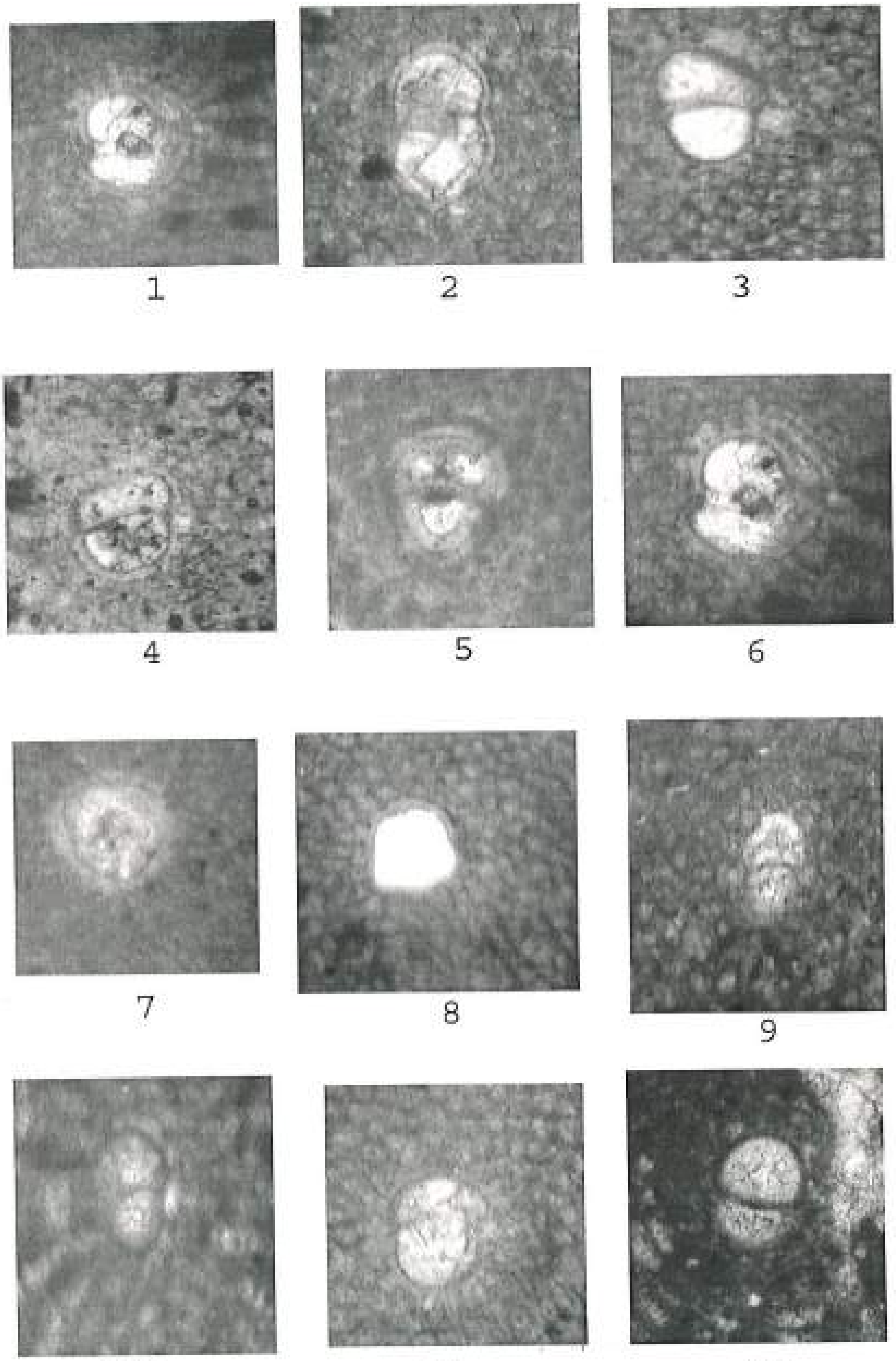

Plate -6-

Figure (1):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani* Unit (II),sample (14),Kirkuk well-19 section, Baba Formation.(35X).

Figure (2):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (14) Kirkuk well-19 section, Baba Formation.(40X)

Figure (3):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit(II),sample(16) Kirkuk well19 section, Baba Formation.(40X)

Figure (4):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit(II),sample(16) Kirkuk well-19 section, Baba Formation.(35X)

Figure (5):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (18), Bai-Hassan well-4 section, Baba Formation.(35X)

Figure (6):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (18), Bai-Hassan well-4 section, Baba Formation.(40X)

Figure (7):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (19), Bai-Hassan well-4 section, Baba Formation.(40X)

Figure (8):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (19), Bai-Hassan well-4 section, Baba Formation.(40X)

Figure (9):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* Unit (II),sample (19), Bai-Hassan well-4 section,BabaFormation.(40X)

Figure (10):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani,* ,Unit (II),sample(16)Bai-Hassan well-4 section, Baba Formation,(30X).

Figure (11):- *Lepidocyclina (Nephrolepidina)ex. interc praemarginata-morgani* Unit (II),sample(19), Bai-Hassan well-4 section, Baba Formation.(35X)

Figure (12):- *Lepidocyclina (Nephrolepidina) praemarginata,* Unit (I),sample (1), Kirkuk well-19 section, Baba Formation.(35X)

Plate -6-

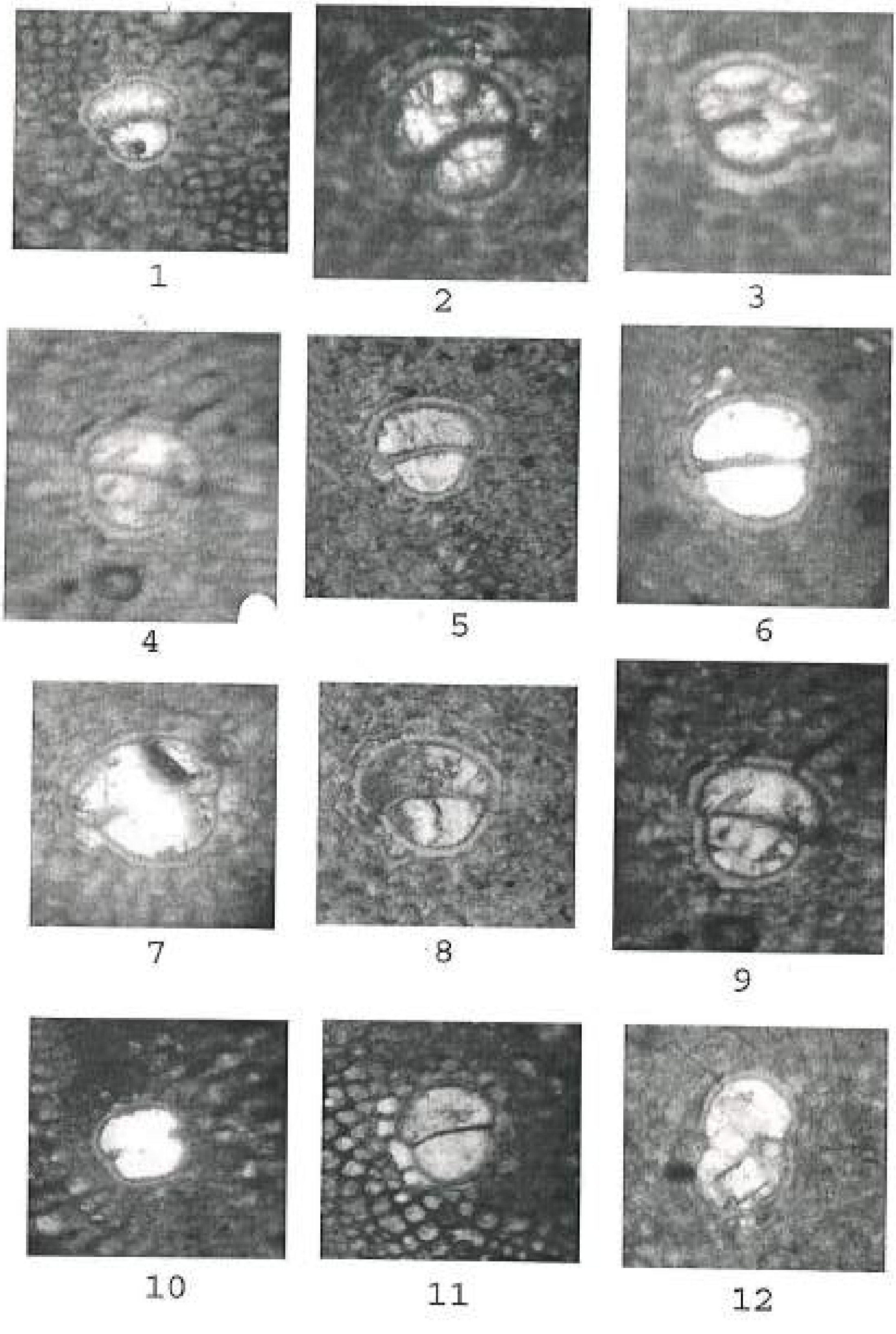

Plate -7-

Figure (1):- *Lepidocyclina (Nephrolepidina) morgani* Units (III),sample (18), Kirkuk well-19 section, Baba Formation.(30X)

Figure (2):- *Lepidocyclina (Nephrolepidina) morgani* Units (III),sample (20), Kirkuk well-19 section, Baba Formation.(30X)

Figure (3):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (III), sample (18), Kirkuk well-19, section, Baba Formation, (35X).

Figure (4):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (III), sample (20), Kirkuk well-19, section, Baba Formation, (30X).

Figure (5):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (II), sample (22), Bai-Hassan well-19, section, Baba Formation, (30X).

Figure (6):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (II), sample (22), Bai-Hassan well-19, section, Baba Formation, (35X).

Figure (7):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (IV), sample (23), Bai-Hassan well-19, section, Baba Formation, (30X).

Figure (8):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (V), sample (7), Khabaz well-3, section, Azkand Formation, (30X).

Figure (9):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (VI), sample (16), Khabaz well-3, section, Azkand Formation, (40X).

Figure (10):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (V), sample (3), Qarah Chauq Dagh, section, Azkand Formation, (30X).

Figure (11):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (VI), sample (12), Qarah Chauq Dagh, section, Azkand Formation, (X30).

