GEOLOŠKI ANALI BALKANSKOGA POLUOSTRVA
Volume 80 (2), December 2019, 39–51
–
https://doi.org/10.2298/GABP1902039T
Original scientific paper
Оригинални научни рад

Bispiraloconulus serbicus Schlagintweit, Bucur & Sudar, 2019 (arborescent benthic foraminifer) and *Torremiroella hispanica* Brun & Canérot, 1979 from the Late Barremian of Kopet-Dagh Sedimentary Basin (NE Iran) and their palaeobiogeographic revisions

Morteza Taherpour-Khalil-Abad[1], Jafar Taheri[2], Mahmoud Reza Majidifard[3], Zinat Hassanzadeh[3] & Ivana Carević[4]

Abstract. During micropaleontological investigations on the Lower Cretaceous successions of the Tirgan Formation in Kopet-Dagh sedimentary basin, some new achievements are yielded. In this regards, the first occurrence of *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar in close association with *Torremiroella hispanica* Brun & Canérot is reported for the first time from the Upper Barremian of Kopet-Dagh sedimentary basin (NE Iran). The biostratigraphic investigations were carried out on a 197.5 m thick Gelian stratigraphic succession cropping out along the Tirgan Formation located 35 km southwest of Shirvan town. This study reviews the palaeogeographical distribution and age of *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar and *Torremiroella hispanica* Brun & Canérot along the northern Tethyan margins and extends its palaeobiogeographical existence.

Key words:
Benthic foraminifera, Early Cretaceous, Tirgan Formation, Kopet-Dagh, Iran.

Апстракт. Микропалеонтолошка истраживања доњокредне сукцесије формације Тирган у Копет-Даг седиментационом басену (СИ Иран) су пружила нове податке. С тим у вези, први пут је у седиментима горњег барема документован *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar у асоцијацији са *Torremiroella hispanica* Brun & Canérot. Биостратиграфска истраживања су обављена на стратиграфском профилу Gelian (Формација Тирган) укупне дебљине 197,5 m који је откривен 35 km југозападно од града Shirvan. У раду је дата ревизија палеогеографског распрострањења и старости фораминифера *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar и *Torremiroella hispanica* Brun & Canérot дуж северног обода Тетиса.

Кључне речи:
Бентоски фораминифери, доња креда, Формација Тирган, Копет-Даг басен, Иран.

[1] Young Researchers and Elite Club, Mashhad Branch, Islamic Azad University, Mashhad, Iran. E-mall: m_taherpour@mshdiau.ac.ir

[2] Geological Survey of Iran, NE territory, Mashhad, Iran.

[3] Institutes for Earth Sciences, Geological Survey of Iran, Tehran, Iran.

[4] University of Belgrade - Faculty of Geography, Studentski trg 3/3, 11000 Belgrade, Serbia.

Introduction

In Iran, the fundamental differences in the crustal character and age of basement consolidation allow three major structural units to be recognized, separated by ophiolite-bearing sutures (Stöcklin, 1968). Other criteria such as structural style, the age and intensity of deformation, and the age and nature of magmatism are used to subdivide these major zones into smaller elements. The three major units and their main constituents are as follows (Fig. 1):

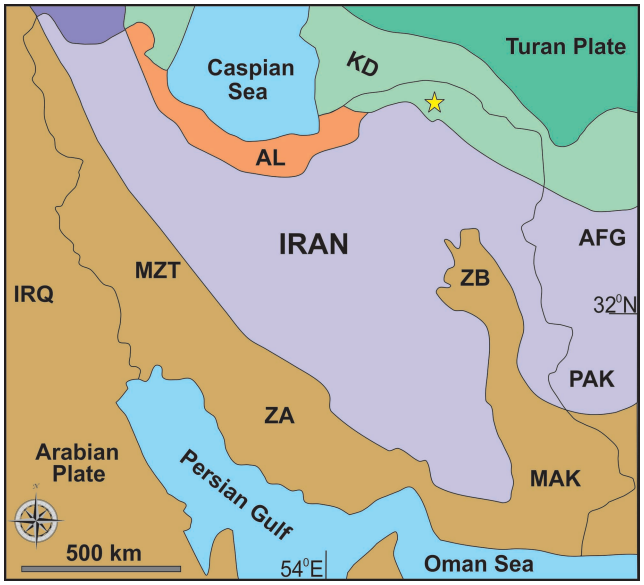

Fig. 1. *The subdivisions of structural zones of Iran (Abbreviations:* ***KD,*** *Kopet-Dagh;* ***Al,*** *Alborz;* ***MZT,*** *Main Zagros Thrust,* ***ZA,*** *Zagros;* ***MAK,*** *Makran;* ***ZB,*** *Zabol-Baluch). Studied area is marked by yellow star (After Poursoltani & Pe-Piper, 2015 with minor revision).*

1) The southern unit, with a crystalline basement consolidated in Precambrian time, platform-type Paleozoic sediments and younger deposits. This unit comprises the Zagros fold belt;

2) the central unit, interpreted as an assemblage of marginal Gondwana fragments, originally united with the main continent and separated from the North (Eurasian) continent during the Paleozoic.

In Mesozoic times, these fragments were detached from Gondwana and attached to Eurasia (Stöcklin, 1968). During the Late Cretaceous they rejoined the Gondwanic Afro-Arabia. This unit comprises Central Iran and the Alborz;

3) the northern unit, markedly separated from the central unit by ophiolites of the North Iran suture. The continental crust includes remnants of more or less cratonized, former (Paleozoic) oceanic crust possibly that of the Palaeotethys. The northern unit represents a marginal strip of the Hercynian realm of Central Asia, broadly overlapped by the Alpine realm. It was deformed and largely consolidated by strong Early Cimmerian and Late Alpine folding (Stöcklin, 1968). The Northern unit comprises the South Caspian Depression and the Kopet-Dagh Range.

This study aims at presenting new results of biostratigraphic investigations of the Lower Cretaceous Tirgan Formation in the Kopet-Dagh (NE Iran). Data obtained from the Gelian stratigraphic succession has revealed new information on the age dating and palaeogeographical distribution of *Bispiraloconulus serbicus* Schlagintweit et al. (2019) and *Torremiroella hispanica* Brun & Canérot (1979).

