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Diversity of the Early-Miocene (Burdigalian) Ostracoda from Northeastern Semnan, Central Iran

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Abstract
Seven genera and seventeen species of marine Ostracoda are reported for the first time from the Attari section (Qom Formation), northeast of the Semnan, Central Iran. In this section, the Qom Formation outcrops with 280 m thickness lies on the Eocene volcanic and under the Upper Red formation. According to the distribution of index foraminifera, there is conspicuous similarity between larger bentic foraminifera assemblages of the Qom Formation foraminifera and those of the Zagros basin, such as Borelis melo curdica the age of Qom Formation in the Attari section is Early Miocene (Burdigalian). The Miocene and even Oligocene Ostracoda fauna, relatively similar to the Attari section, have been reported from the Mediterranean area and the Proto- Indo- Pacific Ocean. The presence of one species with Paratethian origin in the Qom Formation is strong evidence that during the Burdigalian stage, the sea way between Central Iran and Paratethys basin still existed.
Keywords: *Burdigalian, Systematic, Ostracoda, Semnan.*

1. Introduction
The Qom Formation (Oligocene- Miocene), a series of marls, sandstones, and limestone, was deposited in a northwest- southwest oriented Central Iran Basin which extended from northwestern into southwestern Iran (Khaksar and Maghfouri Moghadam 2007). Central Iran is a part of the back- arc basin as defined by (Heydari et al. 2003), (Fig 1a). The Qom Formation is the last transgression of the sea in the Central Iran Zone (Reuter et al. 2008). It was introduced by Loftus in 1855 as Nummulitic series with the Oligocene age. After oil was discovered in 1934, this formation was in the fouls of scientific researchers, such as (Gansser 1955; Furrer and Soder 1955; Abaie et al. 1964; Bozorgnia 1966; Rosenberg 1975; Seyrafian and Torabi 2005; Daneshian and Ramezani Dana 2005; Sadeghi et al. 2009; Behforouzi and Safari 2011; Sedighi et al. 2011; GhasemShirazi et al. 2014-b; Karevan et al. 2014;).
Most of the studies has been done on foraminifera assemblages of Qom Formation. Unfortunately, there are few studies and literature on Iranian Ostracoda, in spite of their very diverse and abundance assemblages. Some of Iranian Miocene ostracoda articles are (Bozorgnia 1961; Faridi 1964; Pourmotamed 1967; Monteil and Grosdidier 1969; Krstic 1979; Hoseini Pour et al. 2009; Torkzadeh Mahani et al 2010; Ehsani et al. 2013). The most important goal of this article is to introduce Ostracoda species in Attari section in noerheastern Semnan and to interpret their paleogeographical distribution.

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2. Material and Methodology
To study the ostracoda assemblage of Lower Miocene deposits in Semnan, a section was measured in Central Iran back-arc basin (Attari section) and 35 specimens collected from its soft sediments. This section shows least tectonic overprint, and their lower and upper contacts are well exposed. We cooled and warmed a 200g of every sample by placing them in the freezer and then repeatedly on the stove until the sediment grains were completely disaggregated. The samples were washed. After drying, we passed them through various sieves, the smallest of which was 74 microns, to separate the Ostracoda from larger grain sediments. Then we put their carapace in the ultrasonics to separate the particles attached to them. All samples of Ostracoda were analyzed under the binocular microscope in 50×magnification for taxonomic purposes and documentation. Some specimens were selected for photographed by Scanning Electron Microscope (SEM). The material used to study is housed in Tehran Energy Consultants Company.

3. Localiyt and Stratigraphy
The attari section is located 27 km to the northeast of Semnan with geographic coordinates of N 35° 43 ' 31" and E: 53 ° 38' 3" (Fig 1b). The Qom Formation in the Attari section consists of 280 m Marl, limestone, sandy limestone and sandstone. This formation rests on Eocene sub-volcanic rocks by nonconformity and it is conformably overlain by the Upper Red Formation (Fig 1c). In this stratigraphic section, the marly sediments of this formation is including of benthonic foraminifera, corals, bivalves, echinoids and Ostracoda.

The Qom Formation in the Attari section is dated to Early Miocene (Burdigalian) based on distribution of the index larger benthic foraminifera, which are also widely spread in the Zagros Basin and Asmari Formation, (Fig 2), such as Borelis melo curdica, Elphidium sp. 14, (Daneshian and Chegini 2006).

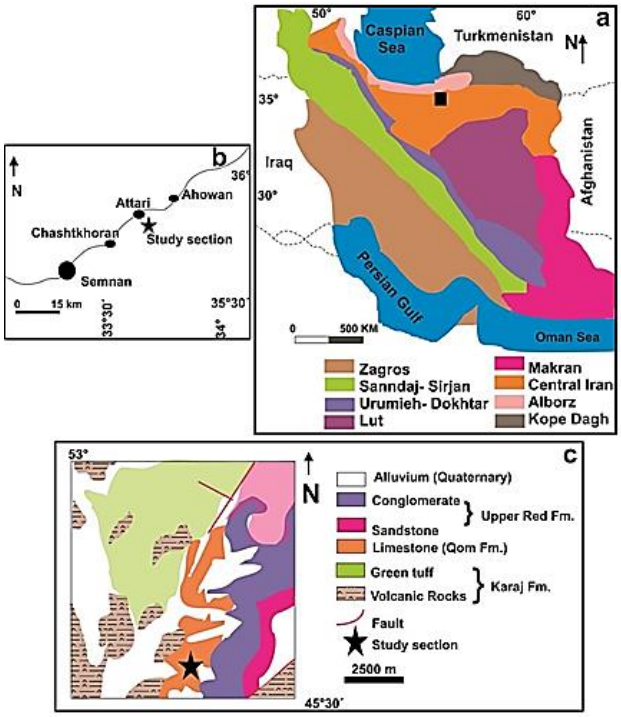

Fig 1. a) Structural framework of Iran (modified from Heydari et al. 2003,) b) Location of the study areas in northeastern Semnan, C) Geological map of the study areas in northeast of Semnan (Alavi Naini 1972).

