

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

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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 Artinskian 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; Central 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.

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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 Djuflian 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 article.

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* Clark [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 mathieuvi* Ciry, *Frondinodosaria* cf. *Pyrula* De Civrieux & Dess, *Geinitzina chapmani* Schubert Var. Longa Suleimanov, *Geinitzina postcarbonica* Spandel, *Geinitzina primitiva* Potievskaja, *Geinitzina reperta* Bykova, *Geinitzina* cf. *taurica* De Civrieux & Dess., *Geinitzina uralica* Suleimanov, *Globivalvulina biserialis* Cushman, *Globivalvulina vonderschmitti* Reitlinger, *Kahlerina pachythea* 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 fragilis* De Civrieux & Dess., *Tuberitina collosa* Reitlinger; **Algae:** *Gymnocodium* sp., *Gymnocodium bellerophontis* Rothpletz, *Gymnocodium nodosum* Rothpletz, *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella nipponica*

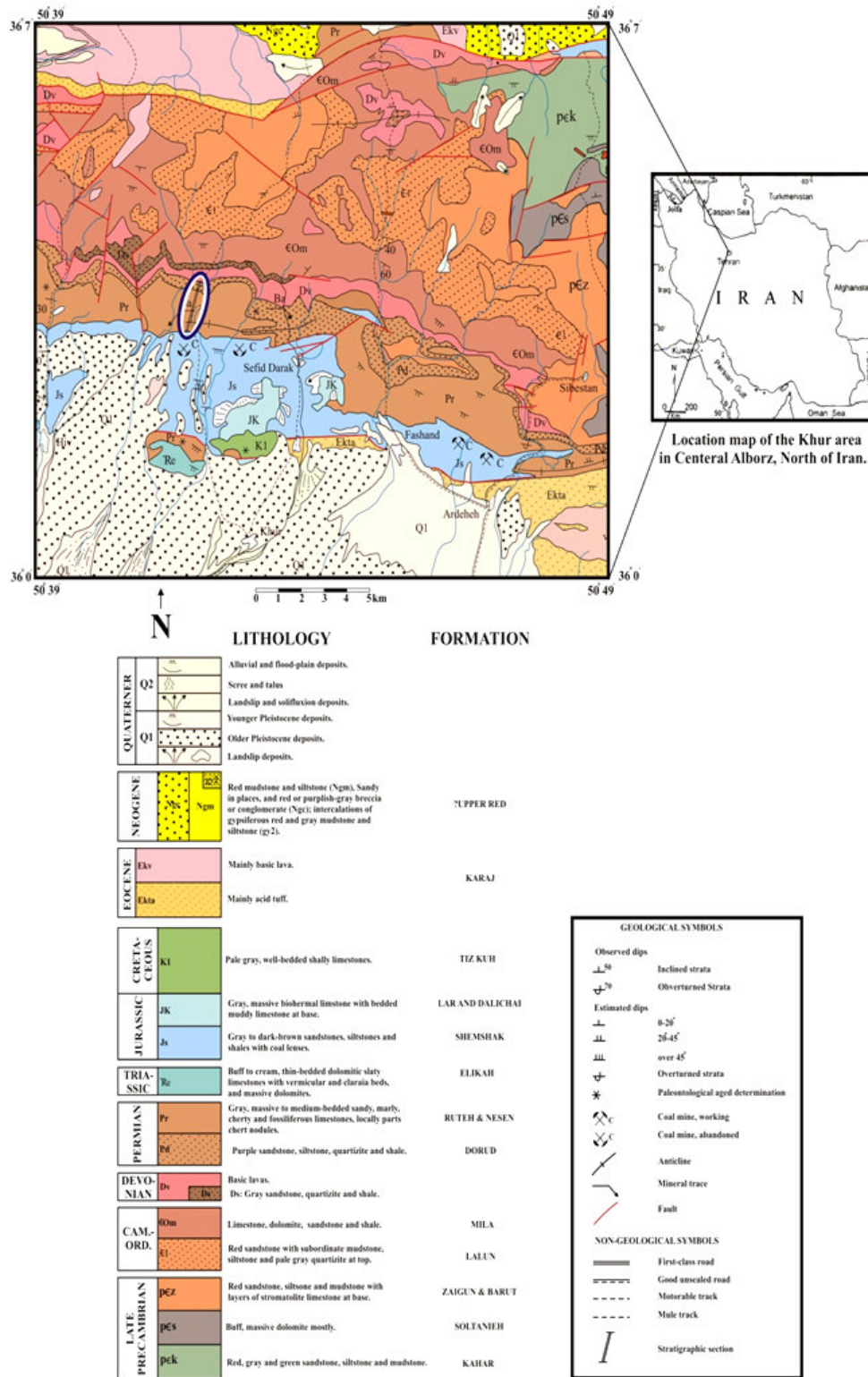


Figure 1. Geological map of the Khur area in Central Alborz, North Iran (Annells et al., 1977).

