

## Biostratigraphy of Upper Valanginian - Upper Aptian Balambo Formation Near Barsarin Village in Rawanduz Area, Northeastern Iraq

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### ABSTRACT

The biostratigraphy of Balambo Formation has been investigated within a well-exposed section at the northeastern limb of Zozik anticline, near Barsarin Village, northeastern Iraq. The studied section consists mainly of marl, marly limestone and limestone. These rocks yielded moderately diversified planktonic foraminiferal fauna and radiolarian skeletons, in addition to some benthonic foraminifera and bioclast. The study is focusing on planktonic foraminiferal taxa, which are classified to ten species belonging to three genera. the stratigraphic distribution of the recorded species permits the recognition of five well defined biozones. These are in descending order:

- . *Globigerinelloides algeriana* Taxon range Zone. (part)
- . *Globigerinelloides ferreolensis* Interval Zone.
- . *Globigerinelloides blowi* Interval Zone.
- . *Hedbergella sigali* Interval Zone.
- . *Globuligerina hoterivica* Interval Zone.

The planktonic foraminiferal biozones are correlated with other zonal schemes. They are considered to be extending from Late Valanginian to Late Aptian age.

**Keywords:** Balambo Fn., Planktonic Foraminifera, Barsarin Iraq.

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الطباقية الحياتية لتكوين بالامبو من الفالانجينيان الاعلى - الابتيان الاعلى قرب قرية  
بيرسرين في منطقة راوندوز، شمال شرقي العراق

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## المخلص

تمت دراسة الطباقية الحياتية لتكوين بالامبو ضمن مكشف صخري يقع على الغاطس الشمالي الشرقي لطية زوزك قرب قرية بيرسرين شمال شرقي العراق. يتألف المقطع قيد الدراسة من صخور الحجر الجيري والحجر الجيري المارلي والمارل، وقد امتازت العينات الصخرية التي جمعت من صخور التكوين بمحتواها المتوسط التنوع من متحجرات الفورامنيفيرا الطافية وهياكل الراديولاريا والقليل من متحجرات الفورامنيفيرا القاعية وحطام الاصداف. ركزت الدراسة الحالية على حشود الفورامنيفيرا الطافية، اذ تم تصنيف عشرة انواع تعود الى ثلاثة اجناس. اعتمادا على التوزيع الطباقى لهذه الانواع تم تمييز خمسة انطقة حياتية كما موضح ادناه، النطاق الاقدم في الاسفل:

- . *Globigerinelloides algeriana* Taxon range Zone. (part)
- . *Globigerinelloides ferreolensis* Interval Zone.
- . *Globigerinelloides blowi* Interval Zone.
- . *Hedbergella sigali* Interval Zone.
- . *Globuligerina hoterivica* Interval Zone.

تمت مضاهاة الانطقة الحياتية للدراسة الحالية مع بعض الدراسات الاخرى، واستنتج بانها تمتد من عمر الفالانجينيان المتأخر - الابتيان المتأخر.

**الكلمات المفتاحية:** تكوين بالامبو، الفورامنيفيرا الطافية، بيرسرين، العراق.

## INTRODUCTION

The studied section is located in northeastern limb of Zozik anticline, near Barsarin village (Fig. 1), near Rawanduz town. The midpoint of the section is at (36° 32' 00") Latitude and (44° 40' 00") Longitude within the imbricated zone of the unstable shelf according to Jassim and Buday (2006).

The Balambo Formation (Valanginian - Turonian) was first described by Wetzel in 1947 in (Bellen *et al.*, 1959) from Sirwan Valley, near Halabja, northeastern Iraq. The type section is about 762m thick and embraces two divisions: Upper division composed of 503m of thin-bedded globigerinal limestone, passing downwards to radiolarian limestone. Lower division of 259m thin-bedded, blue ammonitiferous limestone with intercalation of olive green marls and dark blue shale.

The studied section is 180m thick and consists of alternation of thin bedded pale brownish limestone, marly limestone and pale bluish marl. The lower boundary is recognized by the sharp contact between thick dolostone bed and thinly bedded limestone and marl of Sarmord and Balambo formations respectively. The upper boundary is gradational with the Qamchuqa Formation,

determinate, may be determined by the alternation beds of thinly bedded marly limestone (Balambo Formation) and massive rocks of Qamchuqa Formation.

