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Benthic foraminiferal events of the Qom Formation in the north Central Iran Zone

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Abstract. In order to recognize and verify the lower Miocene deposits and the Aquitanian-Burdigalian boundary, benthic foraminifera from different localities in the north of the Central Iran Zone are considered. These facies-controlled foraminifera are useful for biostratigraphical studies, especially in the absence of planktic foraminifera. We investigated eleven stratigraphic sections of the north and northwest Central Iran Zone, and found datum levels of benthic foraminifera such as *Borelis melo curdica*, *Peneroplis farsensis*, *Elphidium* sp. 14, *Meandropsina anahensis*, *Meandropsina iranica*, and *Austrotrillina howchini*. The most significant event is the first occurrence of *Borelis melo curdica* which appears at the beginning of the Burdigalian. Hence, this datum can be helpful to recognize the Aquitanian-Burdigalian boundary.

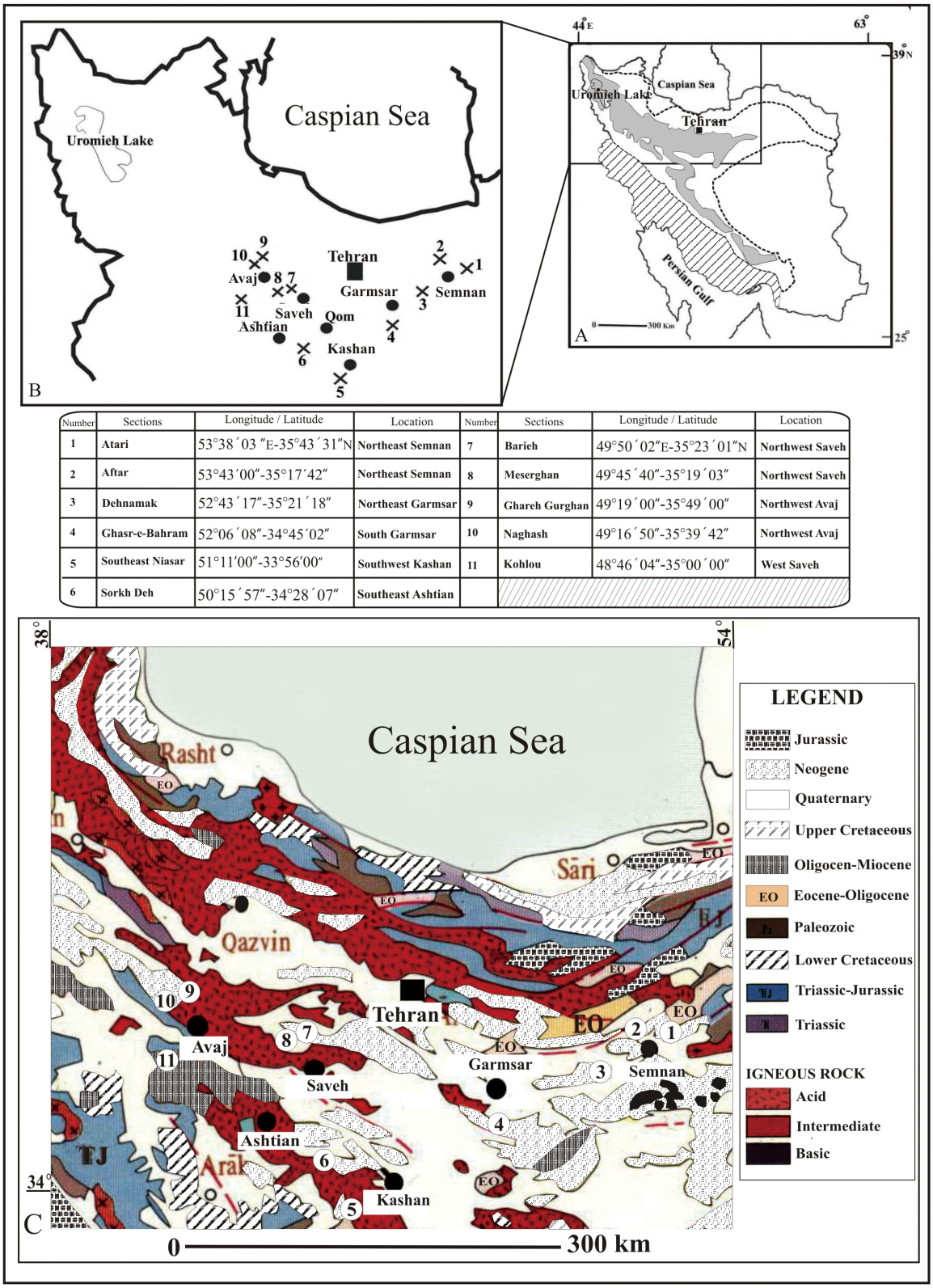
Key words: biostratigraphy, Central Iran, datum level, lower Miocene, Qom Formation

Introduction

The Qom Formation in the Central Iran Zone is a unique formation, with particular lithostratigraphic and biostratigraphic features and oil potential. Thus, proper insight to this formation and its biostratigraphical reference points are of great importance for petroleum exploration. Foraminifera as a protozoan groups are considered as important microfossils because of their stratigraphic usage and as indicators of paleoenvironmental characteristics. The Qom Formation is exposed across a wide area throughout central Iran extending northwest to southeast with well preserved foraminifers (Figure 1A).

