DOI: 10.24996/ijs.2019.60.3.14

Iraqi Journal of Science

ISSN: 0067-2904

Biostratigraphy of the Upper Cretaceous for selected sections in northern Iraq

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Abstract

The Aqra - Bekhme, Shiranish, Tanjero and Kolosh formations outcrop in the High Folded Zone, Northern Iraq in Erbil and Sulaymaniyah governorates. The formations have been studied at two selected geological sections (Bekhme Gorge and Zarda Bee). In this study, these formations are investigated based on both benthic and planktonic foraminifera. Depending on foraminifer's investigation, three biozones have been recognized; two biozones are identified in the benthic foraminifera and the third one is identified in the planktonic foraminifera as follow:

1. *Siderolites calcitropodes* - *Orbitoides apiculatus* - *Omphalocyclus macroporus* Assemblage zone.
2. *Loftusia morgani* range zone.
3. *Abathomphalus mayaroensis* rangezone.

Keywords: Biostratigraphy, Aqra - Bekhme, Shiranish, Tanjero, Kolosh formations.

الطباقية الحياتية لعصر الطباشيري الاعلى لمقاطع مختارة من شمال العراق

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الخلاصة

تناولت هذه الدراسة الطباقية الحياتية لتكاوين عقرة – بخمة(ماسترختي), شيرانش (الطباشيري الاعلى – الماسترختي), تانجيرو (الماسترختي الاعلى) وكولوش (باليوسين – الايوسين الاسفل) والتي تنكشف في نطاق الالتواء الشديد، في محافظتيّ اربيل و السليمانية ، شمال العراق. بالاعتماد على فحص الفورامينيفرا ، تم تحديد الانطقة الحياتية و الحد الفاصل بين العصر الطباشيري الاعلى والعصر الثلاثي. وقد أظهرت نتائج الدراسة هذه الى تواجد ثلاثة انطقة حياتية هي :

1. *Siderolites calcitropodes–Orbitoides apiculatus-Omphalocyclus macroporus* Assemblage zone.
2. *Loftusia morgani* range zone.
3. *Abathomphalus mayaroensis* range zone.

Introduction

The study areas are located in two part of the Zagros Fold-Thrust Belt (ZFTB) in the northeast of Iraq within Erbil (Bekhme Gorge sections) and Sulimaniyah distracts (Mukaba and Zarda Bee sections) Figure-1, within foreland basin at the High Folded Zone (HFZ) and Imbricate Zone (IZ) in the unstable shelf. Aqra - Bekhme (Maastrichtian), and Shiranish (Upper Campanian–Maastrichtian) formations are mainly considered as a carbonate successions that consist of limestone as a main component [1]. As for Tanjero (Upper Maastrichtian) and Kolosh formation (Paleocene-Lower

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Eocene), which are a clastic (flysch) unit [2], this succession belongs to Upper Cretaceous – Tertiary age. The biostratigraphy of these formations will be discussed based on both benthonic and planktonic foraminifera, which are an important tools in dating the Upper Cretaceous-Tertiary succession, along with other microfossils such as rudist, gastropod, echinoderm, ostracod and algae.

In view of recent studies, it has been pointed out that the lower part of (Upper Cretaceous formations) is represented by relatively rich benthonic and planktonic foraminiferal assemblages, while the upper part (Tertiary Formation) contains poor assemblages [3]. The benthonic foraminiferal assemblages are dominated by long-range species. The shorter-range species is dominated by planktonic foraminiferal assemblages, stratigraphical index species have been selected to date the Upper Cretaceous-Tertiary based on the distribution of the species in the High Folded Zone region.

This study aims to determine the biostratigraphy of Aqra - Bekhme, Shiranish, Tanjero and Kolosh formations depending on both benthic and planktonic foraminifera.

