

Benthic Foraminiferal and Calcareous Algae Assemblages in the Tirgan Formation (Urgonien Facies Type) in South Flank of Ghorogh Syncline (North of Chenaran), NE Iran

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How to cite this paper: Yavarmanesh, H., Vaziri, S.H., Aryaei, A.A., Jahani, D., Pourkermani, M. and Bouriabadi, E.K. (2017) Benthic Foraminiferal and Calcareous Algae Assemblages in the Tirgan Formation (Urgonien Facies Type) in South Flank of Ghorogh Syncline (North of Chenaran), NE Iran. *Open Journal of Geology*, 7, 796-805.

<https://doi.org/10.4236/ojg.2017.76054>

Received: May 1, 2017

Accepted: June 5, 2017

Published: June 8, 2017

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Abstract

In this research, the Tirgan Formation in the south flank of Ghorogh Syncline (north of Chenaran), northeastern Iran with the thickness of 251 was studied. This section consists of limestone, marly limestone and shale with impressions of echinoderms *toxasteridae* family, many of foraminifera from orbitolinidae family and also lots of calcareous algae that create facies variation along with other non-skeletal allochems. Micropaleontological investigation has been carried out on 90 thin-sections. These criteria reveal that an equivalent of the Urgonian facies type (in France-Swiss area) and open marine, low depth sedimentary basin are extended in the Kopet-Dagh basin. In this article, we tried to introduce some of the important foraminiferal and calcareous algal assemblages of this area.

Keywords

Tirgan Formation, Ghorogh Syncline, Foraminifera, Calcareous Algae

1. Introduction

The Tirgan Formation is a Lower Cretaceous succession in the Kopet Dagh basin in northeast of Iran which mainly consists of micritic limestones, thick-bedded bio-micritic limestones, shaly limestones, marly limestones and bio-sparite limestones [1]. The study area is located in south flank of Ghorogh Syncline (north of Chenaran) in the Kopet-Dagh basin with coordinates: 36°50'38"N and 59°02'38"E (Figure 1). The Tirgan Formation in study area with a thickness of 251 m, consists

