Journal of Sciences, Islamic Republic of Iran 21(3): 237-250 (2010) http://jsciences.ut.ac.ir
University of Tehran, ISSN 1016-1104

Lithostratigraphy and Microbiostratigraphy of the Ruteh Formation in Northwest of Khur, Central Alborz, Iran

M. Mahdavi[1,*] and S.H. Vaziri[2]

[1] *Research Institute for Earth Sciences, Geological Survey of Iran, Tehran, Islamic Republic of Iran*
[2] *Department of Geology, Faculty of Basic Science, Islamic Azad University-North Tehran Branch, Islamic Republic of Iran*

Received: 29 January 2009 / Revised: 18 May 2010 / Accepted: 30 August 2010

Abstract

A sequence of Permian rocks crops out in Northwest of Khur in Central Alborz, North of Iran. This sequence consists of the Dorud (Asselian-Sakmarian), Ruteh (Artinskian-Murgabian) and Nesen (Early Djulfian) formations. The Ruteh and Nesen formations in Alborz Range were deposited in a shallow marine environment of the continental margin in the Paleo-Tethys. The Ruteh Formation with a thickness of 221m unconformably overlies the Dorud Formation and consists of fossiliferous limestones. This formation in the studied section can be subdivided into three informal members and overlain disconformably by the Nesen Formation (Early Djulfian). This sequence is disconformably overlain by the Elikah Formation (Scythian-Ladinian). The rich foraminiferal fauna indicates an Artiniskian to Early Djulfian age of the succession that can be established with the *Schubertella-Mesoschubertella* Assemblage Zone (Artinskian), *Dunbarula-Deckerella* and *Neoendothyra-Pachyphloia* Assemblage zones (Murgabian), and *Paraglobivalvulina-Ichtyolaria* Assemblage Zone (Early Djulfian).

Keywords: Permian; Foraminifera; Biozonation; Khur area; Centeral Alborz

Introduction

Lower to Upper Permian rocks are widely distributed throughout North of Iran (Alborz Zone). They consist mainly of clastic rocks in the lower part and fossiliferous carbonate rocks in the upper part [13]. These rocks have been named as the Dorud, Ruteh and Nesen formations [3, 8, 1]. The main purpose of this research is lithostratigraphy and microbiostratigraphy of the succession based on the foraminiferal contents and to establish biozones. The research on the Khur area has been carried out by Sieber [20]. Annells et al. [2] prepared geological map of Shakran with scale of 1:100.000, Central Alborz that includes the studied area. For the foraminiferal biostratigraphy, one hundred and twenty four limestone samples were collected from the Ruteh and Nesen formations. The samples were collected at an interval of two meters and one or some times two to four thin sections were prepared.

* Corresponding author, Tel.: +98(912)2250570, Fax: +98(21)22974276, E-mail: me.mahdavi@gmail.com

Lithostratigraphic Description of the Section

Well-defined outcrops of the Lower to Upper Permian rocks lie along the Khur area, northwest of Khur in central Alborz, northern Iran with the following coordinates:

N 36°.03′, E 50°.41′ (Fig. 1). Permian rocks overlie non-conformably the black volcanic rocks Devonian and are covered disconformably by the Elikah Formation that has not shown in the map. The Permian rocks of the Khur area consists of three formations: The Dorud, Ruteh and Nesen formations with Asselian to Early Djulfian age (Fig. 2).

The Dorud Formation

The clastic sediments of the Dorud Formation characterize the Lower Permian rocks of the Alborz Zone. The type section of the Dorud Formation is located in central Alborz near the village of Dorud (North Tehran), where it has a thickness of 180 meters [3]. It overlies nonconformably the Jeirud Formation (Upper Devonian) and consists of red sandstones, shales, conglomerate, fossiliferous limestones and quartzite. This Formation in the Khur area consists of red to purple, thick-bedded sandstones, white quartzite and red shales with Early Permian (Asselian-Sakmarian) age (Fig. 3: c, d, e), which is covered unconformably by the Ruteh Formation. (Fig. 3b).

The Ruteh Formation

The type section of the Ruteh Formation is located in central Alborz near the village of Ruteh (North Tehran), where it has a thickness of 230 meters and consists of dark gray, medium-bedded to massive fossiliferous limestones [3]. In the Khur area, this formation with a thickness of 221 meters unconformably overlies the Dorud Formation and consists of fossiliferous limestones. This Formation in the study section can be subdivided into three informal members as following:

member 1 (7.5 m)

Alternating dark gray, thin-bedded limestones to medium-bedded fossiliferous shaly and wavy limestones. The bedding shows N 297° W strike and 36°SW dip (Fig. 3f). This member contains macrofossils such as Bellerophontid, brachiopoda, ostracoda, ichnofossil of the *Zoophycos* and cyanobacteria of the *Tubiphytes obscurus* Maslov. *Tubiphytes* is commonly interpreted as a calcified cyanobacterium [15]. Senowbari-Daryan and Flugel [17] asserted that a combination of non-preserved soft organism (central tube) and a cyanobacterial envelope is the original interpretation of Maslov regarding *Tubiphytes.* Riding [16] emphasized that the correct name of *Tubiphytes obscurus* is *Shamovella obscura*. The traditional name is consequently used in the articale.

This member also includes the following microfossils (thin sections no. M. KH-1~5): ***Foraminifera:*** *Climacammina sphaerica* Potieskaya, *Eotuberitina reitlingerae* MikLukho-MakLay, *Geinitzina reperta* Bykova, *Geinitzina uralica* Suleimanov, *Langella perforata* Lange, *Mesoschubertella thompsoni* Kanuma & Sakagami, *Pachyphloia cukurkoyi* De Civrieux & Dess., *Schubertella transitoria* Staff & Wedekind, *Tuberitina collosa* Reitlinger; **Algae:** *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella nipponica* Endo; ***Cyanobacteria:*** *Tubiphytes* sp., *Tubiphytes obscurus* Maslov.