Figure (12):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (VII), sample (18), Qarah Chauq Dagh, section,

Plate -7-

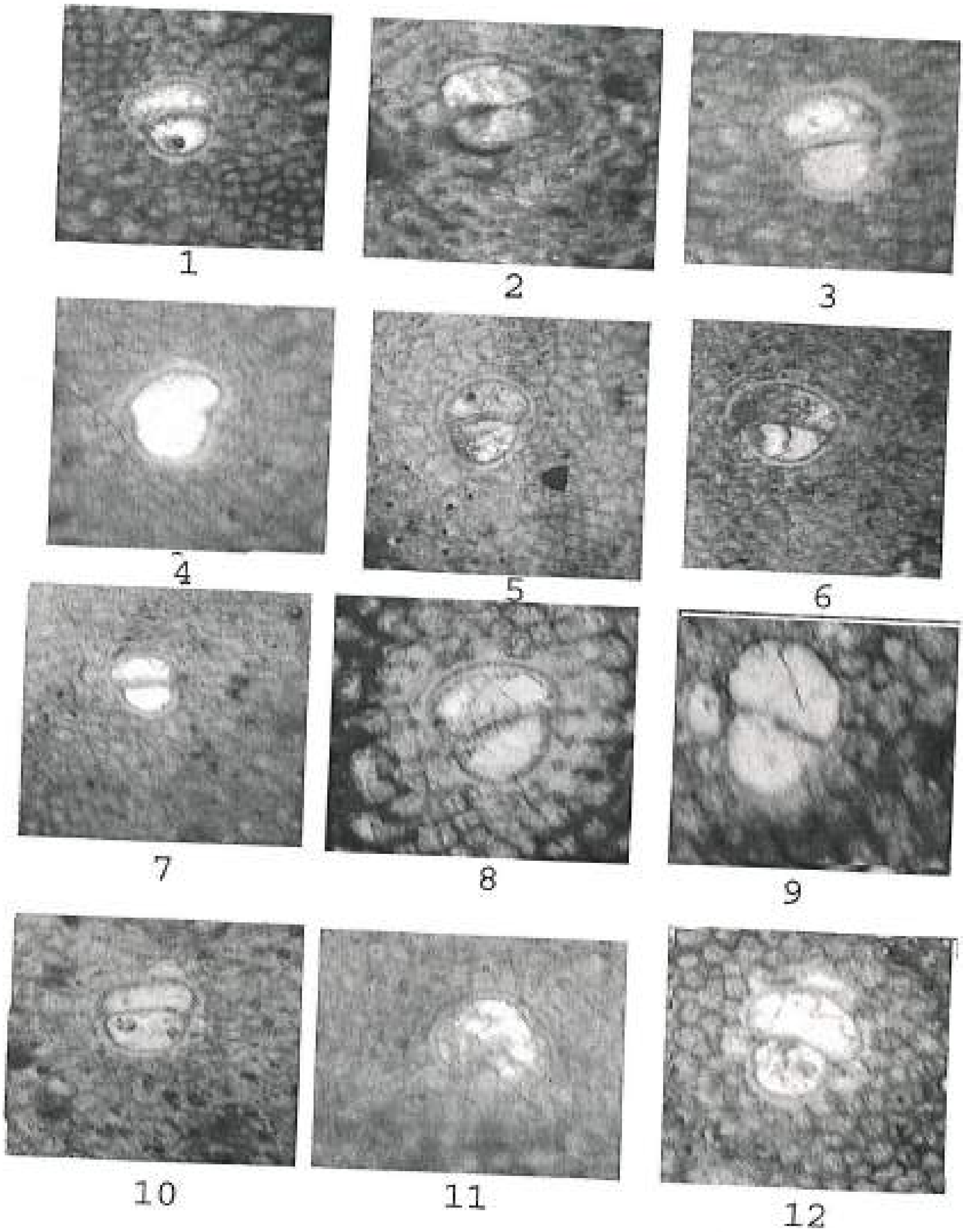

Plate -8-

Figures (1):-*Lepidocyclina (Nephrolepidina) morgani*, Unit (VIi), sample (18), Qarah Chauq Dagh section, Azkand Formation,(30X).

Figure (2):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (VII), sample (20), Qarah Chauq Dagh section, Azkand Formation,(30X).

Figure (3):- *Lepidocyclina (Nephrolepidina) morgani*, Unit (VI), sample (22), Khabaz well-3 section, Azkand Formation,(35X).

Figure (4):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VI), sample (28),Khabaz well 3 section, Azkand Formation, (X40).

Figure (5):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VI), sample (31),Khabaz well 3 section, Azkand Formation, (X30).

Figure (6):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (32),Khabaz well 3 section, Azkand Formation, (35X).

Figure (7):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (35),Khabaz well 3 section, Azkand Formation, (30X).

Figure (8):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (36),Khabaz well 3 section, Azkand Formation,(35X).

Figure (9):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (35),Khabaz well 3 section, Azkand Formation,

Figure (10):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (21),Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (11):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (21),Qarah Chauq Dagh section, Azkand Formation, (30X)

Plate -8-

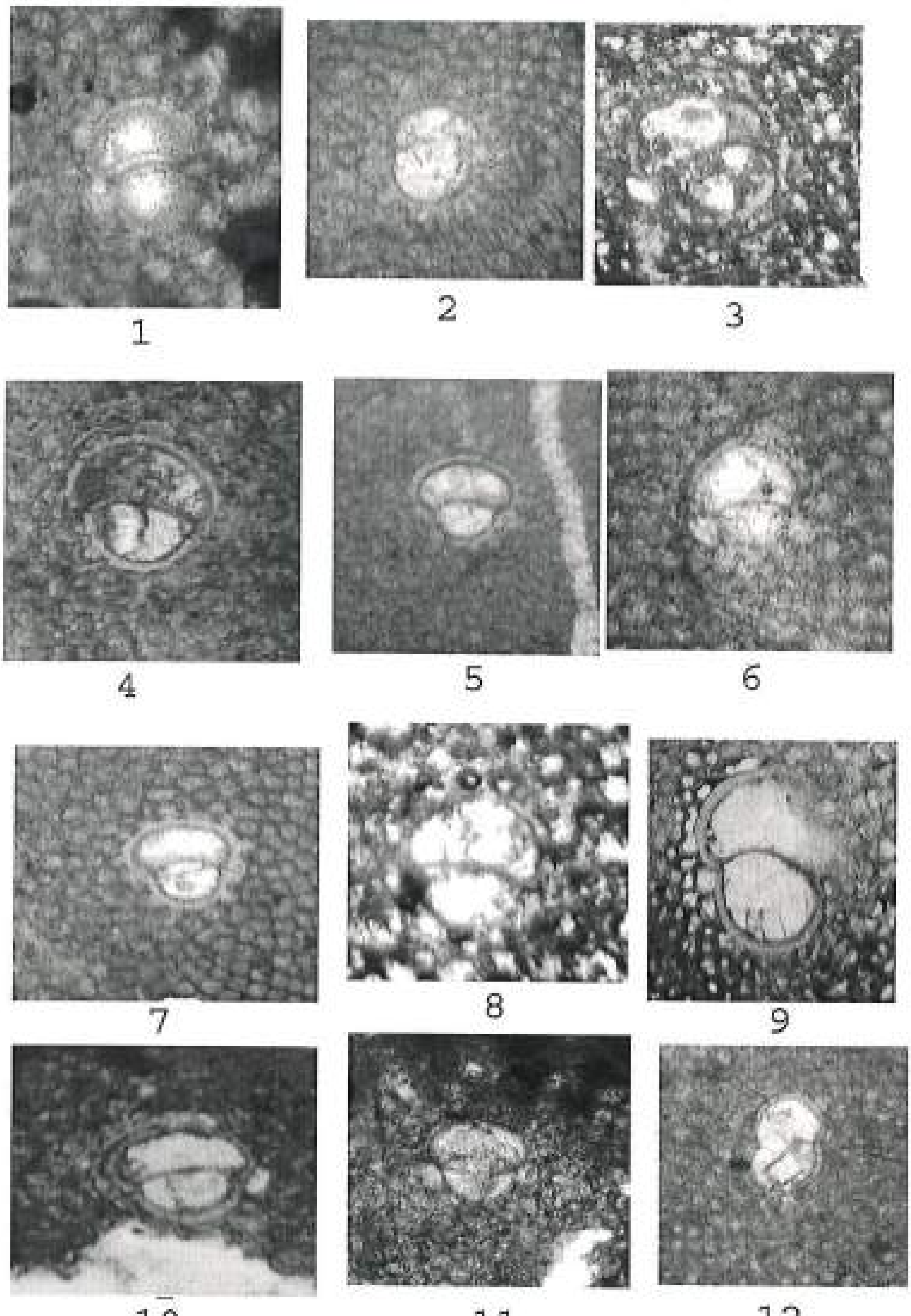

Plate -9-

Figure (1):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (21),Qarah Chauq Dagh section, Azkand Formation, (30X).

Figure (2):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (36),Khabaz well-3 section, Azkand Formation(40X).

Figure (3):- *Lepidocyclina (Nephrolepidina)ex. interc.morgani- tournoueri*, Unit (VII), sample (35), Khabaz well-3 section, Azkand Formation, (40X).

Figure (4):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VII), sample (37), Khabaz well-3 section, Azkand Formation, (40X).

Figure (5):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VII), sample (42), Khabaz well-3 section, Azkand Formation, (35X).

Figure (6):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VIII), sample (49) Khabaz well-3 section, Azkand Formation, (45X).

Figure (7):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VIII), sample (50) Khabaz well-3 section, Azkand Formation, (40X).

Figure (8):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VII), sample (37) Khabaz well-3 section, Azkand Formation, (40X).

Figure (9):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VII), sample (42) Khabaz well-3 section, Azkand Formation, (40X).

Figure (10):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VIII), sample (26) Qarah Chauq Dagh section, Azkand Formation, (45X).

Figure (11):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VIII), sample (26) Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (12):- *Lepidocyclina (Nephrolepidina) tournoueri*, Unit (VIII), sample (26) Qarah Chauq Dagh section, Azkand Formation, (35X).