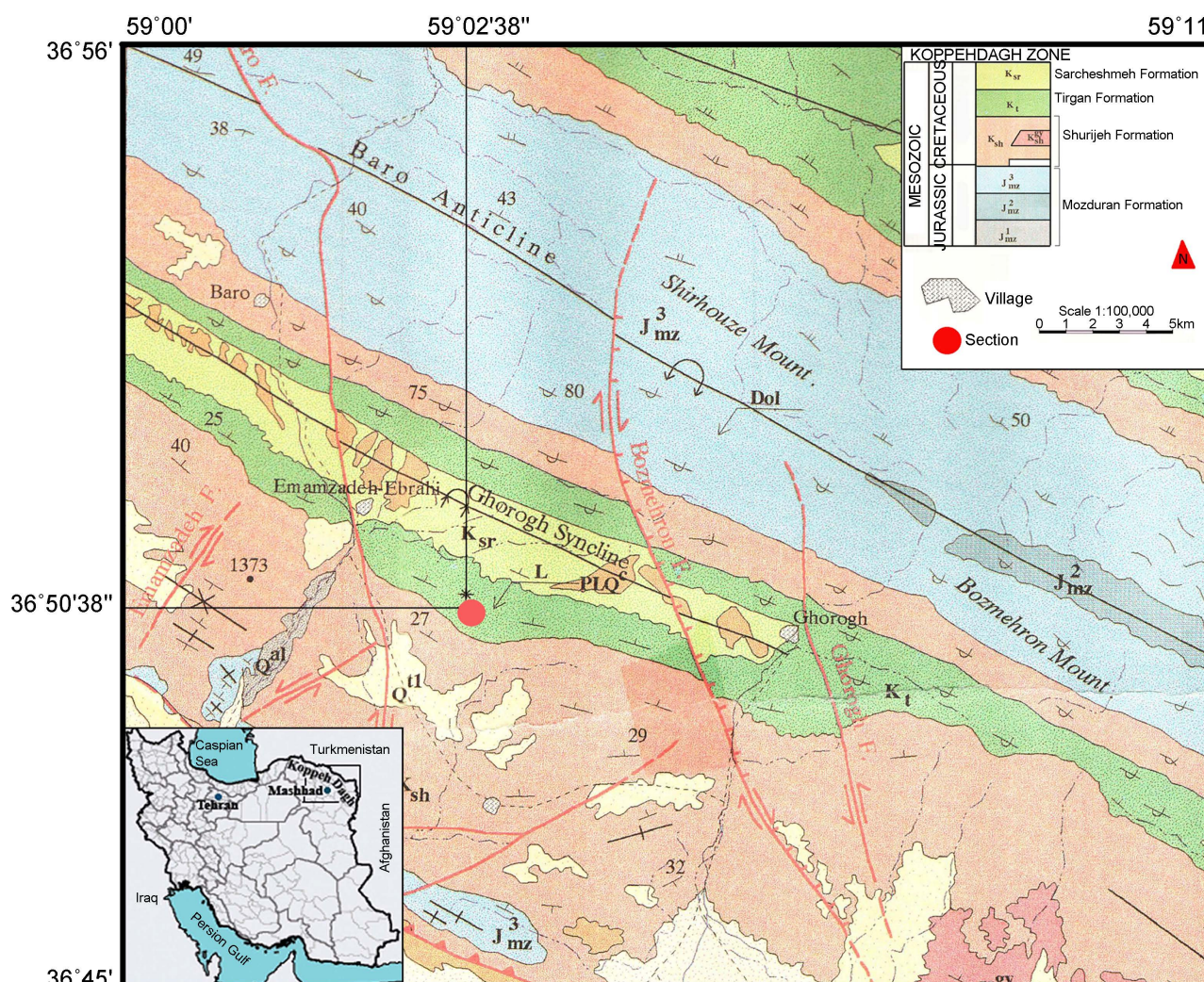


Figure 1. Location map of the Tiran Formation in south flank of Ghorogh Syncline (Kopet Dag basin), NE Iran.

of limestone, marly limestone and shale (**Figure 2**). Detailed micropaleontological investigations have been carried out on one section of the Tiran Formation supported by the analysis of 90 thin-sections. In this section, the benthic foraminiferal assemblages constitute the largest proportion of the total microfaunal content in terms of abundance.

2. Geological Setting

The Kopet Dag mountain range represents a NE-trending about 650 km long and about 200 km wide active fold belt at the frontier between Turkmenistan and Iran, east of the Caspian Sea. It was formed on Hercynian metamorphosed basement at the SW margin of the Turan Platform and is composed of about 10 km of Mesozoic and Tertiary sediments (mostly carbonates). Like to the Zagros Mountains, the Kopet Dag was folded in to long linear NW-SE trending folds during the last phase of the Alpine orogeny in Plio-Pleistocene times. No magmatic rocks are exposed in Kopet Dag except those at the basement occurring in the Aghdar band tectonic window and some Triassic basic dikes. The studied

