

**Paleoecological Analysis and Paleontology of Pilaspi Formation  
in Bekhier Anticline, Dohuk City  
Mohammed Sattam\***

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**Abstract**

Pilaspi Formation had been studied of two outcrops in Bekhier anticline within Dohuk area from paleoecological and paleontological trend.

The first section contained faunal content more than the second section, where it was not affected by diagenesis comparing the second section, and the following fauna could be identified: Miliolids, *Peneroplis dusenburyi*, *Nummulites bayhariensis*, *Praerhapidionina huberi*, *Pyrgo* sp., *Rhapidionina urensis*, *Rhipidionina williamsoni*, Valvulinds, *Lithothaminuim* sp., unidentified taxa, Echinoids, Coral , Gastropoda .

Depending on these taxa, the back-core-fore reef and open marine environment was represented in this section .While the second section was represented by the following fauna: Miliolids, *Praerhapidionina huberi*, *Pyrgo* sp., *Rhapidionina urensis*, *Rhipidionina williamsoni*, Valvulinds, *Lithothaminuim* sp., unidentified taxa , Echinoids ,Gastropoda ,and depending on these taxa the shelf environment and open marine was identified without reef environment occurrence .

**Key words:** Pilaspi Formation, paleoecology, paleontology

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تحليل البيئة القديمة والمتحجرات لتكوين بيلاسبي في طية بيخير ، منطقة دهوك

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### المخلص

تم دراسة تكوين البلاسي في مقطعين منكشفين في طية بيخير المحدبة ضمن منطقة دهوك من ناحية البيئة القديمة والمتحجرات والتحليل السحني ، حيث احتوى المقطع الأول على تجمع من المتحجرات أكثر من المقطع الثاني ، حيث انه لم يكن متأثراً بالعمليات التحويرية بدرجة كبيرة مقارنة بالمقطع الثاني ، اذ تم تمييز المتحجرات التالية ضمن المقطع الأول:

*Miliolids, Peneroplis dusenburyi, Nummulites bayhariensis, Praerhapidionina huberi, Pyrgo sp., Rhapidionina urensis, Rhipidionina williamsoni, Valvulinds, Lithothaminuim sp., unidentified taxa, Echinoids, Coral, Gastropoda .*

واعتماداً على المتحجرات أعلاه ، فان بيئة الشعاب وبيئة البحر المفتوح تم تمييزها ضمن هذا المقطع ، بينما تمثل المقطع الثاني بالمتحجرات التالية:

*Valvulinds, Miliolids, Praerhapidionina huberi, Pyrgo sp., Rhapidionina urensis, Rhipidionina williamsoni, Lithothaminuim sp., unidentified taxa, Echinoids, Gastropoda*

واعتماداً على هذه التجمعات الحياتية فقد تم تمييز بيئة الرصيف وبيئة البحر المفتوح بدون تواجد لبيئة الشعاب ضمن هذا المقطع.

كلمات مفتاحية: تكوين بيلاسبي ، المتحجرات ، البيئة القديمة

### Introduction

Pilaspi Formation has determined at Eocene succession in Spi ris in Duhok in northern part of Iraq, so that we can study the sampling outcrops that belong to this formation. The paleontological and paleoecological studies and the determination of chronological

