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New records of planktonic foraminifera in the Shuaiba Formation (Aptian Age), Mesopotamian plain, South of Iraq

Zain Alabdeen A. Al-Shawi, Maher M. Mahdi*, Abbas H. Mohammed
Department of Geology, College of Science, University of Basra, Basra, Iraq

Abstract

Shuaiba Formation is an important formation in Iraq, because of their deposition in the important period during the geological history of Arabian plate. The study is focused on a number of selected wells from several fields in southern Iraq, despite the many of oil studies to Shuaiba Formation but it lacks to paleontological studies. Four selected wells are chosen for the current study, Zb-290, Ru-358, R-624, WQ1-353, the selected wells are located within different fields, these are Zubair, Rumaila and West Qurna Oil Fields. In this study fourteen species followed to genus *Hedbergella* were discovered for first time as well as three genera followed to genus Heterohelix in the Shuaiba Formation at the different oil fields, Hedbergella tunisiensis Range Zone is suggested biozone to the current study, the age of this biozone is Aptian, most of the other genera located within this zone.

Keywords: Planktonic foraminifera, Hedbergella**,** Aptian, Shuaiba Formation, Iraq

تسجيل جديد للفورامنفيرا الطافية في تكوين الشعيبة (عمر الابتين), سهل وادي الرافدين, جنوب العراق

زين العابدين عبد الله علي الشاوي ، ماهر منديل مهدي*، عباس حميد محمد
قسم علم الارض، كلية العلوم، جامعة البصرة، البصرة، العراق

الخلاصة

يعد تكوين الشعيبة من التكاوين المهمة في العراق ، بسبب ترسبه في فترة مهمة من التاريخ الجيولوجي للصفيحة العربية. تركزت الدراسة على عدد من الآبار المختارة من عدة حقول في جنوب العراق ، على الرغم من كثرة الدراسات النفطية لتكوين الشعيبة الا انه يفتقر إلى الدراسات المستحاثية. في هذه الدراسة تم اختيار اربعة ابار نفطية وهي **Zb-290, Ru-358, R-624, WQ1-353** وتلك الابار تعود الى ثلاثة حقول نفطية وهي حقل الزبير والرميلة وغرب القرنة، تم تسجيل اربعة عشر نوع جديد يسجل لاول مرة تابع الى جنس *Hedbergella* بالاضافة الى ثلاثة انواع تعود الى جنس *Heterohelix* في تكوين الشعيبة في عدد من الحقول النفطية ، اقترحت الدراسة نطاق مدى واحد وهو Hedbergella tunisiensis Range Zone وتم تحديد عمر هذا النطاق بعمر الابتين.

1.1 Introduction

The study was interested in an important age of geological history of Iraq, because of most of the Iraqi oils formed in that period. Although the Shuaiba Formation is important in the oil studies, the paleontological studies are rare. The aims of the current study include the identification of the microfossils of Shuaiba Formation, and determination the age of the formation. Due to the lack of Shuaiba Formation to the production of the oil, the formation was not studied in detail and were not taken core samples only cutting samples. Therefore, the field contains only a few identified genera. Therefore, this study focused in detail to the planktonic foraminifera. The identified species in the

*Email: maher_mandeel@yahoo.com

current study added new information about the Aptian age and added new biozone depending on planktonic genera. Three oil fields were selected to cover the largest area of southern Iraq.

Study Area

Four selected wells are chosen for the current study, Zb-290, Ru-358, R-624, WQ1-353 (Table-1) (Figure-1), the selected wells are located within different fields, these are Zubair, Rumaila and West Qurna Oil Fields. The structural trap of Zubair oil field is a large gentle anticline oriented north/northwest to south/southeast approximately 60 km long and 10-15 km wide. Zubair Field consists of four domes divided by saddles. Rumaila Structure is longitudinal semi symmetrical anticline, the West flank angle is 3.50 and the East flank angle is 2.50. The length of the structure is 41 Km and the width 12 Km. the direction of the structure axis is North West— South East. The importance of producing formations are Zubair, Nahr Umr and Mishrif. West Qurna Field was discovered in the early 70s[1]. The seismic survey confirmed the existence of a third dome on the Rumaila anticlinal axis, separated from North Rumaila by a shallow saddle. This northernmost dome is called a West Qurna, it was drilled by INOC in October 1973.

1.2Methodology

Based on [2], the extract of the microfossils with simple modified for studied case.

Steps for planktonic foraminifers' extraction from carbonate rock by preparation Acetic acid (CH_3COOH), Hydrochloric acid (HCl) and Hydrogen peroxide (H_2O_2), the steps are:

a. Take 100 g of drilling cutting and place it in the baker.

b. Sunk the sample in diluted Acetic acid (75% CH3COOH, 25% H2O) for 8 hours within a beaker. After 8 hours, wash the sample with distilled water.

c. Add diluted hydrochloric acid (10% HCl, 90% H2O) to the sample for 2 hours within a beaker. After 2 hours, wash the sample with distilled water.

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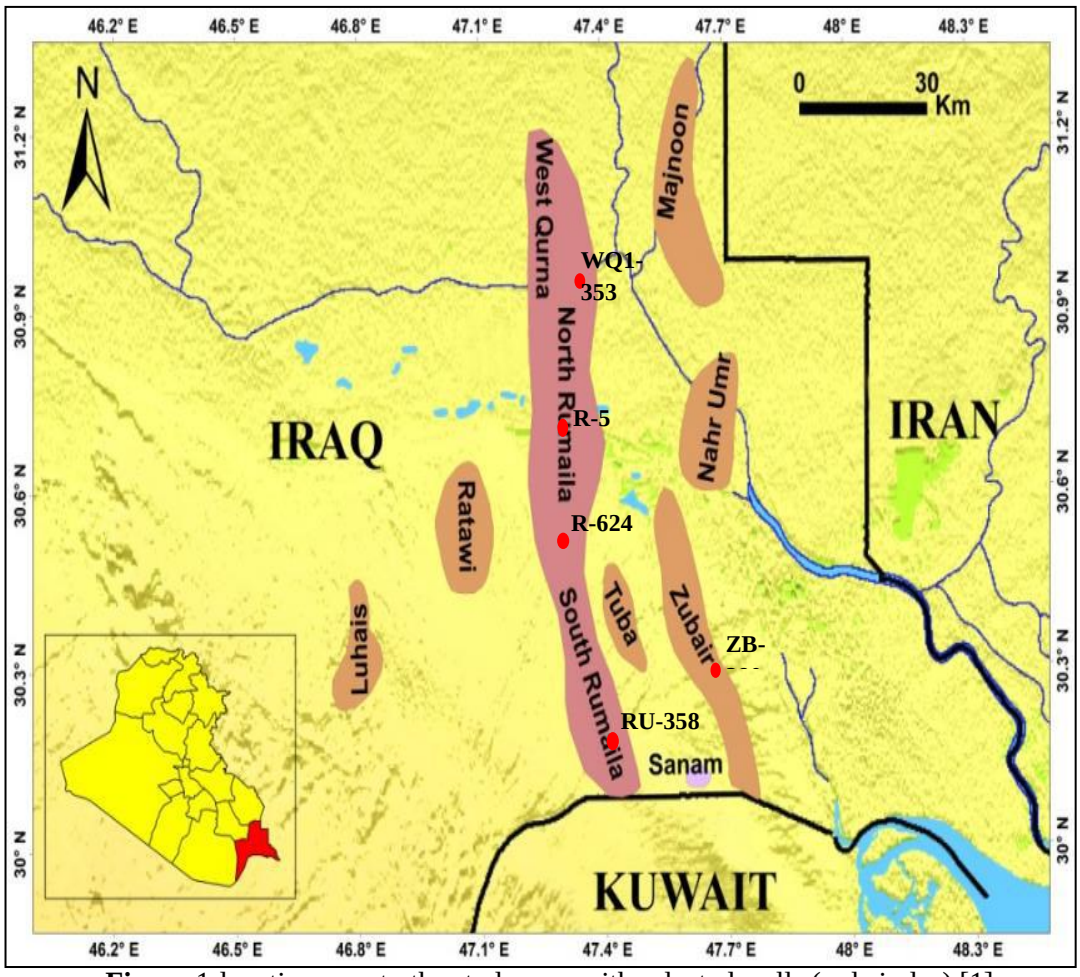