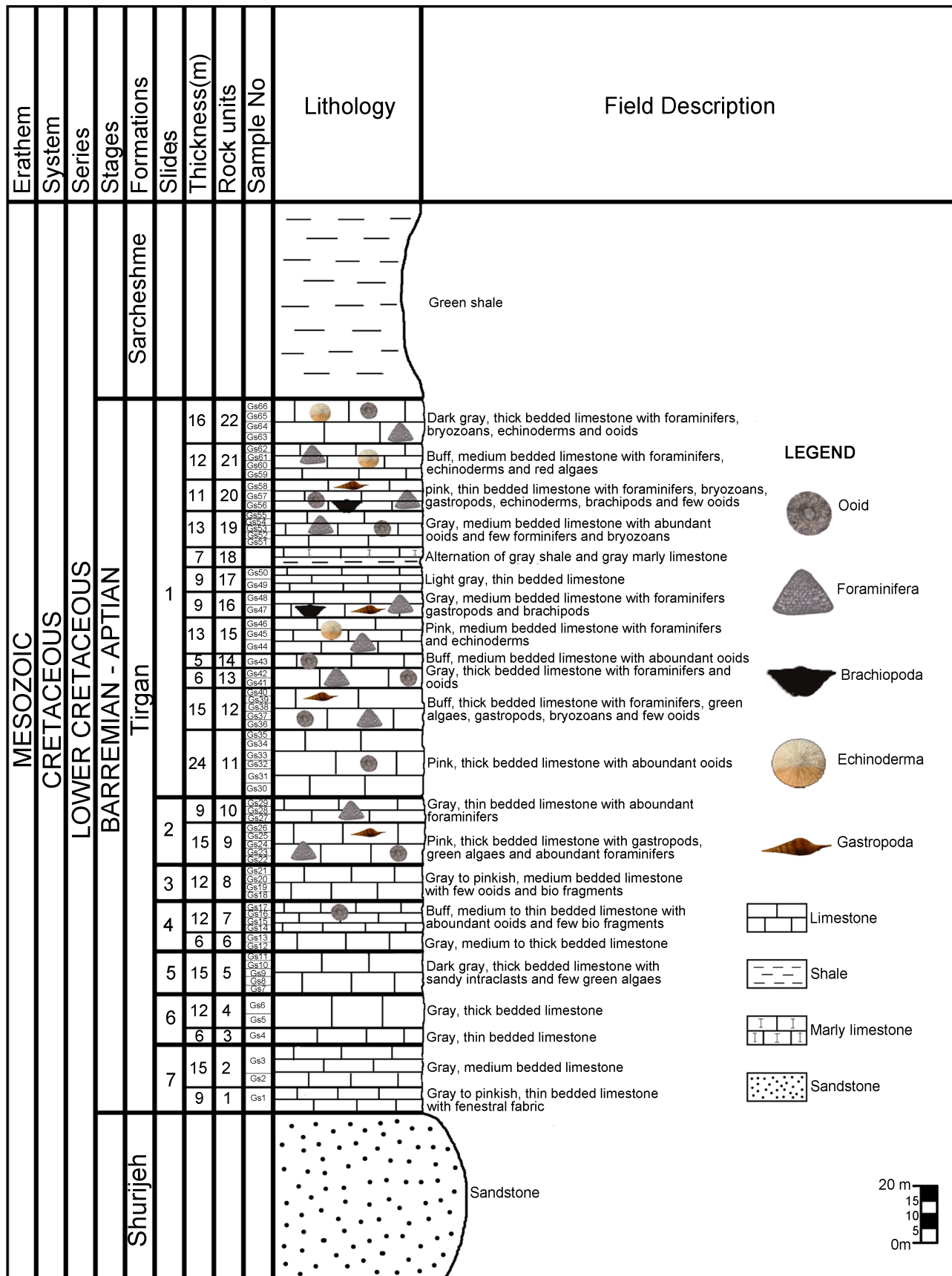


Figure 2. Stratigraphic section of the Tirgan Formation in south flank of Ghorogh Syncline.

samples are from the Barremian-Aptian Tirgan Formation referring to the Tirgan Valley in the eastern central Kopet Dagh sedimentary basin in the northeast of Iran. The name, introduced by geologists of the National Iranian oil company [2] [3], applies to a feature-forming unit of massively bedded, oolitic and organo-detrital limestones occurring throughout the Kopet Dagh mountain range. For the eastern part of Kopet Dagh, thickness of 50 m or less is indicated but in the type area of the Tirgan Valley the thickness is about 700 m [3]. The Tirgan Formation overlies the Shurijeh Formation and underlies by the Sarcheshmeh Formation; the contacts with both are conformable and a transitional inter-fingering between the Tirgan and Shurijeh formations have been observed in the southeastern Kopet Dagh. The lithology of the Tirgan Formation includes oolitic, partly fossiliferous (e.g. orbitolinid limestones), partly marly limestones, and marls allowing further differentiation of the formation. The age of Tirgan Formation was essentially Neocomian, in places extending as high as Aptian. Barremian deposits of the Tirgan Formation may reach up to 300 m thickness and consist of alternating calcareous sand and oolitic sandy limestone containing bryozoans, calcareous algae and both benthonic and planktonic foraminifera [4]. The Aptian part of the Tirgan Formation may reach up to 1100 m in thickness and is mainly represented by massive limestones; its foraminiferal fauna includes beside others orbitolinids such as *Palorbitolina lenticularis*.

3. Discussion

Chenaran area is a part of Kopet Dagh sedimentary basin located in the Khorasan Razavi. In this area, some outcrops of the Mozdooran, Shurijeh, Tirgan and Sarcheshmeh formations are present with the Jurassic and Cretaceous age. This area is located about 25 km north of Chenaran. In this section, the thickness of the Tirgan Formation is 251 m in south flank of Ghorogh Syncline. For micropaleontological studies, 66 samples were taken and 90 thin-sections were prepared. Several references such as [5]-[11] used to identify benthic foraminifera and calcareous algae.