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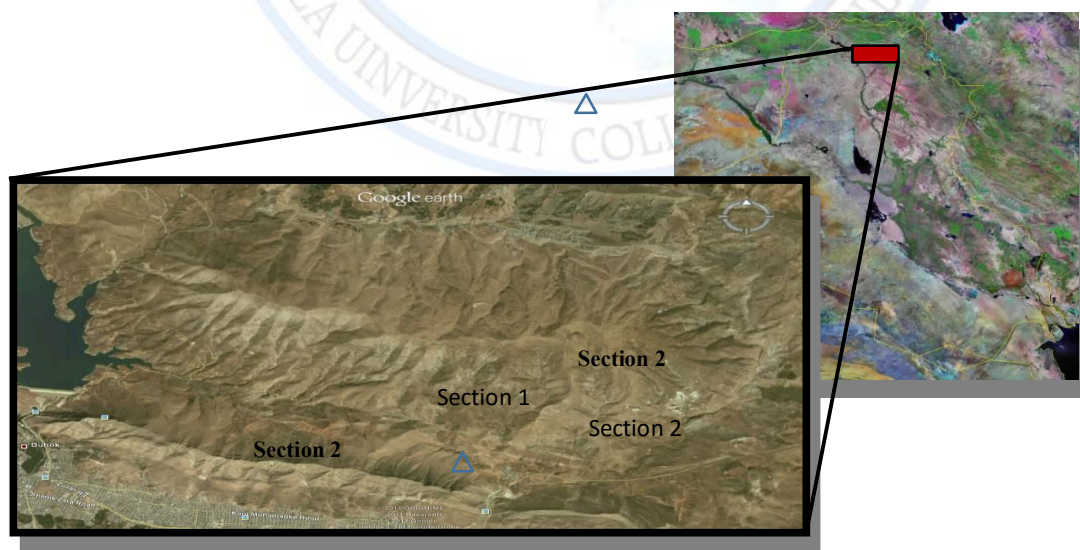
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relationships for the alternative events on the earth are considered as one important fields within earth sciences. The results of these studies will provide an increasing knowledgement concering the ecological and biological changes that happened on the earth through out.

Both evolution and changes in local environment can cause the appearance or disappearance of species, thus the time significance of a particular index fossil must be demonstrated regionally through distinctions made between local environmental effect and time significant events. Environmental effects may bring about the appearance/ disappearance of a species because of local conditions, whereas time significant effects may bring about the appearance / disappearance of a species because of evolution, extinction or regional migration (Li *et al.*, 1999)

**Location of the study area:**

The study area is located at longitudinal lines (42° ,32' ,00" ) and (43° , 09' ,49" ) east and latitude line (36° , 53' , 50" ) and ( 37° , 09' , 55" ) north , where two sections were chosen ,fig(1) .The study area contains non symmetrical anticline fold with double plunging, it is called ( Bekheir fold ) in north of Iraq , east of Mosul city 60 km , north of Dohuk city, this area is located in high folded zone ,the location of field work in south east of this fold .



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## **Methodology**

**Field work:** which consisted of field exploration to determine sections that had been sampled, then sampling of studied sections .

**Laboratory and office work:** which contained

- a) Making thin sections for samples in applied geology atelier by:
  - Cutting samples by cutter machine.
  - Then make grinding and polishing by grinding and polishing machine after the cutting of sample which attached to the slide.
- b) Study the thin sections under microscope to realize the aims of study

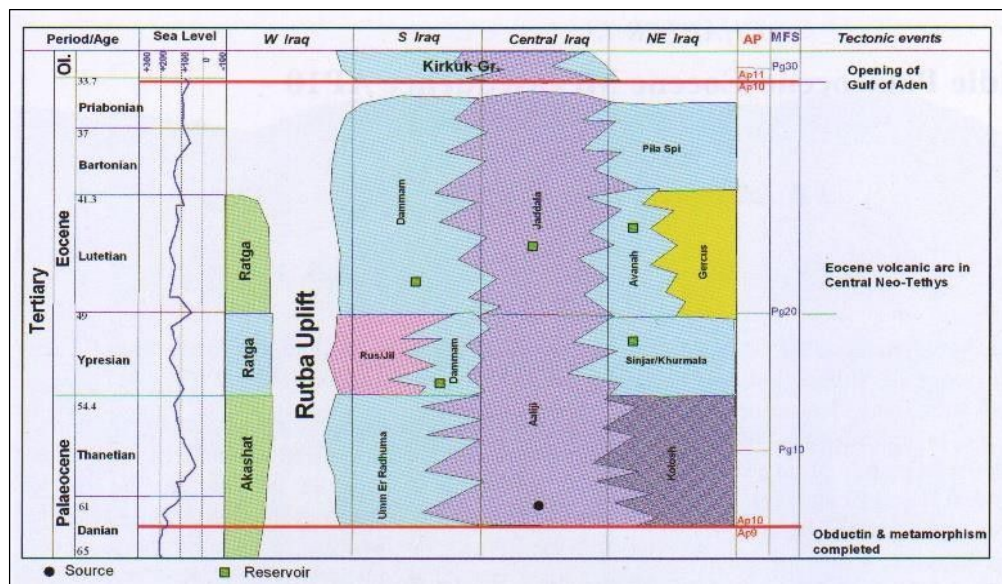
## **Aims of the study**

- 1- Determination of fossils in the studied samples.
- 2- Study of the stratigraphy of Pilaspi Formation in studied area.
- 3- Paleoecology and basin analysis depending on faunal content.