Figure 1-location map to the study area with selected wells (red circles) [1].

Table 1-the coordinate of the selected wells, in the different oil fields, south of Iraq

NO.	Well	N	E
1	ZB-290	30°21'41.91	47°38'53.81
2	WQ1-353	30°50'20.59	47°18'37.89
3	RU-358	30°13'8.86	47°22'47.17
4	R-624	30°26'1.53	47°19'56.11
5	R-5	30°34'40.95"	47°19'52.12"

d. Add hydrogen peroxide to the sample for 24 hours within the baker after 24 hours. Put the sample on the hot plate for 2 hours.
e. Sieving the sample into a 63micron sieve and wash the sample with tap water.
f. Dry the sample and put it in an oven at 80 ° C, and prepared it for picking.
g. The microfossils were picked by the binocular microscope, and then photting them with digital camera type in the geology department, University of Basrah. .

1.3 Stratigraphy of Shuaiba Formation

The Shuaiba Formation was first defined by Owen and Nasr in 1958, The Shuaiba formation was deposit during the lower Cretaceous (Aptian). The thickness of Formation is 50-100m. (Figure-2). The formation is comprised of massive limestone and it is grading into chalky limestone with shale in the top, it was deposit in an open marine environment [3]. Shuaiba Formation overlies of Zubair formation with conformable and gradational contact, while the upper contact is unconformable with Nahr Umr Formation. The lithology and fossils of formation contain pseudo-oolitic limestone and *Orbitolina cf. discoidea* Gras, *Choffatella decipiens* Schlumberger and globogerinids [4].

1.4 Classification

The present study introduces the classification of many genera for first time, 14 genera belong to *Hedbergella*, while 3 genera belong to *Heterohelix*. [5] classification was used for classifying the studied fossils.

1.6 Description systematic

Order Foraminifera
Suborder Globigerinina
Superfamily Rotaliporacea
Family Hedbergellidae
Subfamily Hedbergellinae
Genus *Hedbergella*

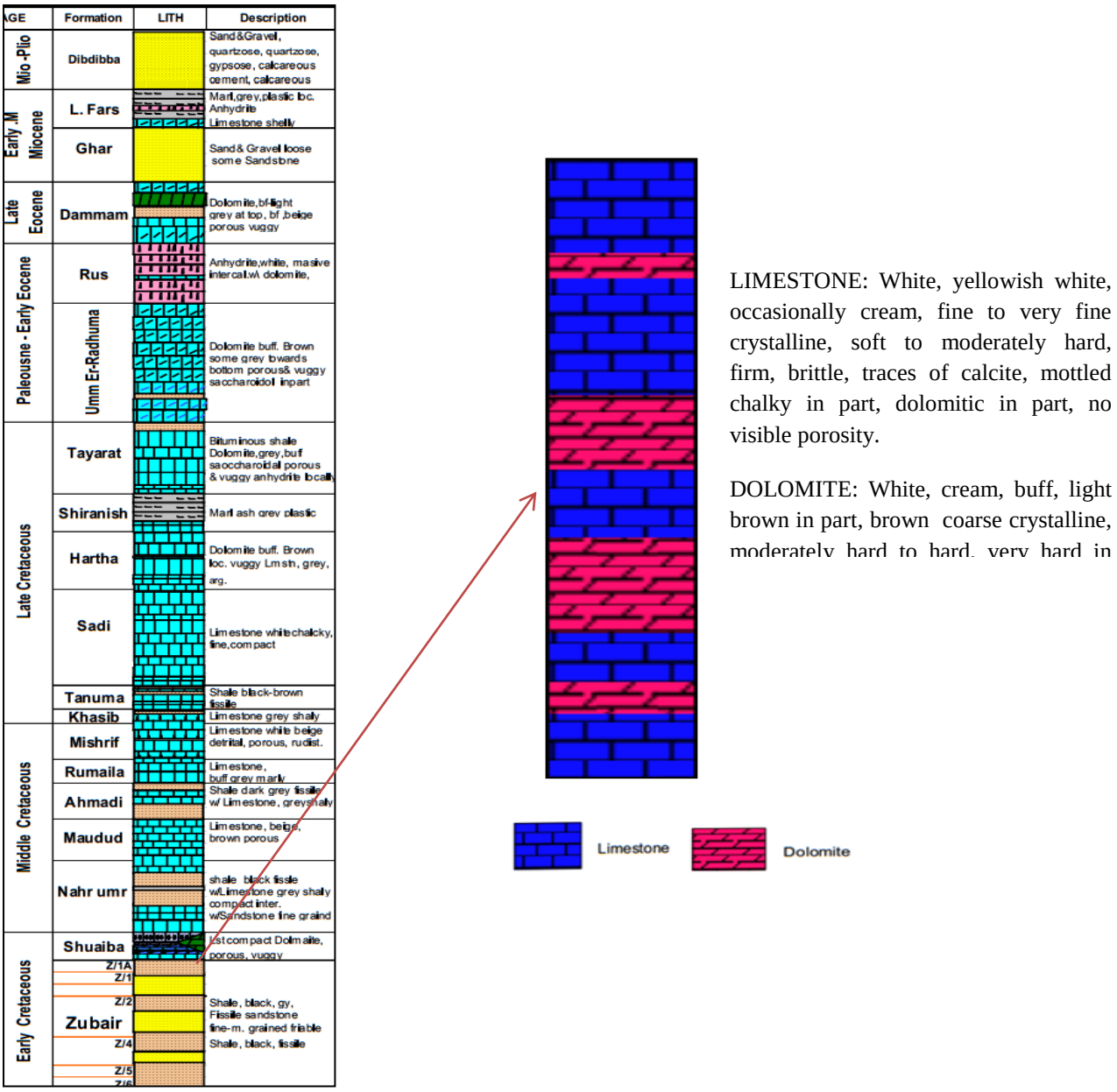

Figure 2-Typical stratigraphic section to the Shuaiba formation in the Rumaila oil fields, south Iraq. [6]

1. Species Hedbergella sigali [7]

Wells (ZB-290, depth 3112 – 3144 m), (WQ1, 3015 – 3060m), (RU-358, 2925 – 2970m).