4. Systematic

The Ostracoda assemblage of the study section includes (Fig 2) *Aurila concentric, Aurila punctata, Aurila bullapunctatissima, Loxoconcha* sp., *Hemicytheria omphaloides, Hemicyprideis miocaenica, Paracypris* sp., *Costa punctatissima, Cytheretta semipunctata, Ruggieria* sp., *Ruggieria micheliniana, Olimfalunia plicatula, Xestoleberis fuscata, Miocyprideis ovalis, Actinocythereis exanthemata, Heliocythere* cf. *vejhonensis and Krithe* sp.

Phylum: Arthropoda
Subphylum: Crustacea Brünnich 1771
Superclass: Oligostraca Zrzavy, Mihulka, Kepka, Bezdek and Tietz 1998
Class: Ostracoda Latreille 1806
Subclass: Podocopa Sars 1866
Order: Platycopida Sars 1866
Suborder: Platycopina Sars 1866
Superfamily: Cytherelloidea Alexander 1929
Family: Cytherellidae Sars 1866
Species: Hemicyprides miocaenica Lienenklaus 1905
Plate 4. Fig 5., Plate 5. Figs 1 and 2

Description: The longest and highest part of the subovate carapace is located at the anterior –posterior and ventral- dorsal, respectivley. Anterior end obliquely rounded in the lower part, with fine marginal denticulations. Anterior and dorsal marginsis almost continuous, forming an arc. The dorsal margin is completely convex, and the ventral margin is sliite. The outer surface is arranged by small pits.

Distribution: Northern Iraq: Early- Middle Miocene (Khalaf 1988).

Olimfalunia plicatula (Reuss 1850)
Plate 3. Figs 7 and 8

Description: The maximum height and length of the quadrangular carapace in the left valve are located in the middle part of the ventral to the dorsal and the axis of the middle part of the anterior-posterior margins, respectively. In the right valve maximum height lies posteriorly. The dorsal and ventral margins are straight. The anterior and posterior margins are round with narrow rim. The outer surfaces have two ridge which are parallel to ventral side.

Distribution: This species is widespread in the Oligocene-Pliocene of Europe and the Mediterranean Basin, Oligocene-Miocene of Central and Western Europe (Reuss 1850; Bosquet 1852; Kuiper 1918; Keij 1957; Kollmann 1960); Oligocene-Pliocene of Aquitaine (Berger and Moyes 1964; Moyes 1965; Carbonel 1985; Ducasse and Cahuzac 1997); Tortonian of Northern Apennines, Italy (Dieci and Russo 1965); Burdigalian of Algeria (Coutelle and Yassini 1973); Badenian of the Central Paratethys (Brestenskí and Jirícek 1978; GhasemShirazi et al. 2014-a).

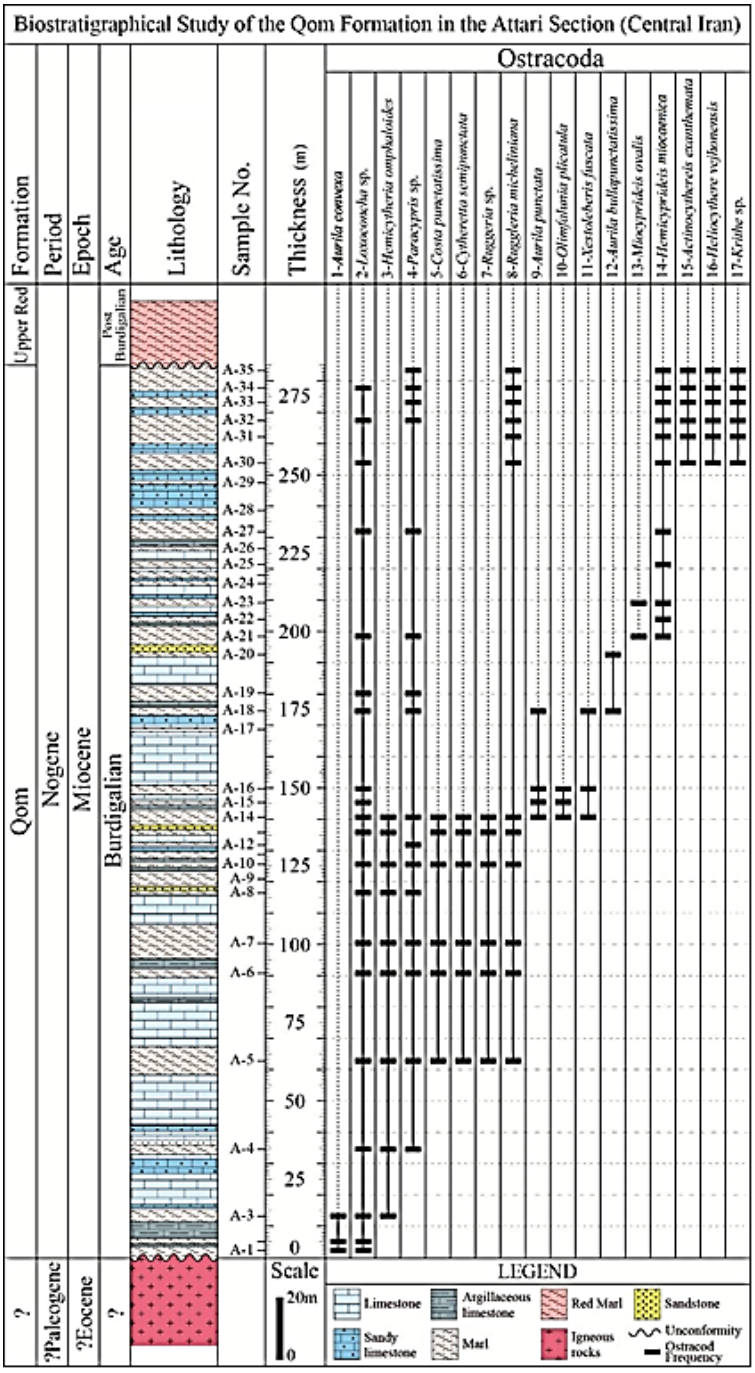

Fig 2. Vertical Ostracoda distribution of the Qom Formation at Attari section, northeastern Semnan.