Conodont species *Sweetognathus whitei* Clarck [23], has been obtained from member 1 of the Ruteh Formation that is an index for the *Whitei* biozone. This confirms an Artinskian age. Another species, *Hindeodus* sp. and *Hindeodus minatus* Ellison, has also been recorded in this member.

member 2 (119 m)

Alternating dark gray, medium to thick-bedded and massive limestones with medium-bedded shaly limestones. The bedding shows N 271° W strike and 43° SW dip. (Fig. 3g). This member contains macrofossils similar to member 1 and includes the following microfossils (thin sections no. M. KH-6~47): ***Foraminifera:*** *Climacammina sphaerica* Potieskaya, *Climacammina valvulinoides* Lange, *Codonofusiella nana* Erk, , *Deckerella composita* Reitlinger, *Dunbarula mathieui* Ciry, *Frondinodosaria* cf. *Pyrula* De Civrieux & Dess, *Geinitzina chapmani* Schubert Var. Longa Suleimanov, *Geinitzina postcarbonica* Spandel, *Geinitzina primitiva* Potievskaia, *Geinitzina reperta* Bykova, *Geinitzina* cf. *taurica* De Civrieux & Dess., *Geinitzina uralica* Suleimanov, *Globivalvulina biserialis* Cushman, *Globivalvulina vonderschmitti* Reitlinger, *Kahlerina pachytheca* Koch. Devide et Ramors, *Langella* cf. *acantha* Lange, *Langella conica* De Civrieux & Dess., *Langella cukurkoyi* De Civrieux & Dess., *Langella ocarina* De Civrieux & Dess., *Langella perforata* Lange, *Minojapanella elongata* Fujimoto and Kanuma, *Nankinella orbicularia* Lee., *Pachyphloia iranica* Bozorgnia, *Pachyphloia pedicula* Lange, *Pseudolangella fraglis* De Civrieux & Dess., *Tuberitina collosa* Reitlinger; **Algae:** *Gymnocodium* sp., *Gymnocodium bellerophontis* Rothpletz, *Gymnocodium nodosum* Rothpletz, *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella nipponica*

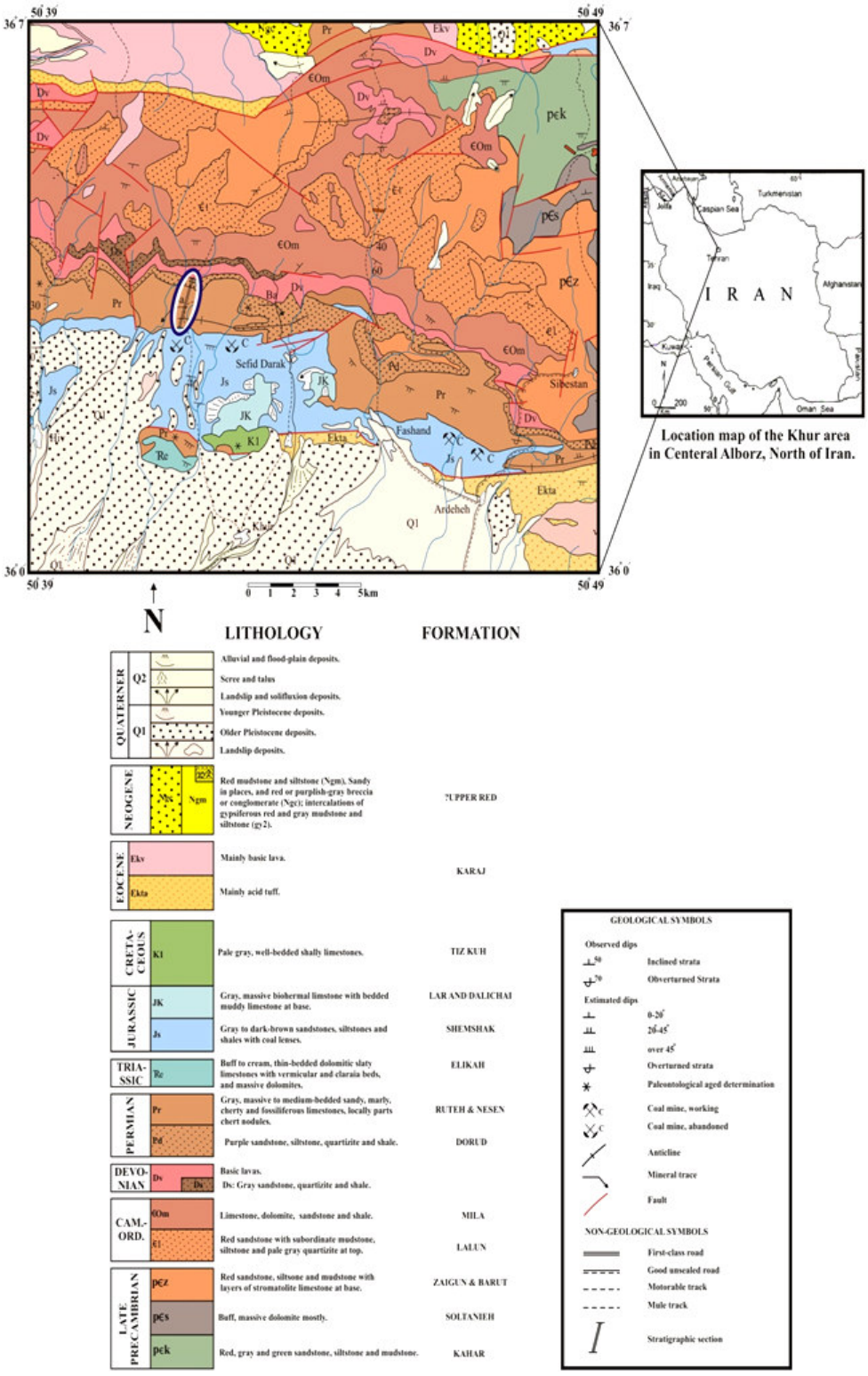

Figure 1. Geological map of the Khur area in Central Alborz, North Iran (Annells et al., 1977).