Description: Test small to medium about 95µ, test outline lobate, trochospiral arrangement, four chambers, the shape of chambers is globular to subglobulars, test suture lightly to strongly, spiral sutures strongly depressed, umbilical narrow, aperture as a low to medium. Wall smooth, finely perforate. Plate 1: Hedbergella sigali (1a, 1b and 1c).

Type locality: Section at Saint-Cyrice, near Orpierre and along Route Deparmentale 116 between Orpierre and Villebois-les-Pins, Hautes-Alpes Department, southeastern France.

Holotype: Lyon, France; Department of Earth Sciences, Lyon Univ.

Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Valanginian stage. 134.7Ma.

2. Species Hedbergella ruka [8]

Wells (ZB-290, depth 3114 – 3144 m), (WQ1, 3015 – 3050m), (RU-358, 2925 m).

Description: Test small to medium about 150µ, test outline lobate, trochospire arrangement , number of chambers between four to five, the shape of chambers is globular to subglobular, test suture slightly to moderately, spiral sutures moderately depressed, umbilical area small, aperture as a low to medium, Wall smooth, finely perforate. Plate 1: *Hedbergella ruka (2a, 2b and 2c).*
Type locality: Central North Sea Well16/28-6RE, (3989.5 m).
Holotype London, UK; NHM.
Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Barremian stage 125.71-128.73Ma.

3. Species *Hedbergella tunisiensis* [9]

Wells (ZB-290, depth 3112 – 3144 m), (WQ1, 3020 – 3040 m), (R-624, 3040 – 3050), (RU-358, 2925- 2970 m).
Description: Test size small to medium about 120µ, test outline circular, chamber arrangement a low trochospire , number of chambers between four to five, the shape is chambers globular, test suture strongly, spiral sutures strongly depressed, umbilical area small, the aperture is a low arch, the surface of the test is smooth. Plate 1: *Hedbergella tunisiensis (3a, 3b and 3c).*
Type locality: Beauvoir-VI Well, Tunisia.
Holotype: London, UK; NHM
Geological Range: Top: Albian stage, 111.84-113.26Ma., Base: Aptian stage, 111.84-113.26Ma.

4. Species *Hedbergella aptiana* [10]

Wells (ZB-290, depth 3126 – 3142 m), (WQ1, 3020 – 3060 m), (RU-358, 2940 -2970 m).
Description: Test medium size about 110µ, test outline lobate, trochospire arrangement , the shape of chamber is coiled in a flat to slighlty depressed, five chambers, test suture slightly to moderately lobate, spiral sutures strongly depressed, umbilical area rather wide and shallow; aperture as a low to medium, wall smooth, finely perforate. Plate 2: *Hedbergella aptiana (1a, 2b and 3c.)*
Type locality: Mittelland-Kanal, near Wenden, Braunschweig, central Germany. Additional material from a core taken in the depth interval 300-304 m. in well Georgsdorf 3, Lower Saxony, northwest Germany.
Holotype: Frankfurt; Seckenberg Mus., Germany.
Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Barremian stage. 128.73-130.37Ma.

5. Species Hedbergella tatianae [11]

Wells (ZB-290, depth 3138 – 3140 m), (WQ1, 3040 m).
Description: Test small to medium about 90µ, test outline lobate, trochospire arrangement, the shape of chamber is reniform, five chambers, test suture moderately to strongly lobate, spiral sutures strongly depressed, umbilical area narrow, aperture as a low to medium, the surface of the test is smooth Plate 2: Hedbergella tatianae (2a, 2b and 2c).
Type locality: Speeton Cliff, Filey Bay, North Yorkshire, England.
Holotype: London, UK; NHM.
Geological Range: Top: Aptian stage, 123.89-125.71Ma., Base: Aptian stage, 123.89-125.71Ma.

6. Species Hedbergella kuznetsovae [11]

Well (WQ1, 3060 m).
Description: Test size medium about 155µ, test outline lobate, chamber arrangement a low trochospire , six chambers, the shape of chambers is inflated to subglobular, test suture moderately to strongly lobate, spiral sutures strongly depressed, umbilical area narrow, The aperture is a low arch, the wall is smooth and microperforate. Plate 2: Hedbergella kuznetsovae (3).
Type locality: Speeton Cliff, Filey Bay, North Yorkshire, England.
Holotype: London, UK; NHM.
Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Valanginian stage 130.37-134.74Ma.

7. Species Hedbergella infracretacea [12]

Wells (ZB-290, depth 3114 – 3132 m).
Description: Test medium sized about 100µ, test outline lobate, trochospire arrangement, five chambers, the shape of chamber is inflat to subglobular, test sutures moderately depressed, spiral sutures moderately depressed, umbilical area rather small and shallow; aerture as a low to medium, Wall finely perforate. Plate 2: Hedbergella infracretacea (4a and 4b).
Type locality: Along Dry Creek in Beegum Basin, T. 28 N., R. 7W. Northwest corner of Sacramento Valley, Tehama County, California.
Holotype: Washington; USNM.

Geological Range: Top: Aptian stage 113.26-118.02Ma., Base: Aptian stage 123.89-125.71Ma.

8. Species Hedbergella primare [13]

Well (ZB-290, depth 3120 – 3132 m).

Description: Test medium sized about 160µ, test outline circular, trochospire arrangement, six chambers, the shape of chamber is globular to subglobular, test sutures moderately depressed, spiral sutures moderately depressed, umbilical area rather wide and shallow; aperture as a low to medium, Wall smooth. Plate 3: Hedbergella primare (1).

Geological Range: Top: Aptian stage, 118.93-122.17Ma., Base: Barremian stage, 125.71-128.73Ma.

9. Species Hedbergella praelippa [14]

Wells (ZB-290, depth 3128 – 3140 m).

Description: Test very small about 95µ, test out line lobate, trochospire arrangement, four chambers, chambers shape subgobular to globular, test sutures moderately depressed, test sutures moderately depressed, radial, straight; umbilicus narrow, Wall texture Finely pustulose. Plate 3: Hedbergella praelippa (2a and 2b).

Type locality: DSDP Site 511 southern souths Atlantic.

Holotype: Washington; USNM.

Geological Range: Top: Aptian stage, 112.95-126.30Ma., Base: Aptian stage, 112.95-126.30Ma.

10. Species Hedbergella occulta [15]

Wells (ZB-290, depth 3126 – 3130 m).

Description: Test medium sized about 115µ, test outline subcircular, chamber arrangement trochospire, six chambers, the shape of chamber is globular to subglobular, test sutures moderately depressed, test sutures moderately depressed, umbilical area small and narrow, aperture as a low to medium and wall smooth finely perforate. Plate 3: Hedbergella occulta (3).

Type locality: From a section in La Boca Canyon, along the dirt road to Congregacion La Boca, in the Sierra de la Silla, south-southeast of Monterrey, Mexico.