Plate -9-


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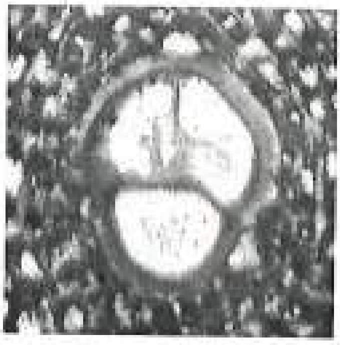
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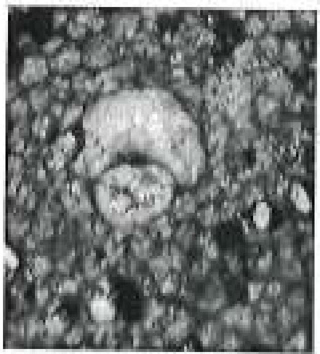
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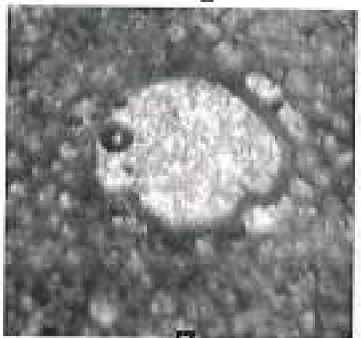
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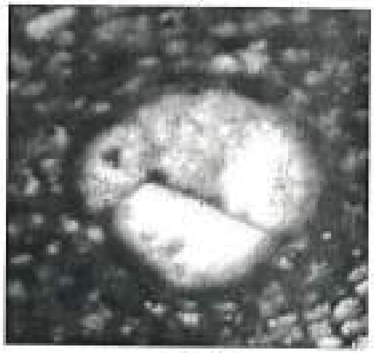
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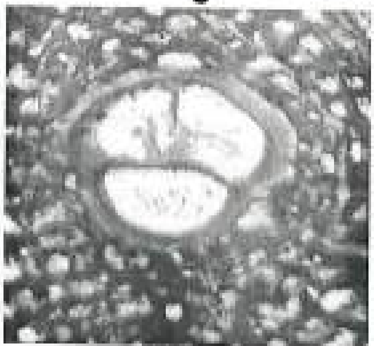
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Plate -10-

Figure (1):- *Miogypsinoides complanata*, Unit (V), sample (7) Khabaz well-3 Section, Azkand Formation, (40X).

Figure (2):- *Miogypsinoides complanata*, Unit (V), sample (7) Khabaz well-3 Section, Azkand Formation, (40X).

Figure (3):- *Miogypsinoides complanata*, Unit (VI), sample (16) Khabaz well-3 Section, Azkand Formation, (40X).

Figure (4):- *Miogypsinoides complanata*, Unit (VI), sample (16) Khabaz well-3 Section, Azkand Formation, (40X).

Figure (5):- *Miogypsinoides complanata*, Unit (V), sample (3) Qarah Chauq Dagh section, Azkand Formation, (45X).

Figure (6):- *Miogypsinoides complanata*, Unit (V), sample (3) Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (7):- *Miogypsinoides complanata*, Unit (V), sample (6) Qarah Chauq Dagh section, Azkand Formation, (45X)

Figure (8):- *Miogypsinoides complanata*, Unit (V), sample (6) Qarah Chauq Dagh section, Azkand Formation, (45X)

Plate -10-

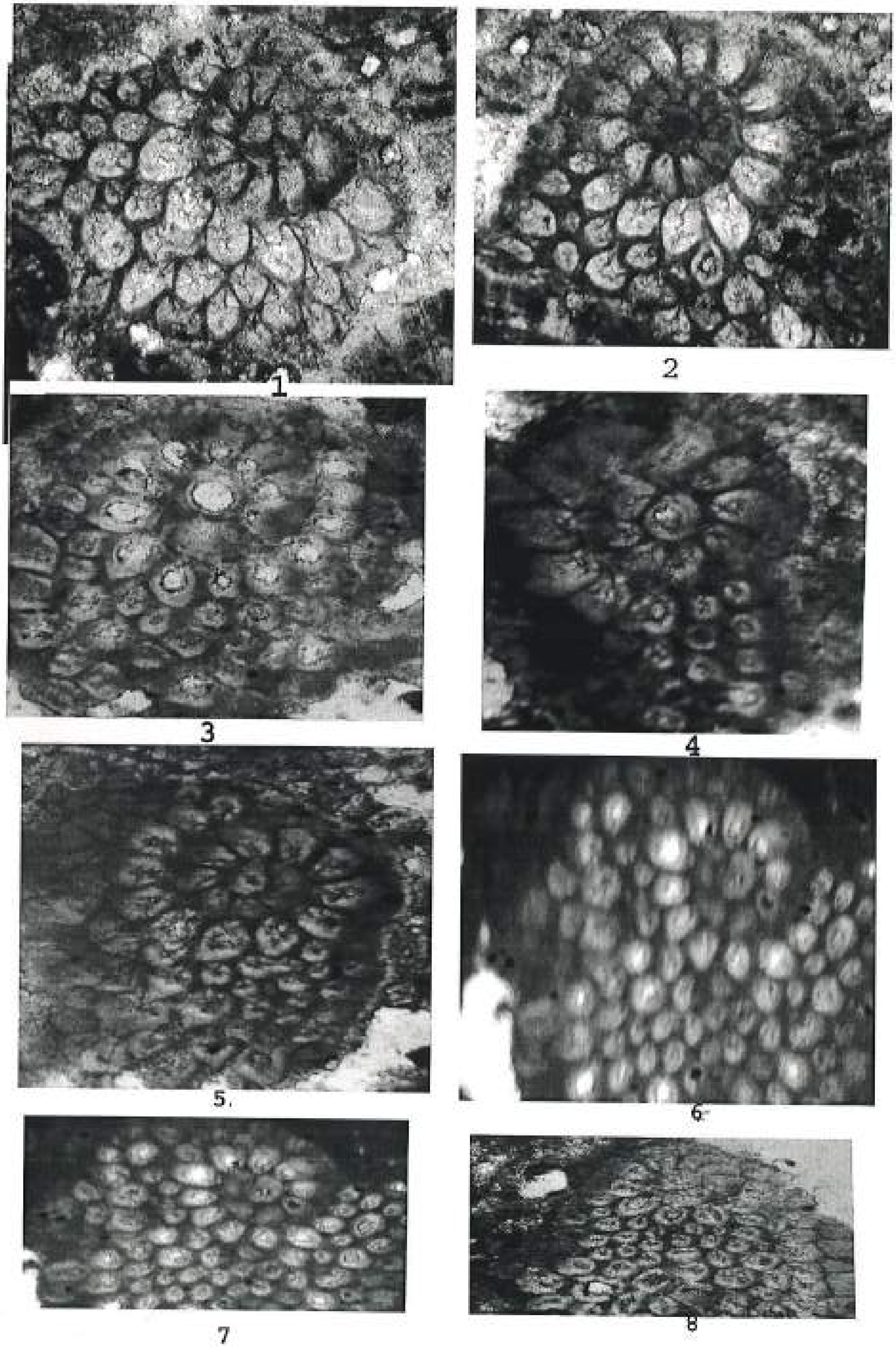


Plate -11-

Figure (1):- *Miogypsinoides complanata*, Unit (V), sample (7) Khabaz well-3 section, Azkand Formation, (40X)

Figure (2):- *Miogypsinoides complanata*, Unit (V), sample (7) Khabaz well-3 section, Azkand Formation, (40X)

Figure (3):- *Miogypsinoides complanata*, Unit (V I), sample (16) Khabaz well-3 section, Azkand Formation, (40X)

Figure (4):- *Miogypsinoides complanata*, Unit (VI), sample (16) Khabaz well-3 section, Azkand Formation, (40X)

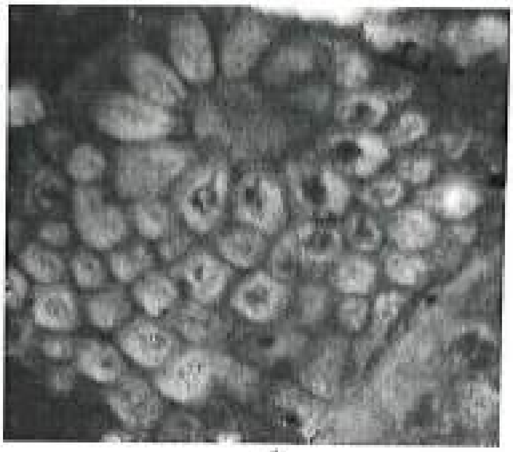
Figure (5):- *Miogypsinoides complanata*, Unit (V), sample (3) Qarah Chauq Dagh section, Azkand Formation, (35X)

Figure (6):- *Miogypsinoides complanata*, Unit (VIII), sample (6) Qarah Chauq Dagh section, Azkand Formation, (35X)

Figure (7):- *Miogypsinoides complanata*, Unit (V), sample (6) Qarah Chauq Dagh section, Azkand Formation, (40X)

Figure (8):- *Miogypsinoides complanata*, Unit (V), sample (.6) Qarah Chauq Dagh section, Azkand Formation, (40X)

Plate -11-



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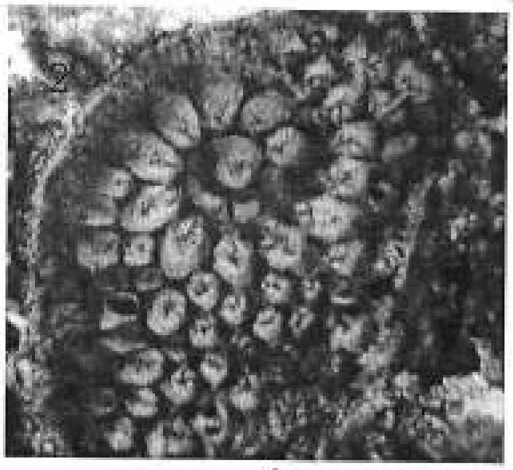

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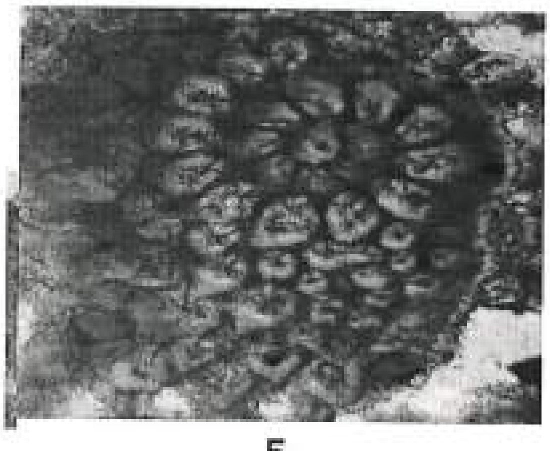

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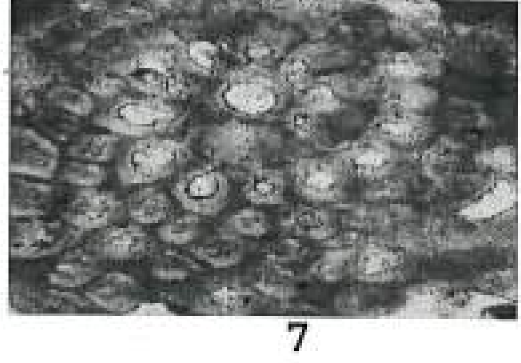

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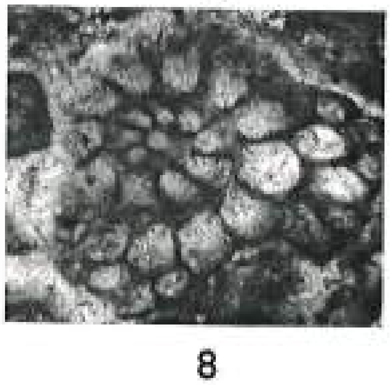

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Plate -12-

Figure (2):- *Miogypsinoides formosensis*, Unit (VI), sample (23), Khabaz well-3 section, Azkand Formation, (40X).