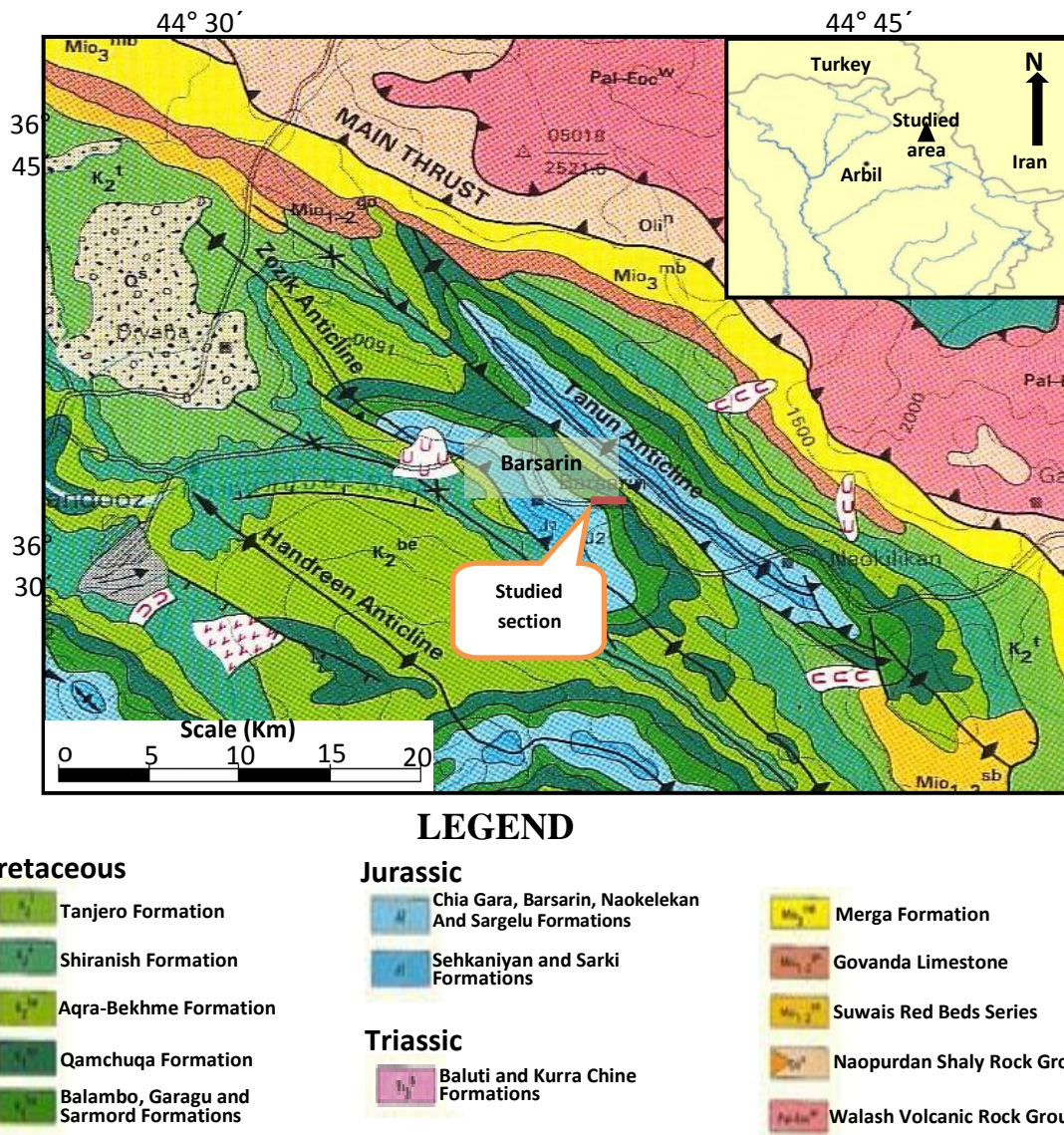


Fig. 1: Geological Map of the Sstudied Area (after Sissakian *et al.*, 1997).

The goal of the present research is to identify the planktonic foraminiferal species and establishing their biostratigraphic zones, which provided the basis for age determined of the studied section. Other microfossils such as radiolaria and benthonic foraminifera are recognized, and tabulated for general biostratigraphic distribution.

## BIOSTRATIGRAPHY

The investigation of foraminiferal assemblages within the studied section revealed that planktonic foraminifera have been used for biostratigraphic analysis. This study enabled us to identify ten planktonic foraminiferal species (Fig. 2). Based on the geological time scale, which recorded by Ogg *et al.* (2016), the absolute age of the planktonic foraminiferal zones have been determined.

The identified planktonic foraminiferal biozones are correlated with their equivalent standard biozones in other regions of the world (Fig. 3). The studied section can be subdivided into five biozones, these biozones are described below in ascending order.

### 1- *Globuligerina hoterivica* Interval Zone.

**Definition:** The present zone is defined by van Hinte (1972) from the Late Hauterivian. It represents the stratigraphic range of the index species *Globuligerina hoterivica* (Subbotina), which precedes the appearance of *Hedbergella sigali* Moullade

**Age:** Late Valanginian.

**Boundaries:** The lower boundary of this zone is marked by the first appearance of index species *Globuligerina hoterivica* (Subbotina), whereas its upper boundary is placed at the first appearance of the species *Hedbergella sigali* Moullade.