A brief comparison of Cretaceous deposits in different parts of Iran

The most complete Cretaceous sections in North Iran are found in the Kopet-Dagh range on the border of Iran and Turkmenistan. The rocks consist of marine shales, marls, limestones and sandstones. The sequence reaches a thickness of more than 3000 m and seems to represent all major parts of the Lower Cretaceous strata (Afshar-Harb, 1994). In the Alborz mountains and farther south, Cretaceous limestones and marls are widely distributed but the sections are less complete. Elsewhere, unfossiliferous red clastic basal beds, which in the Ravar-Darband area, northern Kerman province, contain considerable amounts of gypsum, frequently initiate the Cretaceous sequence and are followed by limestones and marls of different ages. The oldest marine beds are *Orbitolina*-bearing limestones (the Tiz-Kuh Formation of the Alborz, "*Orbitolina* limestone" in general), which are conventionally regarded as Aptian-Albian but may include stages as old as Barremian and as young as Cenomanian. An unusual shale facies reaching great thickness and containing very rare cephalopods represents the

Barremian-Albian in the Biabanak area of Central Iran (Stöcklin & Setudehnia, 1991). With the exception of the Kopet-Dagh area mentioned above, detailed stratigraphic studies of the Upper Cretaceous deposits have been carried out only in a few limited areas such as the central Alborz, Tehran, Jandaq, Esfahan and Kerman areas. Detrital limestones, reef limestones, marls and shales prevail. However, the marine sequences are frequently interrupted by conglomerates, red beds, sedimentary gaps and unconformities and the sections vary in detail over short distances, reflecting the unstable conditions of the sedimentary environment during the initial phases of the Alpine orogeny. Considerable disagreement among different interpretations regarding stratigraphic importance of the fauna has so far made unreliable regional correlation and that is why the consistent stratigraphic subdivision of the Upper Cretaceous strata needs to be established. The Stratigraphic Terminological Committee (STC) of Iran has recommended not introducing any formal stratigraphic names for the Upper Cretaceous strata of Alborz and central and eastern Iran until more regional information becomes available to clarify the situation, in compliance with this recommendation (Stöcklin & Setudehnia, 1991).

Previous studies

The first report of *Torremiroella hispanica* is carried out by Brun & Canérot (1979) from the upper Barremian of Spain. After years two reports by Schlagintweit et al. (2013) from the upper Barremian-early Aptian of Central Iran and by Bucur et al. (2018) from the upper Barremian-(?) early Aptian of Kopet-Dagh sedimentary basins. But the first and only record from *Bispiraloconulus serbicus* is carried out by Schlagintweit et al. (2019) from Berriasian of Serbia (Table 1).

Geological setting

In Iran, Lower Cretaceous shallow-water sediments occur in different main structural zones: Kopet-Dagh (NE Iran), Zagros (SW Iran), Central Iran (Center and SE) and Alborz (N and part of NW). The Kopet-Dagh (or KoppehDagh, Kopeh-Dagh) mountain range represents a NE-trending, about 650 km long and about 200 km wide, active fold belt at the border between Iran and Turkmenistan, east of the Caspian Sea. This sedimentary basin is located in the northeast of Iran and south of Turkmenistan as an intracontinental basin. It was formed on Hercynian metamorphosed basement at the SW margin of the Turan Platform and is composed of about 10 km of mostly conformably Mesozoic and Tertiary sediments (mostly carbonates) (Taherpour-Khalil-Abad et al. 2013). These sediments were deposited in a marginal sea of the northern Tethys Ocean, one of the so-called Peri-Tethyan basins that became closed with the suturing of northeast Iran to the Eurasian Turan platform resulting from the convergence between the Arabian and Eurasian plates (Taherpour-Khalil-Abad et al., 2013, 2017).

This tectono-sedimentary basin has been formed after post collision extensional period with a high amount of terrigenous sediments influx to the basin in a relatively short time span, known as Kashafrud Formation (late Bajocian – late Bathonian; Taheri, 2009). In this point of view, a new cycle of sedimentation has been started from the late Bajocian and more or less continued until the Pliocene. The main non-marine sedimentation phase, especially in eastern Kopet-Dagh occurred in the late Jurassic to early Cretaceous (Shurijeh Formation) composed of reddish sandstone and conglomerate in relation to the late Cimmerian movements.

The study area is located in the Northern Khorasan province (SW of Shirvan city), Northeast Iran

Table 1. The occurrence and report of *Torremiroella hispanica* and *Bispiraloconulus serbiacus* from other localities.

	Spain	**Serbia**	**Iran**	**Recent study**
Torremiroella hispanica	late Barremian	–	late Barremian–early Aptian (CI) late Barremian–early Aptian (KD)	late Barremian–early Aptian
Bispiraloconulus serbicus	–	Berriasian	–	late Barremian

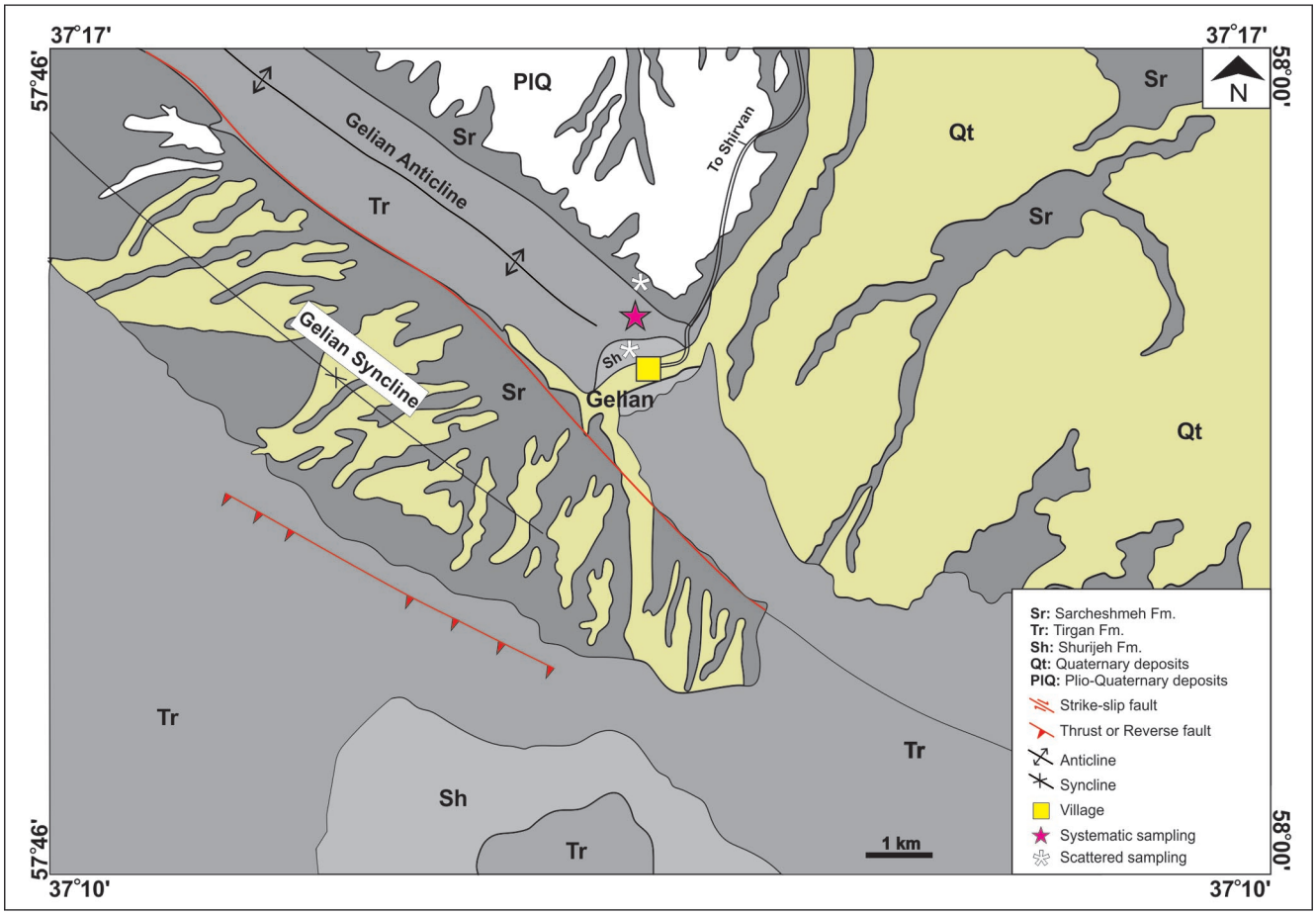

Fig. 2. *Location of the Lower Cretaceous stratigraphic section studied in Gelian village, Kopet-Dagh sedimentary basin, NE Iran.*

(Fig. 2). The locality can be reached by taking the road from Mashhad city to Shirvan city. After 25 km from Shirvan city, it is accessible in the left side of the road near the Gelian village (N 37°15′07′′, E 57°54′59′′). The studied samples are from the Lower Cretaceous Sarcheshmeh Formation referring to the Sarcheshmeh village in the western part of the Kopet-Dagh (NE Iran).