The following benthic foraminifera have been identified (**Figure 3** and **Figure 4**): *Palorbitolina lenticularis*, *Orbitolina* sp., *O. conoidea*, *O. discoidea*, *O. kurdica*, *Simplorbitolina manasi*, *Dictyoconus* sp., *D. arabicus*, *D. cuvillieri*, *D. pachymarginalis*, *Vercorsella* sp., *V. arenata*, *Cuneolina* sp., *C. sliteri*, *Nautiloculina bronimanni*, *Nezzazata isabellae*, *Bolivinopsis rhopaloides*, *Praechrysalidina* sp., *P. infracretacea*, *P. cf. infracretacea*, *Comaliama* sp., *Trocholina* sp., *T. odukpaniensis*, *T. cf. alpina*, *Novalesia* sp., *Debariana hahounerensis*, *Istriloculina eliptica*, *Triloculina* sp., *Rumanoloculina* sp., *R. pseudominima*, *R. ponticuli*, *R. robusta*, *Charentia cuvillieri*, *Debariana* sp., *Paleodictyoconus glanensis*, *Istriloculina* sp.

Also, the following calcareous algae (mainly dasycladales) have been identified (**Figure 5**): *Salpingoporella* sp., *S. muehlbergii*, *S. dinarica*, *Boueina* sp., *B. pygmaea*, *B. hochstetteri*, *Arabicodium* sp., *A. orientalis*, *Cylindroporella* sp., *C. sugdeni*, *Halimeda* sp., *Carpathoporella fontis*, *Triploporella marsicana*, *Kopetdagaria sphaerica*, *Permocalculus* sp.