Holotype: Washington; USNM.

Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Barremian stage, 125.71-128.73Ma.

11. Species Hedbergella hispaniae [16]

Wells (ZB-290, depth 3134 – 3136 m).

Description: Test medium sized about 109µ, test outline subcircular, trochospire arrangement, three chambers, and the shape of chamber is shape subglobular, test sutures moderately depressed, spiral sutures moderately depressed umbilical area small and narrow and wall smooth. Plate 3: Hedbergella hispaniae(4).

Type locality: From an exposure in La Boca Canyon along the dirt road to Congregacion La Boca, in the Sierra de la Silla, south-sputheast of Monterrey, Mexico.

Holotype: Washington; USNM.

Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Aptian stage, 123.89-125.71Ma.

12. Species Hedbergella trocoidea [16]

Wells (ZB-290, depth 3142 – 3144 m).

Description: Test medium sized about 100µ, test outline lobate, trochospire arrangement, six chambers, the shape of chamber is subtriangular to triangular, test sutures moderately depressed, spiral sutures moderately depressed, umbilical area small and narrow, aperture as a low to medium and wall smooth. Plate 3: Hedbergella trocoidea (5).

Type locality: Breggia River, Canton Ticino, Switzerland.

Holotype: Basel, CH; Natural History Museum.

Geological Range: Top: Aptian stage, 113.26-118.02Ma., Base: Aptian stage, 122.17-122.98Ma.

13. Species Hedbergella mitra [11]

Wells (R-624, depth 3040 – 3050 m).

Description: test size medium about 95µ, test outline lobate, trochospire arrangement, five chambers, the shape of chamber is globular, test sutures moderately depressed, spiral sutures moderately depressed, aperture is a low, Umbilicus area narrow and wall smooth. Plate 3: Hedbergella mitra (6).

Type locality: Speeton Cliff, Filey Bay, North Yorkshire.

Holotype: London, UK; NHM.

Geological Range: Top: Aptian stage, 123.89-125.71Ma., Base: Aptian stage, 123.89-125.71Ma.

14. Species Hedbergella bizonae [17]

Wells (RU-538, depth 2940 m).

Description: Test medium sized about 100µ, test outline stellate, trochospire, arrangement four chambers, the shape of chamber is subtriangular, test sutures strongly depressed, spiral sutures strongly depressed umbilicus broad and shallow, aperture as a low and wall smooth and finely pustulose. Plate 3: *Hedbergella bizonae (7).*

Geological Range: Top: Aptian stage, 118.93-122.17Ma., Base: Barremian stage, 125.71-128.73Ma.

Order Foraminifera
Suborder Globigerinina
Superfamily Globigerinacea
Family Heterohelicidae
Subfamily Heterohelicinae
Genus Heterohelix

1. Species Heterohelix striata

Wells (ZB-290, depth 3126 – 3132 m), (RU-538, 2960 m).

Description: Test size medium about 125µ, test outline triangular, biserial arrangement , number of chambers between six to ten, the shape of chamber is globular, test sutures moderately depressed, spiral sutures moderately depressed, aperture interiomarginal and wall coarsely costate. Plate 4: *Heterohelix striata (1a and 2b).*

Type locality: Puszkary, in Grodno, on the banks of Memel, Poland; Jutland, Denmark; Rugen Island off the coast of Pomerania, Germany; and the Hamam Faraun Mountains in Arabian Sinai.

Holotype: Berlin; Humboldt Museum of Natural History

Geological Range: Top: Maastrichtian stage, 67.30-69.18Ma., Base: Coniacian stage, 84.19-86.71Ma.

2. Species *Heterohelix globulosa*

Wells (ZB-290, depth 3132 – 3142 m), (RU-538, 2960 –2970 m).

Description: Test medium sized about 140µ, test outline triangular, biserial arrangement, nine chambers, the shape of chamber is globular, test sutures strongly depressed, spiral sutures moderately depressed, aperture interiomarginal and wall finely smooth. Plate 4: *Heterohelix globulosa (2a, 2b and 3c).*

Type locality: Jutland, Denmark, Egypt, and England.

Holotype: Berlin; Humboldt Museum of Natural History.

Geological Range: Top: Maastrichtian stage, 66.39-67.30Ma., Base: Cenomanian stage, 94.03-95.94Ma.

3. Species *Laeviheterohelix glabrans* [18]

Well (ZB-290, depth 3140 – 3142 m),

Description: Test medium sized about 112µ, test outline subtriangular, biseria arrangement, nine chambers, the shape of chamber is subglobular, test sutures weakly depressed, spiral sutures moderately depressed, aperture interiomarginal and wall smooth. Plate 4: *Laeviheterohelix glabrans* (3).

Type locality: Branch of Mustang Creek, 1 mi. west-southwest of Noack, 900' downstream from road, 0.2 mi southwest of Christ Evangelical Lutheran Church, Williamson County, TX.

Holotype: Washington; USNM

Geological Range: Top: Maastrichtian stage, 67.30-69.18Ma., Base: Campanian stage, 74.00-75.71Ma.

1-6. Biostratigraphy

Biostratigraphy is a well-established branch of stratigraphy based on the palaeontology of rocks. It uses the chronostratigraphic range of fossil species to correlate stratigraphic sections, and their palaeoenvironmental preference to provide information on depositional setting [19]. The studied sections are determine to type of biozones.

1-6-1. *Hedbergella tunisiensis* Range Zone

The species *Hedbergella tunisiensis* represents the taxon range zone, it appears in the top of the formation and continuous to the bottom, sometime disappears but it occurrence in all studied section, this biozone has assemblages of identified species as mentioned in the Figures-(3, 4, 5 and 6). The regional biozone to the middle east is determined depending on benthonic foraminifera therefor no any

biozone could compared to the studied biozone, but most of the diagnosed species belong to the Aptian age, therefore the current study determine the identified biozone within Aptian age.

1-7. Conclusion

1. Fourteen genera were diagnosed for the first time. These are: *Hedbergella sigali (50 Species), Hedbergella tunisiensis (29 Species), Hedbergella bizonae (1 Species), Hedbergella aptiana (10 species), Hedbergella ruka (19 sp.), Hedbergella mitra (1 sp.), Hedbergella tatianae (5 sp.), Hedbergella kuznetsovae (1 sp.), Hedbergella infracretacea (8 sp), Hedbergella primare (1), Hedbergella praelippa (2 sp.), Hedbergella occulta (2 sp.), Hedbergella hispaniae (1 sp.) and Hedbergella trocoidea (1 sp.).*
2. Also three Heterohelix genera were diagnosed, these are*: Heterohelix striata* (4 sp.), *Planoheterohelix globulosa* (10 sp.) and *Laeviheterohelix glabrans* (1 sp.).
3. Hedberglla and Heterohlix genera could consider them as index fossils to the Shuaiba Formation with age of Aptian.
4. All the diagnosed fossils are disappeared in the upper limit with Nahr Umr Formation.
5. *Hedbergella tunisiensis* Range Zone is suggested biozone to the current study, the age of this biozone is Aptian, most of the other genera located within this zone.