Order: Podocopida Sars 1866
Suborder Cytherocopina Baird 1850
Superfamily Cytheroidea Baird 1850
Family Cytherettidae Baird 1850
Genus Cytheretta Müeller 1894
Cytheretta semipunctata (Bornemann 1855)
Plate 1. Fig 8.

Description: The maximum height and length of the subovate carapace are located in the middle part of the ventral to the dorsal and the axis of the middle part of the anterior-posterior margins, respectively. The dorsal and ventral margins are arch and flat, respectively.. The anterior and posterior margins are. The outer surfaces are smooth.

Distribution: Gabon: Miocene (Bold 1866); Siah Kuh and Kavir anticline: Helvetian (Bozorgnia 1961), Karvansarai Sangi and Nardaghi sections: Chattian-Helvetian (Faridi 1964), Deh-Namak: Oligocene-Miocene (Daneshian and Ramezani Dana 2005); Sirjan : Oligo- Miocene (Hoseini pour et al. 2009)

Family Trachyleberididae Sylvester-Bradley 1948
Genus *Ruggieria* Keij 1957

Species *Ruggieria micheliniana* Bosquet 1852
Plate 1. Fig 7 and *Plate 2. Figs. 1 , 2*

Description: The maximum height of the subtriangular to subovate carapace is in the anterior and below mid-height. Anterior margin gently sloping in the upper part, broadly, obliquely rounded in the lower part; posterior end slightly compressed and lower than the anterior, Thre broad, rounded rib extends along the lateral surface. Between this ridge and the ventral margin there is a single rib that extends below the posterior to anterior ridge. The rest of the surface is smooth.

Distribution: Western India: Early Miocene (Khosla 1978); Northern Iraq: Early- Middle Miocene (Khalaf 1984); Ethiopia: Neogene (Gramann 1971); Gabon: Miocene (Bold 1866); Southern Italy, Sicili, Miocene (Ruggieri 1962); Kavansarai Sangi and Nardaghi sections: Chattian- Helvetian (Faridi 1964), Dochah section: Aquitanian- Helvetian (Pourmotamed 1967), Moaleman well no.1: Eocene- Miocene (Grosdidier and Monteil 1970), Kamar Kuh: Early Miocene (Ehsani et al. 2013)

Ruggeria sp.
Plate . Fig 1

Description: The highest part of the ovate carapace is in the middle to the anterior. The anterior edges of both valves are round, While the posterior of left valve is rounded and the posterior of the right valve is shortened. The ventral margin is flat. Theanterior and posterior of the carapace are flat and slightly concave in the middle part.

Distribution: Western India: Miocene (Khosla 1978); Northern Iraq: Early- Middle Miocene (Khalaf 1988); Ethiopia: Neogene (Gramann 1971).

Suborder Bairdiocopina Gründel 1967, basis of record Martin and Davis 2001
Family Krithidae Brady et al. 1874
Subfamily Krithinae Mandelstam 1960
Genus *Krithe* Brady et al. 1874
Krithe sp. Howe and Chambers 1935
Plate 1. Figs, 3 and 4

Description: Carapace is smooth and large, elongate to subtrapezoidal. The highest part of the shell is in the middle and upper part of the anteior margin. The upper part of anterior side is round and convex at the junction with the ventral. The ventral is almost flat. The middle part of the back is flat and tilts forward and backward.

Distribution: Gabon: Miocene (Bold 1966); Northern Iraq: Early- Middle Miocene (Khalaf 1988); Iran, Baft: Aquitanian (Tork Zadeh Mahani et al. 2010), Siah Kuh and Kavir anticline: Sannoisian- Helvetian (Bozorgnia 1961), Kavansarai Sangi and Nardaghi sections: Chattian- Helvetian (Faridi 1964), Dochah section: Aquitanian- Helvetian (Pourmotamed 1967), Moaleman well no.1: Eocene- Miocene (Grosdidier and Monteil 1970), Shams Abad and Rahnis (Kerman): Aquitanian-Langham (Krstic1979), Deh-Namak: Oligocene-Miocene (Daneshian and Ramezani Dana 2005), Kamar Kuh: Earl Miocene (Ehsani et al. 2013), Sirjan : Oligo-Miocene (Hoseini pour et al. 2009). Southern Italy, Sicili, Miocene (Ruggieri 1962).

Superfamily Cytheracea Baird 1850
Family Loxoconchidae Sars 1866
Loxooconcha Sars 1866
Loxococoncha sp.
Plate 1. ***Error! Reference source not found.*** *Fig 4*

Description: The maximum height and length of the subrhomboidal carapace are located in the middle part of the ventral to the dorsal and the axis of the middle part of the anterior-posterior margins, respectively. The dorsal margin is completely concave, and the flat ventral margin is straight to concave. The outer surface is arranged by pits and vertical ridge.

Distribution: Western India: Burdigalian (Khosla 1976); Ethiopia: Neogene (Gramann 1971); Iran, Baft: Aquitanian (Tork Zadeh Mahani et al. 2010), Kamar Kuh: Early Miocene (Ehsani et al. 2013).

