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paleoenvironment of Kometan Formation (late-Turonian -Early Campanian) Sulaymaniyah_northeastern Iraq

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ABSTRACT

The Kometan Formation is widely distributed in the northern and central Iraq, the studied area includes two sections: the Kosrat anticline and the Khalkan anticline sections. The formation consists of dolomitic limestone and limestone as well as three microfacies have been discovered, (lime mudstone, wackestone, packstone microfacies), the wackestone microfacies is divided in to three submicrofacies (planktonic foraminiferal lime wackestone, keeld planktonic foraminiferal lime wackestone and calcisphere planktonic foraminiferal lime wackestone), while the packstone microfacie studies is divided in to tow submicrofacies (planktonic foraminiferal lime packstone and calcisphere foraminiferal lime packstone).

All the sedimentary and fossil evidence refer that the sedimentary environment of the formation is the outer shelf to upper bathyal at the lower and upper parts of formation and its extension to the middle bathyal in the middle part of the formation. Freidman and Reekman 1982.

Keywords: Kometan Formation, Microfacies, Kosrat anticline, Khalakan anticline.

1. Introduction

The Kometan Formation was first described by (Dunnington, 1953 in Bellen *et al.*, 1959) in the type section selected in Ain Dazah and the villages of Kometan, located in north Iraq, the type section is composed of thin layers of gray light limestone deposition. Thickness is about 36 meters. It is also characterized by partial silicification by chert nodes in some layers of grains of glauconite mineral are contained in some lower layers. The lower contact unconformable with two underlying formation, the Gulneri and Qamchoqa (Bellen *et al.*, 1959). Al so the upper contact with Shirinish Formation unconformable too, where it , consists of pebbly sandstone with green glauconite minerals.(Karim *et al.*, 2008), the age of the Kometan Formation determined as L.Turonan - E.Campanan (Youkhanna, 1976 ; Al-Khafaf, 2005). Two sections are selected for this study the first section within the Kosrat anticline about (1)km from the dam site with coordinates (44° 57' 31" E) (35° 59' 36" N) within the intersection of the imbricated zone and the high folds zone, the region of the fold is about (200) km. The second section is located at (44° 45' 52" E) (36° 02' 00" N) within the Khalkan anticline in the High fold zone (fig1).

Tectonically, the study area is located within Zagros belt in the High Folds zone, the Zagros belt represents the deformation resulting from the collision between the Iranian and Arabian plates, which extends about 2000 km from southeast Turkey and southern Iran to

northern Iraq (Lawa *et al.*, 2013; Fouad, 2014). According to (Bignot, 1985), the *Globigerinelloides* and *Globotruncana* are common in the Kometan Formation deposits among the fossils indicative of (Late Cretaceous sequences), (Abawi and Hammodi, 2004). usually abound in open marine sediments. The formation content deposited of limestone, dolomite also chert that is spread in the two section.

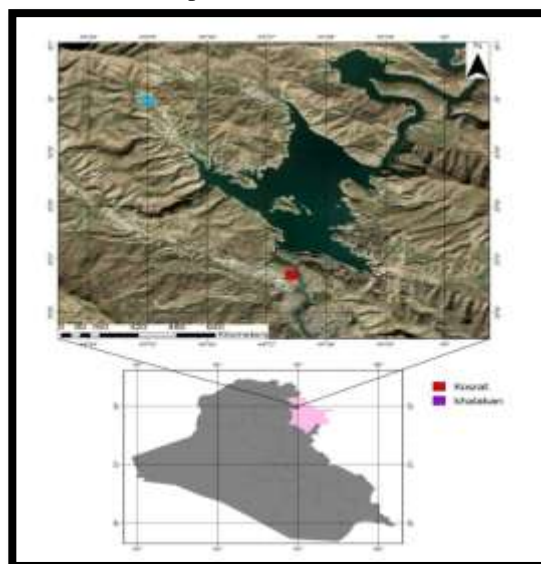


Fig. 1: map of the study area

2- Methods

The fieldwork included a description of all field phenomena in the outcrops, including the thickness of the beds, studying the nature of the contact surfaces between them, the toughness, color, and other physical characteristics as well as following the

lateral and vertical changes of the beds and recording all the sedimentary structures that they may contain, The section kosart consists of 30 sample and khalkan section consists of 20 sample (pl.1). then studied in the laboratory by polarizing microscope.

