

Stratigraphy of the Gulneri Formation (Upper Cretaceous) in the Type Section, Dokan Area, Northeastern Iraq

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ABSTRACT

Eight planktonic and six benthonic foraminiferal species were recorded from the type section of the Gulneri Formation at the site of Dokan Dam, Dokan area, northeastern Iraq. The sediments of the Gulneri Formation consist basically of organic-carbon rich black shale and represent a record of the ocean anoxic event 2 (OAE2) across the Cenomanian-Turonian boundary. The planktonic foraminiferal assemblages of the Gulneri Formation indicates an Early Turonian age for the formation .

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INTRODUCTION

The Gulneri Formation was first described by Lancaster Jones in 1957 (Bellen et al., 1959) from the site of the Dokan Dam in the High Folded Zone in northeastern Iraq. According to the original description, the formation is 1.1 to 1.2 m thick, consists of black, bituminous, finely laminated, calcareous shale with some glauconite and collophane in the lower part and should be of Early Turonian age. Bellen et al., (1959) reported the following fossils from the Gulneri Formation in its type section : *Rotalipora* cf. *appenninica* Renz, *Globotruncana helvetica* Bolli, minute globigerinids, gumbelinids, fish detritus indet, small bicarinate *Globotruncana* spp.

According to Buday (1980) the Gulneri Formation represents the sediments of a relict sea that existed between the regression in the Cenomanian and the transgression in the Turonian. Buday (1980) stated that the depositional basin of the Gulneri Formation was euxenic based on the evidence of the high bitumen content and the dwarfing of the fossils .

Abawi and Hammoudi (1997) studied the foraminiferal biostratigraphy of the Gulneri Formation in Kirkuk area and assigned it to Late Turonian age .

According to Abawi and Mahmood (2005) the Gulneri Formation in Jambour well no. 46 (northern Iraq) is Middle to Late Turonian in age .

The present paper intends to give an account of the stratigraphy, the foraminiferal fauna and the paleoenvironment of the Gulneri Formation as exposed in the type section at the site of the Dokan Dam, northeastern Iraq (Fig . 1)

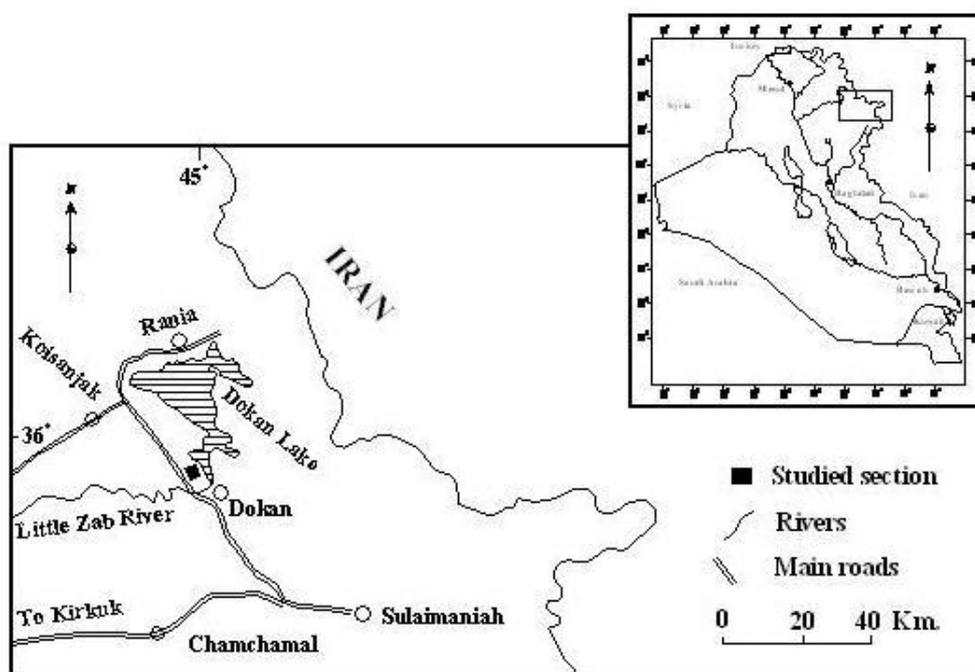


Fig.1: Location map

LITHOSTRATIGRAPHY

This investigation is based on material from the type section of the Gulneri Formation exposed about 200 m west of Dokan Dam , northeastern Iraq, at latitude 36° 40' N and longitude 45° 56' E. In the studied section the Gulneri Formation is 1.75 m thick and unconformably underlain by the Dokan Formation of Cenomanian age and also unconformably overlain by the Kometan Formation of Middle Turonian–Early Campanian age (Fig. 2) .