In 1934, the first oil reserve was discovered near Qom city (Mostofi and Gansser, 1957; Abaie *et al.*, 1964; Reuter *et al.*, 2009). Many researchers were then attracted to the area to study Qom sediments because of their unique facies, tectonic complexity, fossil richness, and petroleum potentials. Also, facies analysis of the sedimentary records indicates a range of paleoenviroments from terrestrial to open marine settings. Some of the latest researches which were carried out on this formation are Seyrafian and Torabi (2005), Khaksar and Moghadam (2007), Berning *et al*. (2009), Morley *et al*. (2009), Hadavi *et al*. (2010), Behforouzi and Safari (2011), YazdiMoghadam (2011), Seddighi *et al*. (2012), Mohammadi *et al*. (2011, 2013, 2015), Amirshahkarami and Karvan (2015), Daneshian and Dana (2016a, b, 2017) and Daneshian *et al*. (2017). The greatly detailed study of the Qom Formation has lead to various stratigraphic names, divisions and ages. Dozy (1944) defined these deposits as the Qom Formation for the first time. Furrer and Soder (1955) introduced a type locality for this formation 30 km southeast of the city of Qom and named it the Marine Formation with six members (a, b, c, d, e and f) and suggested an Oligocene–Miocene age. In each part of the basin, these sediments have contradictory ages from Eocene to middle Miocene (Dozy, 1944; Furrer and Soder, 1955; Abaie *et al.*, 1964; Bozorgnia, 1966; Aghanabati, 2005; Zhu *et al*., 2007; Daneshian and Dana, 2007; Daneshian and Ghanbari, 2009; Daneshian and Aftabi, 2010). Zhu *et al.* (2007) estimated an Eocene age for the Qom Formation. They detected some foraminifera with this age, but their work was criticized by Reuter *et al*. (2009). The key criticism directed at Zhu *et al*. (2007) is neglect in considering the huge amount of previous literature on the Qom Formation which all assumed an Oligocene–Miocene age for the formation (see Mohammadi *et al*., 2013). In addition, Daneshian *et al*. (2008) and Daneshian and Aftabi (2010) studied the locations mentioned by Zhu *et al.* (2007) and could not find the foraminifera reported therein, and they proceeded to introduce foraminiferal assemblages confirmed by previously established ages.

The main aim of this paper is comparing and correlating eleven stratigraphic sections for introducing a precise biozonation of the Qom Formation in the study area.



Number	Sections	Longitude / Latitude	Location	Number	Sections	Longitude / Latitude	Location
1	Atari	53°38´03 ″E-35°43´31″N	Northeast Semnan	7	Barieh	49°50´02″E-35°23´01″N	Northwest Saveh
2	Aftar	53°43´00″-35°17´42″	Northeast Semnan	8	Meserghan	49°45´40″-35°19´03″	Northwest Saveh
3	Dehnamak	52°43´17″-35°21´18″	Northeast Garmsar	9	Ghareh Gurghan	49°19´00″-35°49´00″	Northwest Avaj
4	Ghasr-e-Bahram	52°06´08″-34°45´02″	South Garmsar	10	Naghash	49°16´50″-35°39´42″	Northwest Avaj
5	Southeast Niasar	51°11′00″-33°56′00″	Southwest Kashan	11	Kohlou	48°46´04″-35°00´00″	West Saveh
6	Sorkh Deh	50°15´57″-34°28´07″	Southeast Ashtian				

Figure 1. Location of studied stratigraphic sections in the Central Iran Zone. **A**, dotted line shows Central Iran Zone and crossed zone shows Zagros Zone (cited in Aghanabti, 2005) and gray area indicates exposure of the Qom Formation in the Central Iran Zone (cited in Darvishzadeh, 1991); **B**, location of stratigraphical sections and their exact coordinates; **C**, geological map of the study area and location of sections.

Table 1. Stratigraphic characters of the Lower and Upper Red formations based on stratigraphic lexicon of Iran (after Stocklin and Setudehnia, 1991).

	Lower Red Formation	Lower Red Formation
Division	No division	A tripartite division: M1, M2 and M3 based on Abaie *et al.* (1964)
Thickness	Maximum 1000 m	M1: 2000 m M2: about 2000 m M3: 200–500 m
Lithology	Red and greenish silt shales, gypsiferous marl, reddish brown sandstones gypsum, volcanic flows and pyroclastic, red conglomerate, slain red beds	M1: Dark red gypsiferous sandstone, shale and siltstone M2: Cavernous sandstone, including the green key bed in the lower part M3: Pale yellow, strongly gypsiferous siltstone, marl with intercalation of soft calcareous sandstone
Fossils	Undiagnostic ostracods and poor bivalvia fragments	Brackish water Ostracods, *Turritella*, *Dreissensia*, plant remains, rare mammalian bones, foot prints
Age	early Oligocene	Post-Burdigalian
Underlying	upper Oligocene–lower Miocene Qom Formation	Pliocene conglomerates
Overlying	Basal conglomarate fossiliferous middle–upper Eocene semi-volcanic beds	upper Oligocene–lower Miocene Qom Formation

Geological setting

The lithostratigraphic characteristics of the Qom Formation help us to differentiate it from the immediately overlying and underlying deposits, termed the Upper and Lower Red formations, respectively. The Upper and Lower Red formations have lithologies and faunas distinct from the Qom deposits and consist of evaporitic and terrestrial sediments that are indicative of sea level changes in central Iran (Table 1).

A late Eocene orogenic event (the Pyrenean) resulted in shallow sedimentary basins and deposition of the Lower Red Formation (Darvishzadeh, 1991; Rahimzadeh, 1994). The late Oligocene witnessed a transgression that deposited marine sediments of the Qom Formation, mostly marl and limestone, that unconformably overlie the Lower Red Formation (Berbarian and King, 1980; Darvishzadeh, 1991; Rahimzadeh, 1994). This transgressional flooding initiated in the southeast, moving northwestward. This widespread transgression affected most of the Qom basin during Aquitanian and influenced the sediments of Turkey. During Oligocene–Miocene, a shallow marine sea covered most of central and western Iran, which dried up in a period of continental conditions, leading to deposition of terrestrial evaporites and clastic sediments within the Qom basin. These evaporitic environment prevailed and produced the post-Burdigalian to Pliocene red beds of the Upper Red Formation.

Iran is divided to several zones by Stocklin (1968), Nabavi (1976), Berberian and King (1980), Heydari *et al.* (2003) and Aghanabati (2005). Heydari *et al.* (2003) mentioned eight geological zones including: 1) Central Iran, 2) Sanandaj–Sirjan, 3) Urumieh–Dokhtar magmatic arc, 4) Zagros, 5) Alborz, 6) Kopeh Dagh, 7) Lut, and 8) Makran. According to this division, the study area is located in the Central Iran Zone. Tectonic units of Central Iran originated due to subduction and final collision of the African/Arabian Plate with the Iranian Plate which led to closure of the Tethyan Seaway during early Burdigalian. This closure, called the Terminal Tethyan Event (TTE) (Schuster and Wielandt, 1999; Reuter *et al.*, 2009; Daneshian and Ramezani Dana, 2016, 2017) is believed by Rögl and Steininger (1984) to have happened in the Burdigalian. Also, Bassi *et al.* (2009) mentioned it as pre-Langhian. The connection between the Eastern Tethys as a proto-Indian Ocean and the Western Tethys as a proto-Mediterranean Sea was closed off, and at the northeastern margin of the Iranian Plate the Esfahan–Sirjan fore-arc and the Qom back-arc basins arose (Schuster and Wielandt, 1999; Ghasemi and Talbot, 2006; Reuter *et al.*, 2009; Berning *et al*., 2009; Mohammadi *et al*., 2011, 2013; Yazdi, 2012; Daneshian and Ramezani Dana, 2017 and Daneshian *et al.*, 2017). The Qom Formation was deposited in the Tethyan Seaway in Central Iran (Qom back-arc basin), Sanandaj-Sirjan (Esfahan-Sirjan fore-arc basin) and Urumieh-Dokhtar magmatic arc Zones (intra-arc basin) (Berberian, 1983; Schuster and Wielandt, 1999; Reuter *et al*., 2009; Mohammadi *et al.*, 2013).