**Thickness:** 26 m represented by samples (1 - 9).

**Correlation and Age Determination:** The present zone is equivalent to the *Globuligerina hoterivica* zone of Caron (1985), Sliter (1989), Altiner (1991) and Rojay and Altiner (1998) of Late Hauterivian age in Turkey. While it is correlative to the *Favusella hoterivica* zone of Hardenbol *et al.* (1998) of Late Berriasian – Late Valanginian age. Furthermore, it is equivalent to the *Globuligerina hoterivica* zone of Ogg *et al.* (2016) of Late Valanginian age.



Hauterivian		Barremian		Aptian				Age
Late		Early	Late	Early		Late		
Globuligerina hoterwica		Hedbergella sigali		Globigerinelloides blowi		Schakoina cabri	Globigerinelloides algeriana	Caron, 1985 General
Globuligerina hoterwica		Hedbergella sigali		Globigerinelloides blowi		Leupoldina cabri	Globigerinelloides algeriana	Siker, 1989
Globuligerina hoterwica		Hedbergella sigali		Globigerinelloides blowi		Hedbergella delrioensis- Hed. planispira- Leupoldina cabri- Globigerinelloides blowi	Globigerinelloides algeriana	Althor, 1991 and Rögl & Althor, 1998 Turkey
Berriasian	Valanginian	Hauterivian		Barremian		Aptian		Age
Late	Early	Late	Early	Late	Early	Late	Late	
Favusella hoterwica		Hedbergella sigali/ delrioensis		Hedbergella similis	Globigerinelloides blowi		Globigerinelloides algeriana	Hardsted et al., 1998 Europe
Valanginian		Hauterivian		Barremian		Aptian		Age
Late		Early	Late	Early	Late	Early	Late	
Globuligerina hoterwica		Hedbergella sigali/ delrioensis		Hedbergella similis	Globigerinelloides blowi		Globigerinelloides algeriana	Ogg et al., 2015 General
Globuligerina hoterwica		Hedbergella sigali		Globigerinelloides blowi		L. cabri (consistent) Leupoldina cabri	Globigerinelloides algeriana	Present study, 2015 Northern Iran
							G. ferreolensis	Ogg et al., 2015 Age (Ma)
							G. ferreolensis	120
								125
								130
								135

Fig.3: Correlation chart of planktonic foraminifera of Balambo Formation zones with other Zonal schemes.

## **2- *Hedbergella sigali* Interval Zone.**

**Definition:** The present zone was first defined by Moullade (1966) from the Barremian to Early Aptian. It represents the stratigraphic range of the index species *Hedbergella sigali* Moullade, from the first occurrence of *Hedbergella sigali* Moullade, to the first occurrence of *Globigerinelloides blowi* (Bolli).

**Age:** Latest Valanginian - Early Late Barremian.

**Boundaries:** The lower boundary of this zone is marked by the first appearance of index species *Hedbergella sigali* Moullade, while the upper boundary is indicated by the first appearance of the species *Globigerinelloides blowi* (Bolli).

**Thickness:** 50 m represent by samples (10 - 23).

**Correlation and Age Determination:** This zone is correlative to the *Hedbergella sigali* zone of Caron (1985), *Hedbergella sigali*, *Hedbergella similis* and *Globigerinelloides duboisi* zones of Sliter (1989) of Early Barremian - Early Aptian age. Also it is equivalent to the *Hedbergella sigali* zone of Altiner (1991) and Rojay and Altiner (1998) in same age. While it is correlative with the *Hedbergella sigali/delrioensis* and *Hedbergella similis* zones of Hardenbol *et al.*, (1998) and *Hedbergella sigali/delrioensis* and lower part of *Hedbergella similis* zones of Ogg *et al.* (2016) in Latest Valanginian – Early late Barremian age.

## **3- *Globigerinelloides blowi* Interval Zone.**

**Definition:** This zone was first defined by Moullade (1974) from Early Aptian, representing the interval from the first occurrence of *Globigerinelloides blowi* (Bolli), to the first occurrence of *Globigerinelloides ferreolensis* (Moullade).

**Age:** Early Late Barremian – latest Early Aptian .

**Boundaries:** The lower boundary of this zone is marked by the first appearance of *Globigerinelloides blowi* (Bolli), whereas the upper boundary is determined by the first appearance of the species *Globigerinelloides ferreolensis* (Moullade).