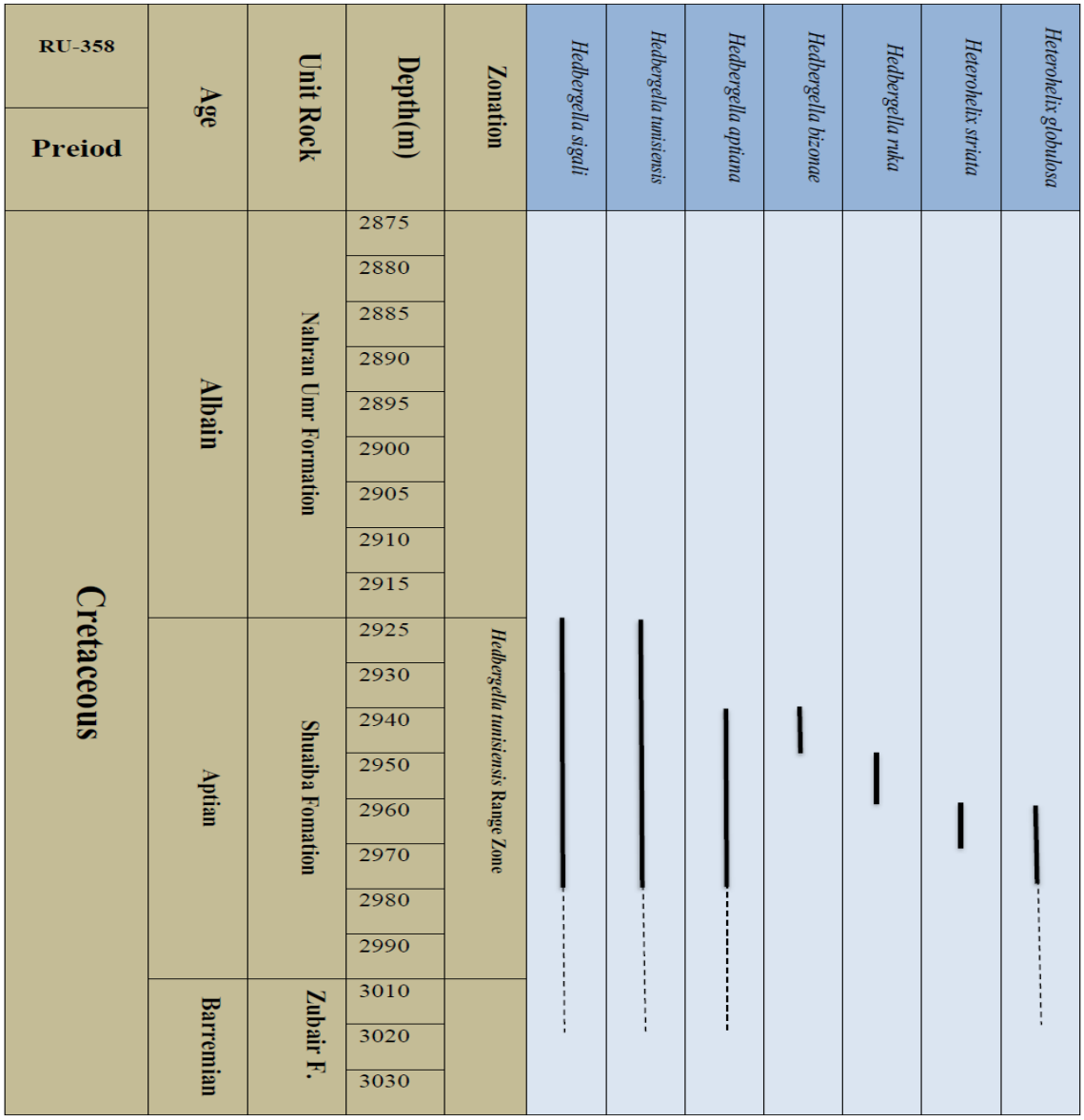

Figure 3-biozonation of RU-358 at the North Rumila Oil field, with assemblage's species which accompanied with *Hedbergella tunisiensis* Range Zone

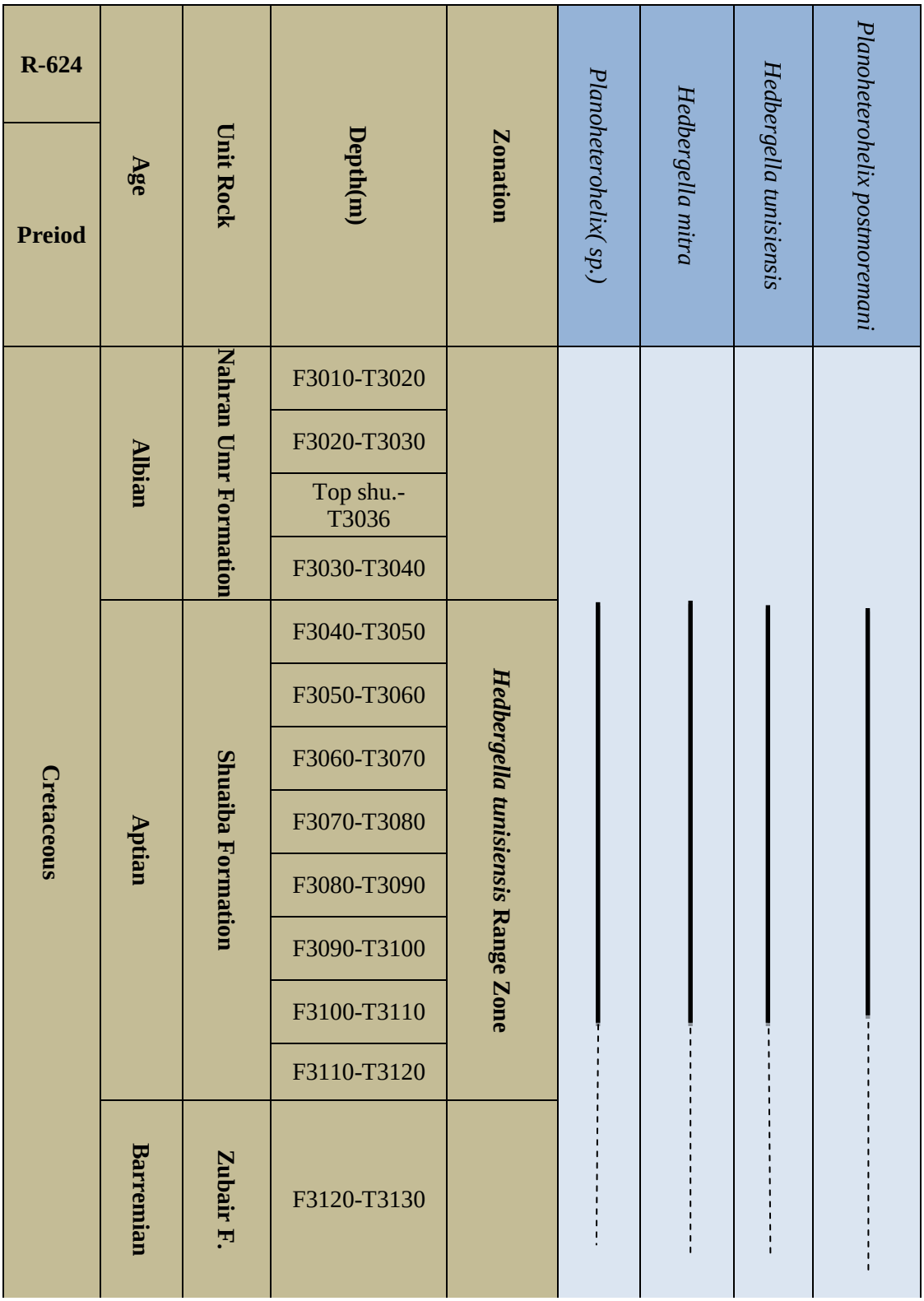

Figure 4-biozonation of R-624 at the South Rumila Oil field, with assemblage's species which accompanied with *Hedbergella tunisiensis* Range Zone.