## **Stratigraphic Setting**

The Middle Palaeocene- Eocene Megasequence AP10 was deposited during a period of renewed subduction and volcanic arc activity associated with final closure of the Neo-Tethys, (Jassim and Goff 2006). Ditmar and the Iraqi-soviet team (1971) recognized an important regional unconformity at the base of the Middle Eocene. However this unconformity is here recognized as a sequence boundary. The megasequence boundary is placed in the following Latest Eocene (Sharland *et al.*, 2001). The Middle Palaeocene - Eocene Megasequence (AP10) is divided into two sequences: The Palaeocene-Early Eocene and Middle Late Eocene sequence. The stratigraphic column of megasequence AP10 is shown in (Fig 2)

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**Figure (2) Stratigraphic Correlation of the formations of Megasequence AP10 (Jassim and Goff 2006)**

The Mid-late Eocene sequence was deposited to the SW of an emergent uplift during the final phase of subduction and closure of the remnant Neo-Tethys ocean, Red beds were deposited in the basin to the NE of the uplifted area, Red bed clastic were also deposited in a narrow intermontane basin, between the uplifted area in the NE and a ridge located along the NE side of the Balambo- Tanjero zone running from Amadiya in the NW through Ranya Sulaimaniya and Halabja in SE.

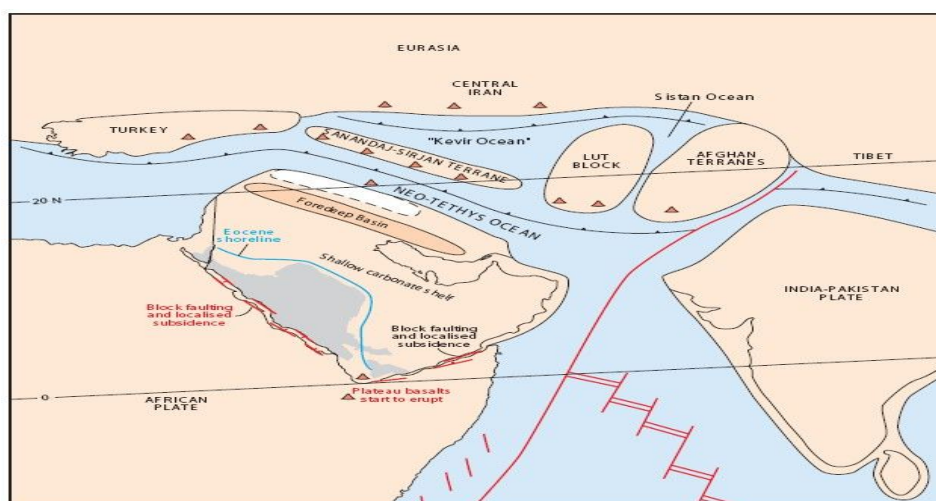
A strongly subsiding trough, in which the molasse of the Gercus Red Beds was deposited, formed southwest of the Balambo- Tanjero zone ridge. At the end of the Mid Eocene the clastic sediment supply from the uplifted area to the NE ceased and the basin was filled with lagoonal carbonates of the Pila Spi formation

The foredeep basin of the Middle and partly Late Eocene was separated from the basin to the SW by a belt of nummulitic shoals (Avana Formation). The foredeep basin was located in the present day Butmah- Chemchemal subzone of the Foothill Zone and extended into Syria and SE Turkey in the NW (Ponikarov *et al.*, 1967) and into SW Iran in the SE. The

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central open marine basin was located in the Mesopotamin Zone, parts of the Mosul High the Jezira subzone (Jaddala Formation) extending to the area of Rutba. The Rutba basin in the N and W shores of the Ga'ara anticline contained phosphate and silica-rich waters resulting in the deposition of phosphorites in addition to open marine Carbonates and nummulitic shoals. The Mid-Late Eocene sequence is represented by the Dammam Ratga, Avanah, Jaddala Pila Spi and Gercus Formation .



