



- Troizkaya, T.D., 1975–Main features of the development of bryozoans in Central Kazakhstan at the boundary between the Devonian and the Carboniferous. – *Paleontological Journal* 9: 323-339.
- Troizkaya, T.D., 1979–Bryozoans of the meistorovi horizon of central Kazakhstan. – *Paleontological Journal* 12: 415-423.16
- Weddige, K., 1984–Externally controlled Late Paleozoic Events of the Iran Plate. – *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen* 168:278-286.
- Wendt, J., Kaufmann, B., Belka, Z., Farsan, N. & Bavandpur, A.K., 2005–Devonian/Lower carboniferous stratigraphy, facies patterns and palaeogeography of Iran. Part Q. North and central Iran. – *Acta Geologica Polonica* 55 (1): 31-97.

References

- Aghanabati, M., 2004–Geology of Iran. – Geological Survey of Iran: 586 p. [in Farsi].
- Alavi, M., 1991–Sedimentary and structural characteristics of the Paleo-Tethys remnants in northeastern Iran. – Geological Society of America Bulletin, 103:983-992.
- Alavi, M., 1996–Tectonostratigraphic synthesis and structural style of the Alborz Mountain system in northern Iran. – Journal of Geodynamics 21 (1): 1- 33.
- Alavi Naini M., 1972–Etude geologique de la ergion de djam. – Geological Survey of Iran Reports 23: 1-45.
- Alavi Naini, M., 1993–Paleozoic Stratigraphy of Iran. Treatise on the Geology of Iran. – Geological Survey of Iran: 269 p. [in Farsi].
- Assereto, R., 1963–Explanatory notes on geological map of upper Djadjerud and Lar valleys (central Elburz, Iran), scale 1: 50 000. – Instituto di Geologia dell, Universita di Millano, Serie G, Pubblicazione 232: 1-86.
- Bigey, F. P., 1988–Devonian Bryozoa and global events: The Frasnian / Famennian extinction. – In: MCMILLAN, N.J.; EMBRY, A. F. & GLASS, D.J., eds., The Devonian of the World, Proceedings of the Second International Symposium of the Devonian System. Calgary, Canada) – Canadian Society of Petroleum Geology, Calgary, Memoir 14, vol. 3: 53-62.
- BLAKE, D. B., 1983–Systematic descriptions for the Suborder Rhabdomesina. –In: ROBISON, R.A.,(ed), Treatise on Invertebrate Paleontology, Part G (1): Bryozoa (revised). – Boulder (Geological Society of America and University of Kansas Press): 550-592.
- Bozorgnia, F., 1973–Paleozoic foraminiferal biostratigraphy of central and east Alborz Mountains, Iran. – National Iranian Oil Company, Geological Laboratories 4: 1-185.
- Fisher Von, Waldhelm, 1837–designated as a type species. – Bulletin of Zoological Nomenclature 51: 285.
- Gaetani, M., 1965–Brachiopods and molluscs from Geirud Formation, Member A (Upper Devonian and Tournaisian). – Rivista Italiana di Paleontologia e Stratigrafia 71: 679-770.
- Gorjunova, R. V., 2006–New bryozoans from the Devonian of Afghanistan and the Carboniferous of Iran. – Paleontologicheskii Zhurnal 6: 43–51 [In Russian].
- International Commission on Zoological Nomenclature. 1994. Opinion 1786. Ascopora TRAUTSCHOLD, 1876 (Bryozoa, Cryptostomata): Ceriopora nodosa
- Lasemi., 2001–Facies analysis, depositional environment and sequence stratigraphy of the upper Pre-Cambrian and Palaeozoic rocks of Iran. – Geological survey of Iran: 1-181[in Farsi].
- Mistlaen B., Gholamalain, H.; Gourvennec, R.; Plusquellec, Y.; Bigey, F.; Brice, D.; Feist, M.; Feist, R.; Ghobadipour, M. & Kebriaee, 2001–Preliminary data on the Upper Devonian (Frasnian, Famennian) and Permian fauna and flora from the Chahriseh area (Esfahan Province, central Iran). – In: Feist, R. & Talent, J.-A., eds., New systematic and palaeobiogeographic data from Palaeozoic of central Iran. – Annales de la Societe Geologique du Nord 8 (2): 93-102.
- Sandberg, C. A. & Dressen, R., 1984–Late Devonian icriodontid biofacies models and alternate shallow water conodont zonation. – Geological Society of America, Special Paper 196: 179-194.
- Stampfli, G., 1978–Etude géologique générale de l'Alburz oriental au S du Gonbad-e-Qabus, Iran NE. – Thèse presentee a la faculte des Science de l'Universite de Geneve, No. 1868, Univ. Genève, 328 p.