A sequence of grey marls and pencil-shales with subordinated *Orbitolina*-bearing limestone intercalations, conformably overlie the Tirgan Formation throughout the Kopet-Dagh Ranges. The Sarcheshmeh Formation is everywhere overlain by the Sanganeh Formation. The contact is marked by a persistent key bed of coquina limestone that contains Upper Aptian ammonites considered as top of the Sarcheshmeh. The thickness increases from some 100m in the southeasternmost Kopet-Dagh to more than 500m in the central Kopet-Dagh. Ammonites and rich microfauna indicate Aptian age (Stöcklin & Setudehnia, 1991).

The Sarcheshmeh Formation in the studied stratigraphic section is mainly composed of marl, shale, marly limestone and limestone. These strata are rich in benthic foraminifera as well as calcareous algae, bryozoans, bivalves and echinoids. The echinoid levels in the studied stratigraphic section are rich in echinoids.

The studied samples are taken and studied from the Lower Cretaceous Tirgan Formation referring to the Tirgan Valley in the eastern central Kopet-Dagh (NE Iran). The name of the Tirgan Formation, introduced by Afshar-Harb (1969), applies to a lithostratigraphic unit of bedded, partly oolitic and organo-detrital limestones occurring throughout the Kopet-Dagh mountain range. The reference section is located near the village of Jowzak, about 55 km west of Bojnourd. Due to their erosional resistance, the

limestones of the Tirgan Formation make up the mountain peaks in the Kopet-Dagh whereas the marls and sandstones form the valleys. For the eastern part of Kopet-Dagh, Afshar-Harb (1969) indicated a thickness of 50 m and less for the Tirgan Formation, but in the type area, the thickness is about 700 m. The Tirgan Formation conformably overlies the Shurijeh Formation, siliciclastic sediments that were deposited in fluvial-terrestrial depositional settings (Moussavi-Harami & Brenner, 1992; Moussavi-Harami et al., 2009), and underlies the Sarcheshmeh Formation. The lithology of the Tirgan Formation includes oolitic, partly fossiliferous (e.g., orbitolinid limestones), partly marly limestones, and marls allowing further differentiation of the formation. The Lower Cretaceous formations of the Iranian part of the Kopet-Dagh, including the Tirgan Formation, were described in detail by Afshar-Harb (1994).

The study area is located in the Northern Khorasan province, NE Iran, an area where several outcrops of the Cretaceous Shurijeh, Tirgan, and Sarcheshmeh formations are present. The locality from which the samples containing *Torremiroella hispanica* Brun & Canérot and *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar were collected is named ''Gelian stratigraphic section'' (Fig. 3), located about 35 km southwest of Shirvan. At the Gelian stratigraphic section, the Tirgan Formation is about 197.5 m thick and is exposed with both the under- and overlying formations. The stratigraphic setting of the Gelian stratigraphic section and its impact on the lithostratigraphic subdivision of the Kopet-Dagh in NE Iran is discussed later in this paper.

Materials and methods

The material comprises 237 specimens from which the prepared thin-sections have been determined systhematically. All of the studied rock samples which were collected by the authors as well as the related thin sections are housed in the repository system of the Geological Survey of Iran and Geosciences Research Center, NE Territory, Geoscience Museum (GSINET, Zinat Hasanzadeh collection).

Systematic paleontology

Class: Foraminiferea d'Orbigny, 1826
Order: Loftusiida Kaminski & Mikhalevich, 2004 (in Kaminski, 2004)
Suborder: Loftusiina Kaminski & Mikhalevich, 2004 (in Kaminski, 2004)
Superfamily: Loftusiacea Brady, 1884
Family: ?Choffatellidae Maync, 1958
Subfamily: Pseudochoffatellinae Loeblich & Tappan, 1985
Genus: *Torremiroella* Brun & Canérot, 1979

Torremiroella hispanica Brun & Canérot, 1979

Pl. 1, figs. a-b, d, e, g-h, j-k; Pl. 2, figs. h, j, k-m

1979 *Torremiroella hispanica* nov. gen., n. sp.; Brun & Canérot, 311–335, 6 pls.
2013 *Torremiroella hispanica* Brun & Canérot; Schlagintweit et al., 272–279, 2pls.
2018 *Torremiroella hispanica* Brun & Canérot; Bucur et al., 13–33, 11 pls.

Description: According to Mikhalevich (2004, p. 257): "*Test is elongated, with early planispiral part followed by uncoiled rectilinear one, wall with imperforate epidermis and very coarse, large irregular projections from the septa can partially fill the chamber and questionably could be considered as endoskeletal structures, aperture terminal, irregularly cribrate in the uncoiled part, unclear in the earlier planispiral one*" (Fig. 4).

Remarks: According to Mikhalevich (2004, p. 257): "*The presence of strange endoskeleton (neither pillar nor other structural elements) possibly makes this genus the intermediate between Pseudochoffatelidae and Spirocyclinidae. The coarse wall obviously obscures the position of initially areal aperture of the planispiral stage if it is disposed close to the base*." According to Schlagintweit et al., (2013) irregular aberrant tests in *Torremiroella* is reported in *Robustoconus*, *Bostiairregularis* and *Anchispirocyclina* . After Bucur et al. (2018), it is the second report from the Kopet-Dagh sedimentary basin in northeastern part of Iran. For more information on the measured dimensions and parameters see Table 2.