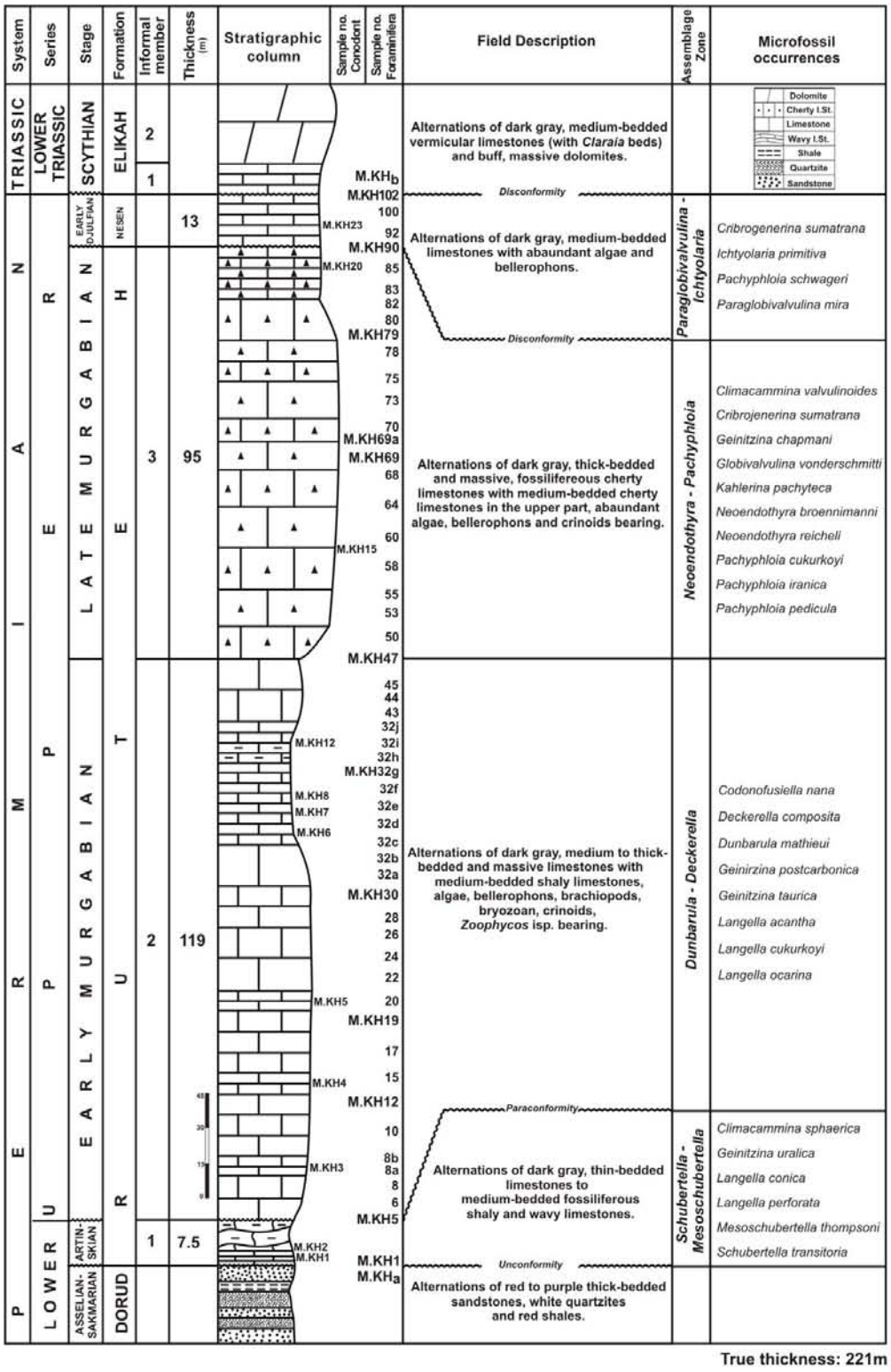

Figure 2. Lithostratigraphical characteristics and biozones of the Ruteh Formation in northwest of Khur, Central Alborz, North of Iran.

Figure 3. (a) Volcanic rocks of the Jeirud Formation. (b) The contact between Dorud and Ruteh Formations. (c) Sandstone of the Dorud Formation. (d) Quartzite of the Dorud Formation. (e) Shale of the Dorud Formation. (f) Thin to medium-bedded fossilifereous shaly and wavy limestones of the Ruteh Formation (member 1). (g) Alternating medium to thick-bedded and massive limestones of the Ruteh Formation (member 2). (h) Ichnofossil (*Zoophycos*) in limestone of the Ruteh Formation (member 2).

Endo; ***Cyanobacteria*:** Girvanella permica Pia, Tubiphytes sp., Tubiphytes obscurus Maslov.

member 3 (95 m)

Alternating dark gray, thick-bedded and massive fossiliferous cherty limestones with medium-bedded cherty limestones in the upper part. The bedding shows S 92° E strike and 44° NE dip (Fig. 4: c, d).

This member includes the following microfossils (thin sections no. M. KH-48~89): ***Foraminifera:*** *Climacammina sphaerica* Potieskaya, *Climacammina* sp., *Cribrogenerina sumatrana* Volz, *Deckerella composita* Reitlinger, *Dunbarula mathieui* Ciry, *Geinitzina chapmani* Schubert, *Geinitzina postcarbo*

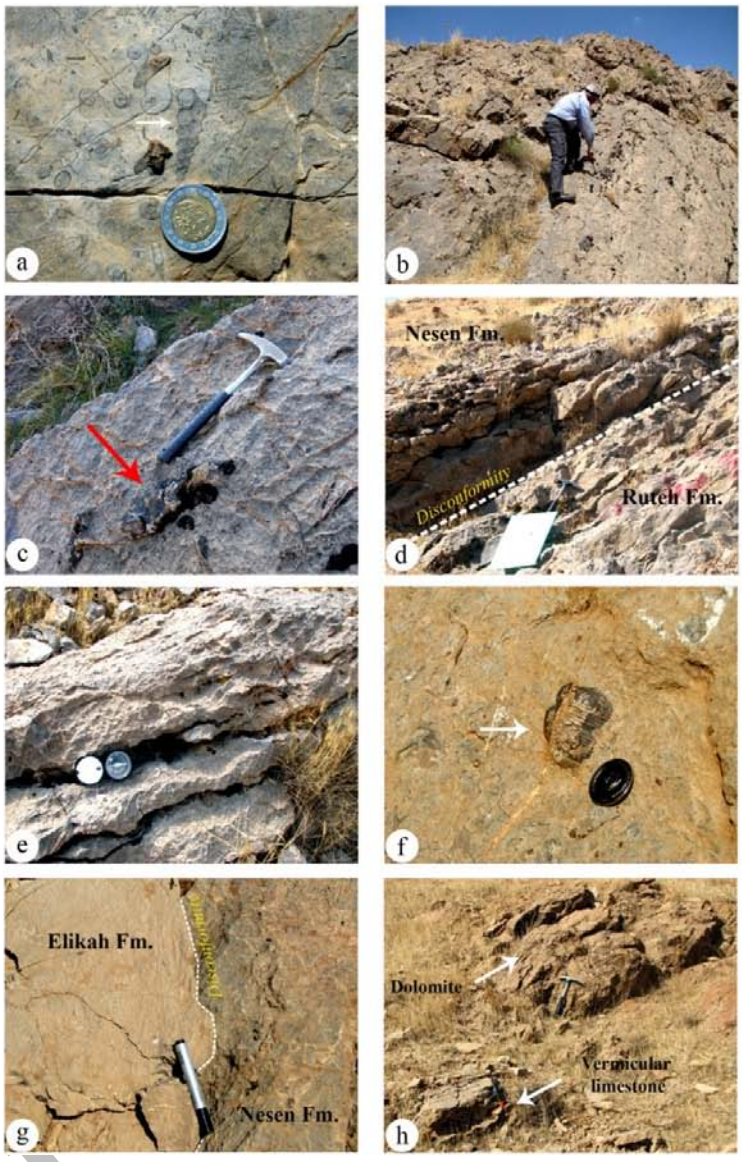

Figure 4. (a) Gastropoda in limestone of the Ruteh Formation (member 2). (b) Alternating limestones of Ruteh Formation (member 3). (c) Chert nodules in alternating limestones of the Ruteh Formation (member 3). (d) The contact between Ruteh and Nesen Formations. (e) Alternating medium-bedded limestones of the Nesen Formation. (f) Brachiopoda in the Nesen Formation. (g) The contact between Nesen and Elikah Formations. (h) Vermicular limestones and dolomites of the Elikah Formation.

nica Spandel, *Geinitzina reperta* Bykova, *Globivalvulina biserialis* Cushman, *Globivalvulina vonderschmitti* Reichel, *Kahlerina pachytheca* Koch. Devide et Ramors, *Langella conica* De Civrieux & Dess., *Langella perforata* Lange, *Minojapanella elongata* Fujimoto and kanuma, *Nankinella orbicularia* Lee., *Neoendothyra broennimanni* Bozorgnia, *Neoendothyra reicheli* Reitlinger, *Pachyphloia cukurkoyi* De Civrieux & Dess., *Pachyphloia iranica* Bozorgnia, *Pachyphloia pedicula* Lange, *Tuberitina collosa* Reitlinger; **Algae:** *Gymnocodium* sp., *Gymnocodium bellerophontis* Rothpletz, *Gymnocodium nodosum* Rothpletz, *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella nippnica* Endo; ***Cyanobacteria*:** *Tubiphytes* sp., *Tubiphytes obscurus* Maslov.