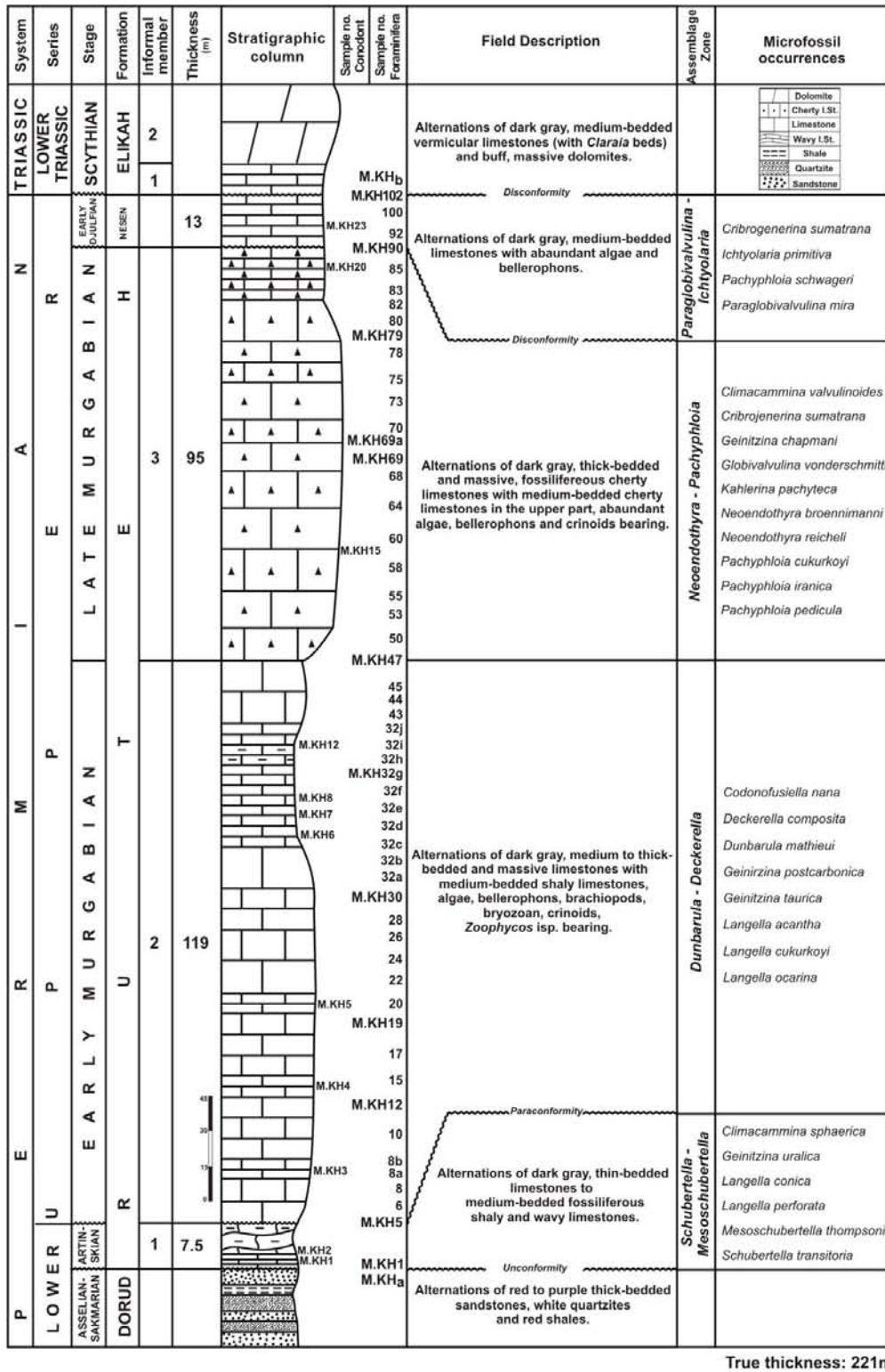


Figure 2. Lithostratigraphical characteristics and biozones of the Ruth Formation in northwest of Khur, Central Alborz, North of Iran.