Figure (3):- *Miogypsinoides formosensis*, Unit (VI), sample (25), Khabaz well-3 section, Azkand Formation, (40X).

Figure (4):- *Miogypsinoides formosensis*, Unit (VI), sample (25), Khabaz well-3 section, Azkand Formation, (40X).

Figure (5):- *Miogypsinoides formosensis*, Unit (V), sample (12), Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (6):- *Miogypsinoides formosensis*, Unit (V I), sample (12), Qarah Chauq Dagh section, Azkand Formation, (40X)

Figure (7):- *Miogypsinoides formosensis*, Unit (V I), sample (17), Qarah Chauq Dagh section, Azkand Formation, (40X)

Figure (8):- *Miogypsinoides formosensis*, Unit (V I), sample (17), Qarah Chauq Dagh section, Azkand Formation, (40X)

PLate -12

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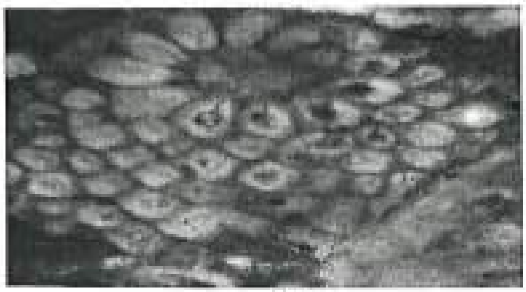

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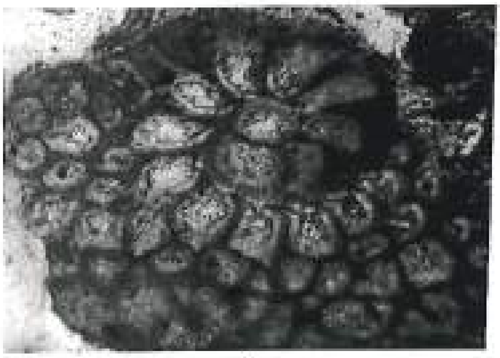

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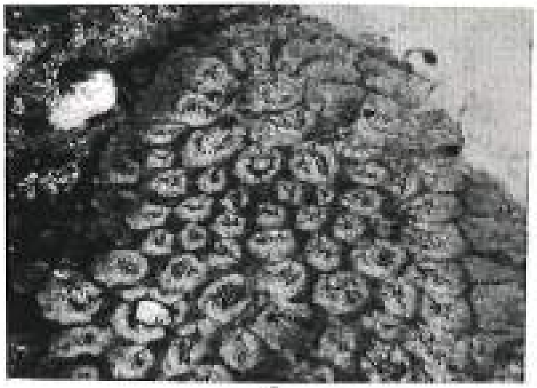

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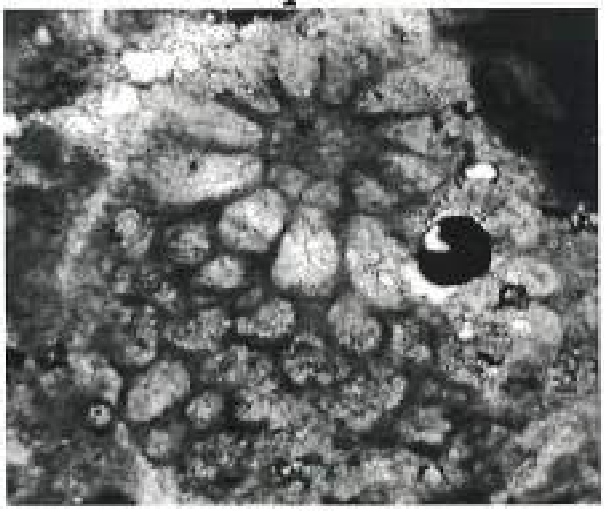

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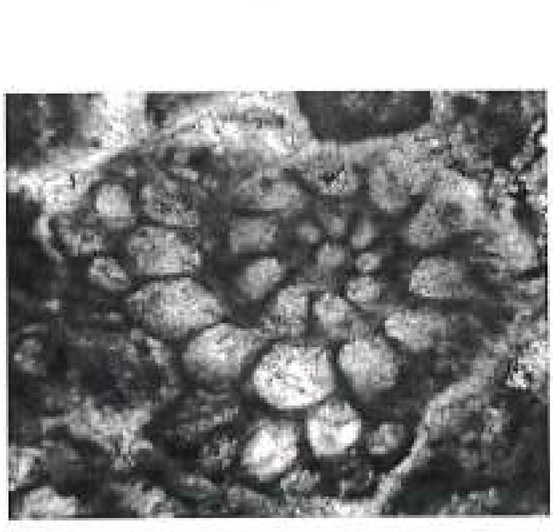

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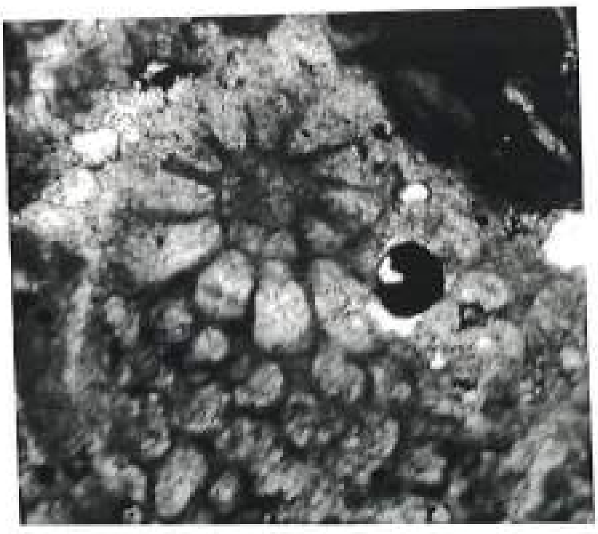

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Plate -13-

Figure (1):- *Miogypsinoides formosensis*, Unit (VI), sample (23), Khabaz well-3 section, Azkand Formation, (40X).

Figure (2):- *Miogypsinoides formosensis*, Unit (VI), sample (25), Khabaz well-3 section, Azkand Formation, (40X).

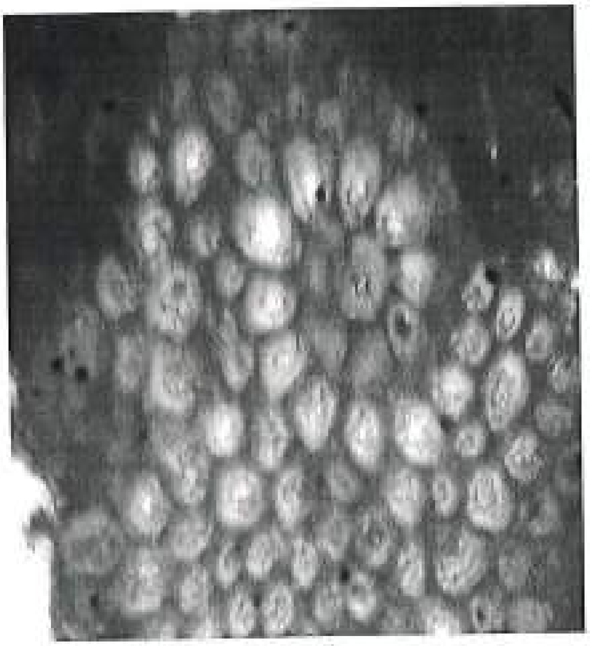
Figure (3):- *Miogypsinoides bantamensis*, Unit (VII), sample (38), Khabaz well-3 section, Azkand Formation, (35X).

Figure (4):- *Miogypsinoides bantamensis*, Unit (VII), sample (39), Khabaz well-3 section, Azkand Formation, (35X).

Figure (5):- *Miogypsinoides bantamensis*, Unit (VII), sample (39), Khabaz well-3 section, Azkand Formation, (35X)

Figure (6):- *Miogypsinoides bantamensis*, Unit (VII), sample (40), Khabaz well-3 section, Azkand Formation, (35X)

Plate -13-



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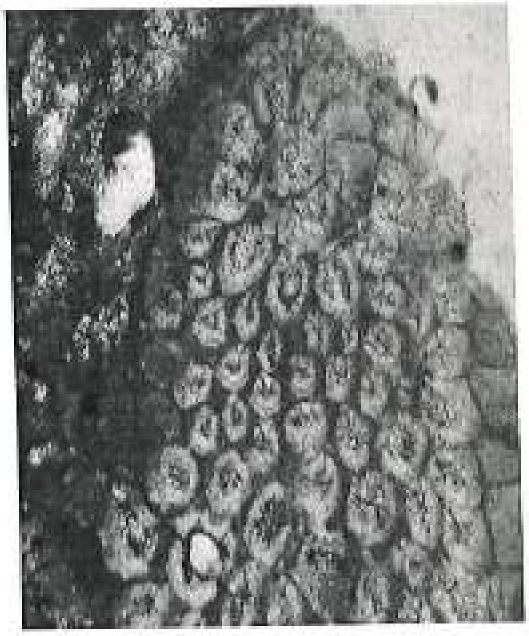

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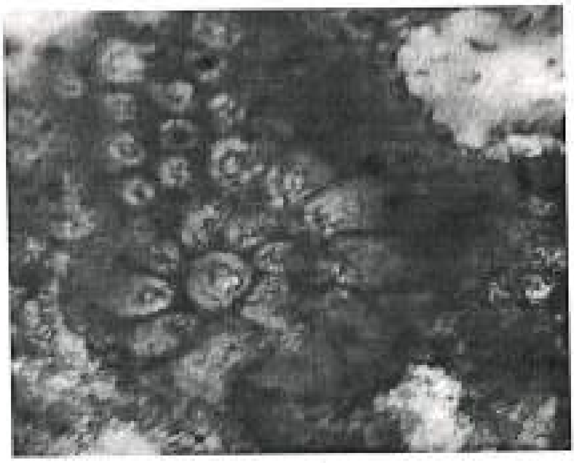

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Plate -14-

Figure (1):- *Miogypsina. gunteri* ,Unit (VII), sample (38) Khabaz well-section, Azkand Formation, (40X).