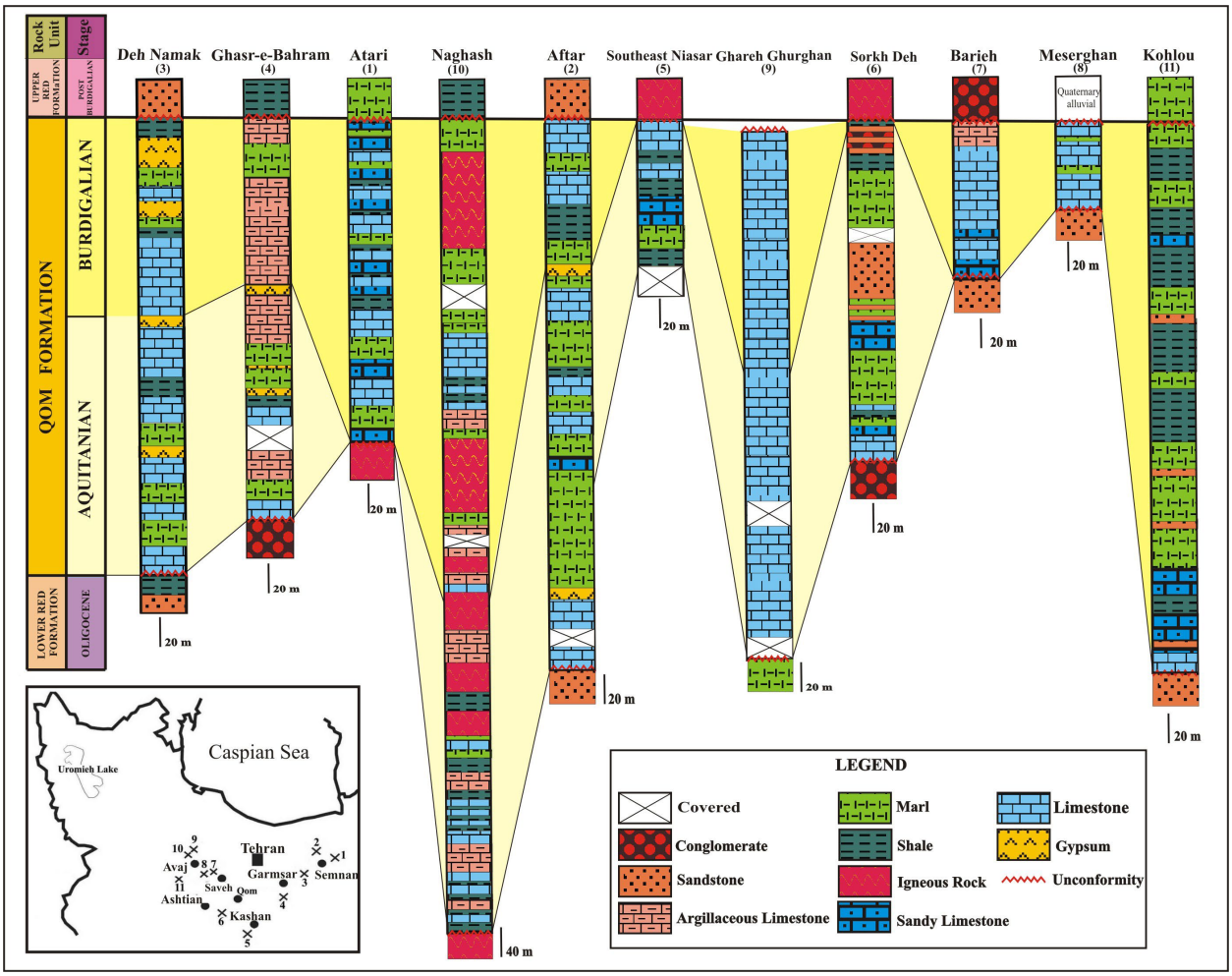


Figure 2. Chronostratigraphical and lithostratigraphical correlation of the studied sections.

Biostratigraphy

Among the fossil groups, the most noticeable one is the benthic foraminifera, which are marked by high diversity and abundance. These microfossils are used for dating the Qom deposits but biozonation of these sediments is controversial because no standard biozones have been established for them yet. In fact, there is no biozonation for the Qom Formation and the biozonation of the Zagros deposits has been used because of the faunal similarity of these zones (Figure 1A). Adams and Bourgeois (1967), Ehrenberg *et al.* (2007) and Laursen *et al.* (2009) offer the main biozonations of the Zagros Zone but among these biozones that of Adams and Bourgeois (1967) is more functional and appropriate. The others have some problems, for example Laursen *et al.* (2009) has some obvious mistakes in biozonation, such as *Hantkenina* being given an Eocene age in this biozonation when it should be Oligocene. Also, they introduced an undetermined biozone which is not acceptable as a biostratigraphic unit. This biozonation is not professional due to its not considering the role of the international stratigraphic guide (Salvador, 1991). The biozonation which has been used for the Qom Formation is the biozonation of Adams and Bourgeois (1967). This biozonation has been introduced based on 50 stratigraphic sections throughout 11,000 km^2 for the Asmari Formation in the Zagros Zone (southwest of Iran). Using this biozonation is acceptable and seems to be beneficial for the Qom sediments. The major reason for using is the resemblance between the faunal contents, especially of benthic foraminifera, of the two Asmari and Qom formations. Investigation by some researchers (Furrer and Soder, 1955; Kashfi, 1988; Stocklin, 1952; Bozorgnia, 1966; Adams and Bourgeois, 1967; Rahimzadeh, 1994) shows that this similarity comes from the paleogeographical construction of the two basins, which indicates the

Table 2. Index foraminifera in the studied stratigraphic sections.