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 fossiliferous 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*

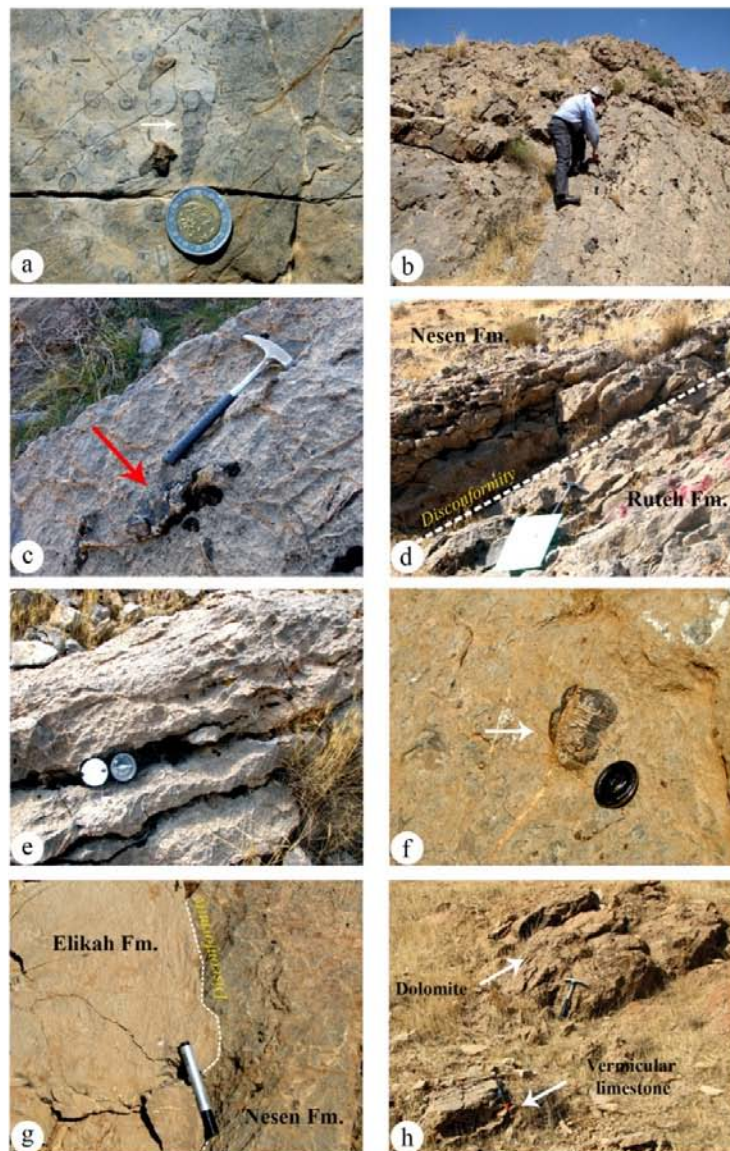


Figure 4. (a) Gastropoda in limestone of the Ruteh Formation (member 2). (b) Alternating limestones of Ruteh Formation (member 3). (c) Chert nodules in alternating limestones of the Ruteh Formation (member 3). (d) The contact between Ruteh and Nesen Formations. (e) Alternating medium-bedded limestones 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 pachythea* 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, *Permo-calculus* 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, *Paraglobivalvulina mira* Reitlinger, *Tuberitina collosa* Reitlinger; **Algae:** *Gymnocodium* sp., *Gymnocodium bellerophontis* Rothpletz, *Gymnocodium nodosum* Rothpletz, *Mizzia* sp., *Permocalculus* sp., *Pseudovermiporella* sp., *Vermiporella* sp., *Vermiporella niponica* 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 foraminifera 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 foraminifera 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., *Climacammina valvulinoides* Lange, *Cribrogenerina sumatrana* Volz, *Geinitzina chapmani* Schubert Var. Longa-Suleimanov, *Globivalvulina vonderschmitti* Reichel, *Kahlerina pachythea* Koch. *Devide et Ramors*, *Langella venosa* *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*