Figure (2):- *Miogypsina.ex. interc. gunteri –tani* ,Unit (VIII), sample (49) Khabaz well section, Azkand Formation, (40X).

Figure (3):- *Miogypsina.ex. interc. gunteri –tani* ,Unit (VIII), sample (49) Khabaz well section, Azkand Formation, (40X).

Figure (4):- *Miogypsina.ex. interc. gunteri –tani* ,Unit (VIII), sample (49) Khabaz well section, Azkand Formation, (40X).

Figure (5):- *Miogypsina. gunteri* ,Unit (VII), sample (3) Khabaz well-section, Azkand Formation, (40X).

Figure (6):- *Miogypsina. gunteri* ,Unit (VII), sample (40) Khabaz well-section, Azkand Formation, (40X).

Plate -14-

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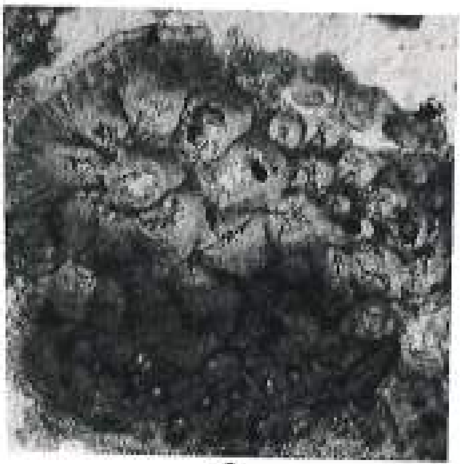

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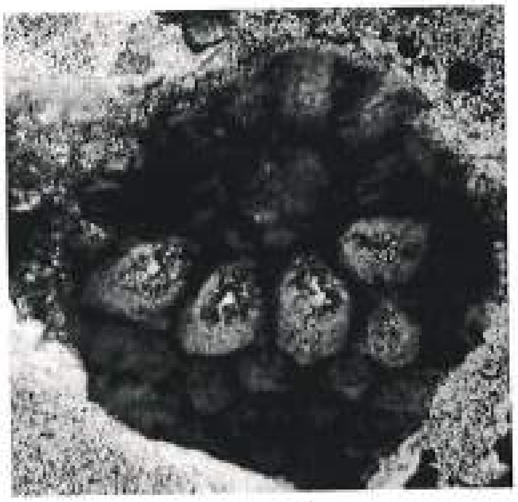

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Plate -15-

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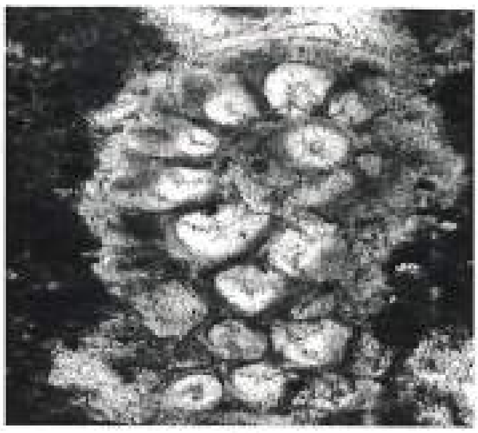

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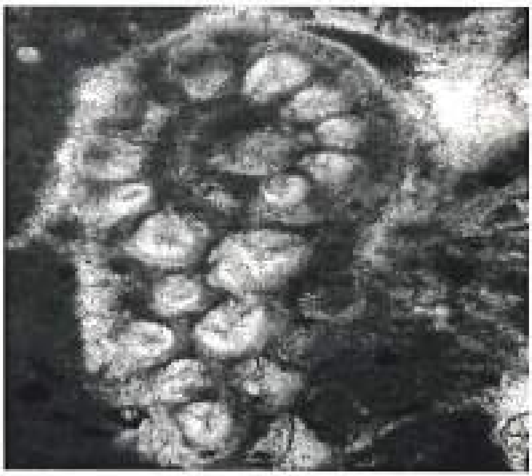

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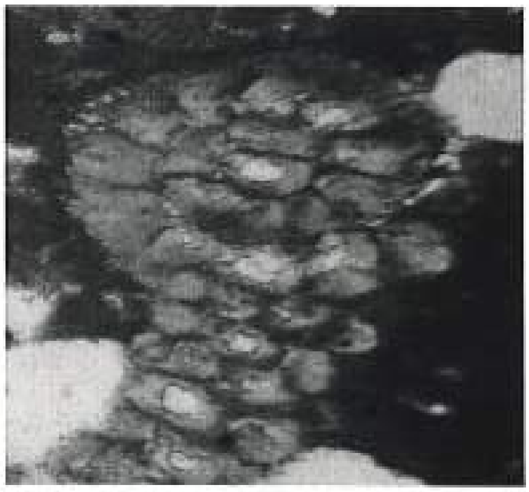

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Plate -16-

Figure (1):- *Miogypsina. gunteri,* Unit (VII), sample (20) Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (2):- *Miogypsina. gunteri- ex. interc. tani,* Unit (VII), sample (21) Qarah Chauq Dagh,section, Azkand Formation, (40X).

Figure (3):- *Miogypsina. gunteri,* Unit (VIII), sample (26) Qarah Chauq Dagh section, Azkand Formation, (40X).

Figure (4):- *Miogypsina. gunteri*, Unit (VII), sample (20) Qarah Chauq Dagh section ,Azkand Formation, (35X).

Figure (5):- *Miogypsina. gunteri*, Unit (VII), sample (20) Qarah Chauq Dagh section ,Azkand Formation, (40X).

Figure (6):- *Miogypsina. gunteri,* Unit (VII), sample (18) Qarah Chauq Dagh, section, Azkand Formation, (40X).

Plate -16-

1

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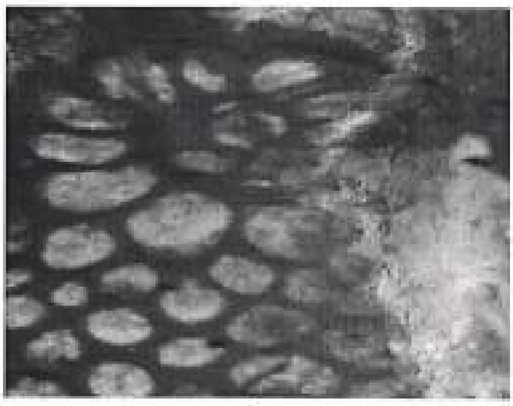

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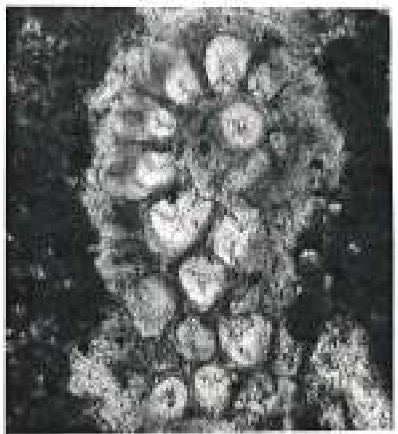

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Appendix

Table I: Basic statistics for *Lepidocyclina (Nephrolepidina)* in Kirkuk well 19 section , σ = Standard deviation of sample; N= Number of observations in sample.

Sample No.	C'	σ	N	A'_1	σ	N	D'_2	σ	N	α'	σ	N
20	4.9	1.4	13	42.5	3.48	13	398.8	153.6	13	193.9	19.42	13
18	4.8	1.7	12	44.1	2.35	12	320	70.04	12	196.75	22.05	12
16	2.9	1.6	10	40.7	3.77	10	320.9	167	10	207.7	26.94	10
14	3.5	1.5	12	40.8	3.75	12	345.8	76.64	12	265	37.13	12
11	2	0.83	11	36.4	4.46	11	298.1	37.15	11	239.1	17.91	11
3	2.3	0.9	11	38.1	3.78	11	312.4	82.06	11	238.2	16.66	11
1	2.1	0.9	12	36.8	4.49	12	315.9	78.97	12	238.8	17.06	12

Table II: Basic statistics for *Lepidocyclina (Nephrolepidina)* in Bai-Hassan well 4 section , σ = Standard deviation of sample; N= Number of observations in sample.

Sample No.	C'	σ	N	A'_1	σ	N	D'_2	σ	N	α'	σ	N
23	4.7	1.39	14	42.8	1.8	14	386	55.72	14	194.9	23	14
22	4.6	1.48	12	42.4	1.7	12	325.3	27.97	12	196.8	17.7	12
20	3.2	4.82	10	39.8	0.87	10	361.5	107.2	10	204.5	35.83	10
19	3.3	4.82	13	40.2	0.87	13	315	84.19	13	200.	835.45	13
18	3.4	2.98	13	39.1	1	13	287.7	87.51	13	201.8	26.47	13
16	2	5.75	13	36.7	0.55	13	265.5	27.65	13	226.9	16.93	13
15	2.1	4.33	10	36.7	0.74	10	257.7	38.8	10	226.3	14.41	10
7	2	3.32	11	35.5	0.63	11	275	167	11	227.6	17.17	11

Table III: Basic statistics for *Lepidocyclina (Nephrolepidina)* in Khabaz well-3 section,
σ = Standard deviation of sample; N= Number of observations in sample.

Sample No.	C'	σ	N	A'_1	σ	N	D'_2	σ	N	α'	σ	N
50	5.9	1.6	14	49.6	3.75	14	386.1	104.2	14	172.4	24.46	14
49	5.6	2.2	12	47.9	3.58	12	399.6	101.5	12	178.2	26.66	12
42	6.9	1.5	15	50.9	17.6	15	403.9	90.63	15	178.4	24.46	15
37	6.3	2.2	14	46.7	6	14	409	106.9	14	189.2	26.52	14
36	5.2	1.3	11	46	7.23	11	441.2	44.16	11	189.9	24.88	11
35	5	0.63	11	45.9	6.58	11	311.8	70.1	11	190.3	31.8	11
32	5.2	0.70	11	46	7.71	11	365.9	45.59	11	190.6	29.8	11
31	5.2	0.72	12	46	9.65	12	378.78	65.34	12	190.8	23.59	12
28	5.1	0.75	11	45.5	7.19	11	339.2	72.7	11	191.1	32.1	11
22	4.4	1.6	15	41.8	1.95	15	334.66	86.03	15	197.8	22.3	15
16	4.9	2	9	44.2	2.06	9	326.3	104	9	198.7	27.5	9
7	5	1.6	10	44.5	2.11	10	386.1	69.22	10	199.6	24.17	10

Table IV: Basic statistics for *Lepidocyclina (Nephrolepidina)* in Qarah Chauq Dagh section,
б = Standard deviation of sample; N= Number of observations in sample.