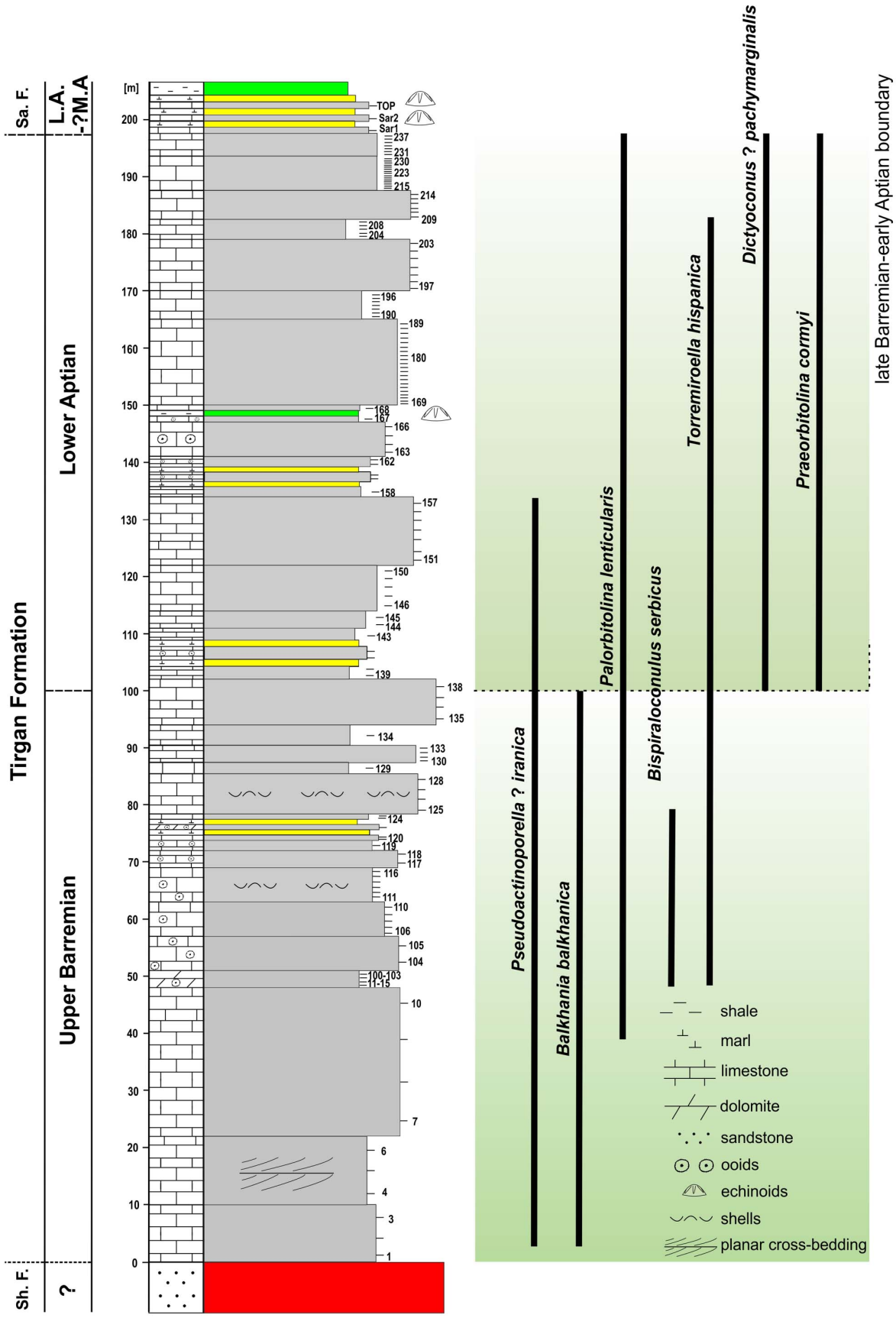

Fig. 3. *Stratigraphic column of the Tirgan Formation in the Gelian stratigraphic section.*

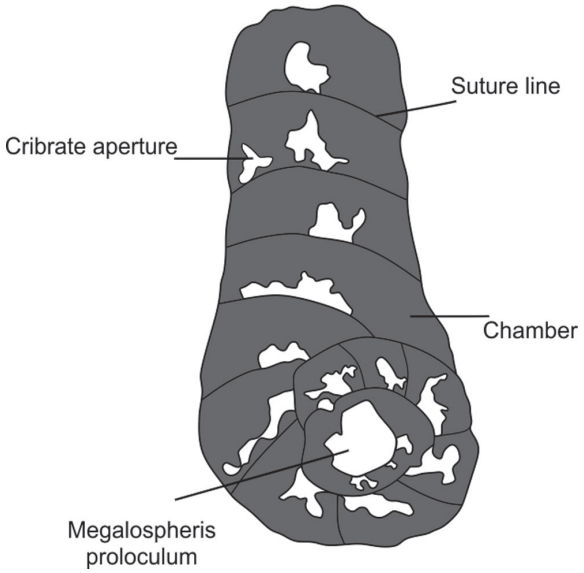

Fig. 4. *A schematic image of Torremiroella hispanica Brun & Canérot (1979). The redrawn image is done from the type-species introduced by Brun & Canérot (1979).*

Glomospira sp. cf. *G. watersi*, *Iraqia simplex*, *Istriloculina* sp., *Lenticulina* sp., *Mayncina bulgarica*, *Mayncina* sp., Miliolids, *Melathrokerion valserinensis*, *Nautiloculina bronimanii*, *Nautiloculina* sp., *Novalesia* sp., *Orbitolina* sp., *Orbitolinopsis* sp., *Palorbitolina lenticularis*, *Praechrysalidnia infracretacea*, *Praeorbitolina cormyi*, *Rumanoloculina* sp., *Scythiolina* sp., *Torinosuella penereopliformis*, *Triloculina* sp., *Vercorsella* sp. cf. *V. arenata*, *Vercorsella* sp. And calcareous algae such as *Acicularia* sp., *Actinoporella podolica, Arabicodium* sp., *Bakalovaella elitzae*, *Boueina* sp. cf. *B. pygmaea*, *Boueina houchesttetri, Boueina minima*, *Boueina moncharmonti*, *Boueina* sp., *Cayeuxia* sp., *Clypeina solkani*, *Clypeina* sp. aff. *C. sulcata*, *Clypeina* sp., *Coptocampylodon* sp., *Deloffrella quercifoliipora*, *Iranella inopinata*, *Juraella bifurcate*, *Kopetdagaria sphaerica*, *Marinella lugeoni*, *Permocalculus innopinatus*, *Permocalculus minutus*, *Permocalculus* sp., *Pseudoactinoporella*? *iranica*, *Rajkaella* sp., *Russoella* sp., *Salpingoporella muehlbergii*, *Salpingoporella* sp. cf. *G. watersi*, *Iraqia simplex*, *Istriloculina* sp., *Lenticulina* sp., *Mayncina bulgarica*, *Mayncina* sp., Miliolids, *Melathrokerion valserinensis*, *Nautiloculina bronimanii*, *Nautiloculina* sp., *Novalesia* sp., *Orbitolina* sp., *Orbitolinopsis* sp., *Palorbitolina lenticularis*, *Praechrysalidnia infracretacea*, *Praeorbitolina cormyi*, *Rumanoloculina* sp., *Scythiolina* sp., *Torinosuella penereopliformis*, *Triloculina* sp., *Vercorsella* sp. cf. *V. arenata*, *Vercorsella* sp. And calcareous algae such as *Acicularia* sp., *Actinoporella podolica, Arabicodium* sp., *Bakalovaella elitzae*, *Boueina* sp. cf. *B. pygmaea*, *Boueina houchesttetri, Boueina minima*, *Boueina moncharmonti*, *Boueina* sp., *Cayeuxia* sp., *Clypeina solkani*, *Clypeina* sp. aff. *C. sulcata*, *Clypeina* sp., *Coptocampylodon* sp., *Deloffrella quercifoliipora*, *Iranella inopinata*, *Juraella bifurcate*, *Kopetdagaria sphaerica*, *Marinella lugeoni*, *Permocalculus innopinatus*, *Permocalculus minutus*, *Permocalculus* sp., *Pseudoactinoporella*? *iranica*, *Rajkaella* sp., *Russoella* sp., *Salpingoporella muehlbergii*, *Salpingoporella* sp., *Suppiluliumaella* sp. and *Trequemella* sp.