**Figure (3) Early Palaeogene to Latest Eocene (63-34 Ma) mild compression and closure of Neo-Tethys (Sharland *et al.*, 2001)**

### **Pilaspi Formation**

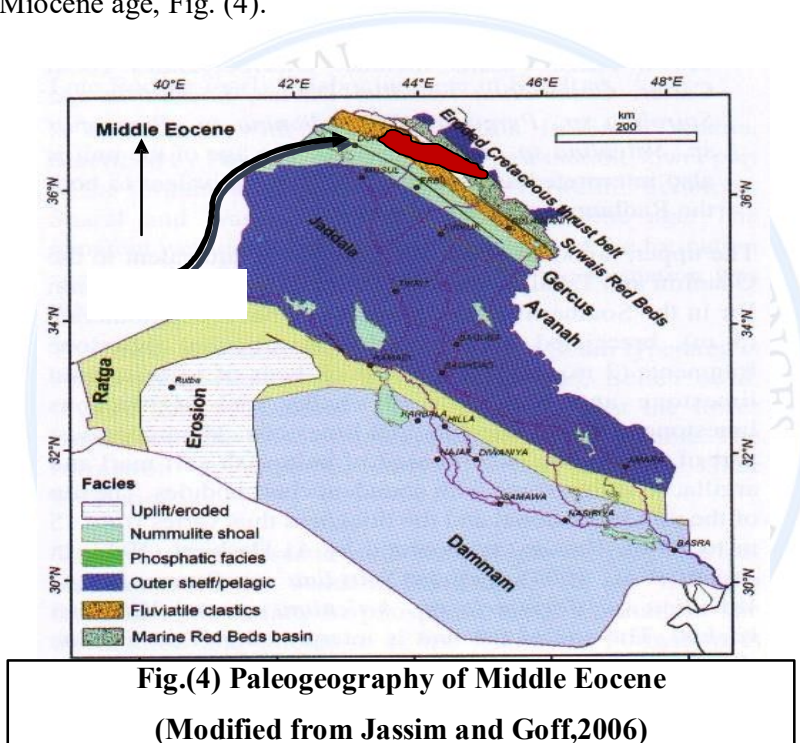
The lower part comprises well bedded hard, porous or bituminous, white, poorly fossiliferous, limestone, with algal or shell section. The upper part of the formation comprises well bedded, bituminous, and crystalline limestone, with bands of white chalky marl and with chert nodules towards the top. In the supplementary type section it consists of dolomitic and chalky limestone with chert nodules.

The Limestones are sometimes oolitic with rare layers of gastropod debris (Bellen *et al.*, 1959). Tongues of the nummulitic Avanah Formation occur within the basal part of the formation near Duhok and in some Kirkuk wells. It was deposited in shallow lagoon. Fossils

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are abundant and indicate a late Eocene age. In N Iraq the formation may be partly of Middle Eocene age. The lower boundary of the PilaSpi Formation appears to be conformable and gradational in the original type section in NE Iraq and near Amadiya in N Iraq, where interfingering of the Gercus and PilaSpi was observed (Hall, 1957 in Jassim and Goff 2006). However conglomerate occurs at the base of the formation in the Derbendikhan area (Jassim and Goff, 2006). The upper boundary is unconformable throughout. The overlying sediments are mostly of Miocene age, Fig. (4).



**Lithology of Pilaspi Formation in Geli Pesri section**

The first section lies in Geli Pesri with thickness (165m.) where it comprises of well bedded limestone, chalky and crystalline, with bands of pale green marl or white chalky marl; bands of chert nodules towards the top, traces of fossils, lower part shows well bedded limestone, hard though of chalky appearance, porous or white, poorly fossiliferous, algal and shell of unidentified taxa, Fig. (5).