Sample No.	C'	б	N	A'_1	б	N	D'_2	б	N	α'	б	N
26	5.6	1.3	10	47.6	4.77	10	330.2	66.86	10	172.7	28.45	10
21	5.4	0.5	14	46.3	1.15	14	325.9	61.85	14	192.1	28.05	14
20	4.5	1.1	16	42.8	1.69	16	300.5	61.72	16	195.12	21.23	14
18	3.5	1.2	12	40.5	2.61	12	292.3	106.4	12	196.5	37.77	12
17	4	1.4	13	42.3	1.61	13	371.5	53.17	13	197.5	19.41	13
12	4	0.97	13	41.4	3.38	13	381.9	8.84	13	198.8	19.47	13
3	4.1	1.4	11	44.7	1.78	11	303.3	39.35	11	198.8	21.02	11

Table V: Basic statistics for *Miogypsinoides* of Units (V, VI, VII and VIII), in Khabaz well-3 section.

Sample Number	X'	6	N	γ	6	N	D'_1	6	N	D'_2	6	N
49	12.3	1.25	13	-106.5	38.24	13	128.1	49.52	13	139	35.82	13
43	12.8	1.15	15	-102.3	55.06	15	137.6	39.75	15	148.1	39.81	15
42	12.3	1.22	18	-129.5	49.84	18	138.4	39.79	18	149.5	41.96	18
41	12.3	1.23	12	-96.3	29.46	12	144.9	32.57	12	154.66	32.97	12
40	12.6	1.13	15	-106.9	36.96	15	136.9	39.49	15	150.1	43.07	15
39	10.52	1.05	15	-110	40.74	15	141.3	41.41	15	151	41.31	15
38	12.3	1.14	18	-134.9	44.85	18	132.8	38.78	18	147.2	45.43	18
25	15.1	1.34	17	-157.1	47.82	17	227.9	27.65	17	237.6	29.36	17
23	15.3	1.41	18	-150.6	46.02	18	231.4	32.87	18	241.9	33.27	18
16	19.3	1.5	15	-171.6	99.08	15	236.8	35.14	15	247.2	37.46	15
7	18	2.06	14	-174.7	52.39	14	242.4	34.3	14	251.8	32.89	14

Table VI: Basic statistics for *Miogypsinoides* of Units (V, VI, VII and VIII),in Qarah Chauq Dagh section.

Sample Number	X'	б	N	γ'	б	N	D'_1	б	N	D'_2	б	N
26	11.54	1.21	12	-166.88	36.55	12	1543.7	42.46	12	155.5	42.31	12
21	11.6	1.15	14	-130.6	39.85	14	133.4	41.19	14	143.8	40.21	14
20	11.7	1.11	15	-132	48.01	15	132.3	35.6	15	142.3	35.1	15
18	11.6	1.2	18	-118.2	58.37	18	127	49.23	18	139.3	46.83	18
17	11.9	1.17	15	-142.8	54.23	15	122.7	40.01	15	139	38.91	15
12	11.6	1.37	14	-145.4	135.6	14	134.4	39.34	14	143.9	42.1	14
6	19.8	1.73	12	-145.6	56.23	12	250.8	30.30	12	259.8	31.61	12
3	19.1	1.73	12	-160.7	52.33	12	257.2	29.87	12	265.7	30.51	12

TableVII : Basic statistics for *Miogypsina s.s.* of Units (V, VI, VII and VIII), in Khabaz well-3 section.

Sample N0.	X'	σ	N	γ'	σ	N	D'_1	σ	N	D'_2	σ	N
49	9.51	1.6	12	-122.8	123	12	117.4	33.83	12	130.2	32.86	12
43	9.4	1.45	11	-98.7	103	11	135.6	42.77	11	142.9	39.76	12
42	10.1	1.41	15	-105.4	118.3	15	153.1	54.16	15	184.9	52.01	15
41	10	1.41	14	-49.07	92.99	14	144.3	48.13	14	194.9	52.1	14
40	10.8	1.36	13	-98.8	101.3	13	133.8	39.98	13	146.4	37.54	13
39	10.5	1.1	11	-112.1	107.3	11	136.2	40.81	11	144.9	40.6	11
38	9.4	1.6	12	-106.3	108.5	12	134.5	39.45	12	143.3	38.25	12

Table VIII: Basic statistics for *Miogypsina s.s.* of Units (V, VI, VII and VIII), in Qarah Chauq Dagh section.

Sample No.	X'	σ	N	γ'	σ	N	D'_1	σ	N	D'_2	σ	N
26	9.1	1.32	10	183.6	105.8	10	108.4	27.15	10	118.5	27.44	10
21	9.7	1.32	13	-140.1	124.6	13	141	51.23	13	152.8	49.53	13
20	9.3	1.27	14	-131.8	116.5	14	147.3	47.66	14	158.1	45.33	14
18	10.6	1.15	20	-127.1	125.7	20	138.3	46.1	20	156.6	41.39	20
17	9.4	1.31	12	-91.4	149.2	12	131	49.44	12	151.8	47.17	12
12	10.3	1.37	12	-148.3	135.6	12	148.4	39.34	12	165	42.1	12

التحليل القياسي الحياتي ل
Miogypsinds , Lepidocyclina(Nephrolepidina)
من تكويني بابا و ازقند(الأوليكوسين – المايوسين) في منطقة كركوك، العراق

الخلاصة

جرى البحث على تتابعات من الصخور الكاربوناتية الحياتية المنكشفة (مقطع قرة جوغ داغ السطحية و التحت سطحية في ابار (كركوك -١٩ ، باي حسن -٤ و خباز-٣) . وان هذه الصخور الكاربونايتية ، ترسبت في بيئات بحرية ضحلة مفتوحة خلال فترة الاوليكوسين المتاخر – المايوسين المبكر ، وان اصداف الفورامينفيرا الكبيرة من الأجناس *Lepidocyclina (Nephrolepidina)*, *Miogypsina* تكون شائعة في الجزء السفلي والعلوي من هذه التتابعات الصخرية، و ان التركيب الداخلي لهذه الأصداف درست بشكل تفصيلي.

ان التحليل الحياتي للجنس *Lepidocyclina (Nephrolepidina)* عكس سلسلة مشكلة من الانواع للجنس *Lepidocyclina (Nephrolepidina)* تضمنت كلا الخطيين للجنس *Lepidocyclina (Nephrolepidina)* البدائية والحديثة وان هذه الانواع تشمل *Lepidocyclina(Nephrolepidina) praemarginata*، من الأوليكوسين المتاخر (Chattian) و *Lepidocyclina (Nephrolepidina) tournoueri* من المايوسين المبكر (Aquitanian). ان التباين في العلاقات (A_1 –C) ترك مجالا واسعا بين الانواع والذي ادى الى تحديد انواع ذات صفات مشتركة(exampleum intercenterale) والتي تمثلت بالنوع *Lepidocyclina (Nephrolepidina) ex. interc. premarginata – morgani* من

الاوليكوسين المتأخر والنوع *Lepidocyclina(Nephrolepidina)ex.inter morgani- tournoueri* من المايوسين المبكر (Aquitanian)

ان التحليل الأحصائي الحياتي للجنس (*Miogypsina*) عكس بان الانواع القديمة لها موجودة في الجزء السفلي من تكوين ازقند وفي كلا المقطعين (بئر خباز-٣ و قره جوق داغ) وهذه الانواع تمثلت بالنوعين *Miogypsinoides formosensis , Miogypsinoides complanata* ان تواجد النوع *Miogypsina s.s* غالبا مايصاحبه تواجد الأنواعالعائدةللجنس *Miogypsinoides* وان الاخير اقرب مايكون للنوع *Miogypsinoides bantamensis* اعتمادا على معدل حجم الغرف الاولية(preimbryonic chambers) ، حيث امكن تميز نوعان من التجمعات يعود للجنس *Miogypsinoides* ضمن ترسبات المايوسين المبكر، حيث النوع الاول (Type I) ذات الحجم الصغير للغرف الاولية والتي تتراوح مابين (D_1= 110 -125 µm) والتي هي تتطابق مع المجاميع او التجمعات الموصوفة في اماكن مختلفة في العالم ، اما النوع الثاني (Type II) ذات الحجم الكبير للغرف الاولية والتي تتطابق مع المجاميع المعروفة من اوروبا، وان المعلومات المتوفرة في الخط التطوري الرئيسي للجنس (*Miogypsinoides*) تظهر تغيرات واسعة مميزة في شكل الغرف الاولية وهذه التغيرات تتفق مع مبدأ (Nepionic acceleration) والتي حددت من قبل (Tan Sin Hok,1936). ان الخط التطوري للأنواع التابعة للجنس (*Lepidocyclina (Nephrolepidina*) مطابق مع الخط التطوري الموصوف من منطقة البحر الابيض المتوسط واوروبا والذي يبدأ في مستوى من الخط التطوري من الجزء الأوسط للاوليكوسين المبكر، حيث هذا الخط يرينا التقدم في تعقيدات الغرف الاولية الجنينية وان هذه التعقيدات ممثلة بزيادة في قيم عوامل (C and A_1) ونقصان في عامل (α).

وانه من الملاحظ بان الاتجاه التطوري للجنس (*Miogypsinoides*) يعتمد على التغيرات التدريجية في معدل قيم (X) في تحديد الانواع.

وان الانتشار الاولي للجنس *Miogypsina s.s.* ذات معدل قيم لـــ(X) تتراوح بين (٩-١٢) في الجزء السفلي في كلا المقطعين والذي يصاحبةوجود اقدم انواع للجنس *Miogypsinoides* الممثلة بـــ(*Miogypsinoides complanata* و *Miogypainoides formosensis*) هذين النوعين لهما معدل قيم لـ (X) يتراوح بين (١٣-١٩) من خلال فترة الاوليكوسين المتأخر، وان الانتشار الثاني للجنس *Miogypsinoides* كان في الجزء العلوي من تكوين ازقند والذي تمثل بظهور النوع *Miogypsina gunteri – tani* ذات معدل قيم لــ(X) تتراوح بين (٩-١٢) في نفس الوقت مع الجنس *Miogypsinoides* والممثل بالنوع *Miogypsinoides bantamensis* ذو معدل قيم (X) تتراوح بين (١٠-١٣).