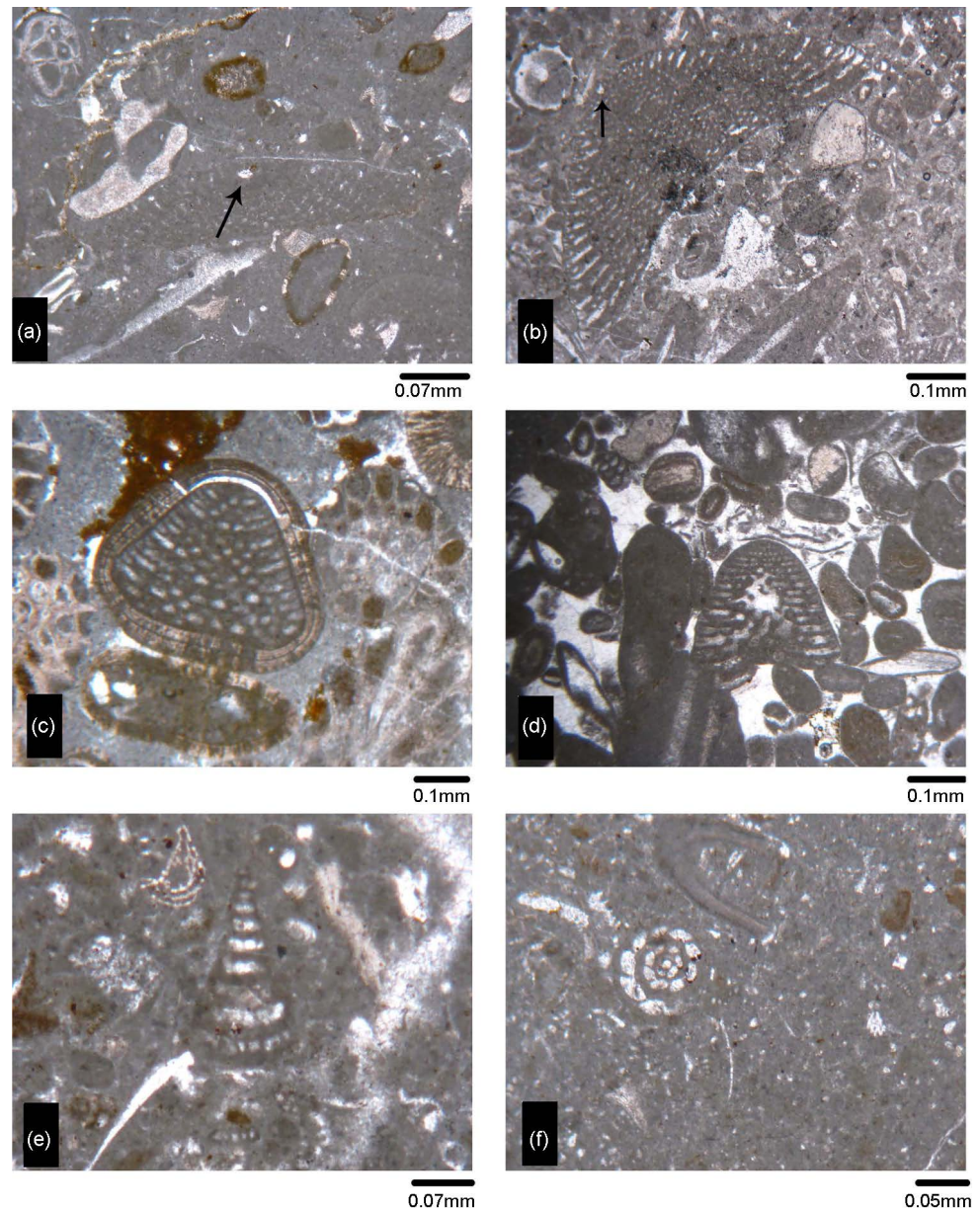


Figure 3. Benthic foraminifera: (a) *Palorbitolina lenticularis*, (b) *Palorbitolina lenticularis*, (c) *Simplotorbitolina manasi*, (d) *Dictyoconus pachymarginalis*, (e) *Cuneolina sliteri*, (f) *Charentia cuvillieri*.

Based on the above-mentioned microfauna four biozones have been recognized as follow:

Benthic Foraminifera Biozones:

1) *Trocholina odukpaniensis* Range Zone: This biozone is associated with the following foraminifers: *Trocholina odukpaniensis*, *Cuneolina sliteri*, *Novalesia* sp., *Praechrysalidina infracretacea*, *Praechrysalidina* cf. *infracretacea*, *Bolivinopsis rhopaloides*, *Comaliama* sp., *Nezzazata isabellae*, *Nautiloculina bronimanni*, *Vercorsella arenata*, *Cuneolina* sp., *Trocholina* sp., *Vercorsella* sp. (**Figure 6**). *Trocholina odukpaniensis* Range Zone is specified with appearance and extinction of *Trocholina odukpaniensis* with a thickness of 7 m (Gs 25, Gs 26) and the age of this biozone is Late Barremian.