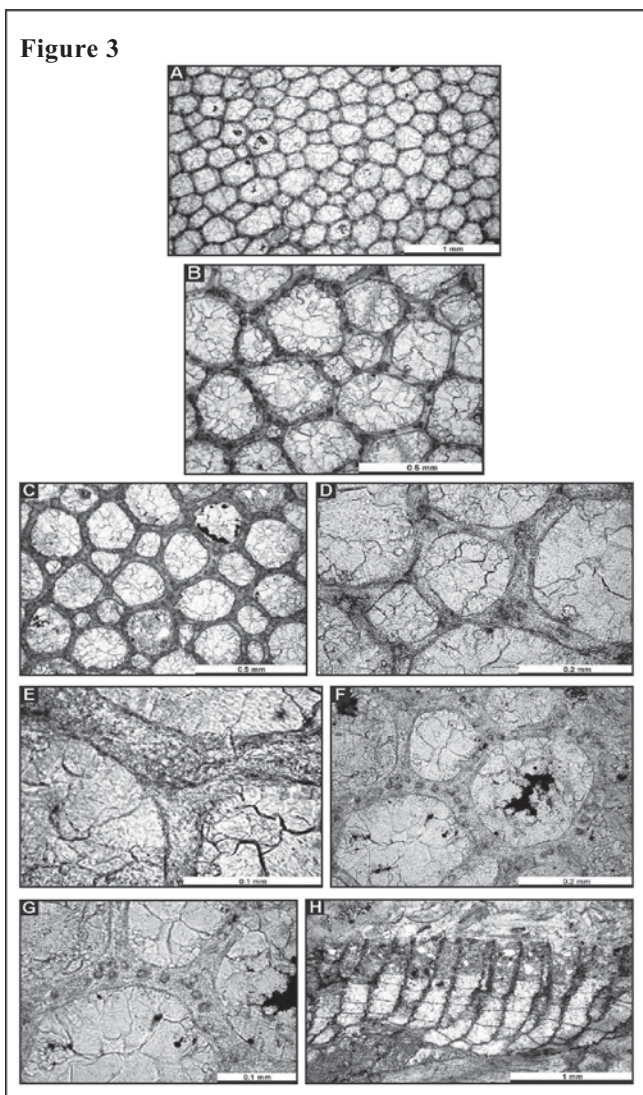


Fig. 3. *Shulgina* sp. All specimens are from the Geirud Formation, Central Alborz, Iran.

A-B: Tangential section showing arrangement of autozooeal apertures, exilazoecia and tubules. M-14-1.

C: Tangential section. M-14-4.

D-E: Tangential section showing aggregations of tubules. M-14-1.

F-G: M-14-4. Tangential section showing distribution of tubules in autozooeal walls.

H: Longitudinal section showing diaphragms and monilae-shaped walls. M-14-5.