The Nesen Formation

The type section of the Nesen Formation is located in northeast Nesen village (Central Alborz) and has a thickness of 144 meters [8]. This formation consists of black shales (with abundant brachiopods and corals) and dark gray, cherty fossiliferous limestones. The lower as well as the upper boundary of the Nesen Formation is disconformable. The Elikah Formation (Lower to Middle Triassic) disconformably overlies the Ruteh Formation. The Nesen Formation in the studied section consists of dark gray, medium-bedded limestones. These beds show N 320° W strike and 57° SW dip (Fig. 4f).

This Formation includes the following microfossils (thin sections no. M. KH-90~102): ***Foraminifera:*** *Climacammina* sp., *Deckerella composita* Reitlinger, *Ichtyolaria primitiva* De Civrieux & Dess, *Langella perforata* Lange, *Nankinella orbicularia* Lee., *Neoendothyra reicheli* Reitlinger, *Pachyphloia cukurkoyi* De Civrieux & Dess., *Pachyphloia iranica* Bozorgnia, *Pachyphloia pedicula* Lange, *Paraglobival-vulina mira* Reitlinger, *Tuberitina collosa* Reitlinger; **Algae:** *Gymnocodium* sp., *Gymnocodium bellerophontis* Rothpletz, *Gymnocodium nodosum* Rothpletz, *Mizzia* sp., *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella nippnica* Endo; ***Cyanobacteria:*** *Tubiphytes* sp., *Tubiphytes obscurus* Maslov.

The Nesen Formation overlies disconformably the Ruteh Formation and is covered disconformably by the Elikah Formation (Scythian-Ladinian), (Fig. 4g).

List of the foraminifera species in the Ruteh Formation are shown in (Fig. 5) and list of the algae and cyanobacteria species are shown in (Fig. 6).

The Elikah Formation

The Elikah Formation in the study section consists of dark gray, medium-bedded vermicular limestones (with *Claria* beds) and buff, massive dolomites with Early to Middle Triassic (Scythian-Ladinian) age. (Fig. 4h). The Elikah Formation was deposited on a vast platform along the shelves of Paleo-Tethys and Neo-Tethys. The rather poor fossil content can deduce the age of the Elikah Formation, mainly concentrated in the lower part. Except in the Jolfa area in northwestern Alborz, where the Permo-Triassic boundary is rather continuous [9,21], elsewhere along the Alborz Zone, the Elikah Formation overlies a distinct disconformity Upper Permian or even older strata [18, 19] and may have thickness up to 1000 meters.

Foraminiferal Biozones of the Permian System in the Study Section

Four informal foraminiferal biozones have been established in the study section as the following:

Schubertella-Mesoschubertella *Assemblage Zone*

This biozone includes member 1 of the Ruteh Formation with a thickness of 7.5 meters. It indicates an Artinskian age and includes foraminifers of the *Climacammina sphaerica* Potieskaya, *Geinitzina uralica* Suleimanov, *Langella perforata* Lange, *Mesoschubertella thompsoni* Kanuma & Sakagami, *Schubertella transitoria* Staff & Wedekind.

Dunbarula-Deckerella *Assemblage Zone*

This biozone includes member 2 of the Ruteh Formation with a thickness of 119 meters. It indicates an Early Murgabian age and includes foraminifers of the *Codonofusiella nana* Erk, *Deckerella* sp., *Deckerella composita* Reitlinger, *Dunbarula mathieui* Ciry, *Geinitzina postcarbonica* Spandel, *Geinitzina taurica* De Civrieux & Dess, *Langella acantha* Lange, *Langella cukurkoyi* De Civrieux & Dess, *Langella ocarina* De Civrieux & Dess.

Neoendothyra-Pachyphloia *Assemblage Zone*

This biozone includes member 3 of the Ruteh Formation with a thickness of 95 meters. It indicates a Late Murgabian age and includes foraminifera of the *Climacammina* sp., *Climammina valvulinoides* Lange, *Cribrogenerina sumatrana* Volz, *Geinitzina chapmani* Schubert Var. Longa-Suleimanov, *Globivalvulina vonderschmitti* Reichel, *Kahlerina pachytheca* Koch. *Devide et* Ramors, *Langella vensoa Neoendothyra broennimanni* Bozorgnia, *Neoendothyra reicheli* Reitlinger, *Pachyphloia cukurkoyi* De Civrieux & Dess, *Pachyphloia iranica* Bozorgnia, *Pachyphloia pedicula* Lange. The Foraminifer assemblage of the Ruteh Formation is similar to the fauna of other outcrops of the Ruteh Formation in the central Alborz [4] and also is similar to an assemblage reported from Afghanistan [5]. Both works indicated an Artinskian-Murgabian age for the foraminifer assemblages of those areas.

Paraglobivalvulina-Ichtyolaria *Assemblage Zone*

This biozone include of the Nesen Formation with a thickness of 13 meters. It indicates an Early Djulfian age and includes frominifers of the *Climacammina*