Plate 1



Plate (1) : (A): upper contact with Shiranish Formation.(B)lower contact with Guluri Formation. (A,B) in khalakan section. (C) : the upper contact with Shiranish Formation.(D)lower contact with Qamchoqa Formation.(C,D) in kosort section.

3- Microfacies Analysis

The microfacies important for determining the depositional environment dependent on the fossils content. According to (Dunham, 1962) classified of carbonate rocks through determining the microfacies, and comparing them with standard microfacies of (Wilson, 1975 and Flügel, 2004). According of accurate diagnosis the content of the thin sections, three microfacies have been determined they are : lime mudstone, lime wackstone and lime packstone microfacies ,which are subdivided into five submicrofacies it is (planktonic foraminiferal lime wackstone, keeld planktonic foraminiferal lime wackstone, calcisphere planktonic foraminiferal lime wackstone) and (planktonic foraminiferal lime packstone and calcisphere foraminiferal lime packstone). figs(3 and 4).

3-1 Lime mudstone microfacies (M)

The proportion of skeletal components is less than 10% of its total components, the floating foraminifera with spherical chambers and small volumes, from the *Heterohelix* and some *Globigerinelloides* in the micrite matrix, this microfacies is discovered in the (lower part and upper part) of the Kometan Formation

in section Khalakan, It has thickness about 6 meter. According to Flügel (2004) this microfacies is similar to SMF (3) within the FZ (3) were most common effective diagenetic processes, such as micritization and compaction, deposited in deep shelf margin. (pl.2 –A) .

3-2 Lime wackstone microfacies (IW)

The proportion of the particles of this microfacies is ranging from (10-40%) of the total components. They are represented by Planktonic and benthonic foraminifera, calcisphere, ostracoda and echinoderms. There is also a high percentage of crystals of pyrite mineral, this microfacies is divided into three submicrofacies.

Planktonic foraminiferal lime wackstone submicrofacies (LW1)

This submicrofacies is considered as the most spread among other microfacies, the submicrofacies is ranging between 10–40% the fauna content are globular foraminifera like *Globigerinelloides* and *Heterohelix* , (pl.3- A and D), and some benthonic foraminifera *Nodorsia*,*Texularia* (pl 3,E and F). The microfacies most common diagenetic processes in this microfacies is compaction and micritization.

According to (Wilson, 1975 and Flügel, 2004) , the microfacies corresponds to SMF (8) within the FZ (2) (Pl.2-B) and deposited in open sea shelf environment.

Calcisphere planktonic foraminiferal lime wackestone submicrofacies(LW2)

This microfacies was noticed in the middle part of Khlakan section, and in the upper part in Kosart section. In thin to medium bedded limestone unit. It was dominated by planktonic foraminifera *Globigerinelloides* and calcispheres (Pl. 3-B) as the main skeletal grains and minor amount of ostracoda. The dominant diagenetic processes affecting this microfacies are dissolution, micritization and pyratization (Pl.2-C). This microfacies is equivalent to SMF (3) of (Wilson, 1975 and Flügel, 2004) FZ (3), and deposited in deep shelf margin environment.

Keeld planktonic foraminiferal lime wackestone submicrofacies (LW3)

This microfacies appeared in the middle part of the formation in Kosrat section and upper part in Khalkan section, it is composed of keeled planktonic foraminifera, about 30% in matrix. The existence of species that contain keel as *Globotruncana*, (pl. 3-C). indicates deep marine environments within the upper slope. This microfacies is equivalent to SMF (10) of (Wilson, 1975 and Flügel, 2004) FZ (2) (pl. 2-D). which deposited in open sea shelf environment. The microfacies was most common diagenetic processes like Physical compaction and micritization.

3 – 3 Lime packstone microfacies (Lp)

This microfacies is components, constitutes 40-60% of the total skeletal components of this microfacies and they are of well-preserved forms characterized by natural sizes and good sorting and back to the races *Globotruncana*, *Heterohelix*, *Hedbergella*, *Globigerinelloides*, *Dicarlana*. This microfacies composed of two submicrofacies.