Distribution: Gabon: Miocene (Bold 1866); Northern Iraq: Early- Middle Miocene (Khalaf 1988); Southern Italy, Sicili, Miocene (Ruggieri 1962); Turkey: Oligo-Miocene (Bassiouni 1979); Siah Kuh and Kavir anticline: Sannoisian- Helvetian (Bozorgnia 1961), Kavansarai Sangi and Nardaghi sections: Chattian-Helvetian (Faridi 1964), Dochah section: Aquitanian-Helvetian Pourmotamed 1967, Moaleman well no.1: Eocene- Miocene (Grosdidier and Monteil 1970), Shams Abad and Rahnis Kerman: Aquitanian- Langham Krstic 1979, Deh-Namak: Oligocene- Miocene Daneshian and Ramezani Dana 2005; Sirjan : Oligo-Miocene Hoseini pour et al., 2009).

Genus: *Aurila* Pokorny 1955
Aurila concentric Amad, Neal, Siddiqui 1991
Synonym Cythere convexa Baird 1850
Aurila convexa
Plate 1. Fig 3

Description: The maximum height and length of the small ovate carapace are located in the middle part of the ventral to the dorsal and the axis of the lower part of the anterior-posterior margins, respectively. The dorsal margin is completely convex, and the flat ventral margin is straight to concave. The outer surface is arranged by pits.

Distribution: Tanzania: Eocene- Recent (Ahmad et al. 1991).

Aurila punctata Muenster 1830
Plate 3. Figs 4, 5 and 6

Description: The maximum height and length of the ovate to subrhomboidal carapace are located in the the posterior half and the axis of the lower part of the anterior-posterior margins, respectively. Anterior and dorsal marginsis almost continuous, forming an arc. The dorsal margin is completely convex, and the anterio- ventral margin is concave and posterior –ventral is convex. The outer surface is arranged byabundant pits.

Distribution: Iran: Siah Kuh and Kavir anticline: Sannoisian- Helvetian (Bozorgnia 1961), Kavansarai

Sangi and Nardaghi sections: Chattian- Helvetian (Faridi 1964), Dochah section: Aquitanian- Helvetian (Pourmotamed 1967), Moaleman well no.1: Eocene-Miocene (Grosdidier and Monteil 1970), Shams Abad and Rahnis (Kerman): Aquitanian- Langhian (Krstic 1979), Deh-Namak: Oligocene- Miocene (Daneshian and Ramezani Dana 2005).

Aurila bullapunctatisma Ruggeri 1967

Plate 4. Fig 1

Description: The maximum height and length of the semitriangular carapace are located in the middle part of the ventral to the dorsal and the axis of the lower part of the anterior- posterior margins, respectively. The dorsal margin is completely convex, and the flat ventralmargin is slightly concave in the middle. The outer surface is reticulate due to the elliptical pits that cover the entire outer surface.

Distribution: Iran: Siah Kuh and Kavir anticline: Sannoisian- Helvetian (Bozorgnia 1961), Kavansarai Sangi and Nardaghi sections: Chattian- Helvetian (Faridi 1964), Dochah secion: Aquitanian- Helvetian (Pourmotamed 1967), Moaleman well no.1: Eocene-Miocene (Grosdidier and Monteil 1970), Shams Abad and Rahnis (Kerman): Aquitanian- Langhian(Krstic 1979), Deh-Namak: Oligocene- Miocene (Daneshian and Ramezani Dana 2005); Baft: Aquitanian (Torkzadeh et al. 2010), Kamar Kuh: Burdigalian (Gheisvand et al. 2012).

Hemicytheria Popkorny 1955

Hemicytheria omphaloides, Reuss 1850

Plate 2. Figs 2and 3

Description: The carapace is semioval in shape. The maximum height and length of the shell are along the ventral-dorsal and anterior-posterior, respectively. The anterior margin of the upper part is sloping and the lower part is round. The posterior end is slightly compressed, rounded and lower than the anterior. The lateral surface is reticulate. The dorsal margin is convex and the ventral margin is concave.

Distribution: Austria, Wein, Miocene (Kollmann); Ukraine; Miocene (Schneider 1953).

Family Xestoleberididae Sars 1928

Genus *Xestoleberis* Sars 1866

Xestoleberis fuscata, Schneider 1953

Plate 4. Fig 2.

Description: The outer surface is smooth. The elliptical carapace is large in size. The end of the anterior and posterior is round and the ventral margin is flat and the dorsal is curved.

Distribution: Gabon: Miocene (Bold 1966); Dochah secion: Aquitanian- Helvetian (Pourmotamed 1967).

Family Cyprididae Baird 1850

Genus Microcyprides Kollmann, 1960

Species *Miocyprides ovalis* Khalaf 1993

Plate 4. Figs 3and 4

Description: The largest height and length of the long, ovate carapace are on the ventral-dorsal axis and the anterior-posterior axis, respectively. The end of the anterior and posterior is round. The dorsal margin is very slightly curved and the ventral margin is smooth. The outer surface of the shell is smooth or very small pit.

Distribution: Western India: Miocene (Khosla 1978); Northern Iraq: Early- Middle Miocene (Khalaf 1988); Ethiopia: Neogene (Gramann 1971).

Genus *Actinocythereis Puri* 1955

Species *Actinocythereis exanthemata* (Ulich and Basaler 1904)

Plate 4. Fig 6

Description: The maximum height and height of the semi-rectangular carapace are between the ventral to dorsal part and the front to rear axis, respectively. The anterior margin is rounded, serrated, and slightly concave at the top. The dorsal and ventral margins are almost flat and the lateral surface has several protrusions, the middle of which is the most prominent.