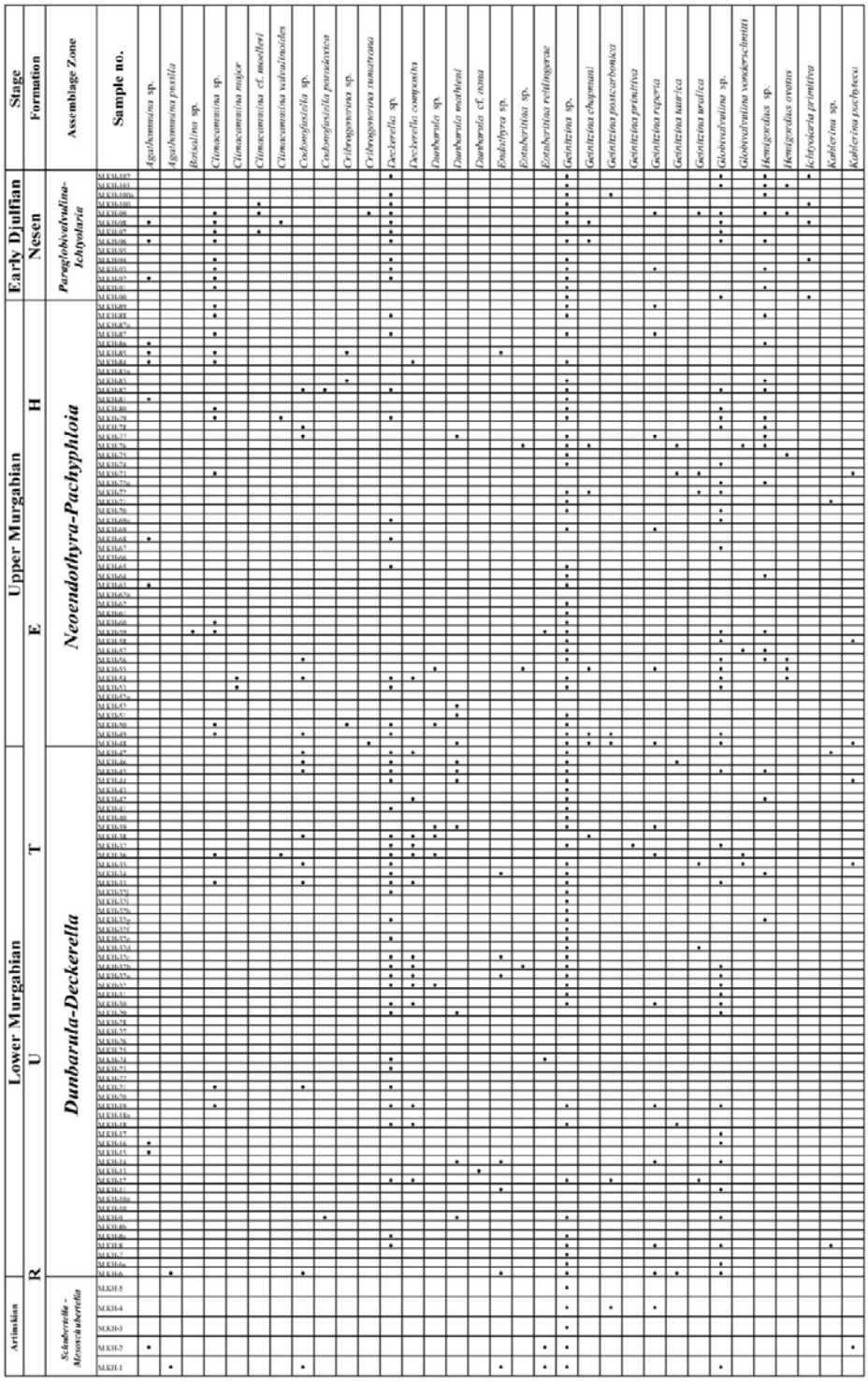

Figure 5. List of foraminifera species of the Ruteh and Nesen formations in Khur area, Central Alborz, North of Iran.

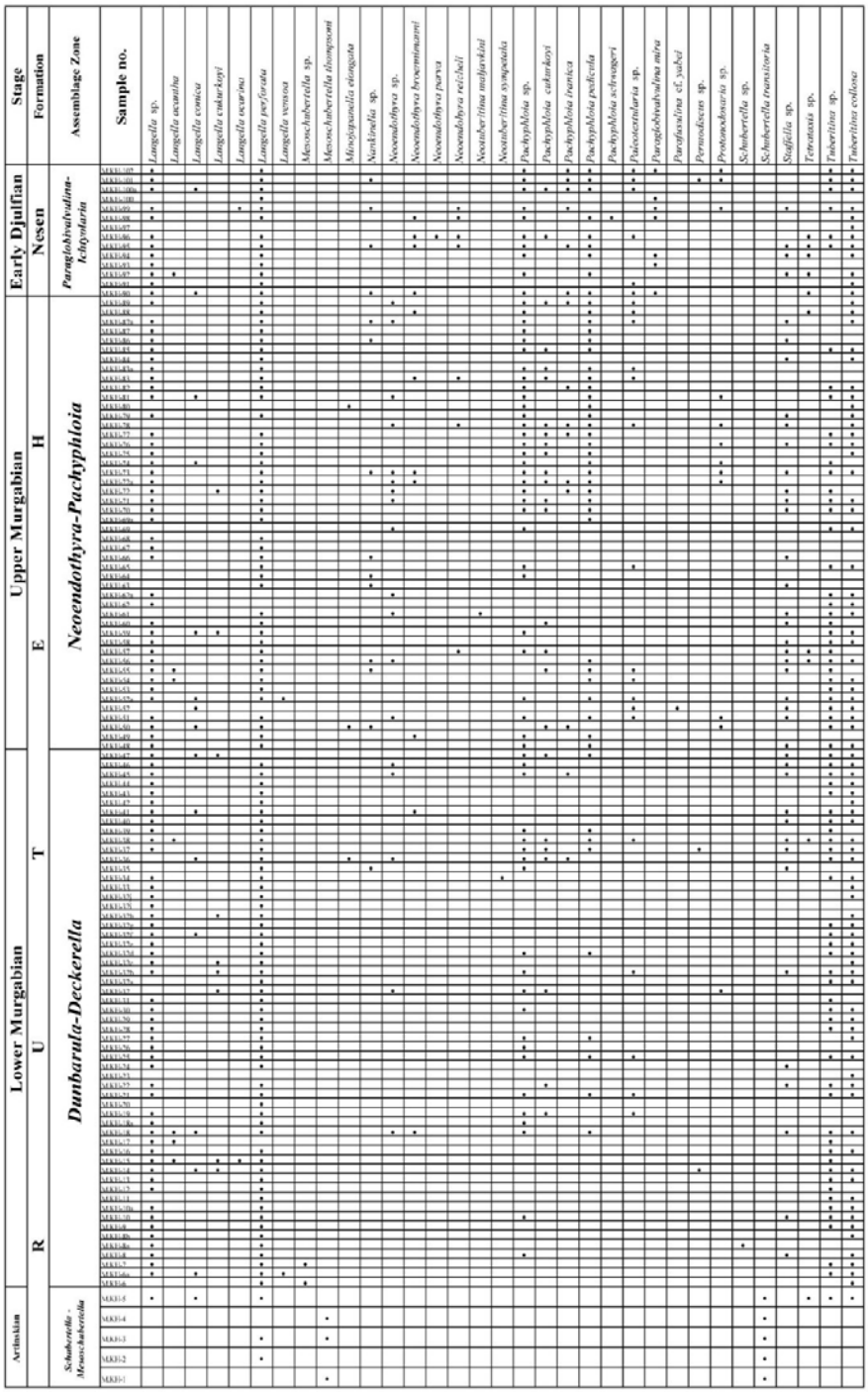

Figure 5. Continued.