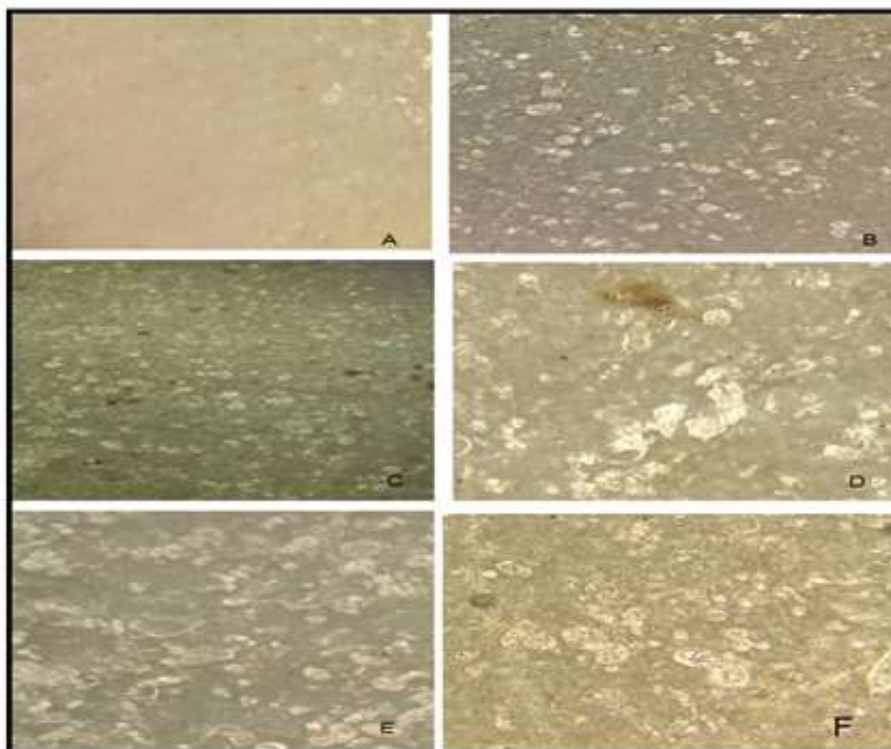
Planktonic foraminiferal lime packstone submicrofacie (LP1)

This sub microfacies is observed in the middle part of the formation in Khalakan section and in the part lower in Kosart section. Although it appears in other units of the section. It was rich *Globigerinelloides*, *Heterohelix* in with some calcispheres indicates relatively deep marine environments. The common diagenetic processes are micritization, fracturing . This microfacies is equivalent to SMF (8) of (Wilson, 1975 and Flügel, 2004) FZ (2) (pl. 2-E) and deposited in open sea shelf environments.

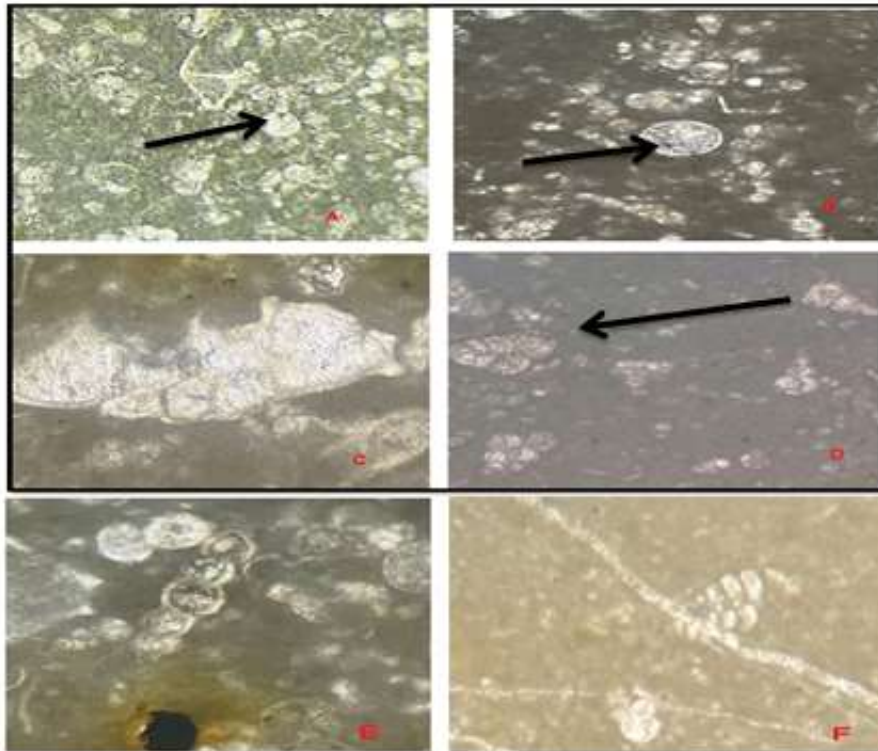
Calcispher lime packstone submicrofacies (LP2)