Stage Formation	Assemblage Zone	Sample no.	Artinskian	Lower Murgabian	Upper Murgabian	Early Diulifian	
R	U	Dunbarula-Deckerella	SKH 5				
			SKH 4				
			SKH 3				
			SKH 2				
			SKH 1				
			SKH 6				
			SKH 7				
			SKH 8				
			SKH 9				
			SKH 10				
R	U	Dunbarula-Deckerella	SKH 11				
			SKH 12				
			SKH 13				
			SKH 14				
			SKH 15				
			SKH 16				
			SKH 17				
			SKH 18				
			SKH 19				
			SKH 20				
R	U	Dunbarula-Deckerella	SKH 21				
			SKH 22				
			SKH 23				
			SKH 24				
			SKH 25				
			SKH 26				
			SKH 27				
			SKH 28				
			SKH 29				
			SKH 30				
R	U	Dunbarula-Deckerella	SKH 31				
			SKH 32				
			SKH 33				
			SKH 34				
			SKH 35				
			SKH 36				
			SKH 37				
			SKH 38				
			SKH 39				
			SKH 40				
R	U	Dunbarula-Deckerella	SKH 41				
			SKH 42				
			SKH 43				
			SKH 44				
			SKH 45				
			SKH 46				
			SKH 47				
			SKH 48				
			SKH 49				
			SKH 50				
R	U	Dunbarula-Deckerella	SKH 51				
			SKH 52				
			SKH 53				
			SKH 54				
			SKH 55				
			SKH 56				
			SKH 57				
			SKH 58				
			SKH 59				
			SKH 60				
R	U	Dunbarula-Deckerella	SKH 61				
			SKH 62				
			SKH 63				
			SKH 64				
			SKH 65				
			SKH 66				
			SKH 67				
			SKH 68				
			SKH 69				
			SKH 70				
R	U	Dunbarula-Deckerella	SKH 71				
			SKH 72				
			SKH 73				
			SKH 74				
			SKH 75				
			SKH 76				
			SKH 77				
			SKH 78				
			SKH 79				
			SKH 80				
R	U	Dunbarula-Deckerella	SKH 81				
			SKH 82				
			SKH 83				
			SKH 84				
			SKH 85				
			SKH 86				
			SKH 87				
			SKH 88				
			SKH 89				
			SKH 90				
R	U	Dunbarula-Deckerella	SKH 91				
			SKH 92				
			SKH 93				
			SKH 94				
			SKH 95				
			SKH 96				
			SKH 97				
			SKH 98				
			SKH 99				
			SKH 100				
R	U	Dunbarula-Deckerella	SKH 101				
			SKH 102				
			SKH 103				
			SKH 104				
			SKH 105				
			SKH 106				
			SKH 107				
			SKH 108				
			SKH 109				
			SKH 110				
R	U	Dunbarula-Deckerella	SKH 111				
			SKH 112				
			SKH 113				
			SKH 114				
			SKH 115				
			SKH 116				
			SKH 117				
			SKH 118				
			SKH 119				
			SKH 120				
R	U	Dunbarula-Deckerella	SKH 121				
			SKH 122				
			SKH 123				
			SKH 124				
			SKH 125				
			SKH 126				
			SKH 127				
			SKH 128				
			SKH 129				
			SKH 130				
R	U	Dunbarula-Deckerella	SKH 131				
			SKH 132				
			SKH 133				
			SKH 134				
			SKH 135				
			SKH 136				
			SKH 137				
			SKH 138				
			SKH 139				
			SKH 140				
R	U	Dunbarula-Deckerella	SKH 141				
			SKH 142				
			SKH 143				
			SKH 144				
			SKH 145				
			SKH 146				
			SKH 147				
			SKH 148				
			SKH 149				
			SKH 150				
R	U	Dunbarula-Deckerella	SKH 151				
			SKH 152				
			SKH 153				
			SKH 154				
			SKH 155				
			SKH 156				
			SKH 157				
			SKH 158				
			SKH 159				
			SKH 160				
R	U	Dunbarula-Deckerella	SKH 161				
			SKH 162				
			SKH 163				
			SKH 164				
			SKH 165				
			SKH 166				
			SKH 167				
			SKH 168				
			SKH 169				
			SKH 170				
R	U	Dunbarula-Deckerella	SKH 171				
			SKH 172				
			SKH 173				
			SKH 174				
			SKH 175				
			SKH 176				
			SKH 177				
			SKH 178				
			SKH 179				
			SKH 180				
R	U	Dunbarula-Deckerella	SKH 181				
			SKH 182				
			SKH 183				
			SKH 184				
			SKH 185				
			SKH 186				
			SKH 187				
			SKH 188				
			SKH 189				
			SKH 190				
R	U	Dunbarula-Deckerella	SKH 191				
			SKH 192				
			SKH 193				
			SKH 194				
			SKH 195				
			SKH 196				
			SKH 197				
			SKH 198				
			SKH 199				
			SKH 200				
R	U	Dunbarula-Deckerella	SKH 201				
			SKH 202				
			SKH 203				
			SKH 204				
			SKH 205				
			SKH 206				
			SKH 207				
			SKH 208				
			SKH 209				
			SKH 210				
R	U	Dunbarula-Deckerella	SKH 211				
			SKH 212				
			SKH 213				
			SKH 214				
			SKH 215				
			SKH 216				
			SKH 217				
			SKH 218				
			SKH 219				
			SKH 220				
R	U	Dunbarula-Deckerella	SKH 221				
			SKH 222				
			SKH 223				
			SKH 224				
			SKH 225				
			SKH 226				
			SKH 227				
			SKH 228				
			SKH 229				
			SKH 230				
R	U	Dunbarula-Deckerella	SKH 231				
			SKH 232				
			SKH 233				
			SKH 234				
			SKH 235				
			SKH 236				
			SKH 237				
			SKH 238				
			SKH 239				
			SKH 240				
R	U	Dunbarula-Deckerella	SKH 241				
			SKH 242				
			SKH 243				
			SKH 244				
			SKH 245				
			SKH 246				
			SKH 247				
			SKH 248				
			SKH 249				
			SKH 250				
R	U	Dunbarula-Deckerella	SKH 251				
			SKH 252				
			SKH 253				
			SKH 254				
			SKH 255				
			SKH 256				
			SKH 257				
			SKH 258				
			SKH 259				
			SKH 260				
R	U	Dunbarula-Deckerella	SKH 261				
			SKH 262				
			SKH 263				
			SKH 264				
			SKH 265				
			SKH 266				
			SKH 267				
			SKH 268				
			SKH 269				
			SKH 270				
R	U	Dunbarula-Deckerella	SKH 271				
			SKH 272				
			SKH 273				
			SKH 274				
			SKH 275				
			SKH 276				
			SKH 277				
			SKH 278				
			SKH 279				
			SKH 280				
R	U	Dunbarula-Deckerella	SKH 281				
			SKH 282				
			SKH 283				
			SKH 284				</