NO.	Species
1	*Archaias kirkukensis*
2	*Austrotrillina howchini*
3	*Borelis melo curdica*
4	*Dendri tina ranji*
5	*Elphidium* sp.14
6	*Meandropsina anahensis*
7	*Meandropsina iranica*
8	*Nephrolepidina tournoueri*
9	*Operculina complanata*
10	*Rotalia viennoti*
11	*Peneroplis evolutus*
12	*Peneroplis farsensis*
13	*Peneroplis thomasi*
14	*Triloculina trigonula*
15	*Triloculina tricarinata*

Species \ Stratigraphic Section	Aftar	Atari	Deh Namak	Ghasr-e-Bahram	Southeast Niasar	Sorkh Deh	Barieh	Meserghan	Ghareh Ghurghan	Naghash	Kohlou
Archaias kirkukensis	●				●	●		●			
Austrotrillina howchini	*	*			●	●				●	
Borelis melo curdica	*	*	*	*			*	*	*	*	*
Dendritina rangi	●	●	●	●	●	●	●	●	●		●
Elphidium sp.14	*	*	*	*	*	*			●	●	
Meandropsina anahensis	●	*	*	●		*	*	*	*		
Meandropsina iranica	●	●	*	*		*	*	*			*
Nephrolepidina tournoueri			●		●					●	
Operculina complanata			●	●	●		●	●		●	●
Peneroplis farsensis	*		*	●	*	*	*	*	*		
Peneroplis thomasi	●				●	●	●	●			
Peneroplis evolutus	●	●		●	●	●		●	●		●
Rotalia viennoti	●	●	●	●	●	●	●	●			
Triloculina trigonula	●	●	●	●	●	●	●	●	●		●
Triloculina tricarinata		●	●	●		●	●	●	●	●	●

Figure 3. Distribution of index foraminifera in the studied sections. *, index foraminifera, of which first or last occurrence are considered as the events; ●, index foraminifera, of which first or last occurrence are not considered as the events.

existence of a narrow connection between the Central Iran (Qom) and Zagros (Asmari) basins. In addition, previous works on the Qom Formation, for example Daneshian and Dana (2017) and Daneshian *et al.* (2017), indicate acceptable and appropriate results. Therefore, Adams and Bourgeois's biozonation is more adequate for biostratigraphic studies of the Qom Formation and we preferred using it in this study. However, this biozonation indicates a few differences in distribution of some species in the Qom basin.

Adams and Bourgeois (1967) defined formal biozones for the Asmari Formation which consist of: Biozone 3) *Eulepidina-Nephrolepidina-Nummulites* Assemblage Zone (Oligocene), 2) *Miogypsinoides-Archaias*-Valvulinid Assemblage Zone (Aquitanian) which is subdivided into two Subzones, *Elphidium* sp. 14-*Miogypsina* Assemblage Subzone and *Archaias asmaricus-Archaias hensoni* Assemblage Subzone, and 1) *Borelis melo* group-*Meandropsina iranica* Assemblage Zone (Burdigalian).

The foraminiferal assemblages of the Qom Formation through this study indicate that there are some differences with the Asmari Formation. Hence, defining a more detailed biozonation will assist improving our understanding of the biostratigraphical characteristics of the Qom Formation. This research seeks to investigate identified datum levels in favor of definitionally suitable biozones for the Qom sediments in the study area.

Methods and material

In this study, the benthic foraminifera of lower Miocene deposits were revised and studied in different localities including eleven stratigraphic sections and 1190 samples in the north of central Iran. The sections were spread throughout a large area in the Central Iran Zone and created an acceptable scheme for datum levels (Figures 1B, C, 2). Sampling intervals were between 1.3 to 4 m in average and included hard and soft sediments. The stratigraphic sections were selected based on their positions and samples for foraminiferal studies were systematically collected with one of the authors (J. Daneshian) in attendance in all geological fieldwork. The published foraminiferal stratigraphic distribution of the sections (Daneshian and Bakhtiari, 2002; Daneshian and Deziani, 2004; Daneshian and Ghasemi, 2004; Daneshian and Poursalehi, 2004; Daneshian and Raziee, 2004; Daneshian and Chegini, 2007; Daneshian and Derakhshani, 2007; Daneshian and Yazdani, 2007; Daneshian and Dana, 2007) were revised, and their foraminiferal datum levels investigated.