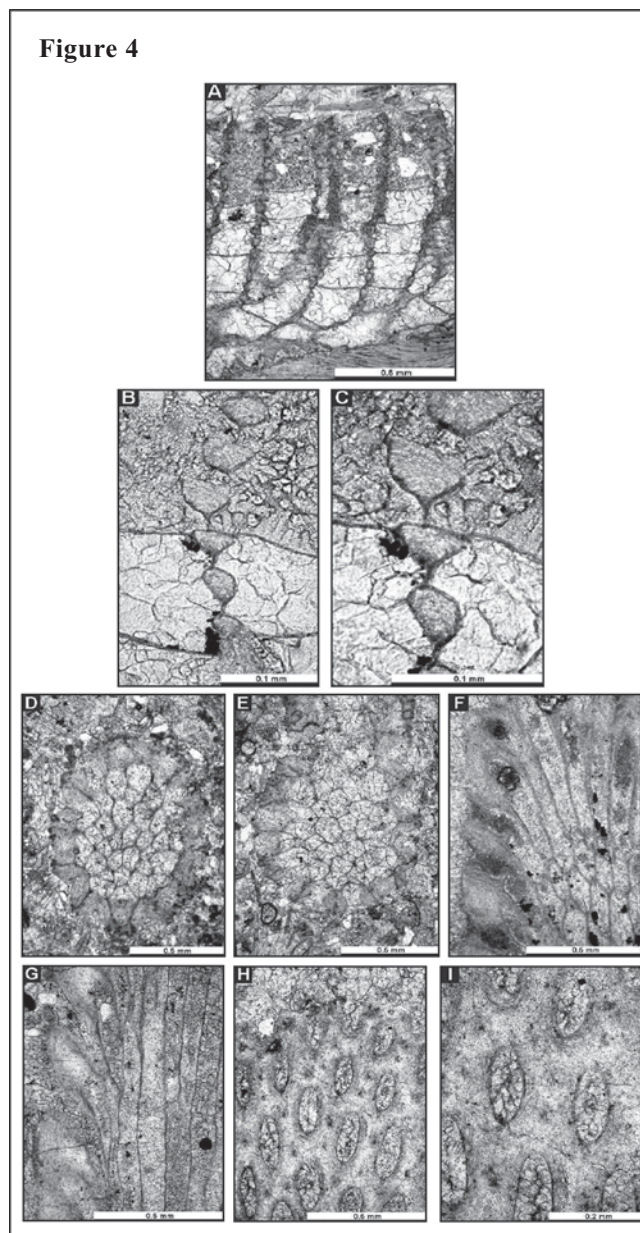


Fig. 4. – *Shulgina* sp. All specimens are from the Geirud Formation, Central Alborz, Iran. –

A-C: Longitudinal section showing diaphragms and monilae-shaped walls. M-14-5. – *Ascopora* sp.

D-E: Branch cross section. L-15-5. – **F:** Longitudinal section showing superior hemisepta. Paratype L-6-2.

G: Longitudinal section. Paratype L-6-1. – **H-I:** Tangential section showing apertures, macroacanthostyles and paurostyles. Holotype GM-38.

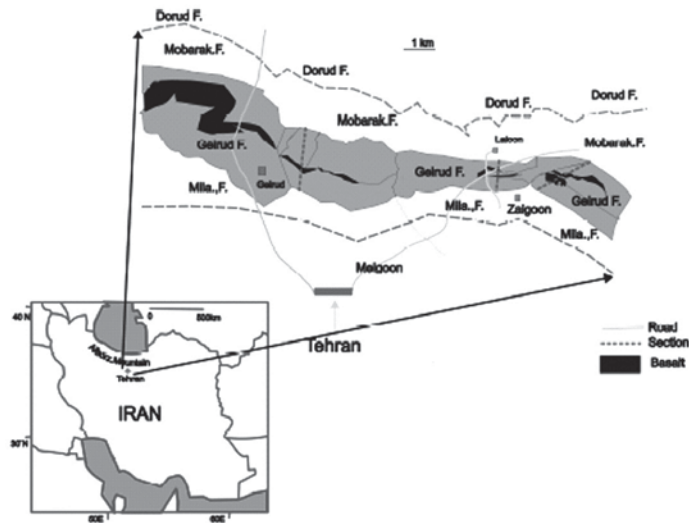


Fig.1- A simplified geological map showing the locations of the studied sections (Mohamadi 2008), based on Nasa world wind satellite map.