This microfacies are distinguished in the upper part of the formation in Kosort section and in the middle-upper part in the Khlakan section. It was dominated by of *Calcispheres* with rare skeletal grains. The diagenetic processes are compaction, glauconization and little micritization. this microfacies is equivalent to SMF (3) of (Wilson, 1975 and Flügel, 2004) FZ (3), and deposited in deep shelf margin environment. (pl.2-F).

Plate 2



A: Lime mudstone microfacies (10X) - B: Planktonic foraminiferal lime wackestone submicrofacies (LW1) (10X),-C: Calcisphere Planktonic foraminiferal Lime Wackestone Submicrofacies(LW2),(10X)- D: Keeld Planktonic foraminiferal lime wackestone Submicrofacies (LW3) (10X)- E: Planktonic Foraminiferal Lime Packstone Submicrofacies (10X) - F: Calcispher Lime Packstone Submicrofacies (LP2) (10X)



A- Genus of *Globigerinelloides* with swollen spherical chambers, magnification (10X). B: Calcispher (40X)- C: of *Globotruncana*, (40X)- D- *Heterohelix* with double-chain shells and spherical chambers (10X)- E- *Nodorsia*(40X)- F :*Texularia*(10X).

4 - Depositional Environment of Kometan Formation:

The determining of the sedimentary environment of the Komitan Formation, based on the study of sedimentary evidence, fossil content and microfacies analysis. Figure 2 explain depositional model of Kometan Formation.

1- The microfacies analysis showed the filling of the ground base of the slides consisting of micrite, which indicates that it is a mud supported microfacies and deposited in quiet environments with low energy, and below the level of the effective wave base level. (Kaiho *et al.*, 1993)

2-planktonic foraminifera (*Globigerinelloides* and *Heterohelix*) are more existing than benthonic foraminifera, and this indicates the deep marine environment far from the coast (Freidman and Reekman, 1982).

3-The presence of *calcispheres* with the Planktonic foraminifers' shells indicates the deep calcareous marine environment (Gibson, 1989)

4-Bioclasts are in a small percentage, and the record of their presence is derived from, which indicates the

deep marine environment with low energy (Folk, 1959).

5-Benthonic skeletal fossils are few in the studied formation, thus indicating a deep sedimentary environment (Luger, 1985).

6-Presence of planktonic foraminifera with carnivorous chambers with foraminifera with spherical chambers is evidence of deep sedimentary environment (Kotsoukos and Hart, 1990).

7-The common of the planktonic foraminiferal species that owns the keeled as (*Dicarinella imbricata*, *Marginotruncana*). The spread of these species within this section is evidence of deep marine environments within the slope (outer shelf to upper-middle bathyal environments with water depth 150-1500m. (Ameen and Gharib, 2014; Jaff and Al-Khatany, 2020).

8- This microfacies corresponds to the standard microfacies (SMF8) located within the (FZ2) zone known as open marine environments within the outer shelf and upper slope according to the Wilson (1975) or the range of the deep shelf according to the Flügel (2004).