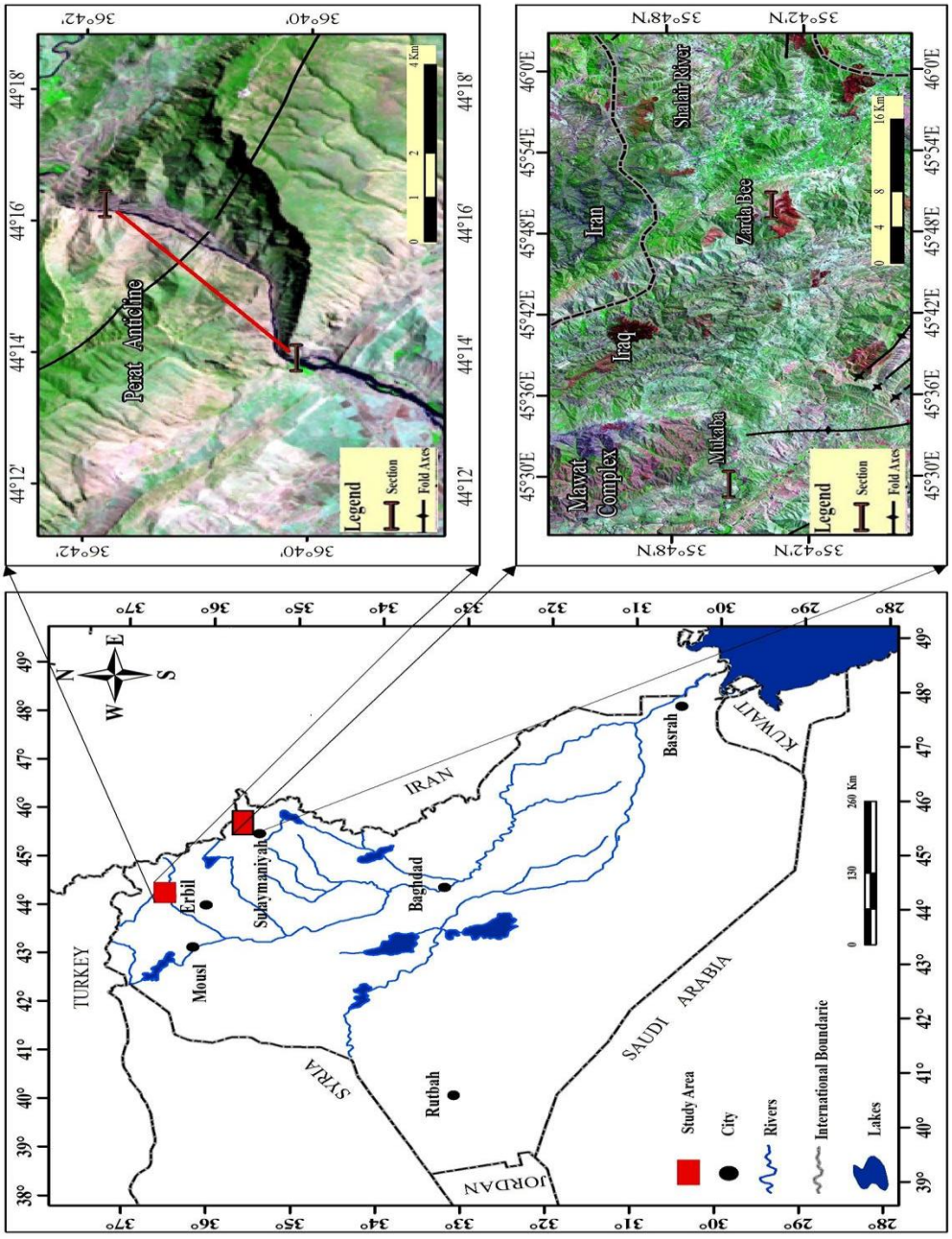

Figure 1- Location map and Landsat satellite image (USGS, 2013) show the studied sections.

Materials and methods

The field work includes describing the lithology and collecting samples from the formations. Laboratory work includes making thin sections. The thin sections were examined using the polarized microscope to differentiate various types of microfossils and microfacies. The digital camera (A M Scope) was used to photograph the thin sections.