Fig. 2 :Gulneri Formation as exposed in the type section northeastern Iraq . Lower and upper boundaries of the formation are marked with black lines .

Seven rock samples were collected, at intervals ranging between 15-35 cm , from the studied section. Lithologically, the Gulneri Formation in the investigated outcrop is composed basically of black, organic-carbon rich, finely laminated shale. The lower part of the section is characterized by the occurrence of glauconite and limestone boulders . These limestone boulders are derived from the underlying Dokan Formation and they represent an oligosteginal limestone containing rich planktonic foraminiferal fauna.

Washed materials and thin sections from the collected samples were investigated with regard to their fossils content and microfacies.

Petrographic investigation of the studied material reveals that the sediments of the Gulneri Formation are mainly represented by two microfacies units following the classification of Dunham (1962) ; these are :

- Mudstone microfacies ,
- Foraminiferal wackestone microfacies .

A detailed measured section of the Gulneri Formation with a brief description of the lithology and location of the samples is presented in Fig. (3).

FORAMINIFERAL FAUNA

The Gulneri Formation in the study area yielded a relatively low diversified foraminiferal assemblage showing common abundance of individuals. The individuals are usually dwarfish; this is due to unfavorable environmental conditions of low oxygen sea water. Washed samples of the investigated material show badly preserved and corroded specimens. The occurrence of the foraminiferal fauna is almost restricted to the middle and upper parts of the formation, whereas the lower part of the formation is nearly barren.

Eight planktonic foraminiferal species belonging to four genera were recorded from the studied section. The heterohelicids dominated the faunal assemblages. The recorded species are: *Globigerinelloides ultramicra* (Subbotina), *Hedbergella delrioensis* (Carsey) , *Hedbergella planispira* (Tappan), *Heterohelix moremani* (Cushman), *Heterohelix reussi*

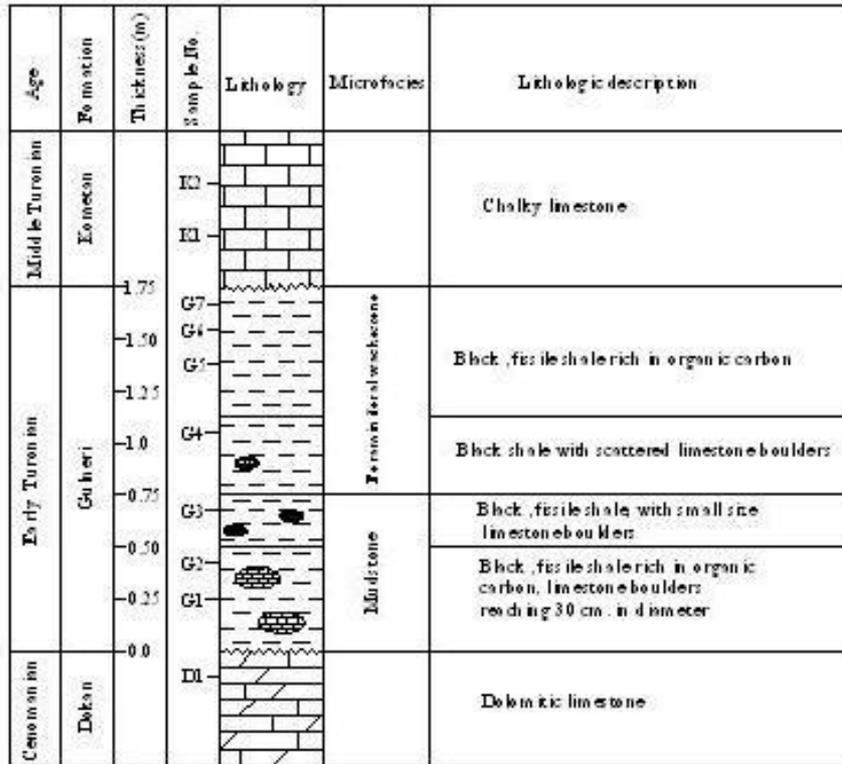


Fig.3: Stratigraphic columnar section of the Gubleri Formation, type section, Dokan Area, northeastern Iraq.

Vertical scale: 0.50 m, 0.25, 0.0

Fig. 3 : Stratigraphic Columnar Section of the Gulneri Formation, Type Section, Dokan Area, Northeastern Iraq.