Distribution: Western India: Miocene (Khosla 1978); Northern Iraq, Early- Middle Miocene (Khalaf 1988); Ethiopia: Neogene (Gramann 1971).

Family Candonidae Kaufmann 1900 (in: Brandão et al . 2022)

Subfamily Paracypridinae Sars 1928

Genus *Paracypris* Sars 1866

Paracypris sp.

Plate 1. Fig 6., Plate 2. Figs 4, 5 and 6.; Plate 1. Fig 3.

Description: The maximum height and length of the large rectangular carapace are in the middle part of the ventral to the dorsal and the vetral margin, respectively. The middle part of the anteriormargin has a steep slope, the ventral part is straight and the dorsal is curved.

Distribution: Iran: Siah Kuh and Kavir anticline: Sannoisian- Helvetian (Bozorgnia 1961), Kavansarai Sangi and Nardaghi sections: Chattian- Helvetian (Faridi 1964), Dochah secion: Aquitanian- Helvetian (Pourmotamed 1967), Moaleman well no.1: Eocene-Miocene (Grosdidier and Monteil 1970), Shams Abad and Rahnis (Kerman): Aquitanian- Langhian (Krstic 1979), Deh-Namak: Oligocene- Miocene (Daneshian and Ramezani Dana 2005); Baft: Aquitanian (Torkzadeh et al. 2010), Kamar Kuh: Burdigalian (Gheisvand et al. 2012).

Family Trachyleberididae Sylvester- Bradley 1948

Subfamily Trachyleberididae Sylvester- Bradley 1948

Genus: *Costa* Neviani 1928

Costa punctatissima Ruggieri 1962

Plate 1. Fig 7

Description: The highest and longest part of the subrectangular carapace is at the end of the anterior part and along the ventral part, respectively. The anterior part is round and has a rim at the margin, which continues to the middle part of the posterior part. The posterior is round and has small spines. The lateral surfaces have very clear longitudinal ridge that end obliquely to the back in one-eighth of the ventral. The ventral ridge starts from the anterior-ventral region and

ends diagonally backwards and ends with a node above the periphery of the ventral at the posterior third end. At the anterior third the subrectangular has reticulate appearance by small nodes scattered.

Distribution: Southern Italy, Sicili: Miocene (Ruggieri 1962), India, Gujarat: Early Miocene (Bahatia and Mandwal 1960)

Heliocythere Bonaduce, Ruggieri and Russo 1988
Heliocythere vejhonensis (Prochazka 1893)
Plate 4. Fig 8

Description: Carapace is rectangular, and its greatest height passing through the middle ventro- posterior line, maximum length at below mid-height. The anterior is slightly sloping at the top and round at the bottom. The end of the posterior is lower than the anterior. So that these two parts are not in the same direction. Both sides of the shell have distinct sponge-shaped protrusions that become larger at the anterior.

Distribution: Slovaki: Miocene (Prochazka 1893), Italy: Miocene (Bonaduce et al. 1988).

5. Discussion and Conclusion

Marine Ostracoda are not suited as well as other groups of planktonic microfossils for interregional and intercontinental stratigraphic correlation. Ostracoda are not able to travel long distances during their larval period and therefore their geographical expansion is limited, which makes them very important for the reconstruction of paleo geography (Pokorny 1998). Many of the discoverd Ostracoda in Iran are identified only to the genus level, so comparison those to other areas are difficult. But, generically Qom Formation Ostracoda of northeastern Semnan are similar to those found in the eastern Mediterranean (Western Tethys) and Proto Indo- Pacific (Eastern Tethys). During Oligocene and Miocene, Tethys Realm was composed of two major biogeography Provinces namely the Western Tethys Region and the Eastern Tethys (Rögel 1999). At that time, a broad connection still existed between the Western Tethys and the Eastern Tethys via the Thetys Sea way (Fig 3). Western Tethys Province coverd southern Europe and Turkey. The common genera and species in this province and section under study consists of *Cytherella* cf. *hemipuncta*, *Heliocythere vejhonensis*.

Eastern Tethys Province covered Africa, India and Pakistan. The common genera and species in this province and section under study are *Cythere convexa, Xestoloberis fuscata, Miocyprides ovalis, and Cythere micheliniana*.

Tethys Sea way Province was covering Zagros to Central Zones in Iran and Mesopotamian. The common genera and species in this province and section under study are *Hemicyprideis miocaenica*, *Ruggieria micheliniana*, *Miocyprides ovalis*, *Aurila punctata*, *Krithe* sp., *Cytheretta semipunctata*.

Hemicytheria omphalaodes is common between Ukraine and Wien (Paratethys Basin) and the section of this study. The presence of this species from Paratethys Basin in the Qom Formation is a strong evidence that during the Burdigalian period, the Central Iran sedimentary basin was connected to Paratethys Basin to the North and the deeper Tethys marine environment to the West. Previously, Ehsani et al. (2013) had reported similar Ostracoda between Qom Formation and Paratethys Basin. The Ostracoda assemblage of Qom Formation in the section under study comprises 2 suborders: Platycopina, Cytherocopina. Detailed study of Ostracoda of Qom Formation in the northeast of Semnan led to identification and described systematically17 species from 7 genera of marine ostracoda.

The Burdigalian Ostracoda from Northeastern Semnan shows affinities with the Mediterranean, Indopacific and Paratethys Basins. It suggests that Northeastern Semnan, Central Iran, is connected from the east to the Indo-Pacific basin, from the north to the Parattethys basin and from the west to the Mediterranean basin. Therefore, Ostracoda species are a very suitable tool for correlation and comparing the Bourdigalian deposits of the Tethys ana Paratethys basins.