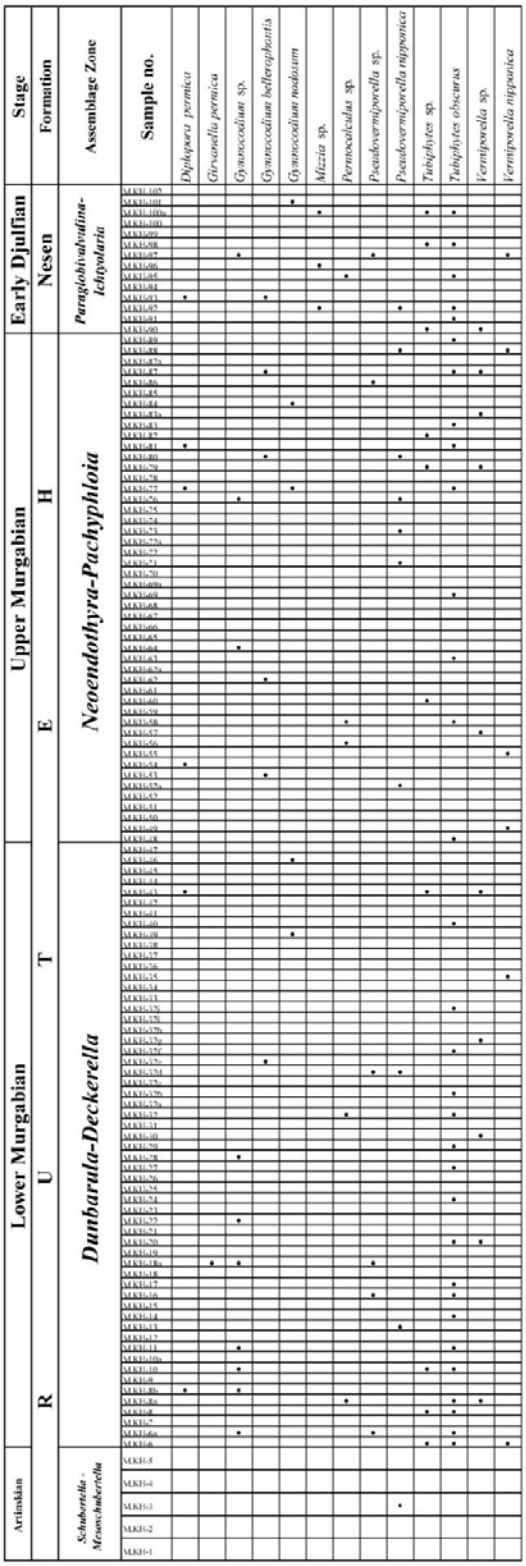

Figure 6. List of algae and cyanobacteria species of the Ruteh and Nesen formations in Khur area, Central Alborz, North of Iran.

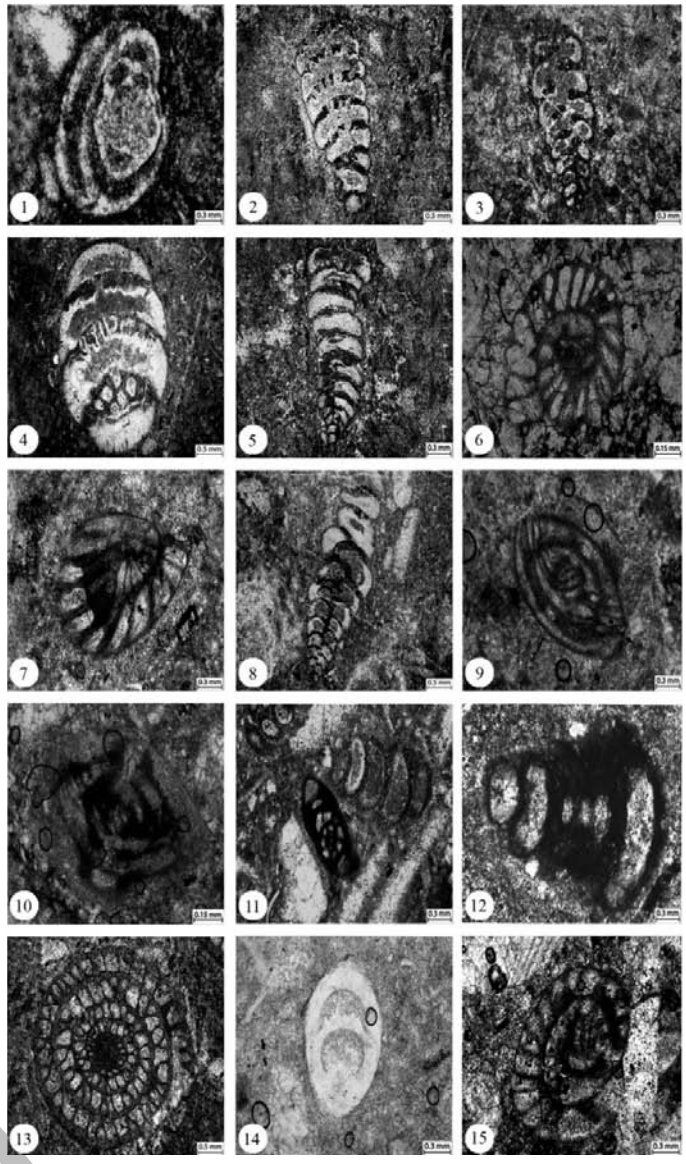

Plate 1.

Figure 1. *Hemigordius* sp. GEINITZ, thin section no. M. KH-1.
Figure 2. *Climacammina major* REITLINGER, thin section no. M. KH-53.
Figure 3. *Deckerella composita* REITLINGER, thin section no. M. KH-4.
Figure 4. *Cribrogenerina* sp., thin section no. M. KH-1.
Figure 5. *Climacammina valvulinoides* LANGE, thin section no. M. KH-36.
Figure 6. *Codonofusiella* sp., thin section no. M. KH-20.
Figure 7. *Codonofusiella* sp., thin section no. M. KH-2.
Figure 8. *Deckerella composita* REITLINGER, thin section no. M. KH-18.
Figure 9. *Schubertella transitoria* STAFF & WEDEKIND, thin section no. M. KH-3.
Figure 10. *Mesoshubertella thompsoni* KANUMA & SAKAGAMI, thin section no. M. KH-2.
Figure 11. *Neoendothyra broennimanni* REITLINGER, thin section no. M. KH-18.
Figure 12. *Neoendothyra reicheli* BOZORGNIA, thin section no. M. KH-78.
Figure 13. *Parafusulina yabei* HAZAWA, thin section no. M. KH-20.
Figure 14. *Langella perforata* LANGE, thin section no. M. KH-32.
Figure 15. *Codonofusiella* sp., thin section no. M. KH-2.