(Cushman), *Whiteinella archaeocretacea* Pessagno, *Whiteinella baltica* Dougals and Rankin, *Whiteinella inornata* (Bolli).

In addition to above mentioned planktonic foraminifera the following benthonic foraminifera were identified: *Dorothia* cf. *bulletta* (Carsey), *Gaudryina* sp., *Gavelinella* cf. *baltica* Brotzen, *Lagena* sp., *Lenticulina* sp., *Silicosigmoilina* sp. The genus *Silicosigmoilina* Cushman and Church, (1929) is recorded for the first time from Iraq.

Investigation of thin section from the Dokan limestone boulders included in the Gulneri shale showed well preserved, abundant and well diversified microfauna (see appendix -1).

AGE DETERMINATION

In spite of the low diversification of the foraminiferal fauna recorded from the Gulneri Formation, an accurate age determination of the formation could be obtained. Following the planktonic foraminiferal zonal scheme of Keller and Pardo (2004), see Fig. (4), the occurrence of *Whiteinella archaeocretacea* above the last occurrence of *Rotalipora cushmani* (Morrow) and below the first appearance of *Helvetoglobotruncana helvetica* (Bolli) represents the *W. archaeocretacea* Zone of latest Cenomanian – Early Turonian age. *R. cushmani* is not recorded in the Gulneri shale. Nevertheless thin sections of the Dokan limestone boulders, included in the Gulneri shale, show occurrence of *Rotalipora* spp., (see appendix 1). Hence the occurrence of *Rotalipora* cf. *appenninica* Renz, which is registered by Bellen et al. (1959) within the fossil assemblage of the Gulneri Formation, is actually derived from the limestone boulders.

| Keller & Pardo, 2004 | | | Present Study | | |
|----------------------|----------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------|--------------|-----------------|
| Age | Zonation | Datum events | Zonation | Formation | Age |
| Early Turonian | <i>H. helvetica</i> | ↑ <i>H. helvetica</i> | <i>H. helvetica</i> | X Kometan | Middle Turonian |
| | <i>W. archaeocretacea</i> <i>Heterohelix moremani</i> | | <i>W. archaeocretacea</i> <i>Heterohelix moremani</i> | X Gulneri | |
| Late Cenomanian | <i>D. hagni</i> | → <i>Heterohelix shift</i> ↑ <i>D. hagni</i> | | X Dokan | Late Cenomanian |
| | <i>G. bentonensis</i> | ↑ <i>G. bentonensis</i> | | | |
| | <i>R. cushmani</i> | ↑ <i>R. cushmani</i> | | | |