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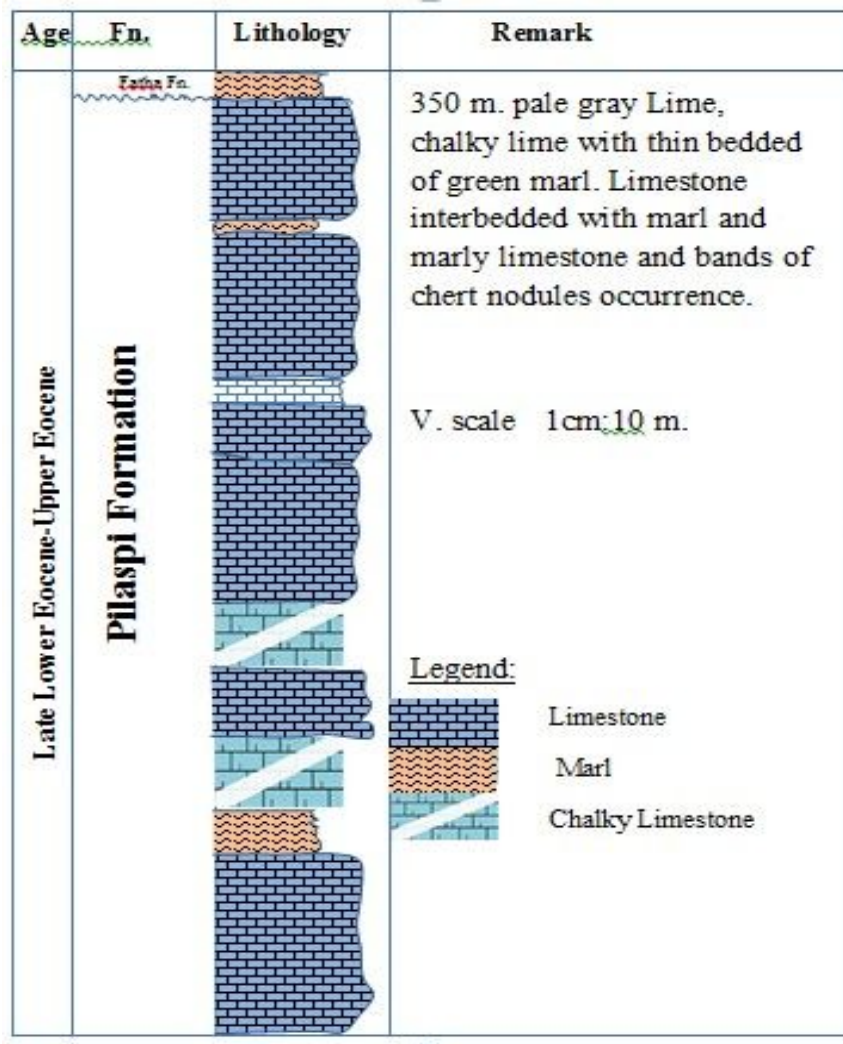


Figure (5) Statigraphic column of Pilaspi Formation in Geli Pesri section

**Lithology of Pilaspi Formation in Bajlor section:**

The second section of Pilaspi Formation lies near Bajlor village with thickness (116 m.) where it comprises of dark limestone and dolomitic limestone with high digenesis in almost parts of this section ,Fig.(6)