Table 2. Dimensions (in mm) of *Torremiroella hiapanica* Brun & Canérot from Central Iran and Kopet-Dagh sedimentary basins compared with the Spanish type specimens.

	Brun & Canérot (1979)	Schlagintweit et al. (2013)	Recent study
Equatorial diameter of test (coiled part)	**0.4–1.0 (mean ~ 0.7)**	**0.49–1.0**	**0.5–0.7**
Axial diameter of test	0.2–0.7 (mean ~ 0.45)	0.4–1.5	0.23–2.0
Diameter embryo	0.2–0.225	0.18–0.36	0.17–0.26
Maximum test height	2.1	5.9	4.27
Max. number of chamber enrolled part	10	?	?

Geographical distribution: Spain (Torre Miro area), Iran (Central Iran and Kopet-Dagh sedimentary basins) (Table 1 & Fig. 5).

Sample numbers: Tr.11, Tr.102, Tr.112, Tr.113, Tr.123, Tr.124, Tr.164, Tr.207, Tr.209a.

Age: late Barremian of Spain (Brun & Canérot, 1979), late Barremian–early Aptian of Central Iran (Schlagintweit et al., 2013) and late Barremian – (?) early Aptian of Kopet-Dagh (Brun & Canérot, 1979) (also recent study) sedimentary basins of Iran.

Associated fauna and flora: Incorporated bioclasts include mainly benthic foraminifera such as *Balkhania balkhanica*, *Bispiraloconulus serbicus*, *Charentia cuvillieri*, *Dictyoconus*? *pachymarginalis*,

The most important Orbitolinid taxa are shown in Plate 4.

Class: Tubothalamea Pawlowski et al., 2013
Order: Loftusiida Kaminski & Mikhalevich, 2004
Suborder: Orbitolinina Kaminski, 2004
Superfamily: Pfenderinoidea Smout & Sugden, 1962
Family: Hauraniidae Septfontaine, 1988 emended
Subfamily: Amijellinae Septfontaine, 1988 emended
Genus: *Bispiraloconulus* Schlagintweit, Bucur & Sudar, 2019

Fig. 5. Geographic occurrences of the benthic foraminifer Bispiraloconulus serbicus Schlagintweit *et al. (2019) and Torremiroella hispanica* Brun & Canérot *(1979) (source: free maps of GinkgoMaps.com).*

northeastern Iran. Previously, Schlagintweit et al. (2019) reported the holotype of this fauna from the Berriasian of Serbia. This could be the second record of this species which can widen the known paleobiogeographic distribution of this form in the northern Tethyan Realm. For more information on the measured dimensions and parameters see Table 3.

Geographical distribution: Serbia (eastern Serbia; Schlagintweit et al., 2019), Iran (Kopet-Dagh sedimentary basin "recent study") (Table 1 & Fig. 5).

Bispiraloconulus serbicus Schlagintweit, Bucur & Sudar, 2019

Pl. 1, fig. i; Pl. 2, figs. a-f; Pl. 3, figs. a-d

2019 *Bispiraloconulus serbicus* gen. et sp. nov.; Schlagintweit, Bucur & Sudar, 98–106, 4pls.

Description: According to Schlagintweit et al. (2019): "*Test large, centimeter-sized, with arborescent morphology. The initial part consists of a small spire of about three chambers, the first one slightly eccentric positioned, later chambers rectilinear, uniserial arranged. Test most likely differentiated into an elongate to bent main stem without side branches from which lateral branches arise in the adult part. The branches are located in different planes. The angle of branching ranges from about 50° to 90°.Transverse sections are roughly circular. The septa are thin (th ickness: 0.03–0.06 mm), microgranular-micritic and convex in test growth direction. They are pierced by multiple tiny foramina distributed along the entire surface. The diameter of the foramina corresponds to the thickness of the septa. Peloids, ooids (up to 0.55 mm in diameter) and other bioclasts are attached to the septa by means of columnar micritic elements or excrescences*" (Fig. 6).

Remarks: This is the first report of *Bispiraloconulus serbicus* (Schlagintweit et al., 2019) from the upper Barremian of the Kopet-Dagh sedimentary basin in

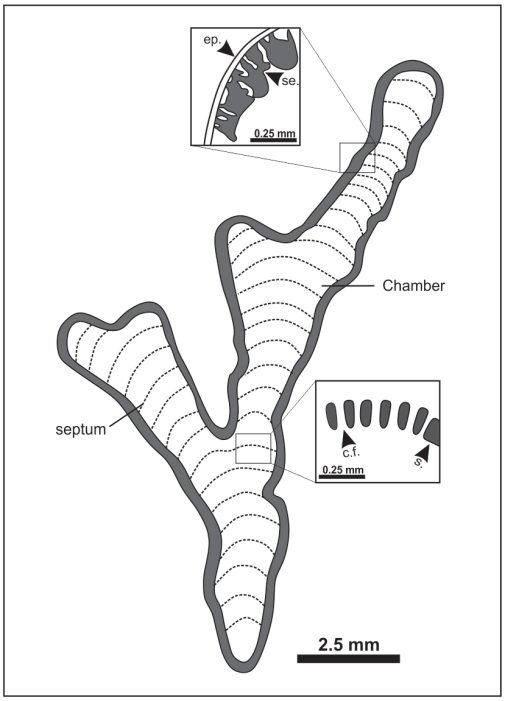

Fig. 6. A schematic image of Bispiraloconulus serbicus Schlagintweit *et al. (2019). The redrawn image is done from the type-species introduced by* Schlagintweit *et al. (2019). Abbreviations:* ***ep.****: epiderm network,* ***se.****: subepidermal network,* ***c.f.****: septa,* ***s.****: cribrate foramina.*

Sample numbers: Tr.13a, Tr.15, Tr.103, Tr.112, Tr.123, Tr.125.

Table 3. Dimensions (in mm) of *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar from Kopet-Dagh sedimentary basin compared with the Serbian type specimens.

	Schlagintweit et al. (2019)	Recent study
Height	20	12
Maximum width	13	6
Height of the chamber	0.6–1.0	0.76–0.97
Maximum test height	2.1	3.4

Age: Berriasian of Serbia (Schlagintweit et al., 2019), late Barremian of Kopet-Dagh sedimentary basin of Iran.

Associated fauna and flora: Incorporated bioclasts include mainly benthic foraminifera such as *Balkhania balkhanica*, *Charentia cuvillieri*, *Debarina hahounerensis*, *Dictyoconus* sp., *Haplophragmoides* sp. cf. *H. jokowski*, *Istriloculina* sp., *Lenticulina* sp., *Mayncina bulgarica*, *Nautiloculina oolithica*, *Melathrokerion valserinensis*, *Nezzazata isabellae*, *Novalesia* sp. cf. *N. product*, *Orbitolina* sp., *Orbitolinopsis* sp., *Paleodictyoconus* sp., *Palorbitolina lenticularis*, *Praechrysalidnia infracretacea*, *Rumanoloculina* sp., *Sycthiolina* sp., *Torremiroella hispanica*, *Vercorsella* sp. cf. *V.arenata* and some calcareous algae such as *Acicularia* sp., *Actinoporella podolica*, *Arabicodium* sp., *Bakalovaella elitzae, Boueina* sp. cf. *B. pygmaea*, *Boueina houchesttetri*, *Boueina minima*, *Boueina moncharmonti*, *Boueina* sp., *Cayeuxia* sp., *Clypeina solkani*, *Clypeina* sp., *Coptocampylodon* sp., *Deloffrella quercifoliipora, Iranella inopinata*, *Juraella bifurcate, Kopetdagaria sphaerica*, *Neomeris cretacea*, *Permocalculus minutus*, *Permocalculus* sp., *Pseudoactinoporella*? *iranica*, *Russoella* sp., *Salpingoporella muehlbergii*, *Salpingoporella* sp., *Salpingoporella* sp., *Suppiluliumaella* sp. and *Trequemella* sp.