Armsian	Lower Murgabian		Upper Murgabian		Early Djulfian	Stage Formation
	R	T	E	H		
<i>Schubertella - Mioschubertella</i>	MR314					Assemblage Zone Sample no.
	MR313					
	MR312					
	MR311					
	MR310					
	MR309					
	MR308					
	MR307					
	MR306					
	MR305					
<i>Dunbarula-Deckerella</i>	MR304					
	MR303					
	MR302					
	MR301					
	MR300					
	MR299					
	MR298					
	MR297					
	MR296					
	MR295					
<i>Neoendothyra-Pachyphloia</i>	MR294					
	MR293					
	MR292					
	MR291					
	MR290					
	MR289					
	MR288					
	MR287					
	MR286					
	MR285					
<i>Paraglobobulimina- Ichtyolaria</i>	MR284					
	MR283					
	MR282					
	MR281					
	MR280					
	MR279					
	MR278					
	MR277					
	MR276					
	MR275					
<i>Langella</i> sp.	MR274					
	MR273					
	MR272					
	MR271					
	MR270					
	MR269					
	MR268					
	MR267					
	MR266					
	MR265					
<i>Mioschubertella</i> sp.	MR264					
	MR263					
	MR262					
	MR261					
	MR260					
	MR259					
	MR258					
	MR257					
	MR256					
	MR255					
<i>Mioschubertella</i> <i>abnormis</i>	MR254					
	MR253					
	MR252					
	MR251					
	MR250					
	MR249					
	MR248					
	MR247					
	MR246					
	MR245					
<i>Microglossomella</i> <i>otlogata</i>	MR244					
	MR243					
	MR242					
	MR241					
	MR240					
	MR239					
	MR238					
	MR237					
	MR236					
	MR235					
<i>Nuculites</i> sp.	MR234					
	MR233					
	MR232					
	MR231					
	MR230					
	MR229					
	MR228					
	MR227					
	MR226					
	MR225					
<i>Neoschubertella</i> <i>bracanthamant</i>	MR224					
	MR223					
	MR222					
	MR221					
	MR220					
	MR219					
	MR218					
	MR217					
	MR216					
	MR215					
<i>Neoschubertella</i> <i>parva</i>	MR214					
	MR213					
	MR212					
	MR211					
	MR210					
	MR209					
	MR208					
	MR207					
	MR206					
	MR205					
<i>Neoschubertella</i> <i>reicbeli</i>	MR204					
	MR203					
	MR202					
	MR201					
	MR200					
	MR199					
	MR198					
	MR197					
	MR196					
	MR195					
<i>Neoschubertella</i> <i>sympetala</i>	MR194					
	MR193					
	MR192					
	MR191					
	MR190					
	MR189					
	MR188					
	MR187					
	MR186					
	MR185					
<i>Pachyphloia</i> sp.	MR184					
	MR183					
	MR182					
	MR181					
	MR180					
	MR179					
	MR178					
	MR177					
	MR176					
	MR175					
<i>Pachyphloia</i> <i>californi</i>	MR174					
	MR173					
	MR172					
	MR171					
	MR170					
	MR169					
	MR168					
	MR167					
	MR166					
	MR165					
<i>Pachyphloia</i> <i>franka</i>	MR164					
	MR163					
	MR162					
	MR161					
	MR160					
	MR159					
	MR158					
	MR157					
	MR156					
	MR155					
<i>Pachyphloia</i> <i>paucifera</i>	MR154					
	MR153					
	MR152					
	MR151					
	MR150					
	MR149					
	MR148					
	MR147					
	MR146					
	MR145					
<i>Pachyphloia</i> <i>schwageri</i>	MR144					
	MR143					
	MR142					
	MR141					
	MR140					
	MR139					
	MR138					
	MR137					
	MR136					
	MR135					
<i>Paraglobobulimina</i> <i>mitra</i>	MR134					
	MR133					
	MR132					
	MR131					
	MR130					
	MR129					
	MR128					
	MR127					
	MR126					
	MR125					
<i>Parafolium</i> cf. <i>yabei</i>	MR124					
	MR123					
	MR122					
	MR121					
	MR120					
	MR119					
	MR118					
	MR117					
	MR116					
	MR115					
<i>Permodiscus</i> sp.	MR114					
	MR113					
	MR112					
	MR111					
	MR110					
	MR109					
	MR108					
	MR107					
	MR106					
	MR105					
<i>Protonodularia</i> sp.	MR104					
	MR103					
	MR102					
	MR101					
	MR100					
	MR99					
	MR98					
	MR97					
	MR96					
	MR95					
<i>Schubertella</i> sp.	MR94					
	MR93					
	MR92					
	MR91					
	MR90					
	MR89					
	MR88					
	MR87					
	MR86					
	MR85					
<i>Schubertella</i> <i>transitoria</i>	MR84					
	MR83					
	MR82					
	MR81					
	MR80					
	MR79					
	MR78					
	MR77					
	MR76					
	MR75					
<i>Stadella</i> sp.	MR74					
	MR73					
	MR72					
	MR71					
	MR70					
	MR69					
	MR68					
	MR67					
	MR66					
	MR65					
<i>Tetrastis</i> sp.	MR64					
	MR63					
	MR62					
	MR61					
	MR60					
	MR59					
	MR58					
	MR57					
	MR56					
	MR55					
<i>Fuberitina</i> sp.	MR54					
	MR53					
	MR52					
	MR51					
	MR50					
	MR49					
	MR48					
	MR47					
	MR46					
	MR45					
<i>Fuberitina</i> <i>colloug</i>	MR44					
	MR43					
	MR42					
	MR41					
	MR40					
	MR39					
	MR38					
	MR37					
	MR36					
	MR35					