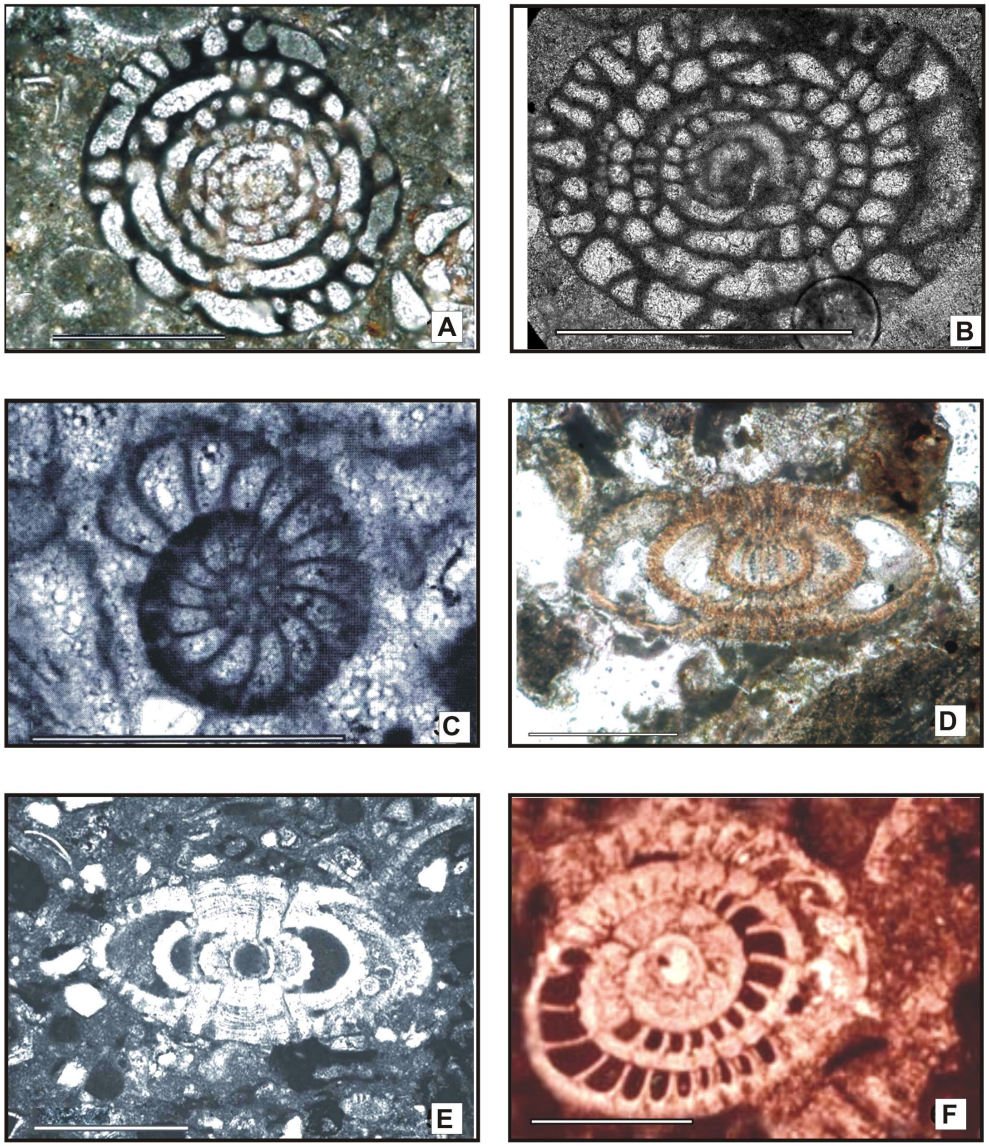


Figure 4. **A, B,** *Borelis melo curdica*; A, Ghasr-e-Bahram section; B, Atari section; **C,** *Peneroplis farsensis*, Atari section; **D–F,** *Elphidium* sp. 14; D, Gasr-e-Bahram section; E, Atari section; F, Aftar section. All scale bars = 0.5 mm.

Afterwards, the index foraminifera and their stratigraphic distributions were revised throughout the studied sections and then datum levels were extracted. Exploiting of these datum levels is based on the first and last occurrences (FO and LO) of six index benthic foraminifera and their abundances and stratigraphic distributions. These datum levels were compared through all sections and used for the correlation, and then biozones were defined.

In our approach, all benthic foraminiferal datum levels identified by Adams and Bourgeois (1967) from the Asmari Formation (Zagros Zone) were considered. These events play key roles in the biozonation. The occurrences and stratigraphic distributions of these events were investigated and considered as datum levels for the Qom Formation in the sections.

Results

In total, fifteen species of foraminifera extracted from the sections were recognized as indexes (Table 2). In the study area, first and last occurrences (FO and LO) of six benthic foraminiferal species were selected and determined as event markers, namely, *Borelis melo curdica*, *Peneroplis farsensis*, *Elphidium* sp. 14, *Meandropsina anahensis*,

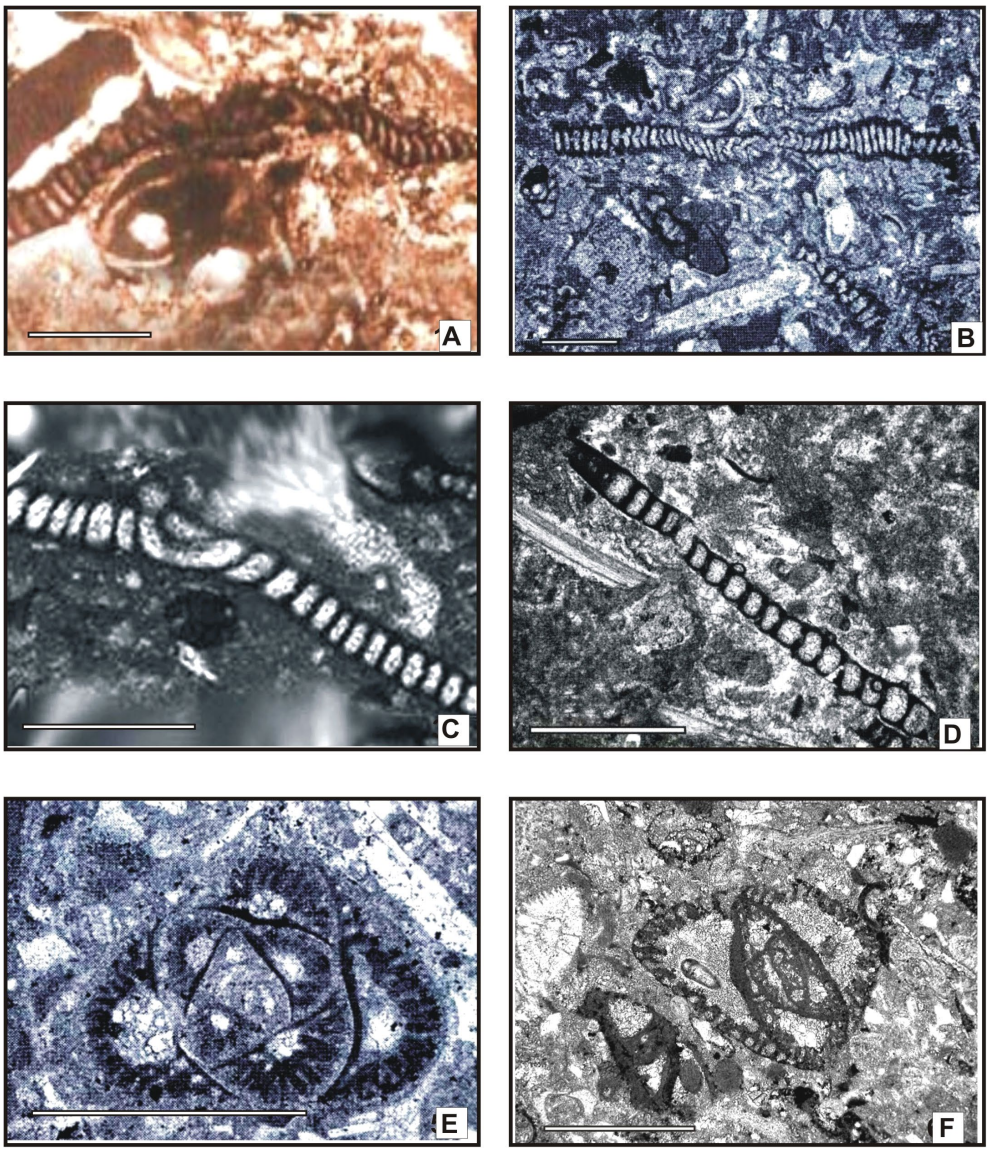


Figure 5. **A, B,** *Meandropsina anahensis*; A, Aftar section; B, Atari section; **C, D,** *Meandropsina iranica*; C, Deh Namak section; D, Naghash section; **E, F,** *Austrotrillina howchini*; E, Naghash section; F, Atari section. All scale bars = 0.5 mm.