Results and discussion

The recognition of biozones depends on the identification of the benthonic and the planktonic foraminifera in the studied sections (Bekhme Gorge and Zarda Bee), which are subdivided into three biozones (Figs. 2 and 3), two of them was concerned with the benthic foraminifera and the third one belongs to planktonic foraminifera, the reason for establishing the three biozones parallel to each other because the first and the last appearance of these biozones coincides with each other, as follow:

1. *Siderolites calcitropodes - Orbitoides apiculatus - Omphalocyclus macroporus* Assemblage zone

This assemblage zone was determined in Iraq [4- 7], Netherland [8], Switzerland [9], Cuba [10], Turkey [11], and Iran [12]. The identification of this zone depends on the range of extension of the three species (Plates 1, 2). It was recorded in Bekhme Gorge and Zarda Bee sections. The lower limit of this zone was identified according to the existence of *Siderolites calcitropodes, Orbitoides apiculatus, Omphalocyclus macroporus* Also, the upper limit of this zone, was determined by the last appearance of the same three species. The thickness of this zone at Bekhme Gorge is about 357m, and at Zarda Bee section is about 127.5m.The zone age is determined to be of Upper Maastrichtian, relying on both the three species age and the age of associated species such as *Loftusia morgani.* As well as the age correlation with those similar species observed in the nearby region and other countries that mentioned above.

2. *Loftusia morgani* range zone

The first appearance of this species configures lower limit of this zone, also the disappearance of the species represents the upper limit. This zone occurs within all three described sections (Plate 2). The thickness of the zone in Bekhme Gorge is 250m, and in the lower part of Zarda Bee section is 60m.The age of this zone was determined depending on its occurrence within the Maastrichtian deposit located worldwide. This range zone was determined in Iran [13], Iraq [14, 7, 6 and 4], France [15], Turkey [11, 16], and Yugoslavia [15].

3. *Abathomphalus mayaroensis* range zone

This range zone was not used in many researches, because this species is rare. In this study it was identified only in the Bekhme Gorge section (Plate 2), the lower limit of this range zone represents first appearance of *Abathomphalus mayaroensis*, the upper limit is the last appearance of this species which is caused by the Late Maastrichtian mass extinction. This species can be seen within the high latitudes [17]. The thickness of *Abathomphalus mayaroensis* range zone is determined as 120m.The age of this range zone is considered to be an Upper Cretaceous at which it did not include the Tertiary age. *Abathomphalus mayaroensis*age is rare in northeastern Iraq, this specie considered to be the Late Maastrichtian marker species that found below the Cretaceous - Tertiary boundary [18], the *Abathomphalus mayaroensis* Zone was mentioned in study of the Zagreus region [19]. Also, in Northern Iraq the *Abathomphalus mayaroensis* is used as a subzone for the *Globotruncana contuse-esnehensis* that determine the Upper Maastrichtian age [20]. In Tunisia [21], the study of micro-biostratigraphy that used the *Racemiguembelina Varians varians* and *Abathomphalus mayaroensis* as zones defined the Maastrichtian age. In study of the Cretaceous planktonic foraminifera of the Tethys, the *Abathomphalus mayaroensis* Bolli was considered as a zone [22]. The determination of the *Abathomphalus mayaroensis* Bolli as a zone in the Tethys for the stratigraphic zonation of the Cretaceous planktonic foraminifers have been examined in thin section study [23]. In the the Europe-Mediterranean zonation study [24] used *Abathomphalus mayaroensis* Bolli, *Contusotruncana contuse, Racemiguembelina fructicosa*zones *and Gansserina gansseri* zone for Late Maastrichtian Planktonic foraminifera of Cretaceous commentary. The standard planktonic foraminiferal zonal scheme divides the Maastrichtian into three zones (*Abathomphalus mayaroensis*, *Gansserina gansseri* and *Globotruncana aegyptiaca.)*[25]. It was mentioned in the practical manual of Cretaceous Planktonic Foraminifera research that the *Abathomphalus mayaroensis* Bolli, *Contusotruncana contuse, Racemiguembelina fructicosa*zones *and Gansserina gansseri* Zone belongs to the Late Maastrichtian [26]. The *Racemiguembelina fructicosa* zone and *Abathomphalus mayaroensis*zone (late

Maastrichtian) are absent in the sections of Gurapi Formation (Late Cretaceous to the Danian age) at the Marun oil field of the Zagros Basin, SW Iran [27].