The most important Orbitolinid taxa are shown in Plate 4.

Results and Discussion

Micropaleontological investigations are carried out on the Tirgan Formation rock samples in the Gelian stratigraphic section. During these researches, huge amount of biocontents (i.e., benthic foraminifera and calcareous algae) are found and described in details (which are published by the first author). In the meantime, these fauna and flora are highly diversified within these succissions. By this research, the giant agglutinating benthic foraminifera *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar and *Torremiroella hispanica* Brun & Canérot are reporting from the upper Barremian and the upper Barremian-early Aptian respectively in inner platform carbonates of Northeastern Iran. This is a revision of the age dating of *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar, who originally reported (Schlagintweit et al., 2019) the species from the Berriasian of Serbia. It extends the age of this fauna from Berriasian to upper Barremian time span.

Acknowledgement

We would like to present our warm thanks to anonymous reviewers for their valuable comments. The authors would also like to thank the Geological Survey of Iran, NE territory (GSINET) for field work equipments and logistics.

References

Afshar-Harb, A. 1969. History of oil exploration and brief description of the geology of the Sarakhs area and the anticline of Khangiran. *Bulletin Iranian Petroleum Industry*, 37: 86–94.

Afshar-Harb, A. 1994. *Geology of Kopet Dagh (In Treatise on the geology of Iran)*. Geological Survey of Iran Press, 275 pp.

Brun, L. & Canérot, J. 1979. *Torremiroella hispanica* n. gen. n. sp. un nouveau Lituolidé (Foraminifère) du Barrémien supérieur du Maestrazgo (Espagne). *Bulletin du Centre de recherches Elf Exploration*, 3: 311–335.

Bucur, I.I, Yarahmadzahi, H. & Mircescu, C.V. 2018. The Lower Cretaceous Tirgan Formationn in the Gelian section (Kopet Dagh, North Iran): microfacies, microfossils and their biostratigraphic significance. *Acta Palaeontologica Romania*, 15 (1): 13–33.

Mikhalevich, V. 2004. On the new understanding of the Lituolida Lankester, 1885 (foraminifera). *Acta Palaeontologica Romania*, 4: 247–267.

Moussavi-Harami, R. & Brenner, R.L. 1992. Geohistory analysis and petroleum reservoir characteristics of Lower Cretaceous (Neocomian) sandstones, eastern Kopet-Dagh Basin, northeastern Iran. *American Association of Petroleum Geologists*, 76: 1200–1208.

Moussavi-Harami, R., Mahboubi, A., Najafi, M., Brenner, R.L. & Mortazavi, M. 2009. Mechanism of calcrete formation in the Lower Cretaceous (Neocomian) fluvial deposits, northeastern Iran based on petrographic, geochemical data. *Cretaceous Research*, 30: 1146–1156.

Poursoltani, M.R. & Pe-Piper G. 2015. Source and diagenesis of Middle Jurassic marine mudstones, Kopet-Dagh Basin, NE Iran. *Geopersia*, 5 (2): 93–109.

Schlagintweit, F., Bucur, I.I. & Sudar, M.N. 2019. *Bispiraloconulus serbicus* gen. et sp. nov., a giant arborescent benthic foraminifer from the Berriasian of Serbia. *Cretaceous Research*, 93: 98–106.

Schlagintweit, F., Bucur, I.I., Rashidi, K., Hanifzadeh, R. & Wilmsen, M. 2013. *Torremiroella hispanica* Brun and Canérot, 1979 (benthic foraminifera) from the Lower Cretaceous of Central Iran and its palaeobiogeographic significance. *Cretaceous Research*, 46: 272–279.

Schlagintweit, F., Velić, I. & Sokač, B. 2013. *Robustoconus tisljari* n. gen., n. sp., a new larger benthic foraminifer from the Middle Jurassic (Early Bajocian) of the Adriatic Carbonate Platform of Croatia. *Geologia Croatica*, 66 (1): 15–28.

Stöcklin, J. 1968. Structural history and tectonics of Iran: a review. *American Association of Petroleum Geologists,* 52: 1229–1258.

Stöcklin, J. & Setudehnia, A. 1991. *Stratigraphic lexicon of Iran (Report No.18)*. Geological Survey of Iran Press, 376 pp.

Taheri, J. 2009. *Stratigraphy, ichnology and sedimentary environments of the Late Bajocian-Late Bathonian Kashafrud Formation, Northeastern Iran*. Unpubl. PhD Thesis, University of Würzburg, 258 pp.

Taherpour Khalil Abad, M., Schlagintweit, F., Vaziri, S.H., Aryaei, A.A. & Ashouri, A.R. 2013. *Balkhania balkhanica* Mamontova, 1966 (benthic foraminifera) and *Kopetdagaria sphaerica* Maslov, 1960 (dasycladalean alga) from the Lower Cretaceous Tirgan Formation of the Kopet Dagh mountain range (NE Iran) and their paleobiogeographic significance. *Facies*, 59 (1): 267–285.

Taherpour Khalil Abad, M. 2017. *Salpingoporella* (dasycladalean algae) species from the Lower Cretaceous carbonate facies of Kopet Dagh basin (NE Iran). *Arabian Journal of Geosciences*, 10 (2): 31.

Резиме

Bispiraloconulus serbicus Schlagintweit, Bucur & Sudar, 2019 (арборесцентни бентоски фораминифер) и *Torremiroella hispanica* Brun & Canérot, 1979 из горњобаремског седиментног басена Копет-Даг (СИ Иран) и њихове палеобиогеографске ревизије

Најкомплетнија сукцесија доњокредних седимената у северном Ирану је откривена у Копет-Даг басену дуж границе Ирана и Туркменистана. Изграђена је од глинаца, лапораца, кречњака и пешчара. У овом раду је приказан први налаз крупних бентоских фораминифера *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar и *Torremiroella hispanica* Brun & Canérot из горњобаремских и горњобаремско-доњоаптских седимената североисточног Ирана.

На стратиграфском профилу Gelian (Формација Тирган), који се налази 35 km југозападно од града Shirvan (координате: N 37°15′07′′, E 57°54′59′′), из сукцесије укупне дебљине 197,5 m је узорковано укупно 237 узорака у којима је утврђена богата асоцијација бентоских фораминифера и кречњачких алги.

Бентоски фораминифер *Torremiroella hispanica* је први пут описан од стране Brun & Canérot (1979) у седименатима горњег барема Шпаније. Након више година, документован је у горњобаремско-доњоаптским седиментима централног Ирана (Schlagintweit et al. 2013) и Копет-Даг седиментационог басена (Bucur et al. 2018).