W = *Whiteinella*
H = *Helvetoglobotruncana*
D = *Dicarinella*
R = *Rotalipora*
G = *Globigerinelloides*

~~~~~ Unconformity  
 Not Studied

Fig.4: Correlation of the present zonal scheme with that of Keller & Pardo, 2004.

Fig. 4 : Correlation of the Present Zonal Scheme that of Keller and Pardo, 2004.

*Helvetoglobotruncana helvetica* is first recorded in this study immediately above the Gulneri / Kometan contact within the lowermost part of the Kometan Formation. Hence the present occurrence of *W. archaeocretacea* in this study represents the *W. archaeocretacea* Zone according to Keller and Pardo (op.cit.). The abundant occurrence of the heterohelicids in the studied samples indicates the *Heterohelix moremani* Subzone of latest Cenomanian to Early Turonian age (Keller and Prado, 2004). The occurrence of *Whiteinella inornata* in the studied material, which ranges from Early Turonian to Santonian (see Caron, 1985), excludes pre-Turonian age for the present formation. Accordingly the sediments of the Gulneri Formation in its type section are Early Turonian in age.

### PALEOENVIRONMENT

Marine strata rich in organic-carbon (black shale) deposited during the Cretaceous, representing oceanic anoxic events (OAE) has been discussed by many authors (Schlanger and Jenkyns, 1976; Jenkyns, 1980; Sliter, 1989). According to Schlanger and Jenkyns (1976) these oceanic anoxia resulted from widespread and expanded oxygen minimum zones linked to transgressive sea-level pulses and the reduced oxygenation of oceanic bottom water leading to deposition of organic-carbon rich black shale. Schlanger and Jenkyns (op.cit.) mentioned two ocean anoxic events during the Cretaceous, the long-term Late Barremian-Albian (OAE1) and the short-term Cenomanian-Turonian (OAE2) events. According to Schlanger et al., 1987 (Cited in Sliter, 1989), the Cenomanian-Turonian maxima of organic-carbon burial occurs mainly within a single planktonic foraminiferal zone, the *Whiteinella archaeocretacea* Zone.

It is obvious that the Gulneri section in the study area represents a sedimentary record of the oceanic anoxia across the Cenomanian – Turonian Boundary (OAE2). This fact is evident by the organic-carbon rich black shale that comprises the lithology of the Gulneri Formation. The dominance of the heterohelicids within the planktonic foraminiferal fauna of the Gulneri Formation indicates a low oxygen marine environment. According to Keller and Pardo (2004), heterohelicids thrived in low oxygen marine environments with well-developed oxygen minimum zone. The low diversified and dwarfish benthonic fauna of the Gulneri Formation also indicates unfavorable conditions of anoxic bottom water. According to Lamolda and Peryt (1995); Peryt and Lamolda (1996), the faunas from the oxygen minimum zone are characterized by low diversity and small size

### CONCLUSION

Sediments of the Gulneri Formation in the type area near Dokan, northeastern Iraq yielded low diversified foraminiferal fauna. The recognition of the *Heterohelix moremani* Subzone within the *Whiteinella archaeocretacea* Zone reveals Early Turonian age for the Gulneri Formation in the study area. The Gulneri sediments represent a record of the ocean anoxic event 2 across the Cenomanian-Turonian Boundary; this is evident by the low diversified and dwarfish foraminiferal fauna, the dominant occurrence of the low oxygen tolerant heterohelicids and the organic-carbon rich black shale of the Gulneri Formation.

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**Appendix -1** : Microfauna recorded from Dokan limestone boulders included in the Gulneri shale :

1- Calcispheres

2- Planktonic foraminifera :

*Globigerinelloides ultramicra* (Subbotina)

*Clavhedbergella simplex* (Morrow)

*Hedbergella delrioensis* (Carsey)

*Hedbergella planispira* (Tappan)

*Heterhelix moremani* (Cushman)

*Rotalipora brotzeni* (Sigal)

*Rotalipora cushmani* (Morrow)

*Rotalipora greenhornensis* (Morrow)

*Rotalipora montsalvensis* Mornod

*Schackoina cenomana* (Schacko)

*Whiteinella archaeocretacea* Pessagno

*Whiteinella baltica* Douglas and Rankin

*Whiteinella paradubia* (Sigal)

3- Benthonic foraminifera:

*Lenticulina* sp.

*Nodosaria* sp.

**Plate No.1**

- 1- *Whiteinella archaeocretacea* Pessagno, equatorial section, Sample no.G 6, X100.
- 2- *Heterohelix moremani* (Cushman), Sample no. G 6, X100.
- 3- Foraminiferal wackestone microfacies of Gulneri Formation, Sample no.G 6, X60.
- 4- *Silicosigmoilina* sp., Sample no. G 4, X70.
- 5- Mudstone microfacies of Gulneri Formation, Sample no. G 3 , X50.
- 6- Foraminiferal wackestone microfacies of Gulneri Formation showing abundant heterohelicids . Sample no. G 6 , X60.
- 7- *Dorothia* cf. *bulletta* (Carsey), Sample no. G4, X70.
- 8- Oligosteginal limestone of Dokan boulders included in sample no. G 1, X70.
- 9- *Whiteinella archaeocretacea* Pessagno, from Dokan boulder included in sample no. G 1, axial section, X80.
- 10- *Gavelinella* cf. *baltica* Brotzen, umbilical side . Sample no. G 4 , X100.
- 11- *Rotalipora cushmani* (Morrow), from Dokan boulders included in sample no. G 2 , X80
- 12- *Hedbergella delrioensis* (Carsey), equatorial section , Sample no. G 6 , X 90.
- 13- *Rotalipora brotzeni* (Sigal), from Dokan boulders included in sample no. G 2, axial section . X80.
- 14- *Whiteinella baltica* Douglas and Rankin. Umbilical side, Sample no.G 6 ,X100.
- 15- *Whiteinella inornata* (Bolli), umbilical side. Sample no. G 4, X100.
- 16- *Whiteinella inornata* ( Bolli), spiral side. Sample no. G 4. X100.
- 17- *Gaudryina* sp., Sample no. G 4, X60.
- 18- *Rotalipora greenhornensis* (Morrow), from Dokan boulders included in sample no. G 2 , axial section , X80.

Plate No. 1