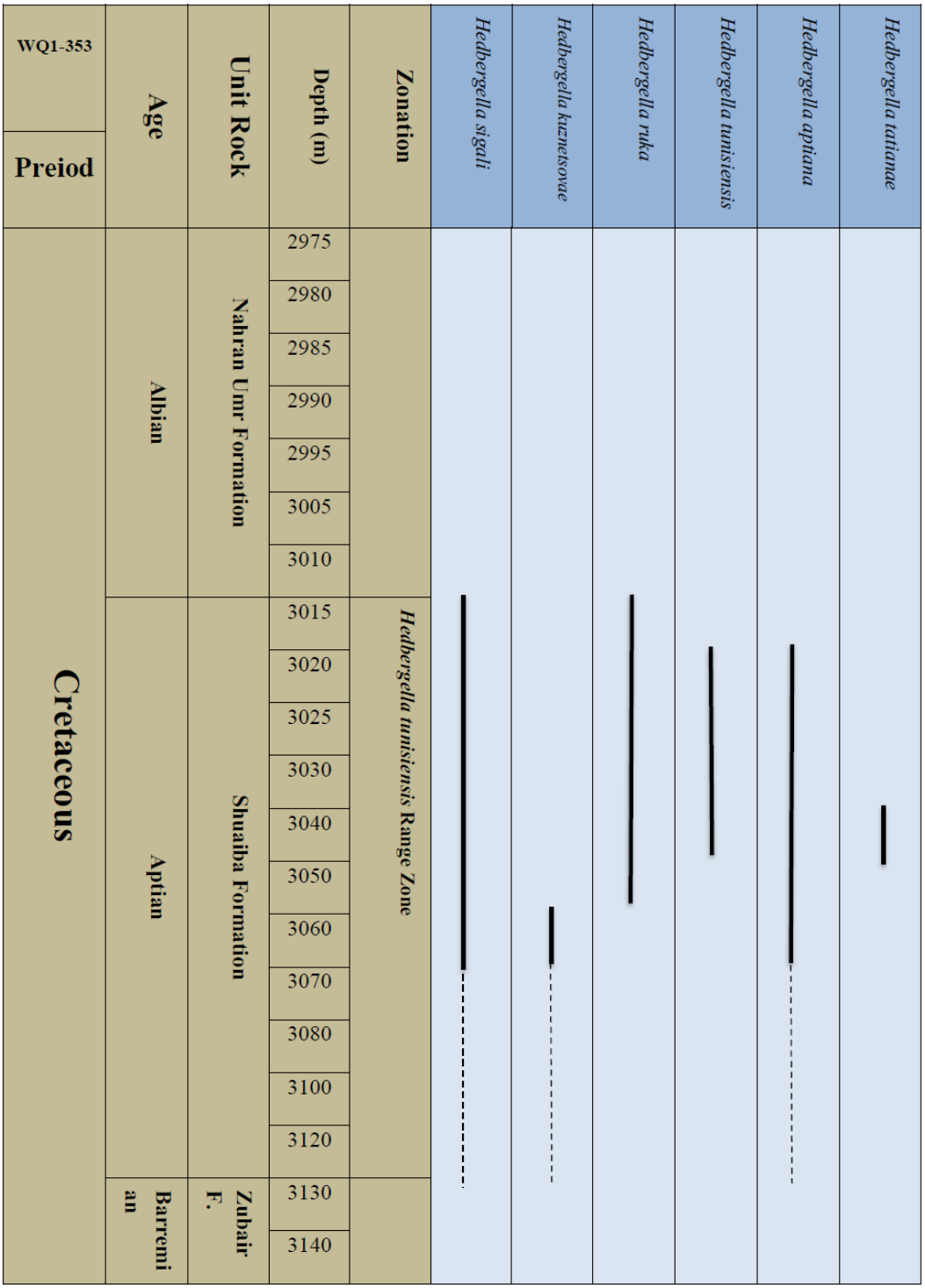

Figure 5-biozonation of WQ-353 at the West Qurna Oil field, with assemblage's species which accompanied with *Hedbergella tunisiensis* Range Zone