پێوانه شیکردنەوەی گیانداری
Lepidocyclina(Nephrolepidina) ,
(Miogypsinids) لە پێکهاتووەکانی بابا و نەزقەند
(ئۆلیگوسین – مایۆسین) لە
ناوچەی کەرکوک ، عێراق

نامەیەکە

پێشکەش کراوە بە کۆلیجی زانست لە زانکۆی سلێمانی وەك بەشێکی تەواو کەر بۆ بەدەست هێنانیپلەی دکتۆرای فەلسەفە لە زانستی جیۆلۆجیدا

لە لایەن

عماد محمود غفور

بەکالۆریوس لە زانستی جیۆلۆجیدا / ١٩٨١

ماستەر لە زانستی جیۆلۆجیدا / ١٩٨٨

بەسەرپەرشتی

د . قحطان احمد محمد

پرۆفیسوری یاریدەدەر

جۆزەردانی ٢٧٠٣ کوردی   حوزەیرانی ٢٠٠٤ زاینی

١

پێوانه شیکردنەوەی گیانداری
Lepidocyclina(Nephrolepidina) و
(Miogypsinids) له پێکهاتووەکانی بابا و ئەزقەند
(ئۆلیگۆسین - مایۆسین) له ناوچەیکەرکوك ، عێراق

پوختە

ئەم توێژینەوەیە ئەنجام دراوە لەسەر چینە بەردەکلسیەدەرکەوتووەکانی ناوچەی قەرەچوغ داغ کەنزیکەی (٥٠کم) دوورە لە باکوری ڕۆژهەلاتی کەرکووکەوە لە گەڵ چینە بەردە کلسیەکانی ژێر زەوی لە بیرە نەوتەکانی (کەرکووك -١٩ ، بای حەسەن -٤ و خەباز -٣) کەنزیکەی (١٠-١٢کم) دوورە لە باشووری خۆر ئاوا بۆ باکوری خۆر ئاوا لە شاری کەرکووکەوە • ناوچەی توێژینەوە بە پێی نووسینە بلاّوکراوەکانی (Buday & Jassim , 1987) ئەکەوێتە بنە پشتێنەی حەمرین- مەکحول ، پشتێنەی بەرزی ژێرەوە (Foot hill zone) بەلاّم بە پێی (Al-Khadhimi et. al. 1996) ئەکەوێتە بنە پشتێنەی حەمرین کە سەر بە پشتێنەی بەرزی ژێرەوە (Foot hill zone) لە ناوچە ی شۆستەی ناجێگیر (Unstable Shelf) لە بەشی باکوری ڕۆژهەهەلاّتی عێراق – کوردستانی عێراق.

سامپلەکان لە بەهاری ساڵی (٢٠٠٢) دا وەرگیراون کە نزیکەی (٢٠٠)سامپڵ ئەبێت لە هەموو بڕگەکانی ئەم توێژینەوەیەدا ،سامپڵەکان زۆر ڕەق بوون بۆیە بڕگەی تەنک (Thin section) یان بۆ دروست کرابە تایبەتی (Oriented section) نزیکەی ٥٠٠ بڕگەی ئاراستە کراو دروست کرا بۆ سامپڵەکان .

چینە بەردە کلسیەکانی ئەم توێژینەوەیە هەردوو پێك هاتووی (باباو ئەزقەند) (Baba and Azkand Formations) ئەگرێتەوە ، کە پێك هاتووی بابا, بڕگەکانی (کەرکووك -١٩ و بای حەسەن -٤) ئەگرێتەوە ، پێك هاتووی ئەزقەند هەردوو بڕگەی (خەباز -٣و قەرەچوغ داغ) ئەگرێتەوە توانرا بڕگەکان دابەش بکرێت بەسەر چەند یەکەیەکدا (Units) لە سەر بنچینەی شێوازی وورد (Microfacies) بڕگەکانی (کەرکووك ١٩و بای حەسەن -٤) دابەش ئەکرێت بەسەر یەکەکان (I , II , III و IV) دا وە بڕگەکانی (خەباز-٢ و قەرەچوغ داغ) دابەش ئەکرێت بە سەر یەکەکان (V ، VI ، VII و VIII) دا

چینە بەردە کلسیەکانی هەردوو پێك هاتووەکە لە بڕگەکان دا لە ژینگەی ئاوی تەنك و بەرەلاّ دا نیشتوون لە ماوەی کۆتای ئۆلیگۆسین (Chattian) و سەرەتای مایۆسین دا (Aquitanian)

سەدەفەی یان توێکلی ا فۆرامینیفیرای گەورە (Large Foraminifera) بە تایبەتی ڕەگەزەکانی (Genera):

(Lepidocyclina(Nephrolepidina) و (Miogypsina) بە شێوەیەکی زۆر ئاشکرا و دیار دابەش بوون لە بەشی خوارەوەی بڕگەکانی دا تا بەشی سەرەوە یان ، وە پێکهاتووی ناوەوەی سەدەفەکان باس کراون بە درێژی .شیکردنەوەی گیانداری لە سەر ڕەگەزی (Lepidocyclina(Nephrolepidina) دەری خست کە زنجیرەیەك لە جۆرەکانی (Species) کە پێك هاتووە لە جۆرە سەرەتایەکان وە جۆرە نوێیەکان لە سەر بنچینەی هەر سێ فاکتەری (α, Ai C) دابەش کراون.

فاکتەری (C) بریتییە لە ژمارەی ژوورە خاوە یاریدەدەرەکان (Accessory Auxiliary chambers کە لەسەر ژووری ناوەندی دا(لە پکەی ناوەندی) (Deutonchonch) دروست ئەبێت .

فاکتەری (A_i) بریتییەلەبڕیدا پۆشینیلە پکەیسەرەتای(Protoconch) لە لایەن لەپکەی ناوەندییەوە (Deuteroconch).

فاکتەری (α) بریتییە لە برێ دا پۆشینی لە پکەی سەرەتای بەهۆی لە پکەی ناوەندییەوە کە بەگۆشەی لە پکەی سەرەتاییەوە ئەناسرێت وە ئەو گۆشەیەی بە هۆی دوو هێڵ دروست ئەبێت کە لە سەنتەری لە پکەی سە رە تایەوە دەکێشرێت تا

ئەو خاڵەی کە توێکڵی لە پکەی لا ناوەندی لە گەڵ توێکڵی لە پکەی سەرەتای لە یەك ئەدەن وە ئەو جۆرانەی کە دروست بوون لە سەر بنچینەی ئەو فاکتەرانەی سەرەوە بریتین لەم جۆرانەی (Species) لای خوارەوە:

Lepidocyclina (Nephrolepidina) praemarginata

Lepidocyclina (Nephrolepidina) morgani

Lepidocyclina (Nephrolepidina) tournoueri

کە لە کۆتای ئولیگوسین (Late Oligocene) واتە (Chattian) دابەش بوون تا سەرەتای مایوسین (Early Miocene) واتە (Aquitanin) وە لەدوای وەرگرتنی نرخی (α, A_i ,C) لە بەشی خوارەوە تا بەشە سەرەوە ی برگەکان دا ، دەرکەوت کە ماوەیەکی زۆر فراوان هەیە لەنێوان ئەو جۆرانەدا کە سیفەتی هاوبەشیان هەیە لە جۆرە سەرەکیەکان ناچن کە پێشتر ئاماژەیان پێ دراوە بەڵکو جیاوازیان هەیە لە تێکرای نرخی فاکتەرەکانی (A_i , α، C) بۆیە ئەو جۆرانەشمان دابەش کردووە بە چەند جۆرێکی ترەوە کە سیفاتی هاوبەشیان هەیە واتە (exemplum intercentrale) وە ئەو جۆرانەش بریتین لە :

L. ex.interc.morgani-tournoueri

L.ex.interc. praemarginata-morgani

دوای تەواو بوونی شی کردنەوەی گیانداری لە سەر ڕەگەزی (Genus)

Lepidocyclina(Nephrolepidina)) بە هۆی تێکڕای نرخی فاکتەرەکانی

(α , A_i, C) توانیمان جۆرەکانی (*Lepidocyclina(Nephrolepidina*

) دابەش بکەین بە م شێوەیەی لای خوارەوە :

Species	**A^{-}_{i}**	**C^{-}**	**α^{-}**
L .tournoueri	$A^{-}_{i} > 45$	$C^{-} > 5.25$	$\alpha^{-} < 189.5$
L. ex.interc.morgani-tournoueri	$44 < A^{-}_{i} < 46$	$5 < C^{-} < 5.5$	$189.5 < \alpha^{-} < 192.5$
L .morgani	40, $A^{-}i < 45$	$3 < C^{-} < 5.25$	$192.5 < \alpha^{-} < 199$
L.ex.interc. praemarginata-morgani	$39 < A^{-}i < 41$	$2 < C^{-} < 4$	$199 < \alpha^{-} < 208$
L.praemarginata	$35 < A^{-}i < 40$	$1 < C^{-} < 3$	$208 < \alpha^{-}$

دابەش بوون جۆرەکان لە بڕگەکاندا (لە بەشی خوارەوە تا بەشی سەرەوە

یان لەیەکەی (I) تایەکەی (VIII) بەم شێوەیەی لای خوارەوە دابەش بوون :

<table>
<tr><th>Series</th><th>Stage</th><th>Unit</th><th>Formation</th><th>Species/Lepidocyclina(Nephrolepidina) /L.ex. interc.</th></tr>
<tr><td rowspan="3">Miocene</td><td rowspan="3">Aquitanian</td><td>VIII</td><td rowspan="4">Azkand</td><td>L.(N.) tournoueri</td></tr>
<tr><td>VII</td><td>L. ex. interc. morgani-tournoueri</td></tr>
<tr><td>VI</td><td rowspan="3">L.morgani</td></tr>
<tr><td rowspan="5">Oligocene</td><td rowspan="5">Chattian</td><td>V</td></tr>
<tr><td>IV</td><td rowspan="4">Baba</td></tr>
<tr><td>III</td><td rowspan="2">L. ex. interc. praemarginasta-morgani</td></tr>
<tr><td>II</td></tr>
<tr><td>I</td><td>L.praemarginata</td></tr>
</table>