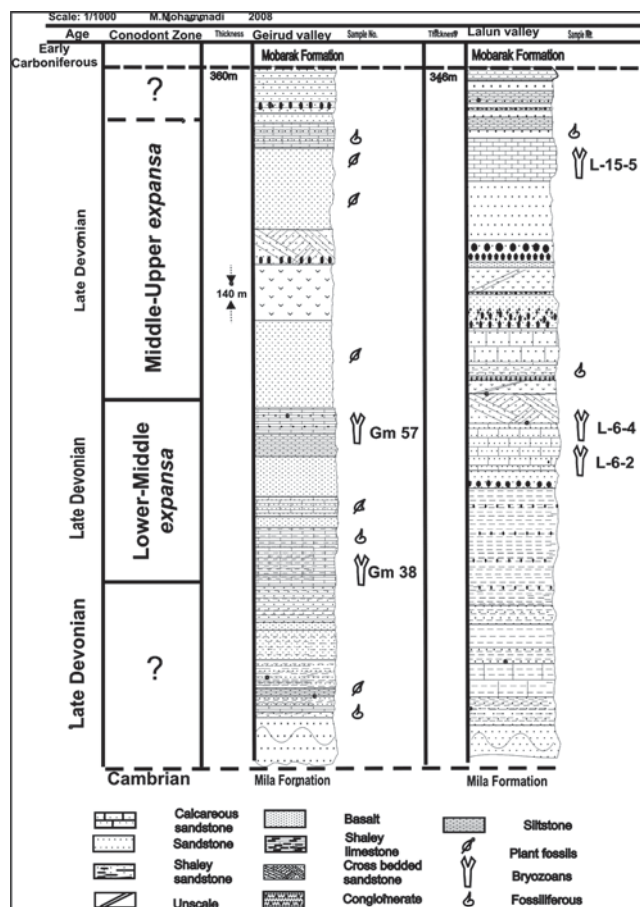


Fig.2. The stratigraphic columns of the Geirud formation in the Geirud and the Lalun valleys

TROIZKAYA, 1979 from the Upper Devonian (Famennian) of Central Kazakhstan, but differs from it in having incrusting colony instead of branched one, smaller autozoecia (aperture width 0.14-0.25 mm vs. 0.21-0.30 mm in *S. pustulosa*), and presence of tubules in autozoecial walls and absence of true acanthostyles.

Occurrence: Upper part of suclifer horizon (Famennian, Upper Devonian); western Central Kazakhstan. Geirud Formation (Upper Devonian); Central Alborz, Iran.

Order Cryptostomata VINE, 1884

Suborder Rhabdomesina ASTROVA & MOROZOVA,
1956

Family Rhabdomesidae VINE, 1884

Genus *Ascopora* TRAUTSCHOLD, 1876

Ascopora.. sp.

Figs. 4D-I

Holotype: GM-38.

Paratypes: L-6-4, L-6-2, L-15-5.

Locus typicus: Central Alborz, Iran.

Stratum typicum: Geirud Formation (Upper Devonian).

Description: Ramose branched colonies. Branches 0.75-2.00 mm in diameter.

Axial bundle indistinct, 0.30-1.05 mm in diameter, consisting of 8-9 axial zooecia. Autozoecia tubular-prismatic, rhombic in cross section in endozones. Autozoecial apertures oval, arranged in regular diagonal rows around branches. Single long superior hemisepta in each autozoecium, slightly curved proximally. Six macroacanthostyles surrounding each autozoecial aperture, two arranged longitudinally between apertures; paurostyles scattered between them, 0.010-0.015 mm in diameter. Autozoecial walls granular, 0.005-0.010 mm thick in endozone; regularly thickened, laminated in exozone.

Comparison: The present species is similar to *Ascopora*

worthenoides MCKINNEY, 1972 from the Mississippian of Alabama in colony and aperture size, character of axial bundle and presence of superior hemisepta. However, the new species differs in having two macroacanthostyles between autozoecial apertures instead of one in *Ascopora worthenoides*.