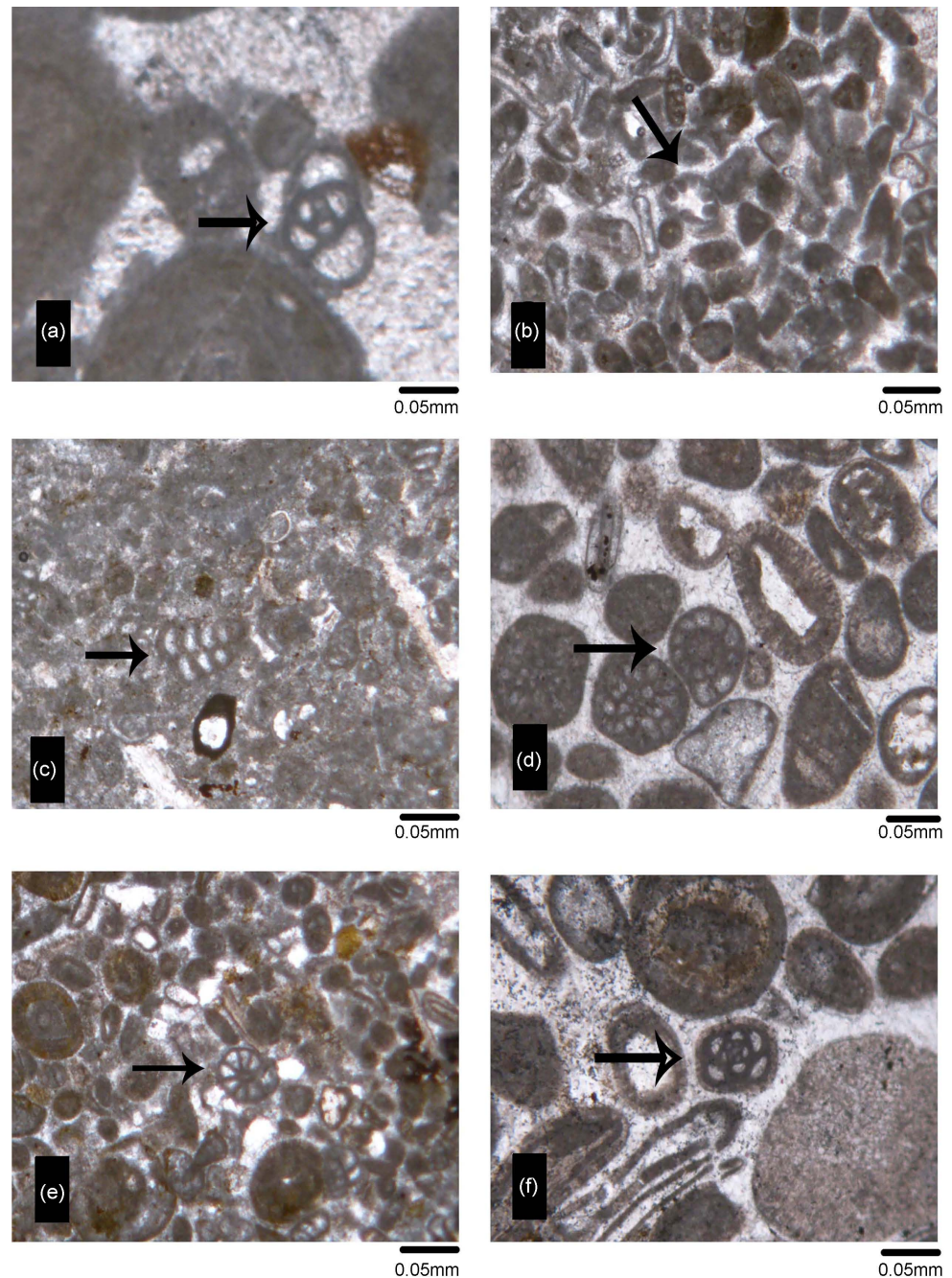


Figure 4. Benthic foraminifera: (a) *Istriloculina eliptica*, (b) *Trocholina odukpaniensis*, (c) *Ver-corsella arenata*, (d) *Debariana hahounerensis*, (e) *Nezzazata isabellae*, (f) *Rumanoloculina robusta*.

2) *Charentia cuvillieri-Debariana hahounerensis* Assemblage Zone: This biozone is associated with the following foraminifera: *Charentia cuvillieri*, *Debariana hahounerensis*, *Istriloculina eliptica*, *Praechrysalidina* sp., *Triloculina* sp., *Rumanoloculina pseudominima*, *Orbitolina* sp. (**Figure 6**). *Charentia cuvillieri-Debariana hahounerensis* Assemblage Zone is specified with appearance of *Charentia cuvillieri* and extinction of *Debariana hahounerensis* with a thickness of 28 m (Gs 34 to Gs 41) and the age of this biozone is Early Aptian.