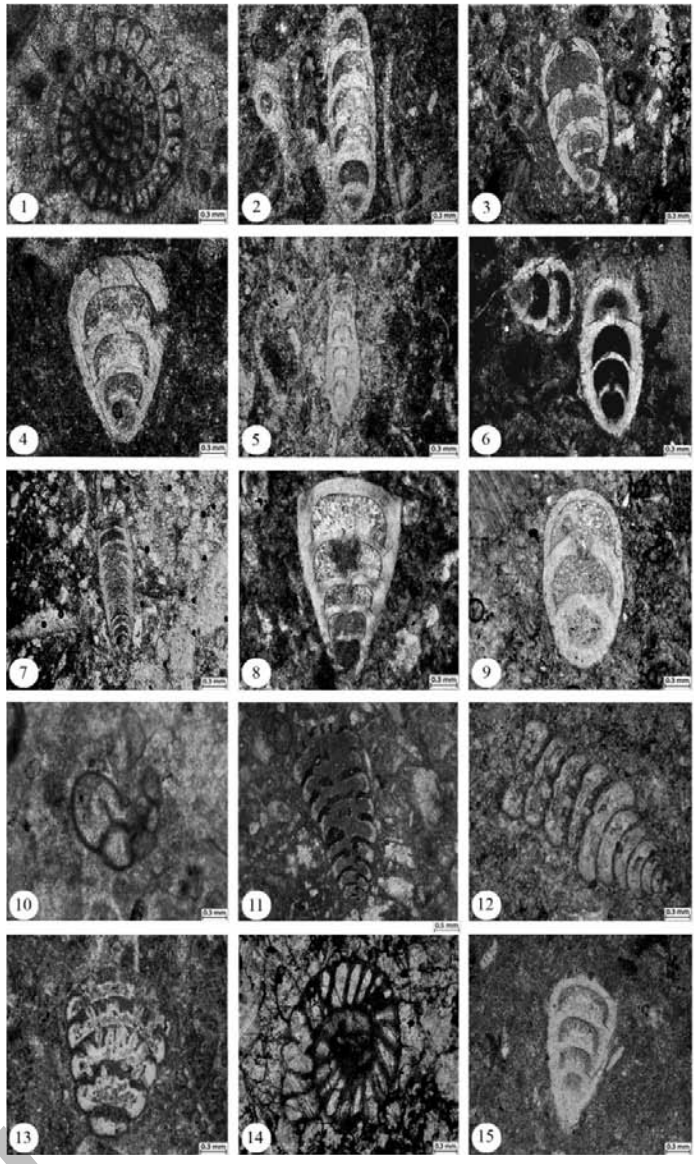

Plate 2.

Figure 1. *Dunbarula mathieui* CIRY, thin section no. M. KH-14.
Figure 2. *Langella acantha* LANGE, thin section no. M. KH-55.
Figure 3. *Langella perforata* LANGE, thin section no. M. KH-8.
Figure 4. *Langella conica* DE CIVRIEUX & DESS, thin section no. M. KH-15.
Figure 5. *Langella ocarina* DE CIVRIEUX & DESS, thin section no. M. KH-34.
Figure 6. *Langella perforata* LANGE, thin section no. M. KH-22.
Figure 7. *Pachyphloia* sp., thin section no. M. KH-38.
Figure 8. *Geinitzina uralica* SCHUBERT var. Longa - SULEIMANOV, thin section no. M. KH-32d.
Figure 9. *Langella perforata* LANGE, thin section no. M. KH-87.
Figure 10. *Globivalvulina Vonderschmitti* REITLINGER, thin section no. M. KH-20.
Figure 11. *Climacammina valvulinoides* LANGE, thin section no. M. KH-20.
Figure 12. *Deckerella composita* REITLINGER, thin section no. M. KH-32g.
Figure 13. *Cribrogenerina* sp., thin section no. M. KH-37.
Figure 14. *Codonofusiella* cf. *nana* ERK, thin section no. M. KH-2.
Figure 15. *Langella perforata* LANGE, thin section no. M. KH-56.

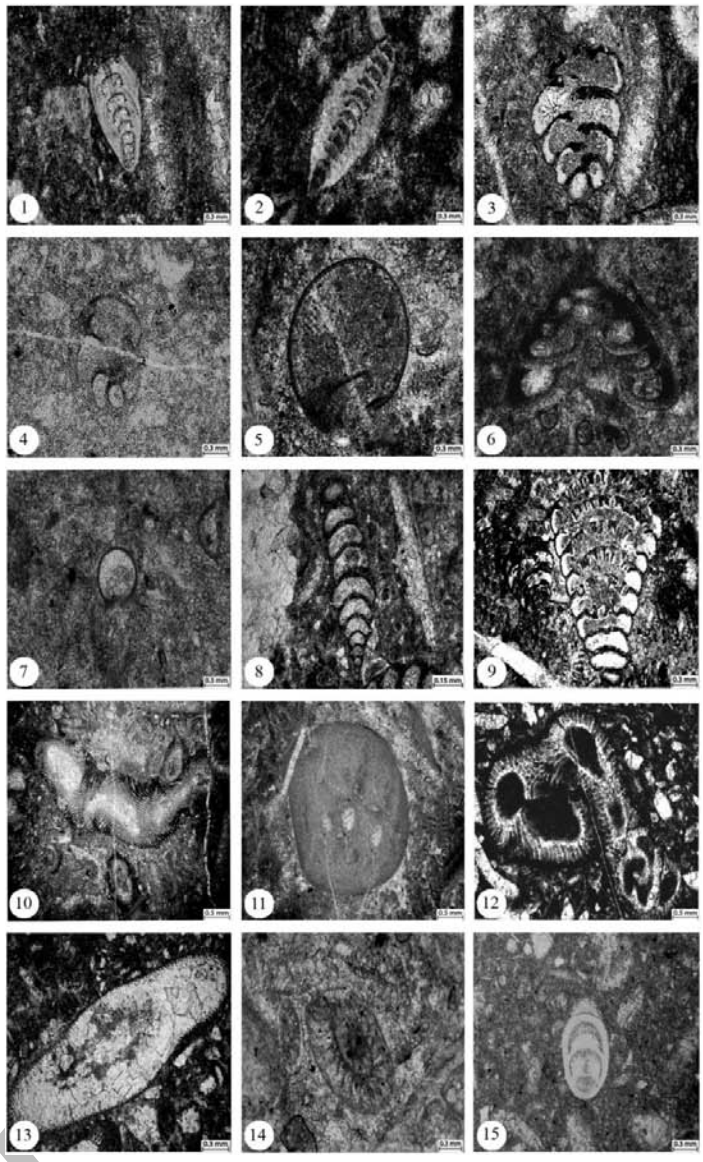

Plate 3.