Conclusion

Devonian bryozoans have already been reported from northeastern and central Iran Bigey(1988) & Mistiaen, et al.,(2001). The Geirud Formation in Central Alborz, Iran, contains abundant bryozoan fauna. The two described species, *Schulgina mutabilis* TROIZKAYA, 1975 and *Ascopora* sp. occur in large numbers. *Schulgina mutabilis* is restricted to the level of Gm 57 (lower-middle expansa zone), whereas *Ascopora geirudensis* has wider distribution (lower-upper expansa zone). *Schulgina mutabilis* is known from Famennian of the west-central Kazakhstan. The genus *Schulgina* MOROZOVA, 1957 is restricted mainly to the Upper Devonian of Siberia, Russian Plate, Kazakhstan, Iran and China. This data maintains palaeobiogeographic connection between Iran and Central Kazakhstan in Famennian, and also Upper Devonian of Siberia, Russian Plate, Kazakhstan, Iran and China.

Acknowledgments

The authors thank to reviewers of the manuscript for their precious suggestions and corrections. This study was supported by the Isfahan University of Iran. Many thanks to Mr. H. Dashtban, field geologist of National Iranian Oil Company and Mr. Sina Farshidi for their assistance in the field works, Investigation and sampling.

suture zone. This suture separates southern part of the Eurasia (Turan plate) from the Iran plate as part of the north Gondwana (Alavi, 1991; Alavi Naini, 1972; Aghanabati, 2004).

The Alborz Range displays a nearly complete succession of strata from Precambrian to Holocene. A significant gap occurs at the boundary between the Devonian sequence and the ... به سن میلا اشاره شود ... Mila Formation. This Devonian sequence starts with sandstones and shale, and intercalated pyroclastics and lava flows, followed by the Upper Devonian shale, sandstones and limestones, and the Carboniferous Mobarak limestone (Fig.1).

Material and method

Detailed investigations were carried out on three sections in the Zaigun, Lalun and the Geirud valleys (Fig. 1) and 252 samples (3-5 kg each) were collected from carbonate layers. Some 200 randomly cut thin sections were prepared from the samples at Payame Noor University in Tehran. Additionally, 7 precisely oriented thin sections were prepared at Kiel University.

Bryozoans were investigated by Dr. Ernst in thin sections, using binocular microscope in transmitted light. Statistics were summarized with arithmetic mean, sample standard deviation, coefficient of variation, and minimum and maximum values. The most bryozoan bearing samples are from Geirud section (Gm-38 and Gm-57) and Lalun section (L.6.2, L.6.4 and L.15.5). Details of these two sections are shown in Figure 2. Also several samples of calcareous beds were washed by acetic acid and conodont species were collected. These species have been determined by Prof. Belka from The studied materials are stored at the Geology Department of the Payame Noor University in Tehran.

Systematic Palaeontology

Phylum Bryozoa EHRENBERG, 1831

Class Stenolaemata BORG, 1926

Order Trepostomata ULRICH, 1882

Suborder Halloporina ASTROVA, 1965

Family Atactotoechidae DUNCAN, 1939

Genus *Schulgina* MOROZOVA, 1957

Schulgina mutabilis TROIZKAYA, 1975

Figs. 3A-H, 4A-C;

Described Material: Gm.57 (8 thin sections).

Description: Colonies incrusting, globular or discoid massive. Colony thickness is 0.84-2.50 mm. Autozooezia growing from a thin epitheca, bending sharply in exozone and intersecting colony surface at angles of 90°. Autozooezial apertures rounded-polygonal. Diaphragms thin, horizontal, abundant. Exilazooezia rare, more abundant around maculae, 3-5 surrounding each autozooezial aperture, having polygonal apertures, originating at the base of exozone. Autozooezial walls finely laminated, 0.005-0.015 mm thick in endozone; showing reversal U shaped lamination, with distinct monilae-shaped thickenings, 0.020-0.055 mm thick in exozone. Maculae indistinct, 0.90-1.20 mm in diameter, consisting of larger autozooezia, irregularly spaced. Usually the largest autozooezium in the centre of a macula, surrounded by 6-7 smaller autozooezia in rosette-like pattern. True acanthostyles absent. Tubules (microacanthostyles) ,0.005-0.010 mm in diameter, distributed irregularly in autozooezial walls in exozone or forming rosette-shaped aggregations in junctions of autozooezia. Aggregations of tubules 0.02-0.04 mm in diameter.