Meandropsina iranica and *Austrotrillina howchini* (Figures 3, 4, 5). The introduced foraminiferal datum levels which have magnificent abundance and distribution are as follows: 1) eight events in Eh Namak, 2) seven events in Aftar, 3) two events in Niasar, 4) five events in Sorkh Deh, 5) five events in Ghareh Gurghan, 6) four events in Meserghan, 7) one event in Kohlou, 8) six events in Ghasr-e-Bahram, 9) six events in Atarti, 10) two events in Naghash, and 11) five events in Barieh (Figures 3, 6).

Discussion

The age of the Qom Formation in central Iran has been mentioned as early Oligocene to early Miocene by Stocklin and Setudehnia (1991). However, based on the occurrences of index benthic foraminifera, an early Miocene (Aquitanian–Burdigalian) age is indicated in the study area. In other words, the Qom basin at this area probably had been rising and coming out of the water during Oligocene. In this study, the Aquitanian/Burdigalian boundary was determined on the basis of the first occurrence of *Borelis melo curdica.* According to Adams

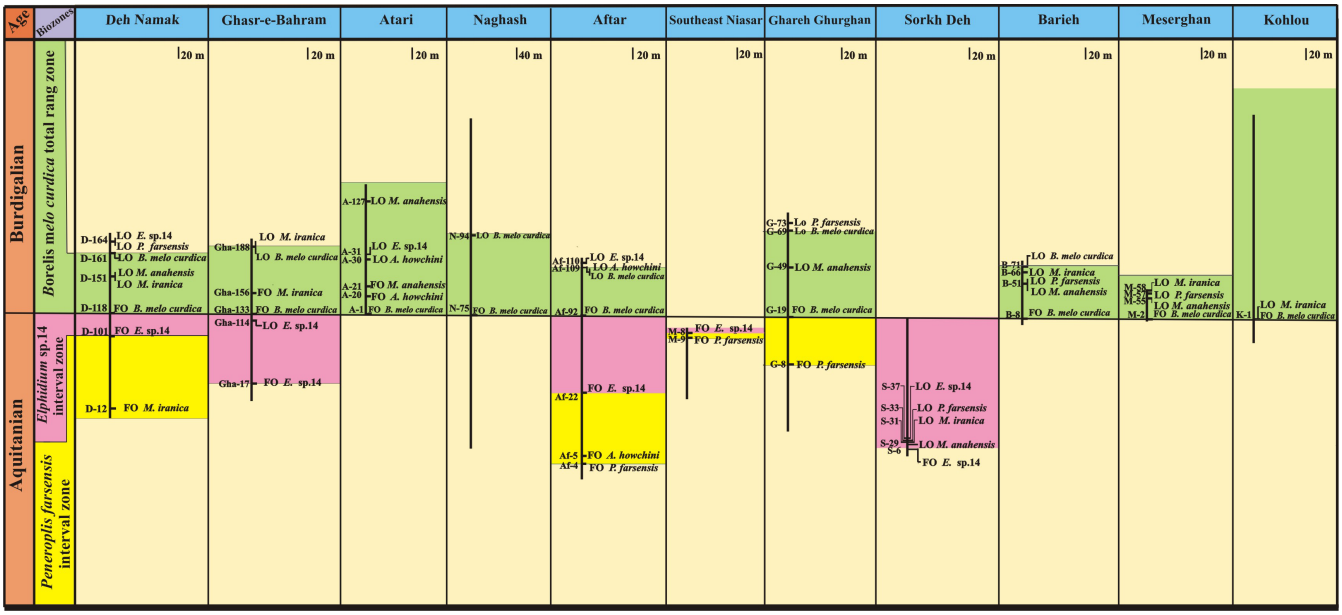


Figure 6. Proposed biozonation of the Qom sediments based on our results. FO, first occurrence; LO, last occurrence; *E*, *Elphidium* sp. 14; *P*, *Peneroplis*; *A*, *Austrotrillina*; *B*, *Borelis*.

and Bourgeois (1967) and Jones *et al.* (2006), the occurrence of *B. melo curdica* has not been reported from the Aquitanian. Also the Aquitanian can be divided into two parts, by the first occurrences of *Peneroplis farsensis* and *Elphidium* sp. 14 with *Meandropsina iranica*.

We suggest three biozones for the Qom Formation based on the stratigraphic distribution of index fossils, taking advantage of the datum levels and the explanations made for introducing the biozones by Salvador (1994).

Peneroplis farsensis interval zone

Category.—Interval zone.

Age.—Early to early late Aquitanian.

Definition.—this biozone is distinguished by the first occurrence of *Peneroplis farsensis* to first occurrence of *Elphidium* sp. 14. The name of this biozone has been selected from the abundance of *Peneroplis farsensis*. Index foraminifera in this biozone consist of *Austrotrilina howchini*, *Meandropsina iranica* and *Meandropsina anahensis* (Figure 6).

Associated foraminifera.—Ammonia beccarii, *Asterigerina* spp., *Bigenerina* spp., *Bolivina* spp., *Bozorgniella qumiensis*, *Dendritina rangi*, *Discorbis* spp., *Elphidium crispum*, *Elphidium* spp., *Globigerina praebulloides*, *Globigerina* spp., *Globigerinoides triloba*, *Glomospira* spp., *Haplophragmium* spp., *Heterillina* spp., *Massilina* spp., *Meandropsina anahensis*, *Meandropsina iranica*, *Miogypsina* spp., *Miogypsinoides* spp., *Heterolepa dutemplei*, *Heterostegina* spp., *Operculina complanata*, *Peneroplis evolutus*, *Planorbulina* spp., *Pyrgo* spp., *Quinqueloculina* spp., *Reussella* spp., *Rotalia viennoti*, *Spirolina cylindracea*, *Schlumbergerina* spp., *Spiroloculina* spp., *Textularia* spp., *Triloculina tricarinata*, *Triloculina trigonala*, *Valvulina* spp.

Elphidium sp. 14 interval zone

Category.—Interval zone.