Figure 5. Continued.

Artinskian	Lower Murgabian			Upper Murgabian			Early Djuflian			Stage Formation		
	R	U	T	E	H	H	Nesen	Nesen	Assemblage Zone			
<i>Schubertella - Mesoschubertella</i>	MKJ-3									<i>Paraglobobulimina-ichthyolaria</i>	Sample no.	
	MKJ-4											<i>Diplopora pernica</i>
	MKJ-5											<i>Girvanella pernica</i>
	MKJ-6											<i>Gyanozocodium</i> sp.
	MKJ-7											<i>Gyanozocodium heterophanatis</i>
	MKJ-8											<i>Gyanozocodium modestum</i>
	MKJ-9											<i>Mazza</i> sp.
	MKJ-10											<i>Perroncaldus</i> sp.
	MKJ-11											<i>Pseudovermiporella</i> sp.
	MKJ-12											<i>Pseudovermiporella nipponica</i>
	MKJ-13											<i>Tubiphites</i> sp.
	MKJ-14											<i>Tubiphites obscurus</i>
	MKJ-15											<i>Vermiporella</i> sp.
	MKJ-16											<i>Vermiporella nipponica</i>
	MKJ-17											
MKJ-18												
MKJ-19												
MKJ-20												
MKJ-21												
MKJ-22												
MKJ-23												
MKJ-24												
MKJ-25												
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MKJ-94												
MKJ-95												
MKJ-96												
MKJ-97												
MKJ-98												
MKJ-99												
MKJ-100												