شیكردنەوەی گیانداری لە سەر ڕەگەزی(*Miogypsina*) بە هەمان شێوە چەند جۆرێكی كۆنی دیاریكراو كەلە بەشی خوارەوەی پێك هاتووی ئەزقەند دایە لە هەردوو بڕگەی(خەباز -٢ و قەرەچوغ داغ) دایە ، وە ئەم جۆرانەش بریتین لە : (*Miogypsinoides formosensis , Miogypsinoides complanata*) وە بوونی ڕەگەزی (*Miogypsina s.s.*) ، كە هەندێك جار دەردەكەوێت لە گەڵ (*Miogypsinoides*) وە زیاتر لە جۆری (*Miogypsinoides bantamensis*) ئەچێت ، ئەوەش بە پشت بەستنی بە تێكڕای قەبارەی ژووری لە پكەی سەرەتای كە توانرا دوو جۆر لە كۆمەڵەی *(Miogypsinoides)* بدۆزینەوە لە نیشتووەكان مایوسینی سەرەتای دا ، كە جۆری یەكەم (Type I) قەبارەی ژوورەكەی واتە ژووری لە پكەی سەرەتای لە نێوان ($D_1 = 110\text{-}125\mu m$) كە ئەم جۆرانە وەكو ئەو جۆرانەیە كە باس كراون لە شوێنی جیاواز لە جیهان دا بۆ نموو نە لە ئەمەریكا دا ، بەلآم جۆری دووەم (Type II) كە قەبارەكەی گەورەیە واتە قەبارەی لە پكەی ژووری سەرەتای كە لە نێوان ($D_2 = 210\text{-}220\mu m$) كە ئەم جۆرانەش وەكو ئەو جۆرانەوایە كە لە ئەوروپا دا باس كراون ، وە ئەو زانیاریانەی كە هەیە لە سەر هێڵی گەشەكردن (Evolutionary Line) سەرەكی ڕەگەزی *Miogypsinoides*) دەرئەكەوێت كە گۆڕانكاری زۆر

ئاشكرا هەیە لە شێوەی ژووری لە پکەی سەرەتای وە ئەم گۆرانکاری یانەش لە گەڵ پرینسیپی (Nepionic acceleration) دا ئەگونجێت کە لەلایەن (Tan Sin Hok, 1936) باس کراوە .

هێلی گەشەکردن جۆرەکانی *Lepidocyclina(Nephrolepidina)* لەم توێژینەوەیەدا لە گەڵ هێڵە گەشە کردووەکان کە باس کراوە لە ناوچە کان دەریای سپی ناوەڕاست و ئەوروپا دا چوون یەکن ، کە لەسەر ئاستی هێڵی گەشەکردن لە بەشی ناوەڕاستی سەرەتای ئۆلیگوسین ، وە ئەم هێڵی گەشەکردنە ئەوەمان پیشان ئەدا کە پێش کەوتنێك هەیە لە ئاڵۆزبوونی ژووری لە پکەی سەرەتای ، وە ئەم ئاڵۆز بوونە ش ڕوو ئەدات بە هۆی زیادبوونی نرخی فاکتەرەکانی (A_i ،C) وە کەمبوونی نرخی فاکتەری (α).

لەم توێژینەوەیەدا توانیمان هێڵی گەشەکردنی (*Lepidocyclina(Nephrolepidina*) لە یەکەکانی (I, II, II , IV) دا دیاری بکەین بەم شێوەیەی لای خوارەوە :

لە یەکەی (I) دا ك ە سەر بەبڕگەی (کەرکووك -١٩) یە بە جۆری (*Lepidocyclina(Nephrolepidina) praemarginata*) هەیە, لە یەکەی(II) دا سەر بە بڕگەکانی (کەرکووك - ١٩، بای حەسەن-٤) جۆرەکانی (*Lepidocyclina(Nephrolepidina) praemarginata, Lepidocyclina(Nephrolepidina)ex. interc. praemarginata-morgani*) هەیە, لە یەکەی (III) کە سەر بە بڕگەکانی (کەرکوك – ١٩ ؛ بای حەسەن-٤)

جۆری(Lepidocyclina (N.) morgani , L.(N.)ex. interc praemarginata morgani, هەیە . لە یەکەی (IV) دا سەر بە بڕگەی (بای حەسەن -٤) جۆری (Lepidocyclina(Nephrolepidina) morgani,) هەیە , لە یەکەی (V) کە سەر بەبڕگەکانی(خەباز – ٣ ، قەرەچوغ داغ) ، جۆری L.(N.)morgani هەیە , لەیەکەی (VI)دا سەربە بڕگەکانی (خەباز -٣، قەرەچوغ داغ)، جۆرەکانی (L.(N.) morgani L.(N.)ex. interc. morgani-tournoueri) هەیە ، لەیەکەی (VII) دا سەربە بڕگەکانی (خەباز-٣ ، قەرەچوغ داغ) ، جۆرەکانی (L.(N.)ex. interc. turnourier morgani- L .(N.)tournoueri) هەیە ، لەیەکەی (VIII) دا سەربە بڕگەکانی (خەباز-٣، قەرەچوغ داغ) جۆری L. (N.) -tournoueri هەیە وە توانرا دابەش بوونی و جۆرەکانی Lepidocyclina (Nephrolepidina) لەم توێژینەوەیەدا لە سەر بنچینەی (α , A_i, C) بەم خشتەیەی لای خوارەوە دەربېرێت :

Formation	Stage	Species	$C^{\prime}$	$A^{\prime}_{i}$	$\alpha^{\prime}$
Azkand	Aquitanian	*L.tournouri*	$C^{\prime}>5.25$	$A^{\prime}_{i}>45$	$\alpha^{\prime}<189.5$
		L.ex.interc.morgani-tournouri	$5<C^{\prime}<5.5$	$44<A^{\prime}_{i}<46$	$189.5<\alpha<1925$
Azkand / Baba	Chattian	*L.morgani*	$3<C<5.25$	$40<A^{\prime}_{i}<45$	$192.5<\alpha<199$
		L.ex.interc.praemarginata-morgani	$2<C^{\prime}<4$	$39<A^{\prime}_{i}<41$	$199<\alpha<208$
		L.praemarginata	$1<C^{\prime}>3$	$30<A_{i}<40$	$208<\alpha^{\prime}$

هێڵی گەشەکردن جۆری (*Miogypsinoides*) لە سەر بنچینەی گۆڕانکاری لەسەر تێکڕای نرخی فاکتەری (X) کە بریتییە لە کۆی ژمارەی ژوورەکان (Nepionic) لە لوول پنچی سەرەتای کە هەردوو ژوورەکانی لە پکەی سەرەتای و ناوەندی ناگریتەوە ، وە لەسەر بنچینەی ئەو فاکتەرە جۆرەکانی دیاری ئەکرێت •

دابەشبوونی یەکەمی ڕەگەزی (*Miogypsina s.s.*) کە تێکڕای نرخی فاکتەری (X) لە نێوان (٩- ١٢) دایە لە بەشی خوارووی هەردوو بڕگەی (خەباز -٣ و قەرەچوغ داغ) لە گەڵ ئەم جۆرانەش دا جۆری (*Miogypsinoides complanata*) هەیە کە تێکڕای نرخی فاکتەری (X)

لە نێوان (١٣ – ١٩) یە لە ماوەی کۆتای ئۆلیگۆسین دا ، وە دابەش بوونی دووەمی ڕەگەزی (*Miogypsinoides*) لە بەشی سەرەوەی پێکهاتووی ئەزقەند دا ڕووی دا وە کە بە جۆرەکانی (*Miogypsina gunteri-tani*) ئەناسرێت کە تێکڕای نرخی فاکتەری(X) یان لە نێوان (٩-١٢) یە لە هەمان کات دا ی‌جۆری (*Miogypsinoides bantamensis*) کە تێکڕای نرخی فاکتەری (X) لە نێوان (١٠-١٢) دایە دەرئەکەوێت ٠

گەشەکردن (*Miogypsinoides*) لە یەکەکانی (V, VI, VII, VIII) دا لە پێك هاتووی ئەزقەند دا بەم شێوەیەی لای خوارەوە دابەش بوون کە بڕگەکانی (خەباز -٣و قەرەچوغ داغ) دایە.

لە یەکەی (V) دا جۆری (*Miogypsinoides complanata*) دەرکەوتووە لە بەشی خوارووی بڕگەکان دا ، وە تەمەنی ئەگەڕێتەوە بۆ (Chattian) یە ٠

لە یەکەی (VI) دا جوری(*Miogypsinoides formosensis*) کەلە بەشی خوارەوەی برکەکاندایەو تەمەنی (Chattian).

لە یەکەی (VIII) دا جۆری (*Miogypsinoides formosensis-*) دەرکەوتووە وە لە یەکەی (VII) دا هەردوو جۆری (*Miogypsinoides bantamensis*) لە گەڵ (*Miogypsinoides dehaartii*) هەیە

هەردوو یەكەی (VII, VIII) ئەگەڕێتەوە بۆ تەمەنی (Aquitanian) كە سەرەتای مایۆسینە.

گەشەكردن (*Miogypsina.s.s* .) لە یەكەكانی (V، VI، VII ، VIII) دا سەر بە بڕگەكانی (خەباز -٣و قەرەچوغ داغ ، بەم شێوەیەی خوارەوە دابەش بوون :

لە یەكەكانی(V، VI) دا جۆری (*Miogypsiona gunteri*) هەیە كەتەمەنیان ئەگەڕێتەوە بۆ كۆتای ئۆلیگۆسین واتە (Chattian) لە یەكەكانی (VII، VIII) دا جۆری (*Miogypsina gunteri-tani*) هەیە كە ئەگەڕێتەوە بۆ تەمەنی سەرەتای مایۆسین واتە (Aquitanian)

التحليل القياسى الحياتى لـ

Lepidocyclina (Nephrolepidina) ,

Miogypsinids

من تكوينى بابا و ازقند (الأوليكوسين – المايوسين) فى منطقة كركوك ،العراق

رسالة مقدمة الى مجلس كلية العلوم-
جامعة السليمانية كجزمن المتطلبات
نيل درجة دكتوراه فلسفة فى علم الارض

من قبل

عماد محمود غفور
ماجستير / جيولوجى - ١٩٨٨

جمادى الأولى ١٤٢٥ هـ

حزيران -٢٠٠٤ م