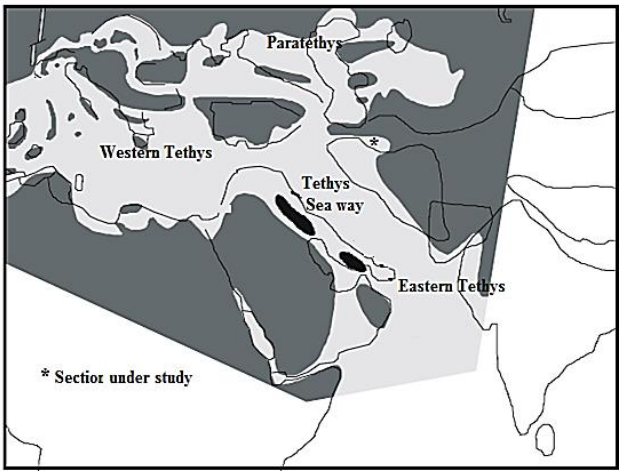

Fig 3. Burdigalian paleogeography of Tethys and the adjacent region (Rögel 1999).

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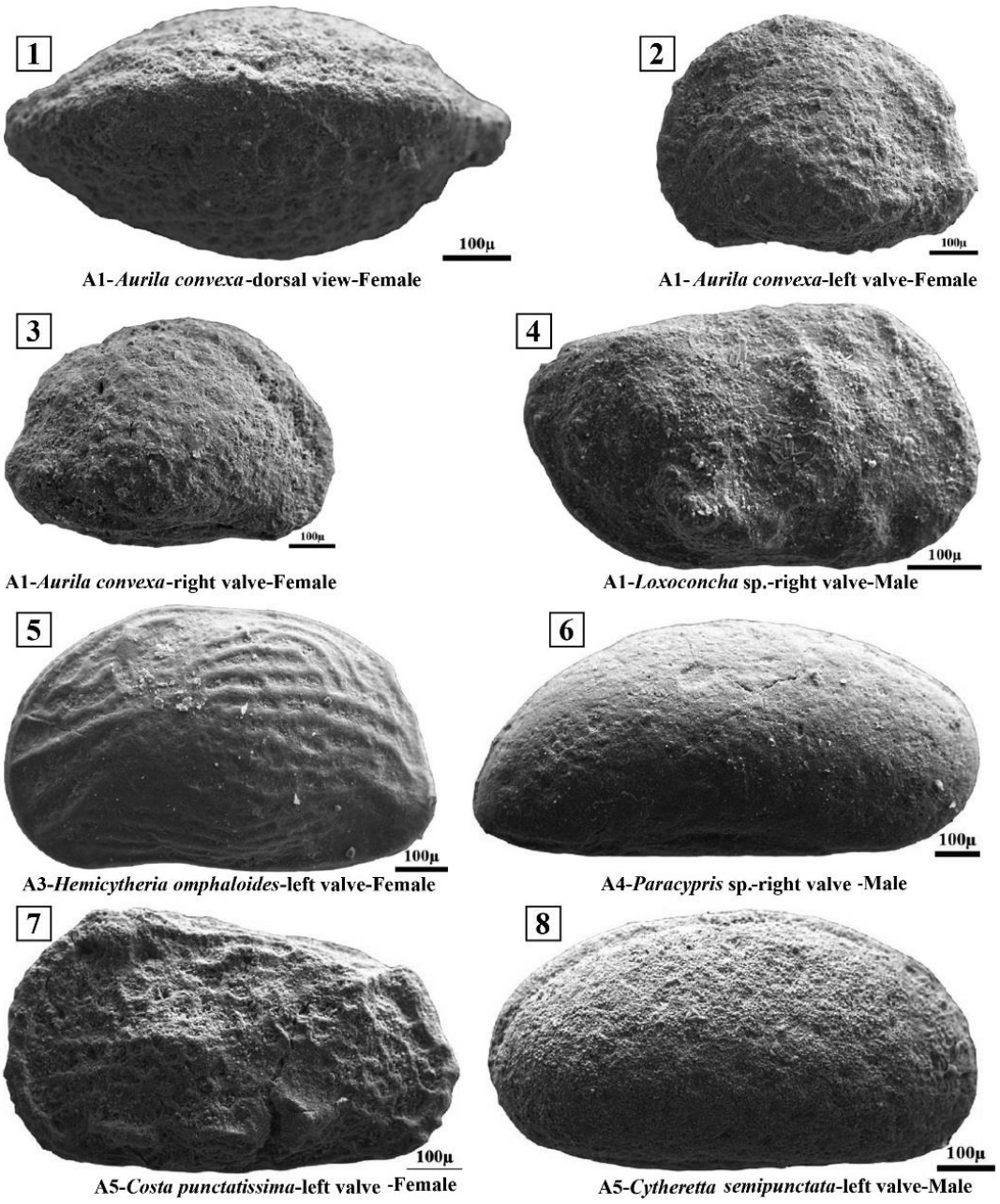
1
100µ
A1-*Aurila convexa*-dorsal view-Female
2
100µ
A1-*Aurila convexa*-left valve-Female
3
100µ
A1-*Aurila convexa*-right valve-Female
4
100µ
A1-*Loxoconcha* sp.-right valve-Male
5
100µ
A3-*Hemicytheria omphaloides*-left valve-Female
6
100µ
A4-*Paracypris* sp.-right valve -Male
7
100µ
A5-*Costa punctatissima*-left valve -Female
8
100µ
A5-*Cytheretta semipunctata*-left valve-Male