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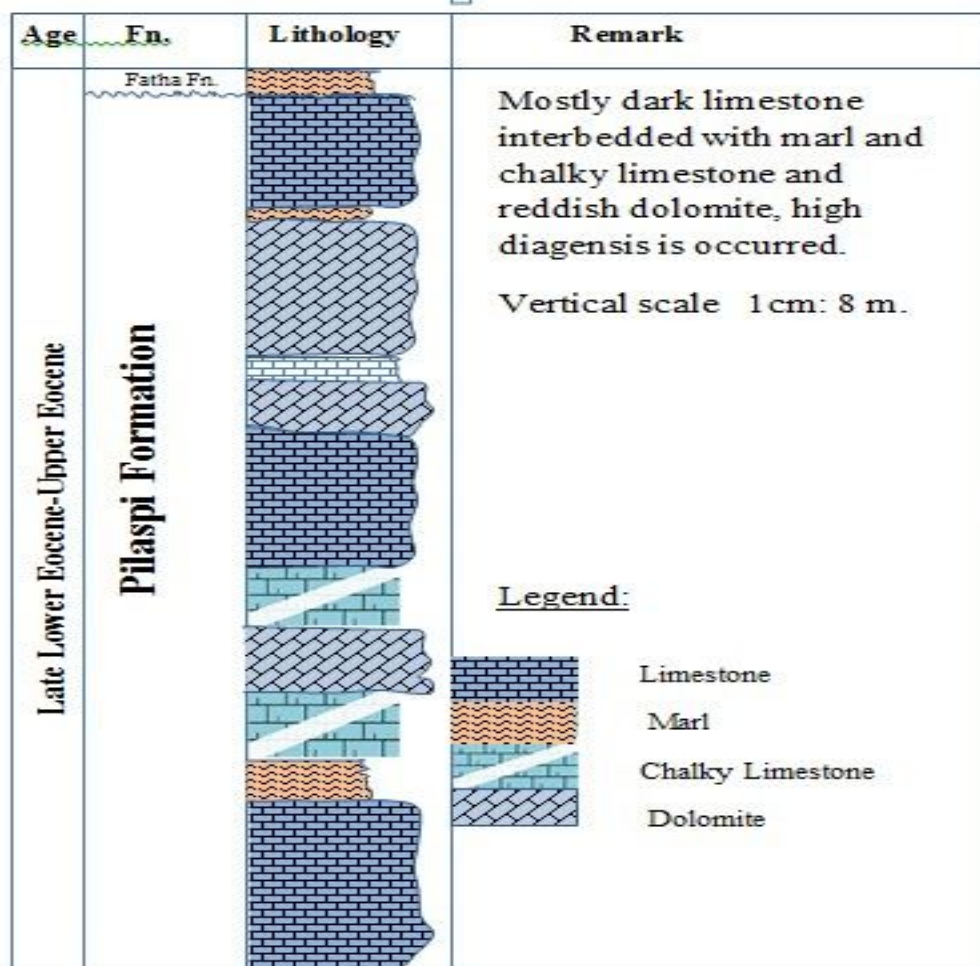


Figure (6) Stratigraphic column of Pilaspi Formation in Bajlor section

Paleontology

Benthonic Foraminifera was depended in most studies when planktonic disappear, like shallow marine sediments; therefore, in the present study they are used where Pilaspi Formation environment range from shallow lagoon to open marine environment sometimes.

**Paleontology of Pilaspi formation in Geli Pesri Section**

Many taxa had been identified within this section where it consist of limestone as a main unit, and this Lithology suitable for contain and preserved many of fossils .

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The following fossils had been distinguished after making thin section from rock sample which taken from the studied section:

Miliolids, *Peneroplis dusenburyi*, *Nummulites bayhariensis*, *Praerhapidionina huberi*, *Pyrgo* sp., *Rhapidionina urensis*, *Rhapidionina williamsoni*, Valvulinds, *Lithothaminuim* sp., unidentified taxa, Echinoids, Coral, Gastropoda.

It should be mentioned that Pilaspi Formation in this section interfingers with limestone with *Nummulites bayhariensis* which refers to Avanah Formation.

#### **Paleontology of Pilaspi formation in Bajlor Section**

This section faced digenesis which destroyed the fossils which might be preserved in this column or may be another column. Any way few of taxa had been identified within this section as follows:

Miliolids, *Praerhapidionina huberi*, *Pyrgo* sp., *Rhapidionina urensis*, *Rhapidionina williamsoni*, Valvulinds, *Lithothaminuim* sp., unidentified taxa, Echinoids, Gastropoda.

Pilaspi Formation in this section isn't interfingering with another formation where the taxa in this section refers to Pilaspi Formation just.

#### **Paleoecology**

In a sense, paleoecology is ecology projected backward in time (Keller, 2004). Not only can paleoecologic studies provide answers to the basic paleontologic questions of why particular groups of organisms evolved as they did and what environmental pressures they were adapting to, but it can provide a basis and an approach to interpreting past oceans and climates (Keller *et al.*, 2007).

The most abundant faunas in present study are Foraminifera. The use of Foraminifera as proxies for sea level change and changing depositional environment, and approaches to

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Foraminiferal paleoecology are basic ideas borrowed from modern ecology and from the study of paleoslope distribution of Foraminifera (Sattam, 2010).