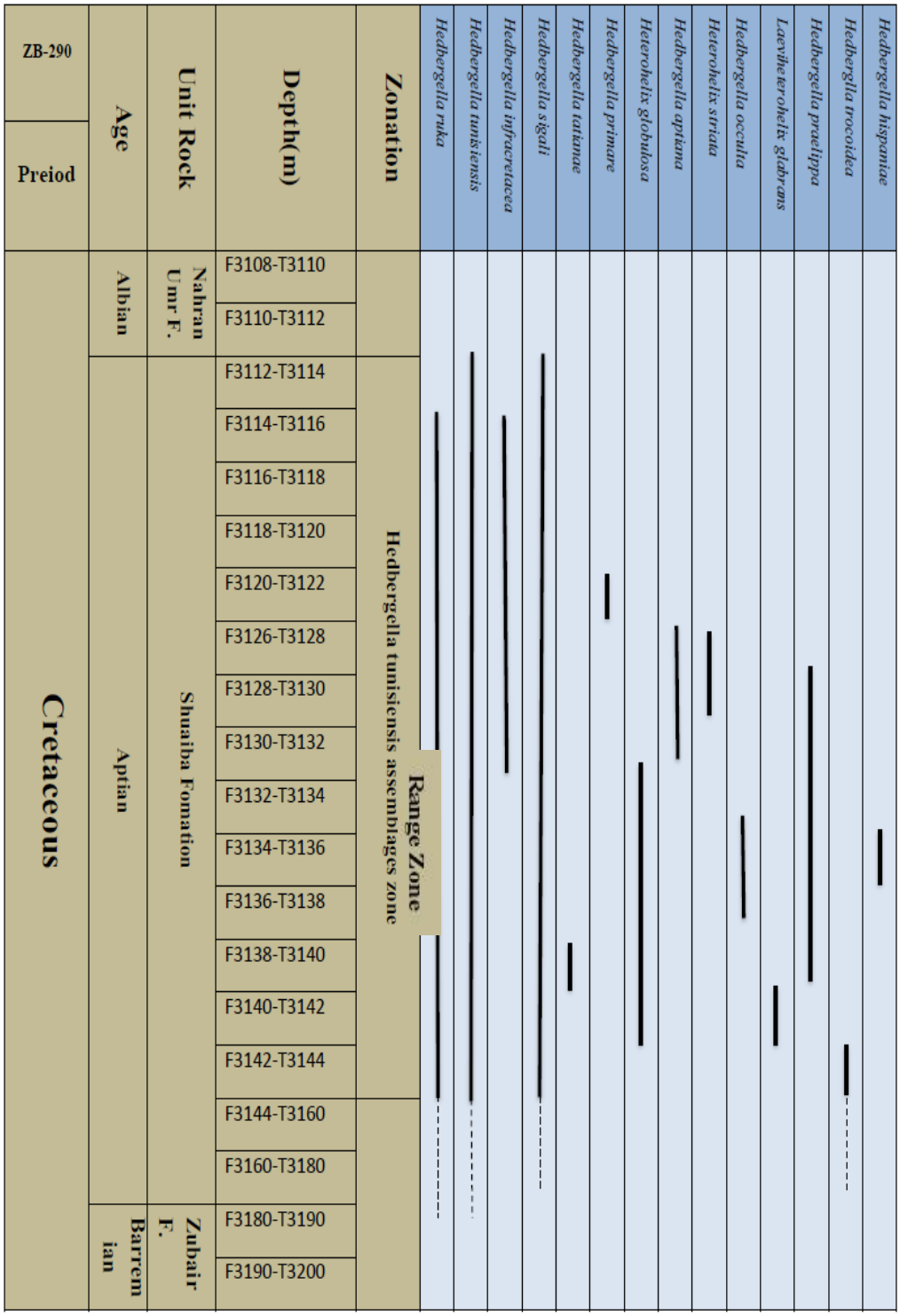

Figure 6-biozonation of ZB-290 at the Zubair Oil field, with assemblage's species which accompanied with *Hedbergella tunisiensis* Range Zone.

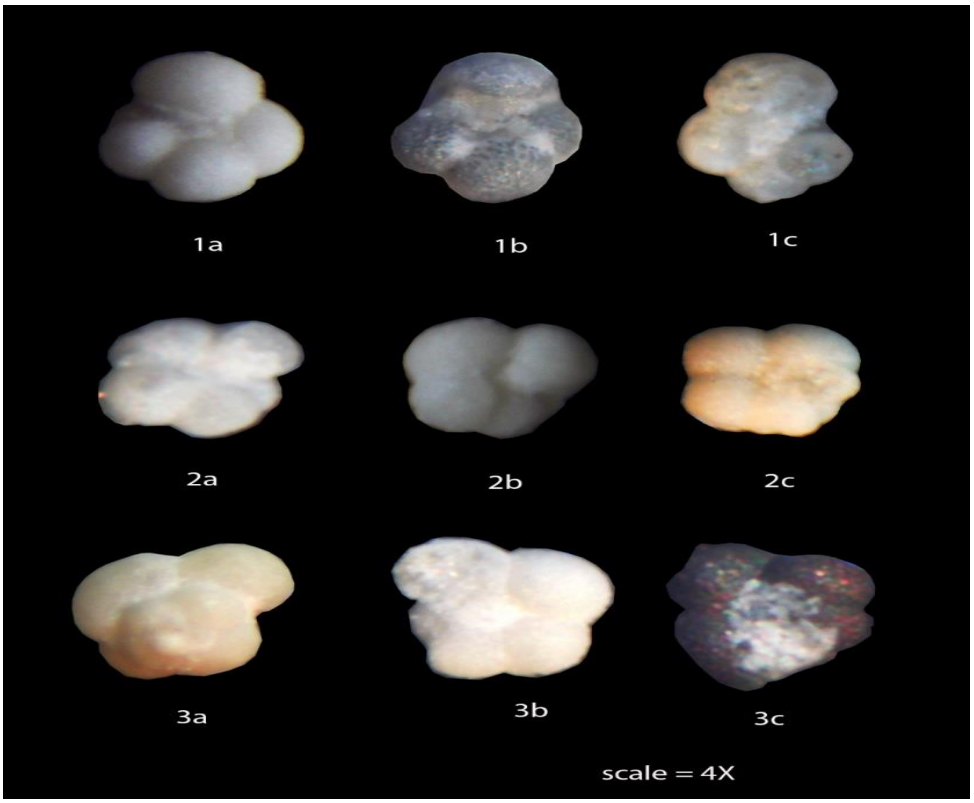

Plate 1-*Hedbergella sigali (1a, 1b and 1c), Hedbergella ruka (2a, 2b and 2c) and Hedbergella tunisiensis (3a, 3b and 3c).*

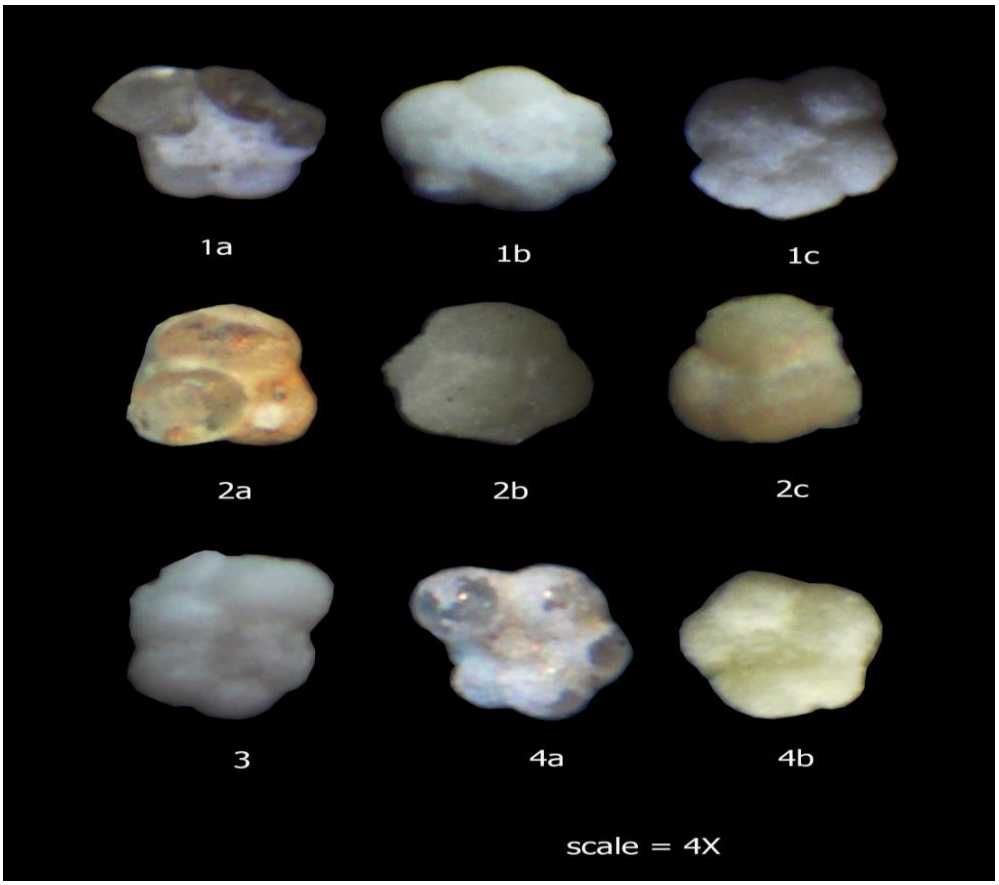

Plate 2-*Hedbergella aptiana (1a, 2b and 3c), Hedbergella tatianae (2a, 2b and 2c), Hedbergella kuznetsovae (3) and Hedbergella infracretacea (4a and 4b).*