3) *Dictyoconus pachymarginalis* Range Zone: This biozone is associated

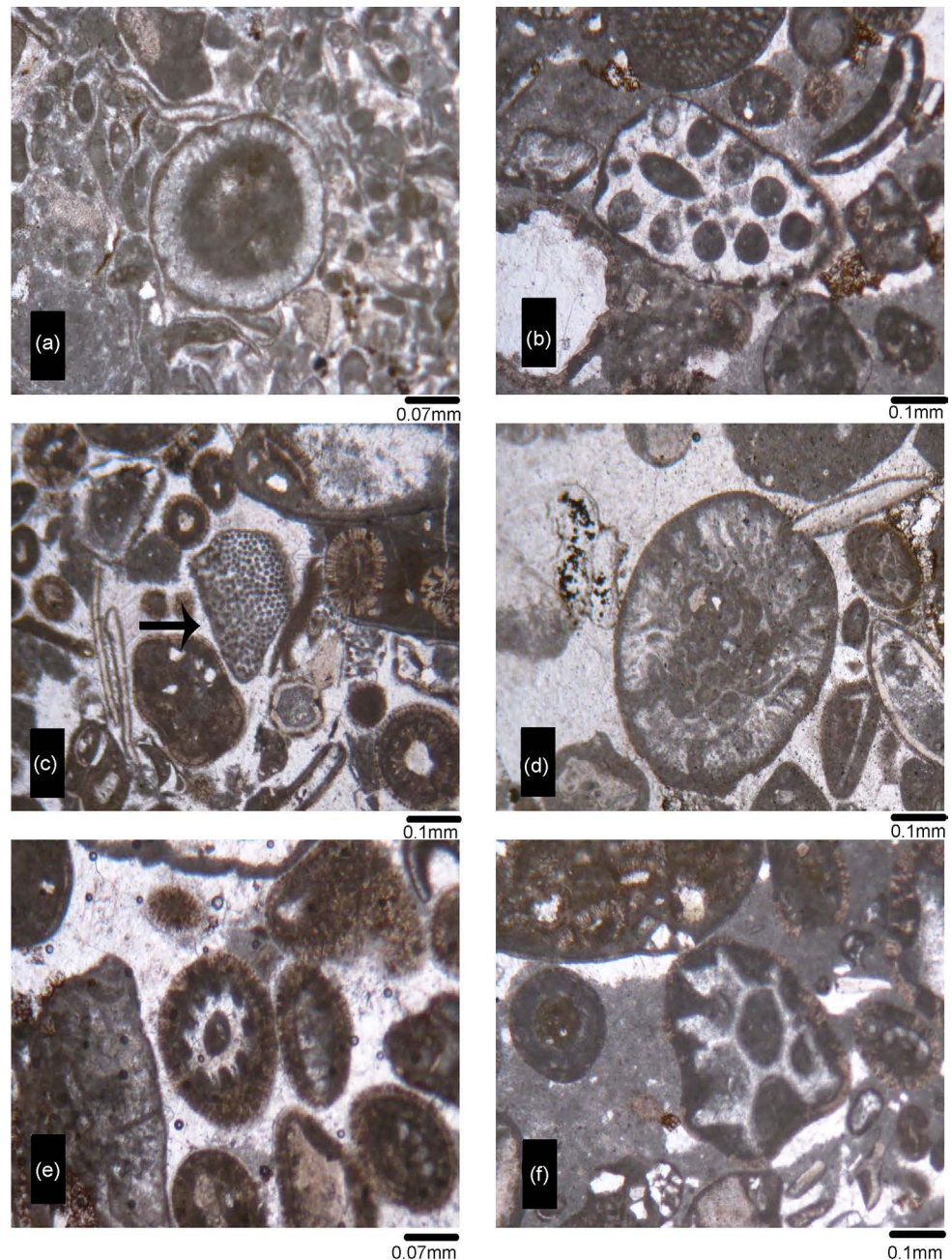


Figure 5. Calcareous algae: (a) *Arabiodium orientalis*, (b) *Cylindroporella* sp., (c) *Permocalculus* sp., (d) *Boueina hochstetteri*, (e) *Carpathoporella fontis*, (f) *Kopetdagaria sphaerica*.

with the following foraminifers: *Dictyoconus pachymarginalis*, *Palorbitolina lenticularis*, *Orbitolina conoidea*, *Orbitolina discoidea*, *Rumanoloculina* sp., *Rumanoloculina robusta* (Figure 6). *Dictyoconus pachymarginalis* Range Zone is specified with appearance and extinction of *Dictyoconus pachymarginalis* with a thickness of 39 m (Gs 35 to Gs 45) and the age of this biozone is Early Aptian.

Calcareous Algae Biozone:

4) *Boueina hochstetteri*-*Cylindroporella* Assemblage Zone: This biozone is associated with the following calcareous algae: *Boueina hochstetteri*, *Cylindroporella* sp., *Boueina pygmaea*, *Arabiodium orientalis*, *Boueina* sp., *Cylindropo-*