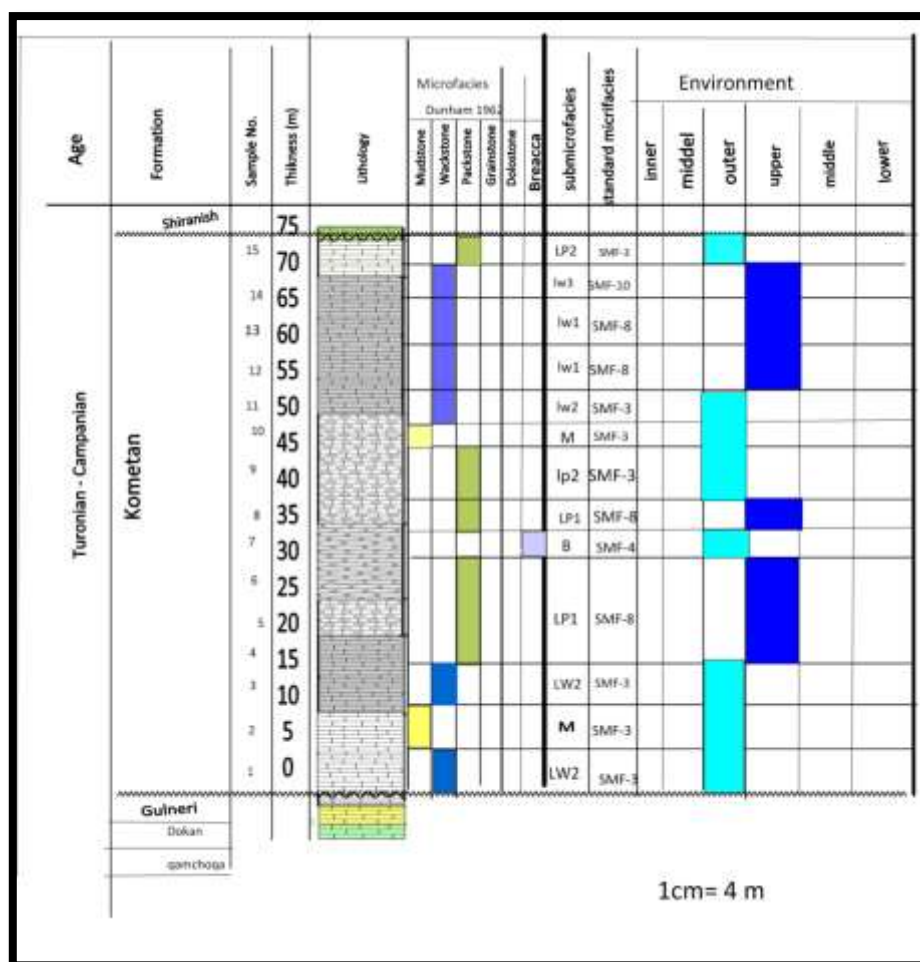


Fig. 4: Stratigraphic column in Khlakan section

5. Conclusion

1- Microfacies analysis show that the Kometan Formation consist of three microfacies, (lime mudstone wackestone, packstone microfacies), these microfacies are divided into five submicrofacies where the wackestone microfacies includes three submicrofacies (planktonic foraminiferal lime wackestone, keel planktonic foraminiferal lime wackestone, calcisphere foraminiferal lime wackestone) while the packstone microfacies two submicrofacies (planktonic foraminiferal lime

packstone and calcisphere foraminiferal lime packstone).

2- The microfacies are rich in planktonic foraminifera and micrite.

3- According microfacies analysis and fossils, the depositional environments of formation outer shelf and upper and middle bathyal zone . Freidman and Reekman, 1982.

4- The Kometan Formation consists of limestone and dolomitic limestones, which have cherts nodules throughout the formation. and consists of dark brown gradient to light.

References

Abawi T. S., and Mahmood, S. A. (2004): Biostratigraphy of the Kometan and Gulneri Formations (Upper Cretaceous) in Jambur well No.46, Northern Iraq, Iraqi Jour. Earth Sci., Vol.5, No.1, PP.1-8
Al-Khafaf, A.O., 2005. Stratigraphy of Kometan Formation (Upper Cretaceous) in Dokan-Endezah Area, NE Iraq Unpub. M.Sc. Thesis, University of Mosul, 79pp
Ameen, F. A., and Gharaib, H. 2014. Biostratigraphy of the Tethyan cretaceous successions from northwestern Zagros fold-thrust belt, Kurdistan

region, NE Iraq. Arabian Journal of Geosciences, 7(7), 2689-2710.