Conclusion

The biostratigraphic investigation of the studied formations indicates a three biozones, two of them are concerned with the four species of benthic foraminifera which are; *Siderolites calcitropodes-Orbitoides apiculatus-Omphalocyclus macroporus* and *Loftusia morgani.* And the third biozone includes a rare planktonic species which resembles an important indicator for the Upper Cretaceous succession, which is *Abathomphalus mayaroensis.* Based on this biostratigraphic zonation, Upper Campanian-Late Eocene age for the studied formations at Bekhme Gorge and Zarda Bee sections have been determined.

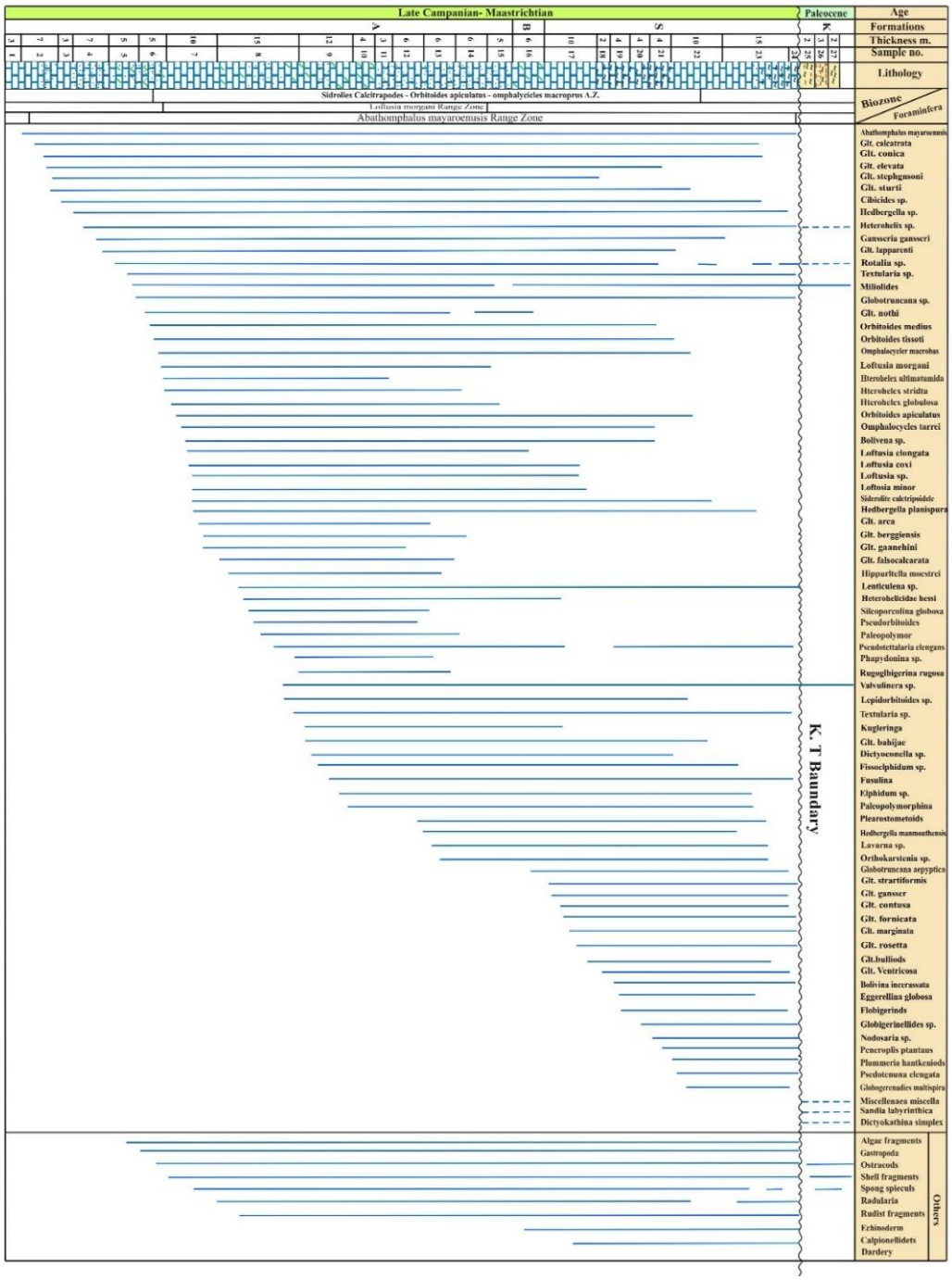

Figure 2- Biostratigraphy of Upper Cretaceous succession at Bekhme Gorge section.