Figure 1. *Pachyphloia pedicula* LANGE, thin section no. M. KH-98.
Figure 2. *Pachyphloia cukurkoyi* DE CIVRIEUX & DESS, thin section no. M. KH-22.
Figure 3. *Paleotextularia* sp., thin section no. M. KH-52.
Figure 4. *Globivalvulina* sp., thin section no. M. KH-99.
Figure 5. *Paraglobivalvuina mira* REITLINGER, thin section no. M. KH-90.
Figure 6. *Tetrataxis planolocula* DE CIVRIEUX & DESS, thin section no. M. KH-38.
Figure 7. *Neotuberitina maljavkini* MIKHAILOV, thin section no. M. KH-20.
Figure 8. *Deckerella* cf. *composita* REITLINGER, thin section no. M. KH-25.
Figure 9. *Cribrogenerina sumatrana* VOLZ, thin section no. M. KH-99.
Figure 10. *Pseudovermiporella nipponica* ENDO, thin section no. M. KH-71
Figure 11. *Tubiphytes obscurus* MASLOV, thin section no. M. KH-94.
Figure 12. *Vermiporella nipponica* ENDO, thin section no. M. KH-54.
Figure 13. *Gymnocodium bellerophontis* ROTHPLETZ, thin section no. M. KH-65.
Figure 14. *Codonofusiella* sp., thin section no. M. KH-60.
Figure 15. *Langella perforata* LANGE, thin section no. M. KH-90.

moelleri Reitlinger, *Cribrogenerina sumatrana* Volz, *Ichtyolaria primitiva* De Civrieux & Dess., *Pachyphloia Schwageri* De Civrieux & Dess., *Paraglobivalvulina mira* Reitlinger.

Results and Disscussion

The Permian sequence in the Khur area consists of three formations in the studied section: The Dorud, Ruteh and Nesen formations. The Ruteh Formation in the study section consists mainly of fossiliferous limestones that were deposited in marine shallow environment. The Ruteh Formation with a thickness of 221 meters can be subdivided into three informal members. In the Present study, three foraminiferal biozones were differentiated for the Ruteh Formation these include: *Schubertella-Mesoschubertella* Assemblage Zone (Artinskian), *Dunbarula-Deckerella* and *Neoendothyra-Pachyphloia* Assemblage zones (Murgabian). The Ruteh Formation is equivalent to the Surmaq Formation in the Abadeh (Central Iran) and Jolfa (northwestern Iran) regions, middle part of the Jamal Formation in the Shotori Range, Tabas area (eastern Iran) and the lower part of the Dalan Formation in the Zagros Range, Southwestern Iran. Comparing the studied section with those of equivalent sediments in western and eastern parts of Alborz shows that the Permian sediments decrease in thickness from west to eastern Alborz.

Acknowledgements

The authors wish to thank Dr. E. Ghasemi-Nejad, Department of Geology, Faculty of Science, University of Tehran, for reading the manuscript and making useful comments and Dr. M. R. Majidifard at the Geology Survey of Iran for his comments.

References

1. Aghanabati S. A., Geology of Iran. *Geol. Surv. Iran,* 586 p. (2004), (in Persian).
2. Annells R. N., Arthurton R. S., Bazley R. A. and Davies R. G. Hamedi, M. A. R., and Rahimzadeh F., Geological map of Shakran (scale of 1:100.000), *Geol. Surv. Iran,* sheet No. **6162** (1977).
3. Assereto R., The Paleozoic formations in Central Elburz (Iran)-(Preliminary note), *Riv. Ital. Paleont. Strat.,* **69**(4), pp. 503-543 (1963).
4. Bozorgnia F., Paleozic foraminiferal Biostratigraphy of Central and East Alborz Mountains, N.I.O.C. Geological labratories, Rep. NO. **4** (1973).
5. Delapparent A. & Lys M., Etude du Permian et esquisse geologique de la region khwahan (province du Badakhchan, Afganistan septentrional). Bull. Soc. Geol. Belgique, **74**, pp. 57-88 (1972).
6. Flugle E., Microfacies of carbonate rocks (Analysis, Interpretation and Application). *Springer-Verlag,* Berlin, 976 p. (2004).
7. Ghasemi-Nejad E., Biostratigraphy and Depositional History of the Paleozoic Deposits in the South of Central Alborz Basin, Based on Foraminifera, Iranian Int. J. Sci. **3**(1), pp. 93-114 (2002).
8. Glaus M., Trias und oberperm in Zentralen Elburz (Persien); Eclig. Geol. Relv, **57**(2), pp. 497-508 (1964).
9. Golshani F., Partoazar H., and Seyed-Emami K., Permian-Triassic Boundary in Iran (1986).
10. Iranian-Japanese Research Group, The Permian and the Lower Triassic System in Abadeh Region, Central Iran. *Mem. Fac. Sci. KyotoUniv. Ser.Geol. Min.*, **47**(2), pp. 61-133 (1981).
11. Maslov V. P., Iskopaemye izvestkovye vodorosli USSR {Fossil calcareous algae of the USSr}: *Akademiya Nauk USSR, Trudy Instituta Geologicheskii Nauk* {*Transactions of the academy of Sciences, USSR Geological Institute*}, **160, 301** (1956), (in Russian).
12. Mokhtarpour H. A., Sedimentary petrology and depositional environments of the Lower Permian (Dorud Formation) clastic rocks in the Abadeh Region. *Scientific quarterly journal of Geosciences, Geol. Surv.* Iran, **6(25)**, pp. 72-91 (1997a).
13. Mokhtarpour H. A., Petrology, Sedimentary environments and sequences of the Permian rocks in the Alborz Region, North Iran, Ph. D. Thesis, *Islamic Azad University Sciences and Research* (1997b).
14. Partoazar H., Permian deposits In Iran. *Geol. Surv. Iran,* Pub. (in Persion), No. **22** (1995).
15. Riding R., Calcified cyanobacteria, in Riding, R., ed, calcareous Algae and stromatolites Berlin, *Springer - Verlag*, pp. 55-87 (1991).
16. Riding R., *shamovella obscura:* the correct name for *Tubiphytes obscuras* (Fossil). *Taxon*, **42**: pp. 71-73 (1993).
17. Senowbari-Daryan B. and Flugel E., *Tubiphytes* Maslov, enigmatic fossil: classification, fossil record and significance through time. Part 1: Discussion of Late Paleozoic material, in Barattolo, F., ed., Studies on Fossil Benthic Algae. *Societa Palaeontologica Italiana Bolletino*, Special **1**, pp. 353-382.
18. Seyed-Emami K., A summary of the Triassic in Iran, *Geol. Surv.* Iran, Report No. **20**, pp. 41-53 (1971).
19. Seyed-Emami K., Triassic in Iran, *Facies,* **48**, pp. 91-106 (2003).
20. Siber N., Zur geologie des Gebietes Sudlich des Taleghan-Tales Zentral Elburz Iran, *univ. Europeennes,* pp. 41-52 (1970).
21. Stepanov D. L., Golshani F. and Stocklin j., Upper Permian and Permian-Triassic boyndary in North Iran, *Geol. Surv. Iran* (1969).
22. Vaziri S. H., Yao A. and Kuwahara K., Lithofacies and microbiofacies (foraminifers and radiolarians) of the Permian Sequence in the Shalamzar area, Central Alborz, North Iran*, Journal of Geosciences, Osaka City University,* **48**, pp. 39-96 (2005).
23. Wang C. Y., Scott M. R., Clark D., The Sweetognathus Complex in the Permian of China: Implication for evolution and Homeomorphism, *Journal of Palaeontology*, **61**, No. **5**, pp. 1047-1057 (1987).