**Paleoecology of Pilaspi Formation in Geli Pesri section :**

The main content of fauna assemblage in Pilaspi Formation is Foraminifera , so it had better to discuss the Paleoecology of taxa that had been identified which belongs to Foraminifera .

The foraminiferal cells live as free benthonic or as stable on the bottom, another cells live as a planktonic within the upper parts of water. The foraminifera distribution is affected with environmental factors which are common in those environments, they represented by physical factors such as temperature and depth, chemical factors such as salinity and biological factors such as nourishment (Hallock and Glenn, 1986).

The depth distribution of marines is determined through exchanging of environmental factors with the variation of depth such as temperature, light, oxygen concentration etc. Generally the foraminifera is known at shallow water continuous to the depths at 5000 m or more, but the benthic foraminiferal larger distribution lie within the shallow area which its depth is less than 200 m because of the exemplary conditions. The distribution of foraminifera with argillaceous shells decreases at the high depth and the foraminifera with shells assemblage is common at the depth 3000 m. The planktonic foraminifera at the far water from the coast has its larger distribution from the water surface to the depth 200 m, it occasionally may found at 1000 m (Keller,2004). The Miliolidae are a foraminiferal group having small requirements in respect of water salinity, for they may be found in both salt and brackish waters, but their occurrence is frequently restricted to only certain depths and temperatures, It is good indicators to shallow depth especially marine waters (Sattam.2010). (Ghose, 1977) shows that the Miliolids varies are referd to back-reef lagoons and reef flat. The Miliolids are abundant in the soft sand deposits. it rare at the deep water and abundant at depths 6-9 m at the back-reef (Al-Mutawli,1992), generally the small foraminifera prefer the reef margin area, in fact, the back reef area has the best vary of small foraminiferal assemblages.

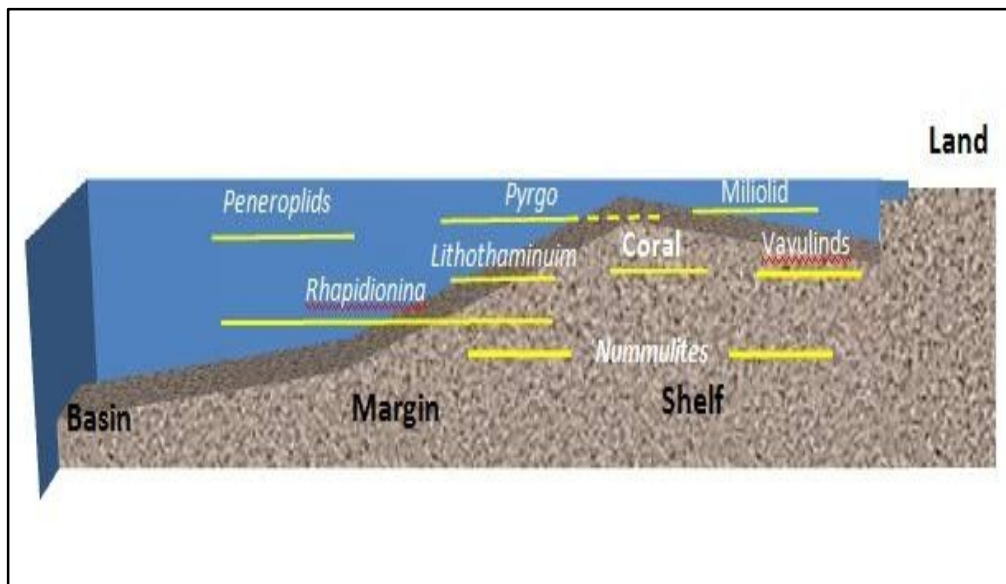
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*Nummulites* assemblage presence is refer to shallow environments within depths 30-150 m (Berggren,*et al.* 1988).Hanson in (1950) detailed that Nummulitids, especially *Nummulites* sp. with large shapes live in the shallow fore-reef area. This group is rare in the deep water, but it found in the coastal lake area. Sattam in (2005) showed up that *Nummulites* sp. assemblages may form the Nummulitic bank because of sea currents and waves that remove the fine materials and accumulate *Nummulites* fossils.