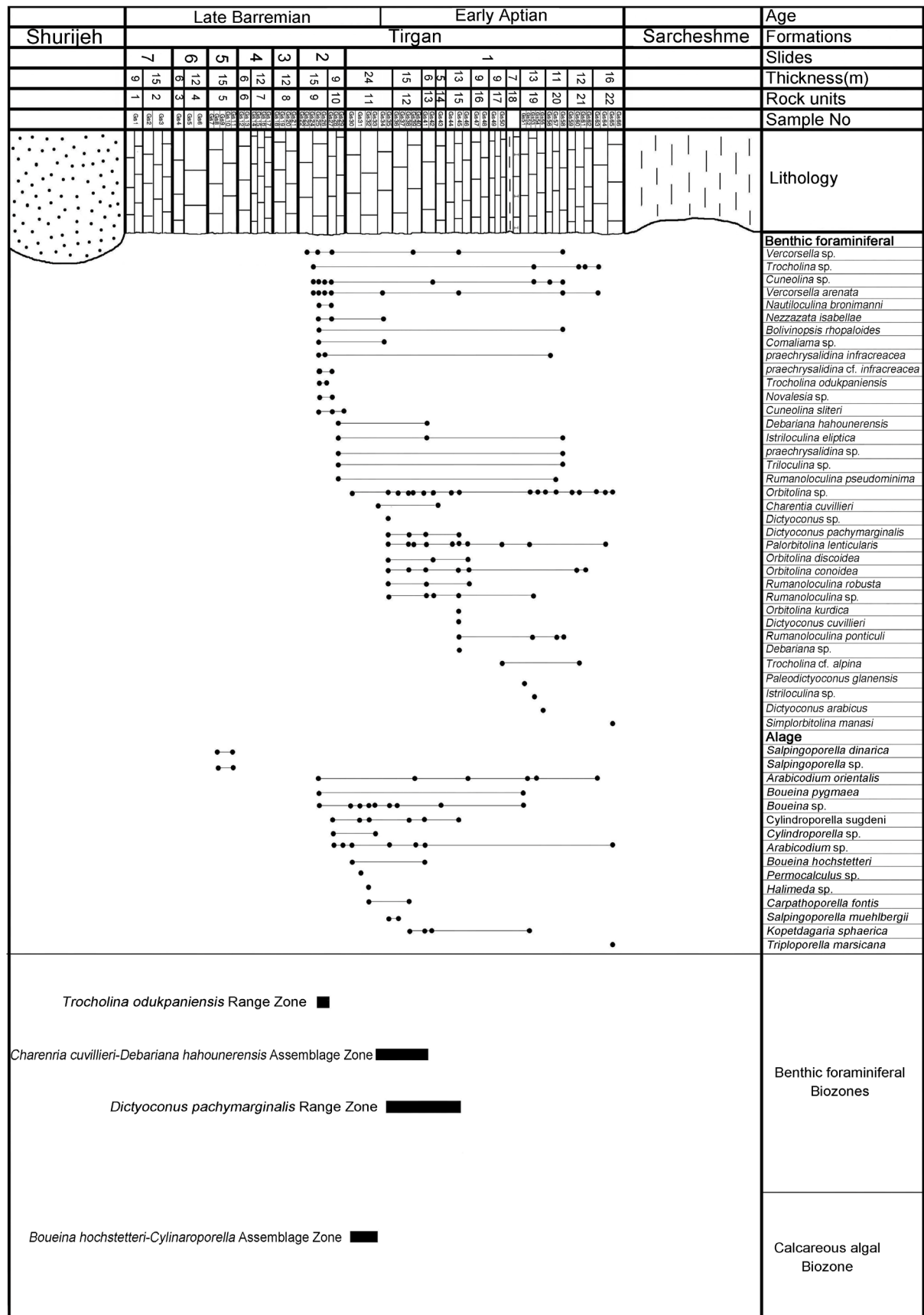


Figure 6. Main foraminiferal and calcareous algae range chart.

rella sugdeni, *Arabicodium* sp. (Figure 6). *Boueina hochstetteri*-*Cylindroporella* Assemblage Zone is specified with appearance of *Boueina hochstetteri* and extinction of *Cylindroporella* sp. with a thickness of 16 m (Gs 30 to Gs 33) and the age of this biozone is Late Barremian.

According to the mentioned biozones, the Late Barremian-Early Aptian age is suggested for the formation.

Overall, the importance of this research is that it will lead to determine the age of the Tirgan Formation more precisely and also it conveniently enables us to compare this formation with other sections of the basin on the future studies.

4. Conclusions

The main results of the present research as follow:

- 1) Tirgan Formation in the study area consists mainly of medium- to thick-bedded biogenic oolitical limestones with intercalations of shales.
- 2) 19 genera and 21 species of foraminifera and 9 genera and 9 species of calcareous algae have been determined. 2 Range Zone and 1 Assemblage Zone of benthic foraminifera (*Trocholina odukpaniensis* Range Zone, *Charentia cuvillieri*-*Debariana hahounerensis* Assemblage Zone, *Dictyoconus pachymarginalis* Range Zone) and 1 Assemblage Zone of calcareous algae (*Boueina hochstetteri*-*Cylindroporella* Assemblage Zone) have been identified.
- 3) The existence of Urgonian facies in the NE Iran is accurately certified according to the micro-and macrofauna in the studied area.
- 4) Based on the identified benthic foraminifera as well as dasycladalean algae, the Late Barremian-Early Aptian age can be ascribed for the Tirgan Formation in the studied area.

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