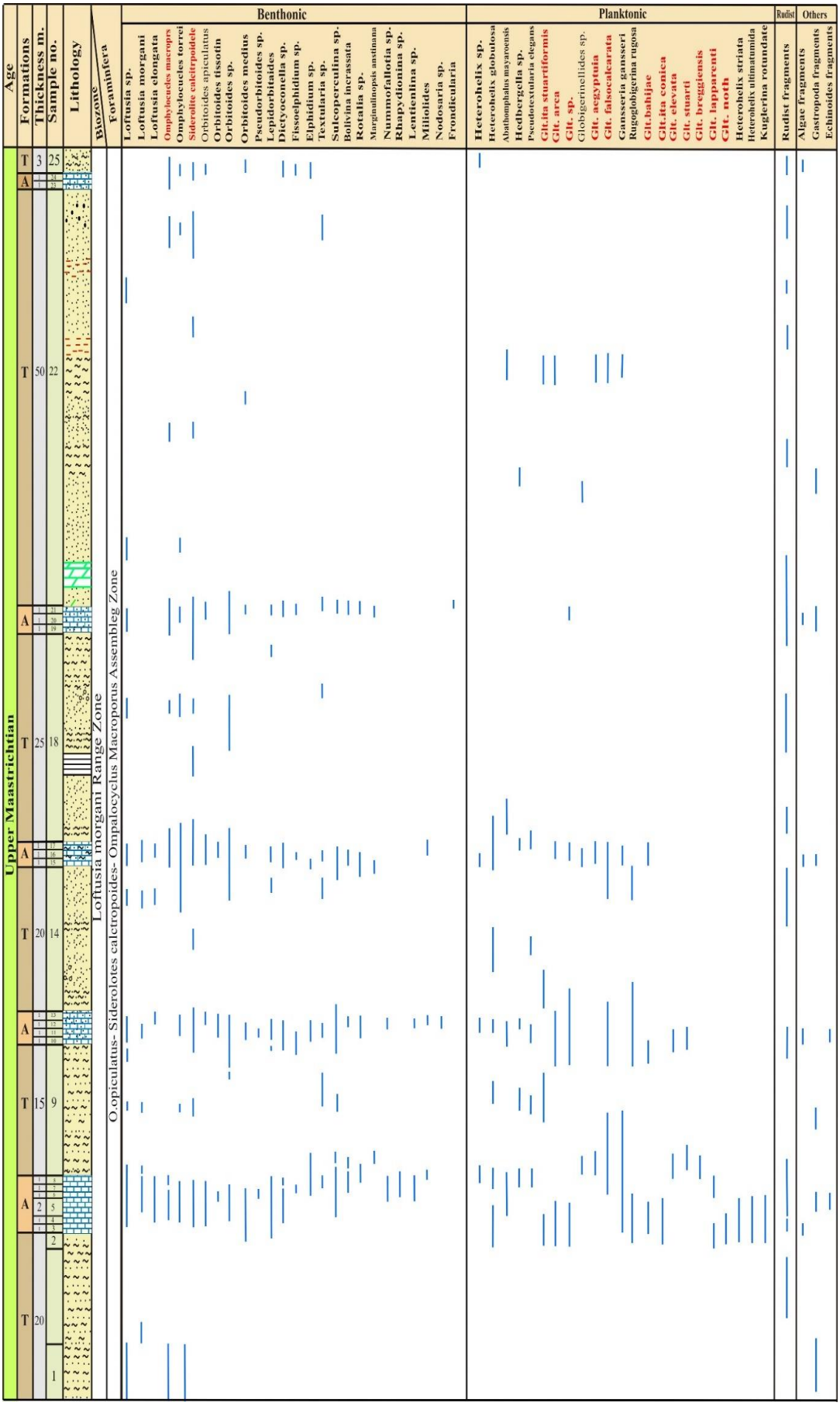

Figure 3- Biostratigraphy of Upper Cretaceous succession at Zarda Bee section

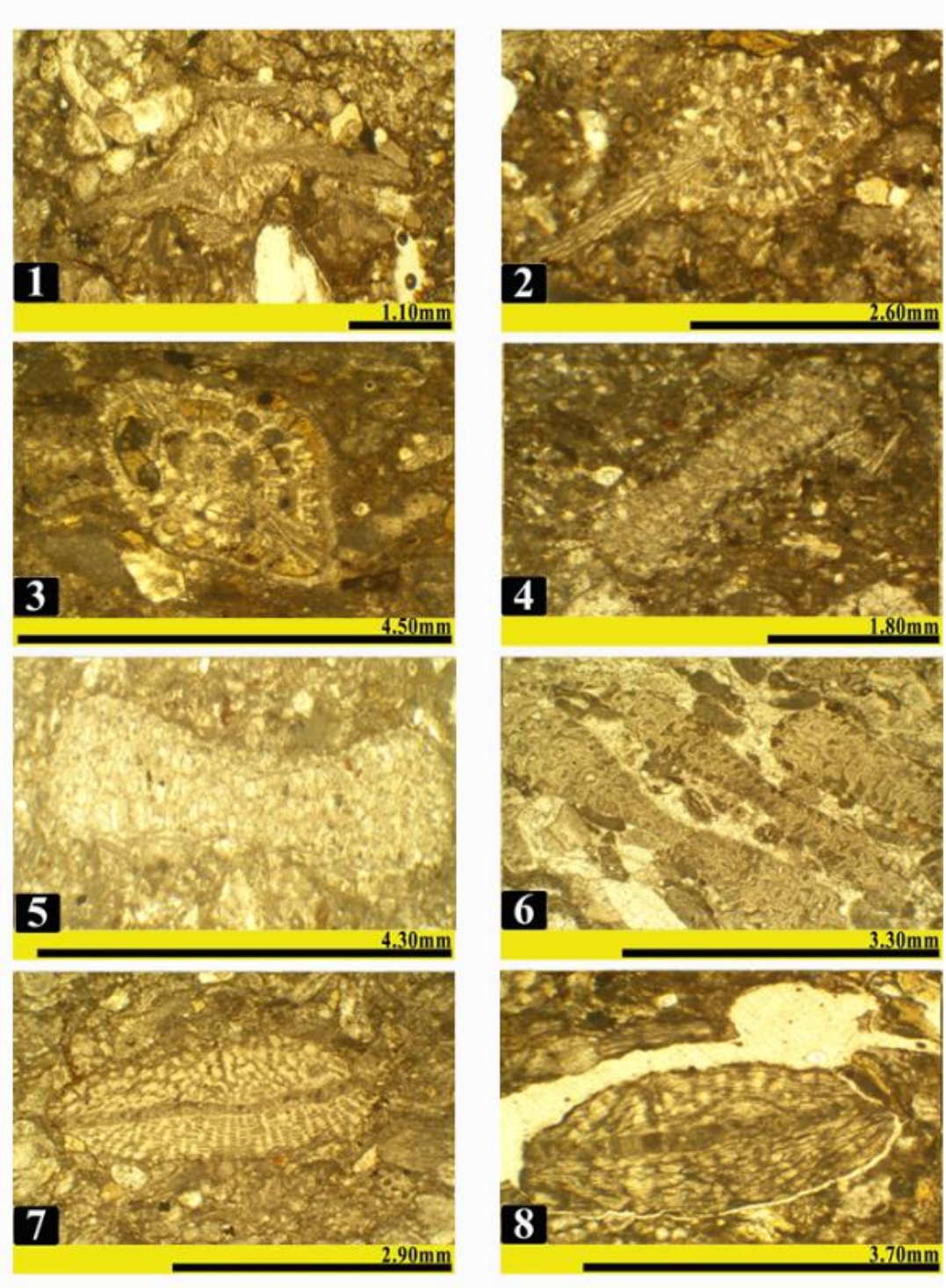

Plate 1

1. *Siderolites calcitropoides* Lamarck; axial section, grainstone to packstone; Aqra Formation; Maastrichtian; Zarda Bee section. Sample No. Z12.
2. *Siderolites calcitropoides* Lamarck; axial section, packstone texture; Aqra Formation; Maastrichtian; Bekhme Gorge section. Sample No.39.
3. *Siderolites calcitropoides* Lamarck; axial section, wackestone texture; Bekhme Formation; Upper Campanian-Lower Maastrichtian age; Bekhme Gorge section. Sample No.25.
4. Micrtzed, *Omphalocyclus macroporus* Lamarck; axial section, wackestone texture; Aqra Formation; Maastrichtian; Zarda Bee section. Sample No. Z1a.
5. *Omphalocyclus macroporus* Lamarck; axial section, packstone texture; Aqra Formation; Maastrichtian; Bekhme Gorge section. Sample No. 42.

6. *Omphalocyclus macroporus* Lamarck; axial section, packstone texture; Aqra - Bekhme Formation; Upper Campanian-Lower Maastrichtian age; Bekhme Gorge section. Sample No. 22.
7. *Orbitoides apiculatus* (d'Archiac); axial section; Grainstone to packstone texture ; Aqra Formation; Maastrichtian; Zarda Bee section. Sample No. Z18.
8. *Orbitoides apiculatus* (d'Archiac); axial section; Grainstone to packstone texture ; Aqra Formation; Maastrichtian; Bekhme Gorge section. Sample No. 40.