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

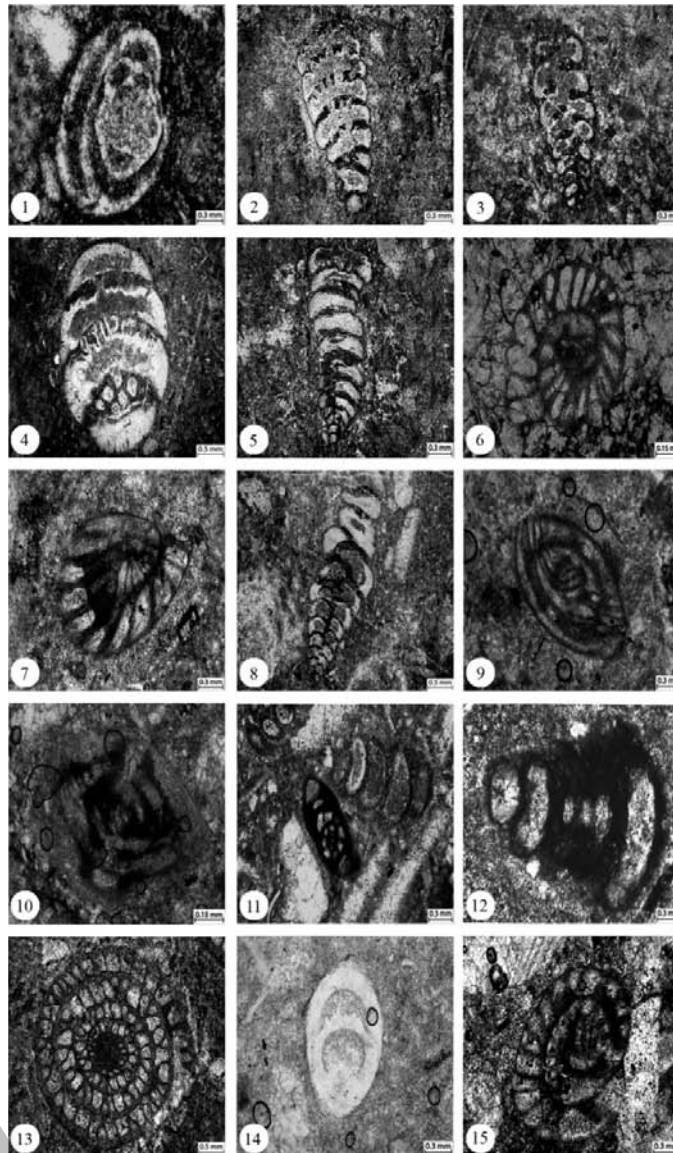


Plate 1.

- 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 valvulinoidea* 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* BOZORGIA, 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.