Крупни аглутинантни фораминифер *Bispiraloconulus serbicus* је први пут пронађен и описан у седиментима беријаса Србије (Schlagintweit et al. 2019). У раду је дата ревизија старости *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar документованог у горњобаремским седиментима Копет-Даг басена (СИ Иран). На овај начин је старост ревидирана у распону беријас-горњи барем.

Manuscript received October 14, 2019
Revised manuscript accepted December 09, 2019

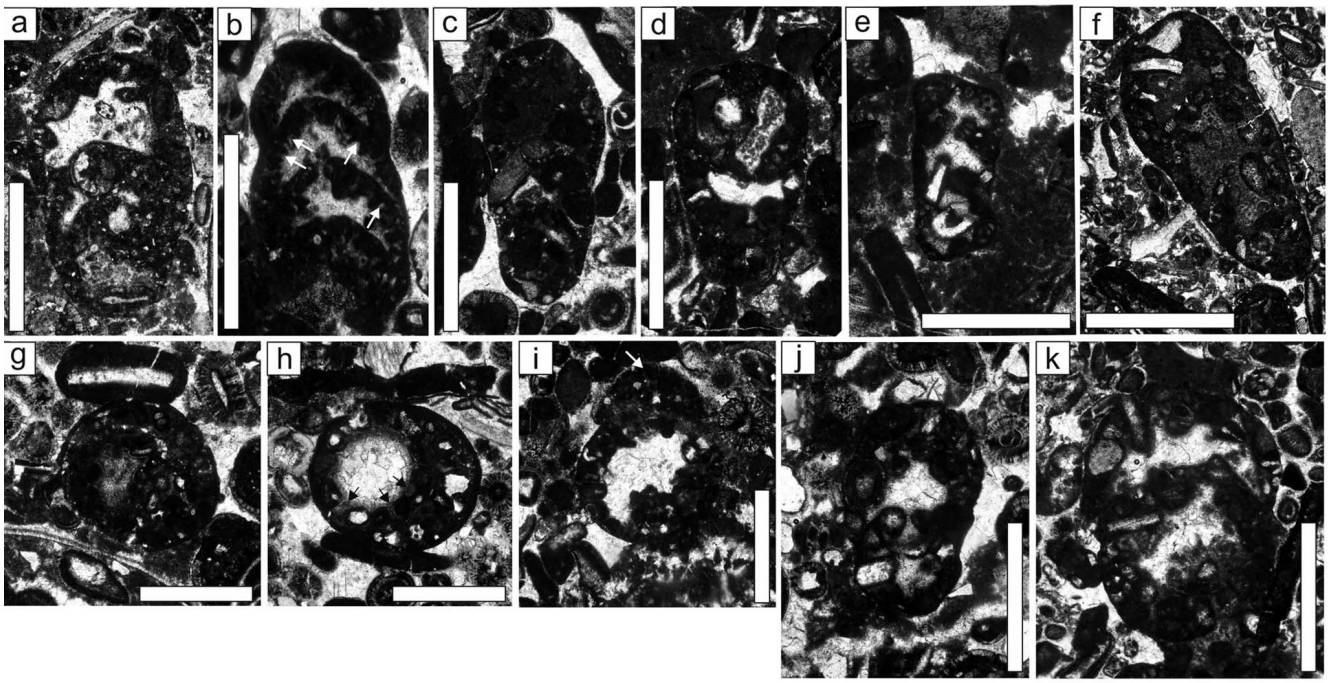

Plate 1. a–b, d, e, g–h, j–k: *Torremiroella hispanica* Brun & Canérot, **c, e, f:** ?*Reophax* sp., **i:** *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar. **a, e.** Juvenile specimens, **b, f, j, k.** Oblique section, **i.** Transverse section, white arrows displaying subepidermal network, **c, d.** Oblique section, **g.** Transverse section, **h.** Oblique transverse section, thin microcrystalline membrane enveloping the protoconch (black arrows). Scale bars: a-d, k. 2 mm, e, g-h, j. 1 mm, f. 2.5 mm, i. 1.5 mm. Thin section number in repository system: a. Tr.11, b. Tr.209a, c. Tr.112, d. Tr.113, e. Tr.113, f. Tr.125, g. Tr.102, h. Tr.102, i. Tr.103, j. Tr.102, k. Tr.123.