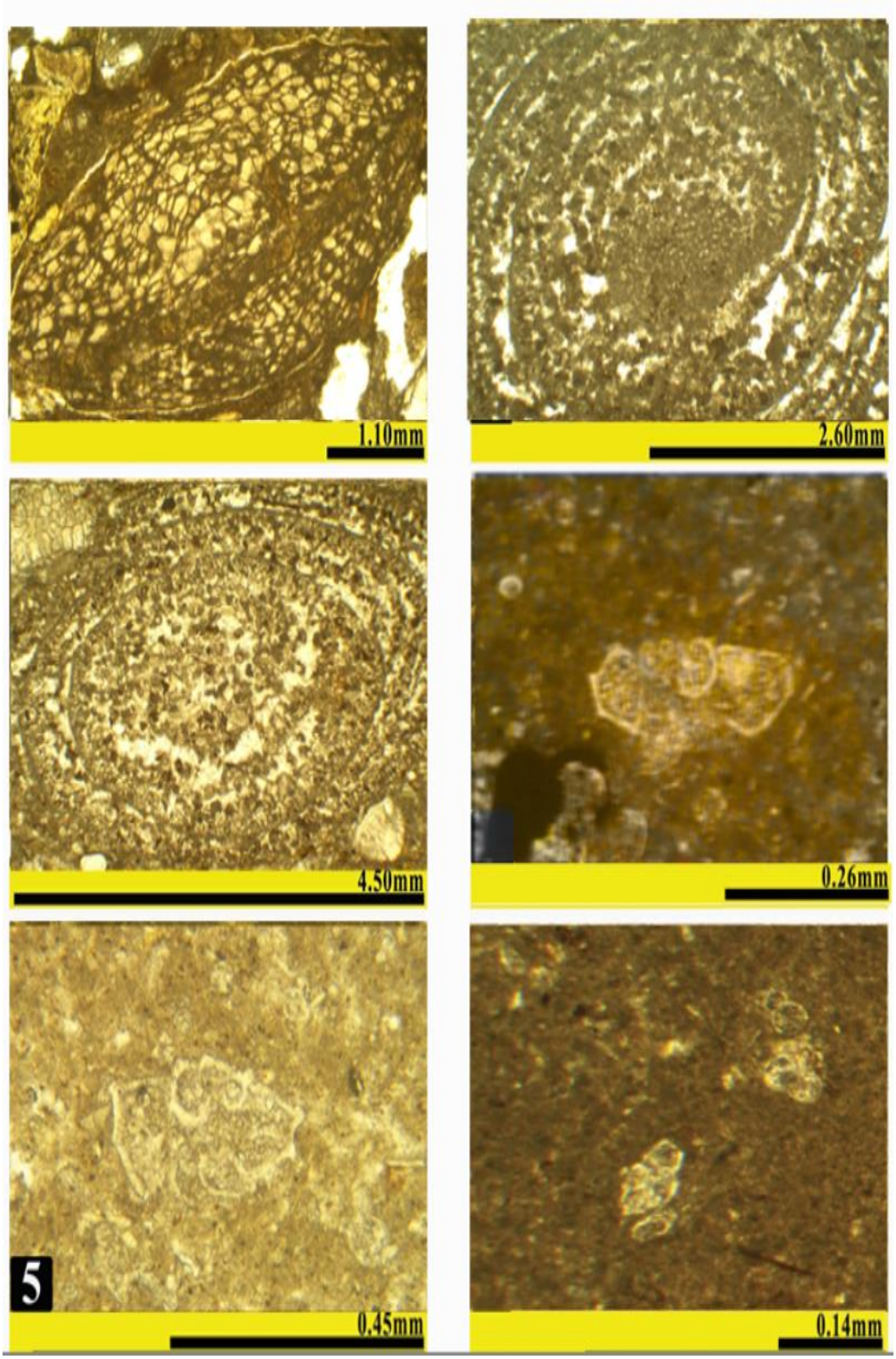

Plate 2

1. Micrtized, *Orbitoides apiculatus* (d'Archiac); axial section; wacketone texture, Bekhme Formation; Upper Campanian-Lower Maastrichtian age; Bekhme Gorge section. Sample No. 27.
2. Loftusia morgana Douville; equatorial section; grainstone texture; Aqra Formation; Maastrichtian; Zarda Bee section. Sample No. Z, 24.
3. Loftusia morgana Douville; equatorial section; packstone texture; Aqra Formation; Maastrichtian; Bekhme Gorge section. Sample No. 55.
4. *Abathomphalus mayaroensis* Bolli; in planktonic mudstone to wackestone texture; Shiranish Formation; Upper Campanian–Maastrichtian; Bekhme Gorge section. Sample No.4.
5. *Abathomphalus mayaroensis* Bolli; wackestone texture; Shiranish Formation; Upper Campanian–Maastrichtian; Bekhme Gorge section. Sample No.7.
6. *Abathomphalus mayaroensis* Bolli; bioclastic wackestone texture; Shiranish Formation; Upper Campanian–Maastrichtian; Bekhme Gorge section. Sample No.18.

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