Plate 1

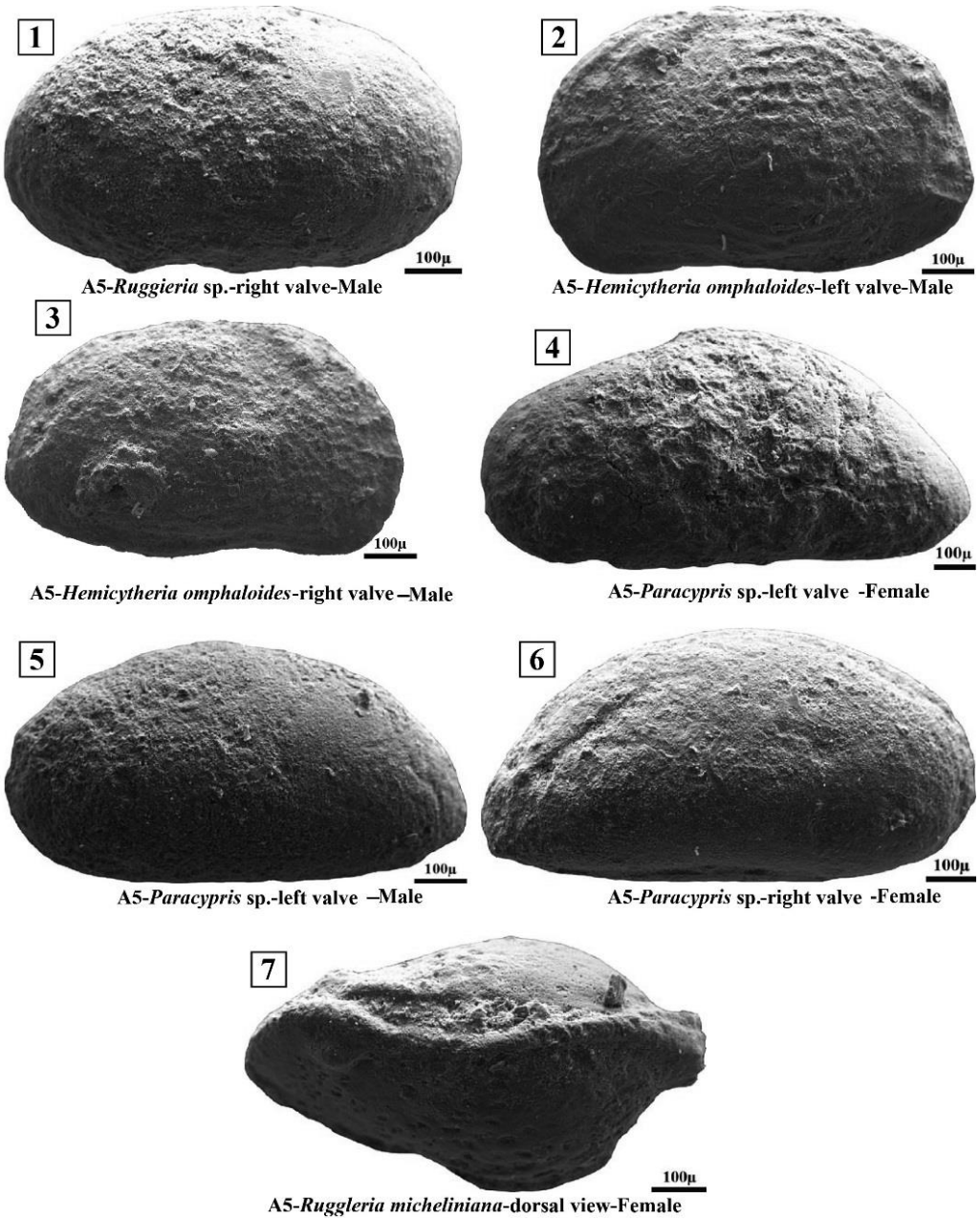
1
100µ
A5-*Ruggieria* sp.-right valve-Male
2
100µ
A5-*Hemicytheria omphaloides*-left valve-Male
3
100µ
A5-*Hemicytheria omphaloides*-right valve –Male
4
100µ
A5-*Paracypris* sp.-left valve -Female
5
100µ
A5-*Paracypris* sp.-left valve –Male
6
100µ
A5-*Paracypris* sp.-right valve -Female
7
100µ
A5-*Ruggleria micheliniana*-dorsal view-Female