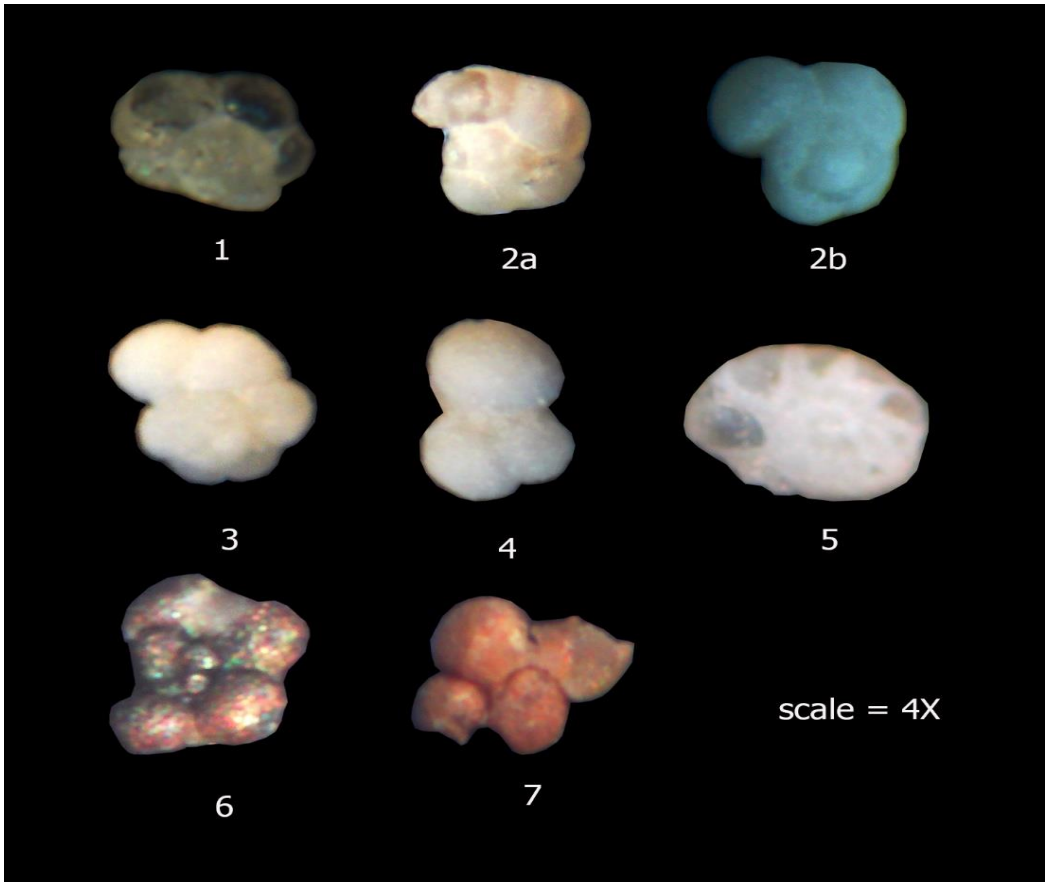

Plate 3-*Hedbergella primare (1), Hedbergella praelippa (2a and 2b), Hedbergella occulta (3), Hedbergella hispaniae(4), Hedbergella trocoidea (5), Hedbergella mitra (6) and Hedbergella bizonae(7).*

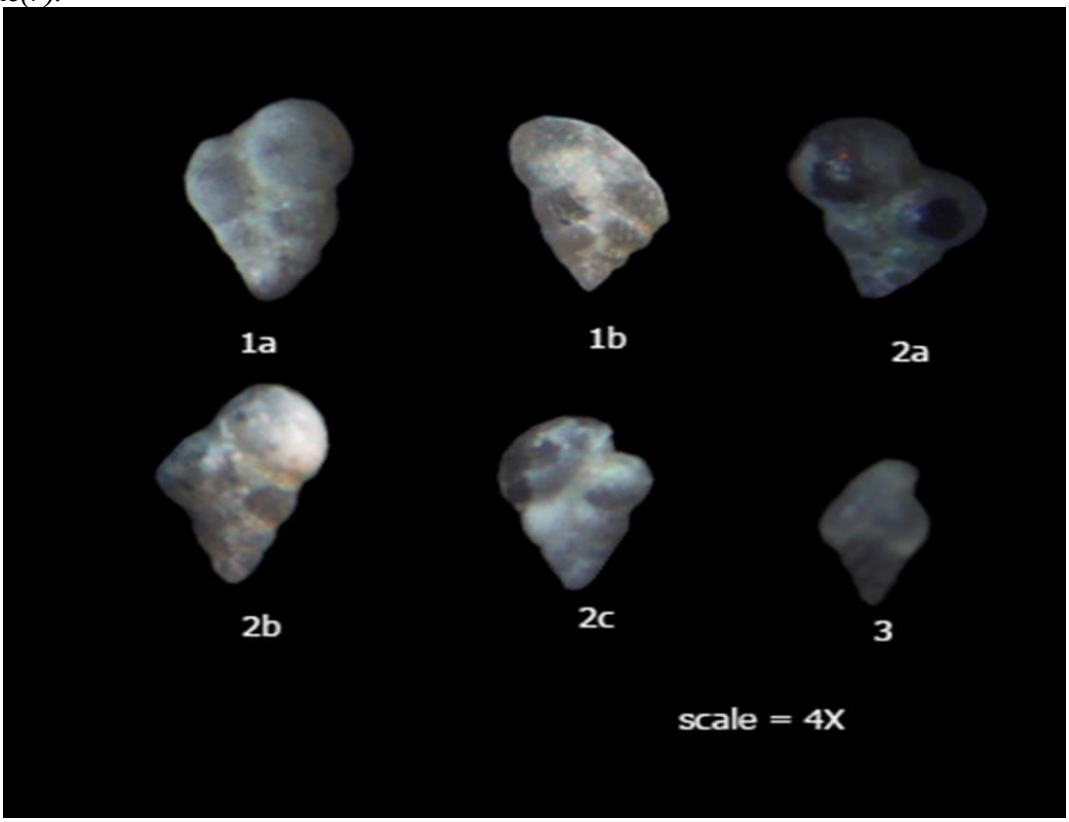

Plate 4-*Heterohelix striata (1a and 2b), Planoheterohelix globulosa (2a, 2b and 3c) and Laeviheterohelix glabrans (3)*

1-7. References

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