Bellen, R. C. van, Dunnington, H.V., Wetzel, R. and Morton, D., (1959). Lexique Stratigraphique International Asie, Iraq, Fasc. 10a, Paris, 333pp

Bignot, G., (1985) : Elements of micropaleontology, microfossils-their geological and paleobiological applications, Graham and Trotman Limited, London, 218p.

Fouad, S.F.A., 2014 Western Zagros Fold-Thrust Belt, PartII: The High Folded Zone. Iraqi Bulletin of Geology and Mining, Special Issue, 6, pp: 53-71.

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- Flügel, E., 2004. *Microfacies of Carbonate Rocks: Analysis, Interpretation and Application*. Springer, Berlin, 976 pp.
- Folk, R. L., 1959. Practical petrographic classification of limestone. *AAPG. Bull.*, Vol. 43, No. 1 pp. 1-38.
- Friedman, G. M., Reekman, A., 1982. *Exploration for Carbonate Petroleum Reservoirs*, Elf- Equitatine Centers de Recherche de Boussenset et de pau, John Wiley and Sons. New York, 213 pp.
- Gibson, T.G., 1989: Planktonic benthonic foraminiferal ratios: Modern patterns and Tertiary applicability. *Marine Micropaleontology*. Vol. 15, pp. 29-52.
- Irfan, Sh. A. 2007. Sedimentology and Stratigraphy of Kometan Formation (Upper Turonian- Lower Campanian), in the Kometan Village - Imbricated Zone Iraqi Kurdistan Region, Salahaddin University, Erbil, Iraq: 95 pp.
- Jaff, R. B. and Al-Khatany, K. 2020. Coniacian/ Santonian calcareous nannofossil and planktonic foraminifera in the Kurdistan Region, NE Iraq: biostratigraphy and bioevents. *Arabian Journal of Geosciences*, 13 (18), 1-12.
- Karim, K. H.; Khalid, M. I. ; Bakhtiar, M. A., 2008. Lithostratigraphic study of the contact between Kometan and Shiranish Formations (Cretaceous) from Sulaimaniyah Governorate, Kurdistan Region, NE Iraq. *Iraqi Bulletin of Geology and Mining*, 4(2), 16-27.
- Koutsoukos, A. M. and Hart, M. B., 1990. Cretaceous foraminiferal morphogroup distribution patterns palaeocommunities and trophic structures: A case study from the Sergipe Basin, Brazil. *Transaction of the Royal Society of Edinburgh: Earth sciences*, Vol. 81, pp. 221-246.
- Kaiho, K.; Morgans, H. E. and Okada, H., 1993. Faunal turnover of intermediate – water benthic foraminifera during the Paleogene in Newzealand, *Marine Micropaleontology*, Vol. 23, pp. 51 – 86.
- Luger, P., 1985. Stratigraphie dre marinen ob erkreide und des Alttertiars in sudwestlichen Oberrnil –Bechen (SW-Egypten) unter besonder Berucksichtigung, *Micropaleontologic, Paleocologie and Paleogeographie Berliner geowiss. Abh.*, Ae 63, 151P.
- Lawa, F.A. ; Koyi, H. and Ibrahim, A., 2013. Tecton -stratigraphic evolution of the NW segment of the Zagros Fold-Thrust Belt, Kurdistan, NE-Iraq. *Journal of Petroleum Geology*, 36 (1), 75-96.
- Youkhanna, A. K., 1976. *Foraminifera and biostratigraphy of some Late Cretaceous marine sediments of North-East Iraq*, University of Wales (Swansea), Unpublished Ph. D. Thesis, 318 pp
- Varol, O., 1991. *New Cretaceous and Tertiary Calcareous nannofossils*.
- Wilson, J.L. 1975. *Carbonate facies in geologic history*. New York. Springer–Verlag, 471P.