Plate 2

A5-*Ruggleria micheliniana*-left valve-Female

A5-*Ruggleria micheliniana*-right valve-Female

A7-*Paracypris* sp.-left valve - Male

A14-*Aurila punctata*-dorsal view-Female

A14-*Aurila punctata*-left valve-Female

A14-*Aurila punctata*-right valve-Female

A14-*Olimfalunia plicatula* -left valve-Female

A14-*Olimfalunia plicatula*-right valve-Female

Plate 3

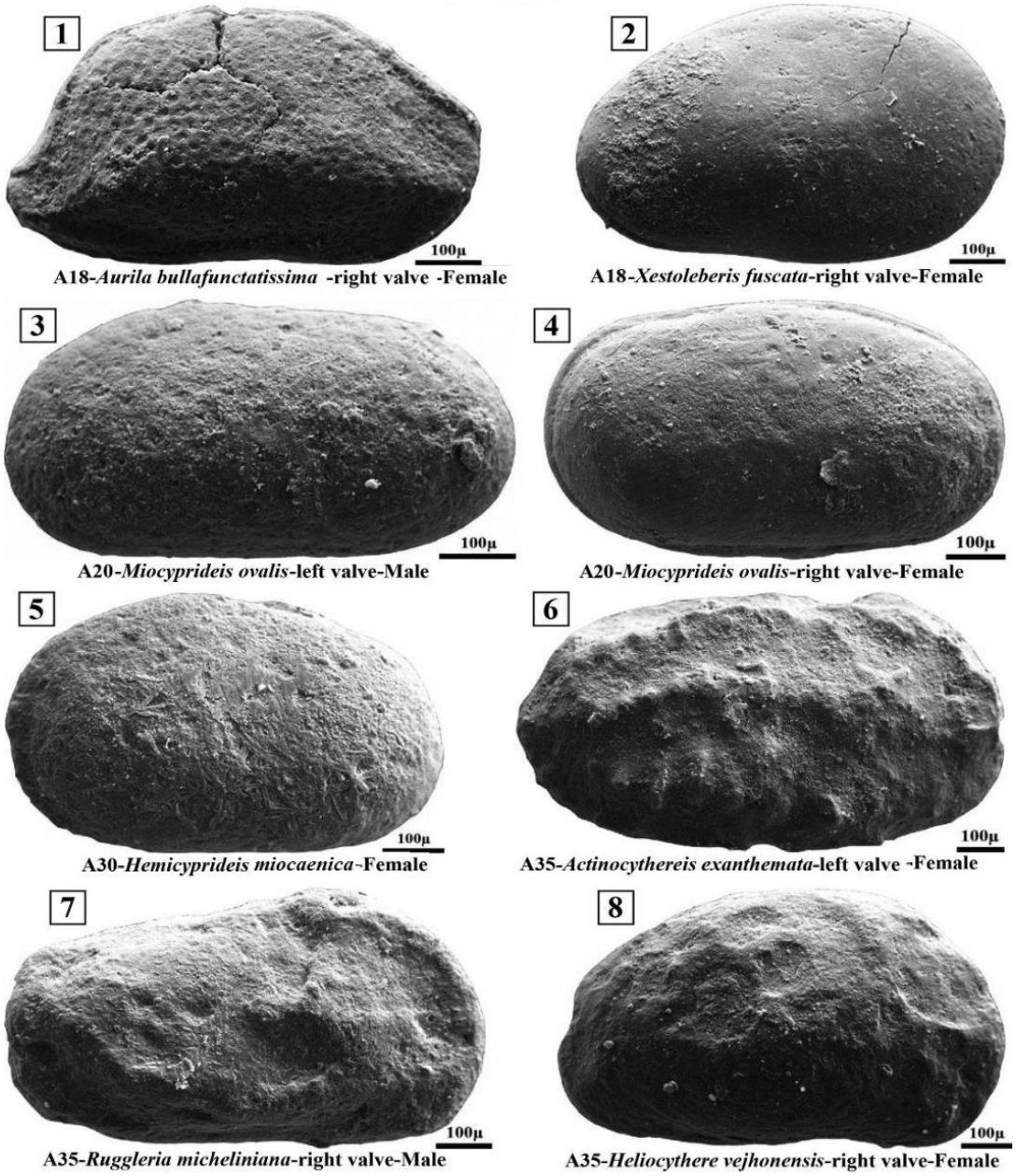
1
100µ
A18-Aurila bullafunctatissima -right valve -Female
2
100µ
A18-Xestoleberis fuscata-right valve-Female
3
100µ
A20-Miocyprideis ovalis-left valve-Male
4
100µ
A20-Miocyprideis ovalis-right valve-Female
5
100µ
A30-Hemicyprideis miocaenica-Female
6
100µ
A35-Actinocythereis exanthemata-left valve -Female
7
100µ
A35-Ruggleria micheliniana-right valve-Male
8
100µ
A35-Heliocythere vejhonensis-right valve-Female

Plate 4

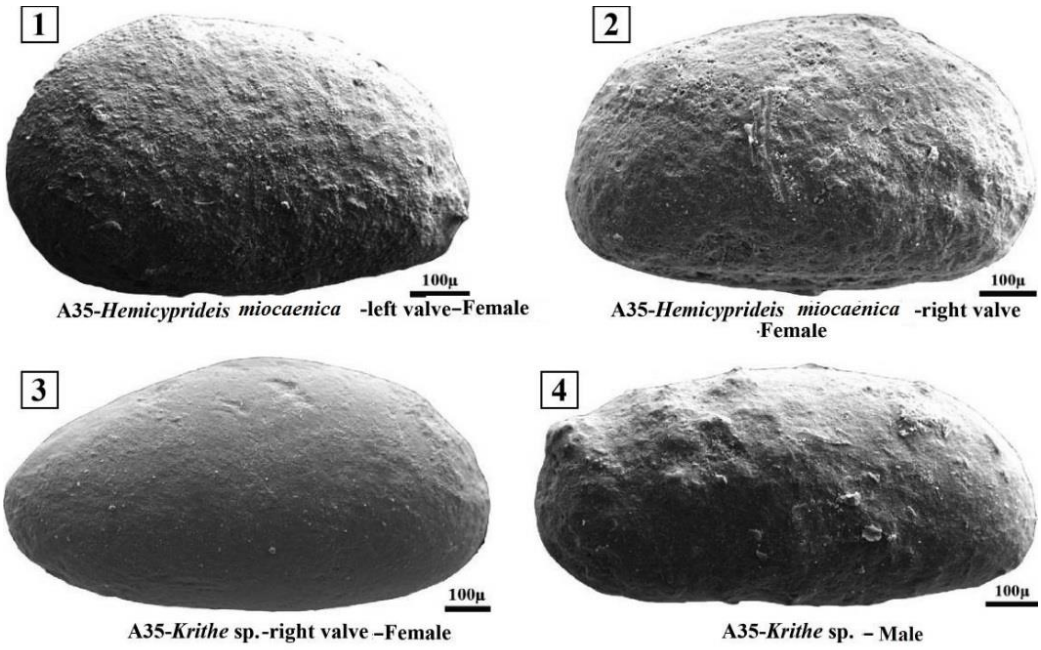
1
100µ
A35-*Hemicyprideis miocaenica* -left valve–Female
2
100µ
A35-*Hemicyprideis miocaenica* -right valve
·Female
3
100µ
A35-*Krithe* sp.-right valve –Female
4
100µ
A35-*Krithe* sp. – Male

Plate 5