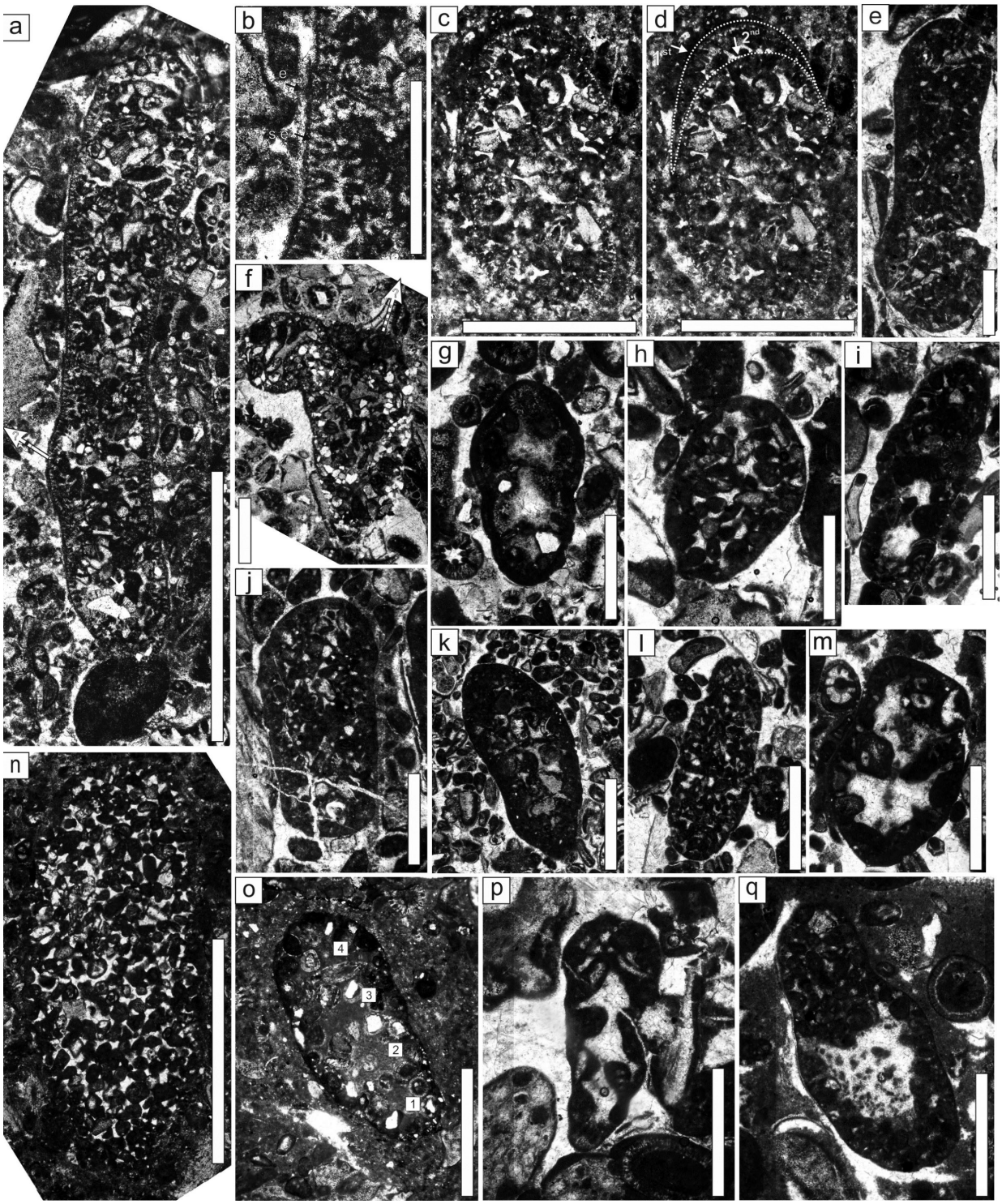

Plate 2. A–f: *Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar, **g, i, p:** ?*Reophax* sp., **h, j, k-m:** *Torremiroella hispanica* Brun & Canérot, **a.** Longitudinal section (in **a** and **f** the probable side branch cutting place is shown by arrow), **b.** Magnified view of the wall with epiderm (e) and subepidermal (se) are shown by black arrows, **c, d.** Oblique section with two chamber, the 1st and 2nd whorls are shown by white arrows, **e.** Longitudinal section, **f.** Oblique section of a fragment showing branching which possibly branch has been broken, **h, j, i, n, q.** Oblique sections, **m, p.** Juvenile specimens, **o.** Oblique section with four chamber, **g, k.** Oblique section. Scale bars: a, n. 3 mm, b. 0.5 mm, c-d, i, k-l, o. 2 mm, e-f. 0.8 mm, g, q. 1.5 mm, h, j, m, p. 1 mm. Thin section number in repository system: a, b. Tr.125, c, d. Tr.13a, e. Tr.112, f. Tr.15, g. Tr.102, h. Tr.112, i. Tr.209a, j. Tr.112, k. Tr.124, l. Tr.164, m. Tr.207, n. Tr.133a, o. Tr.115, p. Tr.203, q. Tr.205.

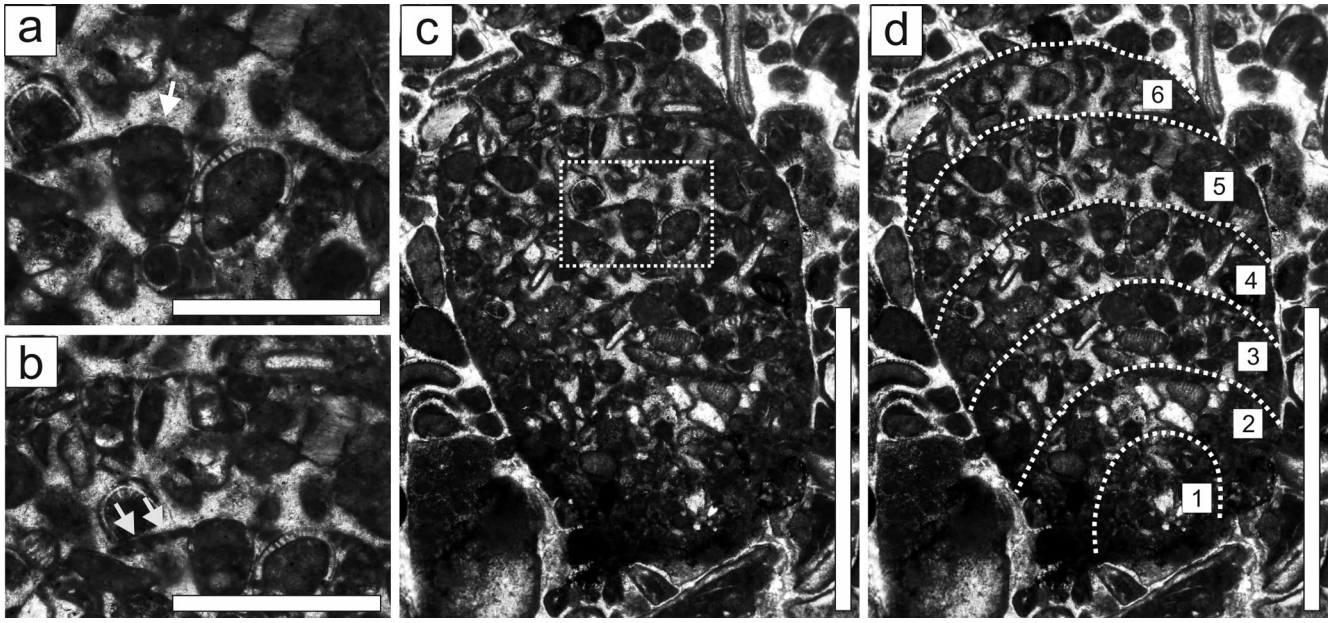

Plate 3. a–d: ?*Bispiraloconulus serbicus* Schlagintweit, Bucur & Sudar, **a–b:** focused on the wall of the taxa (the focused part is shown by a rectangle in fig. **c**, in fig. **a** the indet. benthic foraminifera is located in the wall thickness (shown by arrow) and in fig. **b** the shape and location of apertures are shown by arrows. In fig. **d** the whorls are shown and numbered. Scale bars: a-b. 0.5 mm, c-d. 2.5 mm. Thin section number in repository system: Tr.123.

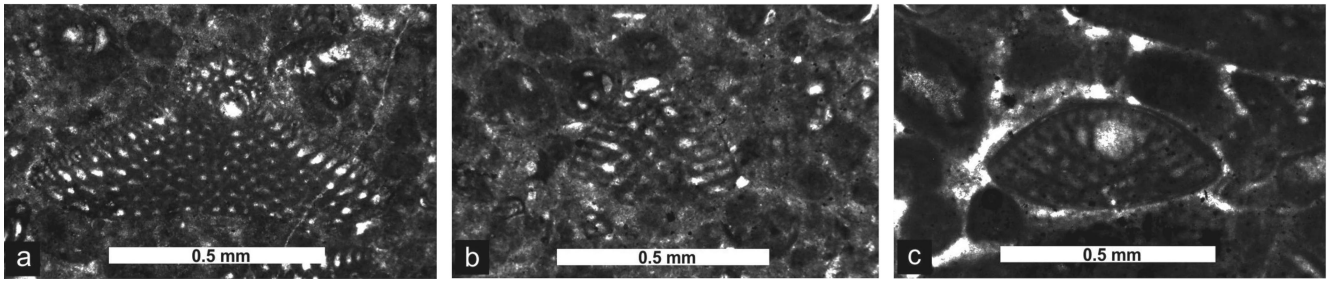

Plate 4. a: *Praeorbitolina cormyi* Schröeder (thin section Tr.195), **b:** *Dictyoconus*? *pachymarginalis* Schröeder (thin section Tr.139), **c:** *Palorbitolina lenticularis* Blumenbach (thin section Tr.139) index taxa in late Barremian and early Aptian Limestone of the Tirgan Formation, Kopet-Dagh sedimentary basin, NE Iran.