Age.—late late Aquitanian.

Definition.—Lower boundary of this biozone is recognized by the first occurrence of *Elphidium* sp. 14 and upper boundary is determined on the basis of the first occurrence of *Borelis melo curdica*. The name is determined by *Elphidium* sp. 14 (Figure 6).

Associated foraminifera.—Ammonia beccarii, *Asterigerina rotula*, *Austrotrillina howchini*, *Bigenerina* spp., *Bozorgniella qumiensis*, *Dendritina rangi*, *Discorbis* spp., *Elphidium* spp., *Glomospira* spp., *Heterillina* spp., *Massilina* spp., *Meandropsina farsensis*, *Pyrgo* spp., *Quinqueloculina* spp., *Reussella* spp., *Rotalia viennoti*, *Schlumbergerina* spp., *Spiroloculina* spp., Textularia spp., *Triloculina tricarinata*, *Triloculina trigonala*, *Valvulina* spp.

Borelis melo curdica total range zone

Category.—Total range zone.

Age.—Burdigalian.

Definition.—This biozone is defined by the occurrence of *Borelis melo curdica.* The lower boundary of

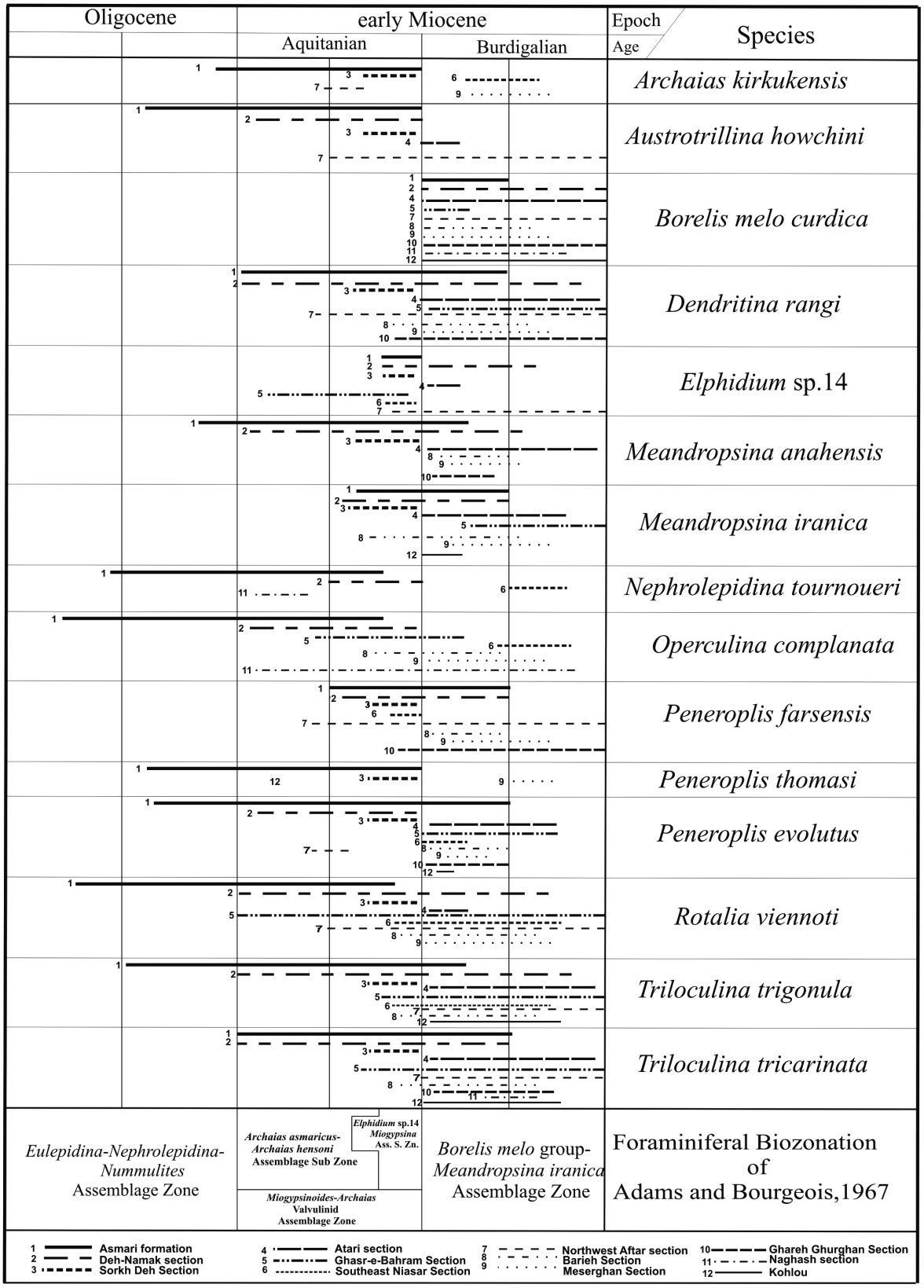


Figure 7. Distribution of index foraminifera in the studied sections.