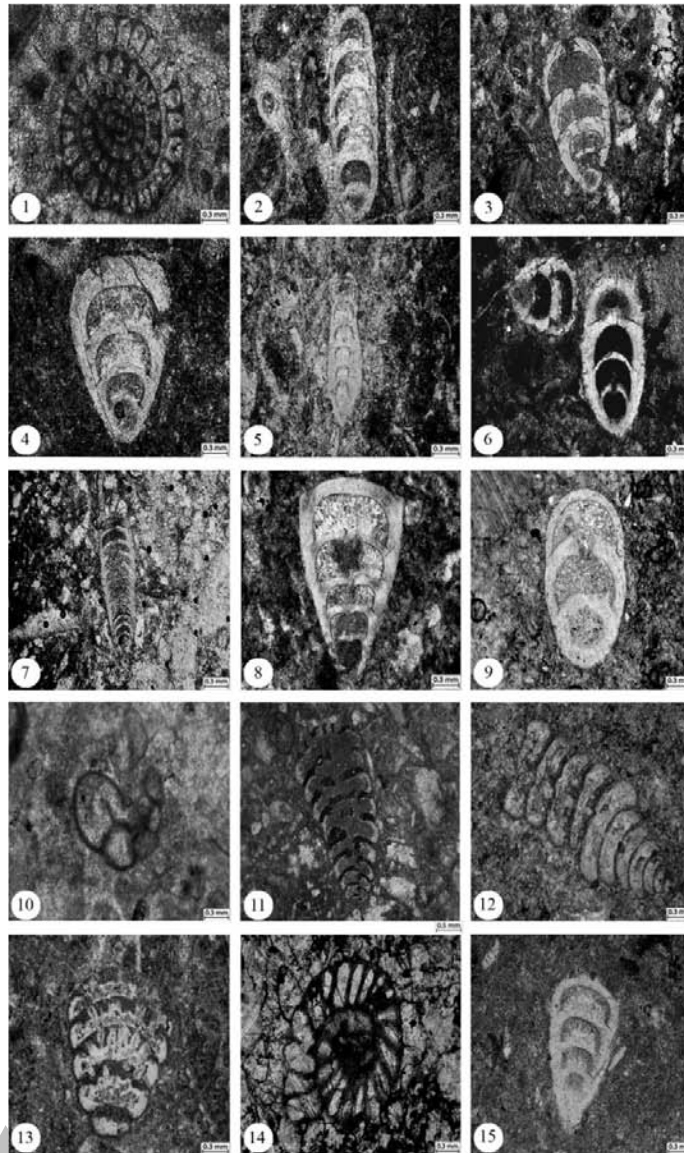


Plate 2.

- 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.

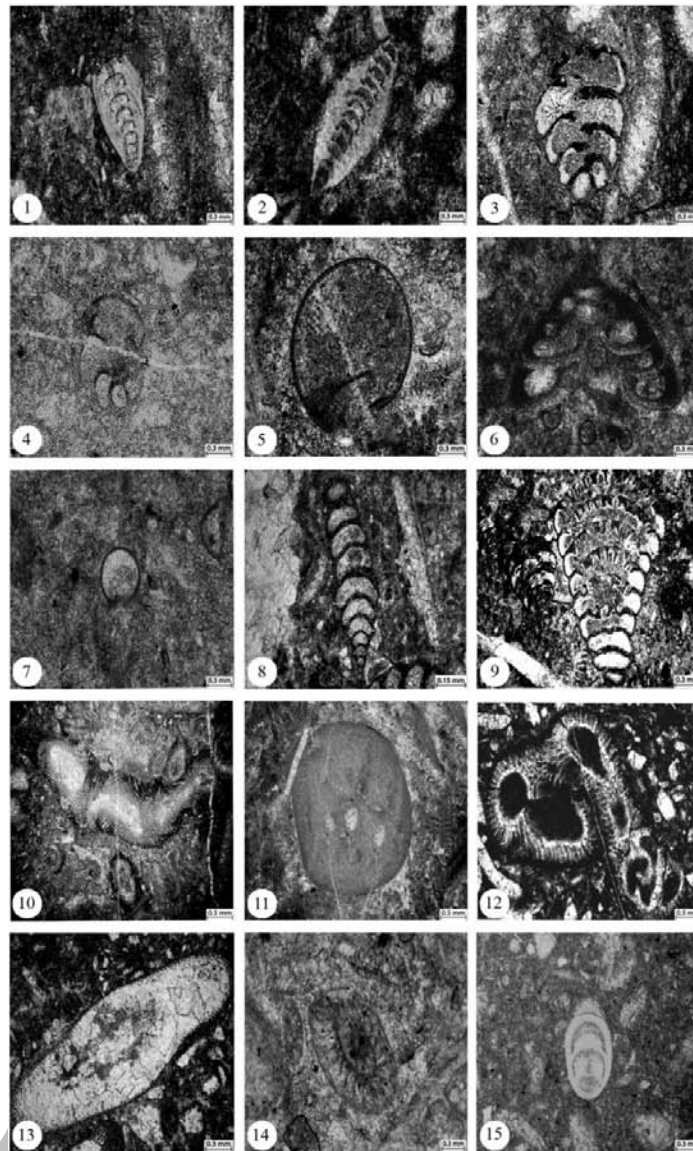


Plate 3.

- 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. *Paraglobivalvulina 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 Discussion

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.

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