**Thickness:** 71 m represent by samples (24 - 46).

**Correlation and Age Determination:** This zone is correlated with the *Globigerinelloides blowi* and lower part of *Schakoina cabri* zones of Caron (1985),

*Globigerinelloides blowi* and *Leupoldina cabri* zones of Sliter (1989) and lower - middle part of *Hedbergella delrioensis*- *Hed. planispira*- *Leupoldina cabri*- *Globigerinelloides blowi* zone of Altiner (1991), and Rojay and Altiner (1998) of Early - Late Aptian age. On the other hand, its equivalent to the *Globigerinelloides blowi* and *Leupoldina cabri* zones of Hardenbol *et al.* (1998) and Upper part of *Hedbergella similis*, in addition to *Globigerinelloides blowi* and *Leupoldina cabri* zones of Ogg *et al.* (2016) in Early Late Barremian – Early Aptian age.

#### **4- *Globigerinelloides ferreolensis* Interval Zone.**

**Definition:** The present zone is representing the Interval zone of *Globigerinelloides ferreolensis* (Moullade). Which precedes the appearance of *Globigerinelloides algeriana* Cushman and Ten Dam.

**Age:** Late Aptian.

**Boundaries:** The lower boundary of this zone is marked by the first appearance of *Globigerinelloides ferreolensis* (Moullade), whereas the upper boundary is determined by last appearance of *Globigerinelloides ferreolensis* (Moullade), which coincides with first appearance of *Globigerinelloides algeriana* Cushman and Ten Dam.

**Thickness:** 19 m represented by samples (47- 54).

**Correlation and Age Determination:** The current zone is equivalent to the upper part of *Schakoina cabri* zone of Caron (1985), *Globigerinelloides ferreolensis* zone of Sliter (1989) and upper part of *Hedbergella delrioensis*-*Hed. planispira*-*Leupoldina cabri*- *Globigerinelloides blowi* zone of Altiner (1991) and Rojay and Altiner (1998) of Late Aptian age. Furthermore, it is also correlative to the *Globigerinelloides ferreolensis* zone of Hardenbol *et al.* (1998) and Ogg *et al.* (2016) in Late Aptian age.

#### **5- *Globigerinelloides algeriana* Taxon range Zone. (part).**

**Definition:** The present zone is representing the total range of *Globigerinelloides algeriana* Cushman and Ten Dam.

**Age:** Late Aptian.



**Boundaries:** The lower boundary of this zone is marked by the first appearance of *Globigerinelloides algeriana* Cushman and Ten Dam, whereas the upper boundary is determined by the last occurrence of the nominate taxon. The upper boundary of this zone is not included in the current study.

**Thickness:** 9 m represented by samples (55- 58).

**Correlation and Age Determination:** The present zone is equivalent to the *Globigerinelloides algeriana* zone of Caron (1985), Sliter (1989), Altiner (1991), Rojay and Altiner (1998), Hardenbol *et al.* (1998) and Ogg *et al.*, (2016) of Late Aptian age.

## CONCLUSION

The investigation of the cosmopolitan planktonic foraminiferal fauna of the Balambo Formation in Barsarin Village, northeastern Iraq yielded ten species belonging to three genera. According to their stratigraphic range, the formation subdivided into five biozones, these are from older at the base:

5. *Globigerinelloides algeriana* Taxon range Zone. (part).
4. *Globigerinelloides ferreolensis* Interval Zone.
3. *Globigerinelloides blowi* Interval Zone.
2. *Hedbergella sigali* Interval Zone.
1. *Globuligerina hoterivica* Interval Zone.

The distribution of the faunal sequence and the correlation between these biozones and other zonal schemes reveal a Late Valanginian to Late Aptian age for the Balambo Formation in Barsarin Village.

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**PLATE 1**

- A:** *Globuligerina hoterivica* (Subbotina), equatorial section, sample number 1.
- B:** *Hedbergella sigali* Moullade, equatorial section, sample number 23.
- C:** *Hedbergella acculta* Longoria, axial section, sample number 44.
- D:** *Hedbergella bizonae* (Chevalier), equatorial section, sample number 24.
- E:** *Hedbergella delrioensis* (Carsey), equatorial section, sample number 55.
- F:** *Hedbergella planispira* (Tappan), equatorial section, sample number 53.
- G:** *Globigerinelloides algeriana* Cushman and Ten Dam, axial section, sample number 55.
- H:** *Globigerinelloides algeriana* Cushman and Ten Dam, equatorial section, sample number 58.
- I:** *Globigerinelloides ferreolensis* (Moullade), axial section, sample number 53.
- J:** *Globigerinelloides ferreolensis* (Moullade), equatorial section, sample number 47.
- K:** *Globigerinelloides blowi* (Bolli), equatorial section, sample number 24.
- L:** *Hedbergella trocoidea* (Gandolfi), equatorial section, sample number 55.
- M:** Textulariid Benthonic foraminifera, sample number 43.
- N:** Radiolarian skeleton, sample number 20.

**PLATE 1**