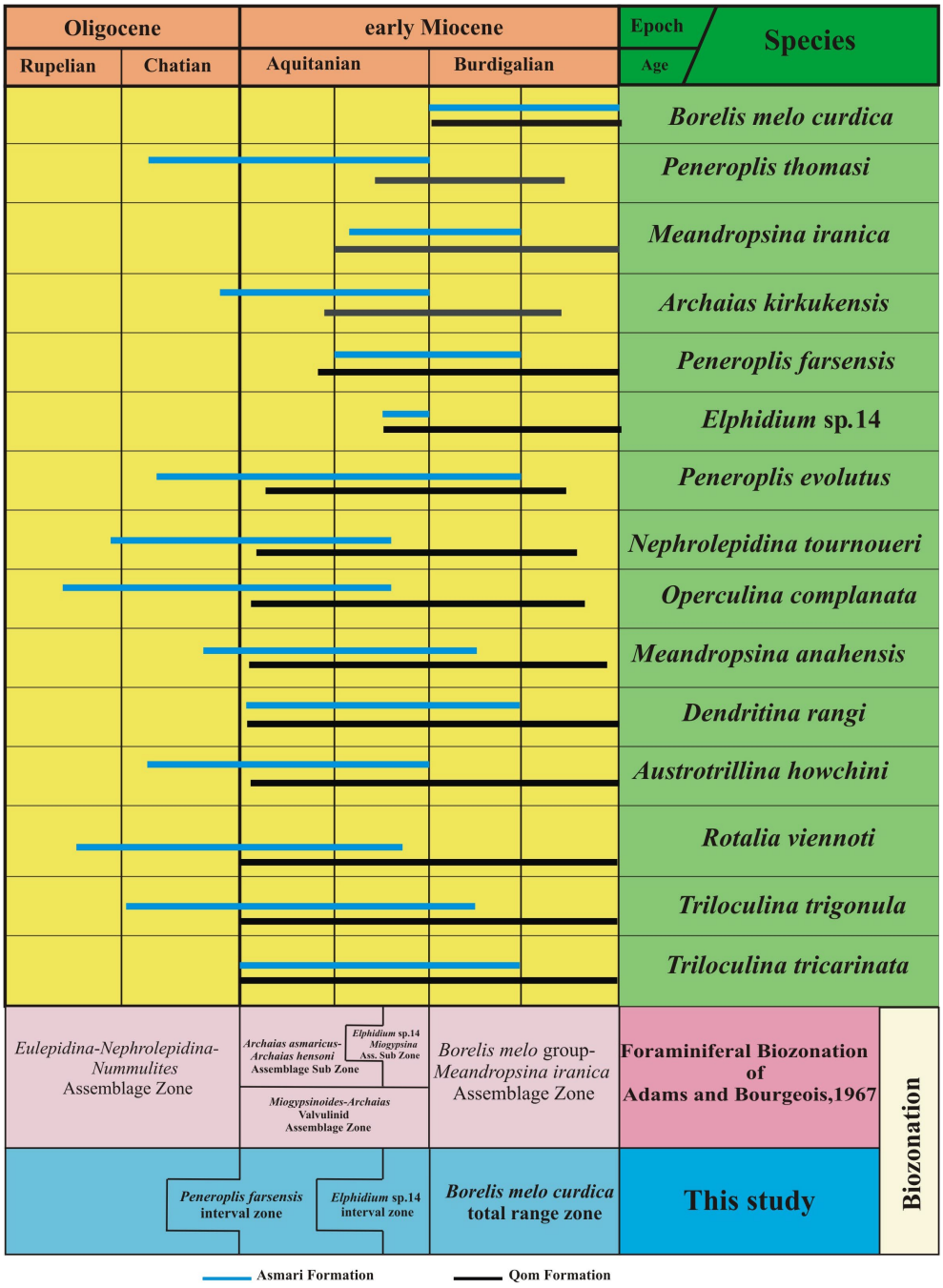


Figure 8. Comparative distribution of index foraminifera in the Asmari and Qom formations.

this biozone is based on the first occurrence of *Borelis melo curdica* and the upper boundary is defined by the last occurrence of this species. The occurrence of *Borelis melo curdica* suggested the age of this biozone (Figure 6).

Associated foraminifera.—*Ammonia beccarii*, *Amphistegina lessonii*, *Amphistegina* spp., *Archaias* sp., *Asterigerina rotula*, *Asterigerina* spp., *Austrotrillina howchini*, *Bigenerina* spp., *Borelis melo melo*, *Bozorgniella qumiensis*, *Cibicides* spp., *Dendritina rangi*, *Discorbis* spp., *Elphidium crispum*, *Elphidium* sp. 14, *Elphidium* spp., *Globigerina praebulloides*, *Globigerinoides subquadratus*, *Globigerinoides triloba*, *Globigerinoides* spp., *Globorotalia* spp., *Glomospira* spp., *Haplophragmium* spp., *Heterillina* spp., *Massilina* spp., *Meandropsina*

anahensis, *Meandropsina iranica*, *Miolepidocyclina* spp., *Miogypsina* spp., Nonion spp., *Peneroplis evolutus*, *Peneroplis farsensis*, *Planorbulina* spp., *Pyrgo* spp., *Quinqueloculina* spp., *Reussella* spp., *Rotalia viennoti*, *Schlumbergerina* spp., *Sphaerogypsina globulus*, *Spirolina cylindracea*, *Spiroloculina* spp., *Textularia* spp., *Triloculina tricarinata*, *Triloculina trigonala*, *Valvulina* spp.

Introducing formal biozones requires study of more stratigraphic sections and surely having precise biozonation and study of index fossils is essential. Current research just has been concentrated in the north of central Iran, so this illustrates the informality of the biozonation. With these biozones, we are just able to indicate the boundary of the Aquitanian–Burdigalian in the study area.

Comparing Adams and Bourgeois' biozonation with proposed biozones of this research displays an acceptable resemblance. However, differences in the occurrence of some index foraminifera, which have been shown in Figure 7 and their list in Table 2 caused us to define new biozones for the north of central Iran. Also, comparing the occurrence and distribution of index benthic foraminifera in Central Iran and the Zagros Zone indicates that there is almost an equal and a similar situation between them. Accurate calibration of these taxa has revealed some differences between following species (Figures 7, 8).

According to Adams and Bourgeois (1967) *Rotalia viennotti* and *Elphidium* sp. 14 do not occur with *Borelis melo curdica* during Burdigalian. But in central Iran, as shown in Figure 7, *Elphidium* sp. 14 in the Dehnamak, Atari and northwest Aftar sections exists with *Borelis melo curdica* in the Burdigalian. Also, *Rotalia viennotti* occurs with *Borelis melo curdica* in all sections. *Operculina complanata* and *Nephrolepidina tournoueri* in the Asmari basin disappeared before the Burdigalian but in central Iran these species occurred in some sections. Moreover, differences in distributions of both *Archaias kirkukensis* and *Ausrotrillina howchini* can be considered, as in the Zagros they come up to the end of Aquitanian, while in the Qom Formation these species are reported during Aquitanian and Burdigalian. However, Laursen *et al.* (2009) believed that the different species of *Archaias* belongs to the Oligocene (Figures 7, 8).

Conclusion

Investigating of important taxa of the Qom and Zagros basins in eleven studied stratigraphic sections led us to recognize benthic foraminiferal datum levels and define three informal biozones. Comparing the proposed biozonations in this study with Adams and Bourgeois's biozonation (1967), there is a resemblance between the occurrence of some index foraminifera in the Central Iran and Zagros Basins. There are some taxa which reveal a different distribution and occurrence such as *Rotalia viennoti*, *Operculina complanata*, *Nephrolepidina tournoueri*, *Archaias kirkukensis* and *Ausrotrillina howchini*. This result confirms that we need a new biozonation for the Qom Formation based on its faunal assemblage and this study can be a first step in approaching this goal.

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