Al-Hashimi in (1977) showed up that the wide spreading and assembling of *Nummulites* sp. may cause a reef built at less than 50 m depths in the marine water , (Ghose, 1977) detailed that *Nummulites* sp. is usually common in all reef facies except the reef core and coastal lakes center (lagoon), that mean these species can live in various accommodations and have high capacity to stand up to the noise, salinity and turbulence .Red algae (*Lithothamnium*) refers to fore reef environment ,while Coral intend to grow in carbonate reef environment (Haq &Boersma,1978) .

Peneroplids refers open marine environment and *Rhaphidionina* prefer to live in fore reef to open marine environment (Keller, *et al.*, 2007). Depending on all these studies, Paleoecology of Pilaspi Formation could be reconstructed as in block diagram, Fig. (7).

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**Figure (7) Block diagram of Pilaspi Formation paleoenvironment in Geli Pesri section**

**Paleoecology of Pilaspi Formation in Bajlor section :**

The main content in this section is Foraminifera and calcareous algae where there is little occurrence of fauna compared with the first section due to diagenesis process .

Miliolids is abundant in shallow marine environment less than 40-50 m. (Sattam, 2005). Peneroplids refers open marine environment and *Rhabidionina* prefer to live in fore reef to open marine environment (Keller, *et al.*,2007) .

Depending on faunal occurrence, it could be said that Pilaspi Formation in this section was deposited under depths more than in the first section, and model of paleoecology could be reconstructed as in Fig. (8)

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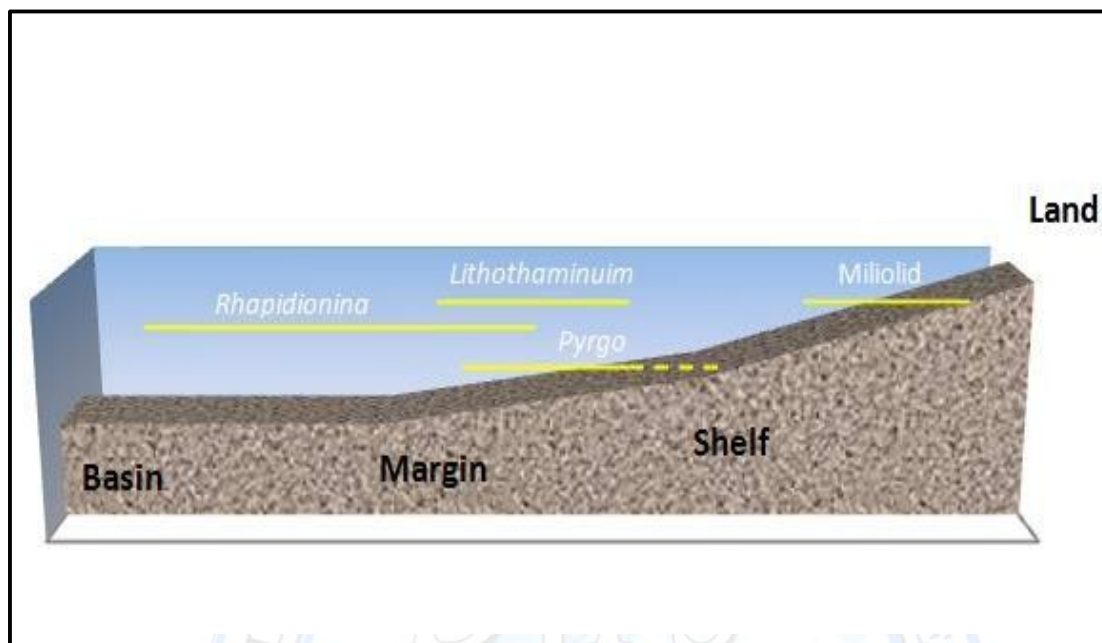


Figure (8) Block diagram of Pilaspi Formation paleoenvironment in Bajlor section

### Conclusions

- 1- Laterally, Pilaspi Formation passes southwest wards into the Avanah limestone Formation with interfingering in the transitional zone.
- 2- The variation in thickness due to the location of Pilaspi Fn. relative to basin .
- 3- The diagenesis process in Pilaspi Fn. varied from place to place depending on location and conditions against this formation .
- 4- According to above ,it can be said that the basin became shallow at south-east and more depth toward north-west .

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