Comparison: *Schulgina mutabilis* TROIZKAYA, 1975 is similar to *S. pustulosa*

1. Introduction

The Devonian Bryozoans have scarcely been studied in Iran. Bigey (1988) reported several bryozoans including Trepostome *Eostenopora* sp., Rhomboporid and Rhabdomesid bryozoans from the Upper Devonian in northeastern Iran. Mistiaen, et al. (2001) introduced few bryozoans including *Fistulipora* sp. and *Isotrypa* sp. from the Frasnian of Chahriseh area, Esfahan province.

Gorjunova (2006) described three species- *Primorela iranica* GORJUNOVA, 2006, *Heloclema magnificum* Gorjunova (2006) and *Worthenopora elbursensis* GORJUNOVA, 2006. - from the Lower Carboniferous (Viséan) of northern Iran.

The present study aims to present an overview of bryozoan fauna and a taxonomic description of two species from the Geirud Formation in Central Alborz.

The occurrence of index conodont species "*Ieriodus costatus darbyensis*" suggests an upper Famennian (*expansa* zone) age to the bryozoans in the Geirud Formation.

Geirud Formation

Assereto (1963) introduced the term "Geirud Formation" for a thick succession of siliciclastic, carbonate and volcanic rocks cropped out extensively in the Central Alborz Ranges in northern Iran (Fig. 1). The name refers to the Geirud Valley in northern Tehran where he studied this succession for the first time. The Geirud Formation is well exposed in northern Tehran (Fig. 1). Three sections were studied:

1. Geirud section (type section): 51°28'52" E, 35°59'24" N.
2. Lalun section: 51°34'55" E, 35°58'22" N.
3. Zaigun section: 51°36'15" E, 35°58'21" N.

The Geirud Formation is 300-375 meters thick (from west to east), and shows characteristics of a continental and shallow marine sequence (Assereto, 1966; Bozorgnia, 1973; Stampfli, 1978; Lasemi, 2001; Alavi

Naini, 1993; Weddige, 1984; Gaetani, 1965).

The lower part of the sequence consists of quartzitic sandstone followed by 30-40 meters of interlayered black shale and sandstone. This unit contains layers of phosphate-rich rocks, especially in the type section, where it was mined under "Geirud Phosphate mine".

The basal unit is overlain by an alternation of siliciclastic and carbonate rocks, locally associated with highly fossiliferous limestones, and intercalations of pyroclastic materials and lava flows.

In the Geirud valley, a 140 m thick basaltic lava flow covers the basal siliciclastic, carbonate and shale succession. The lava flow pinches eastward in the Lalun and Zaigun valleys. a basaltic sill, 10-12 m thick, occurs in the basal unit below the main basaltic lava flow in the Zaigun and Lalun valleys. This sill disappears westward in the Geirud valley (Fig.2).

The Geirud Formation is considered to be of Upper Devonian age, and its facies changes are attributed to the transgression/regression of the Paleotethys sea (Wendet et al., 2005; Weddige, 1984; Lasemi, 2001) was caused by The Caledonian orogeny in the Early Devonian led to a regional sea level low stand and the emergence of large areas of northern Gondwana land including the west, central and east parts of the Alborz Mountains (Lasemi, 2001). Consequently, a big depositional gap occurred at the base of the Late Devonian sequence in the Central Alborz.

Geological setting

The Iran plate is regarded as part of a marginal fragment of north Gondwana (Weddige, 1984; Lasemi, 2001; Alavi Naini, 1993). The Alborz Mountain system in northern Iran extends for about 2000 km from Azerbaijan in northwestern Iran to northern Afghanistan. The northern boundary of the Alborz is the Palaeo-Tethys collisional

اولین مطالعه بریوزوئرهاى سازند جیرود در البرز مرکزی

نوشته: مهین محمدی*، آندری ارنست** و مهدی یزدی*

* دانشگاه اصفهان، اصفهان، ایران

** دانشگاه کیل، کیل، آلمان

The First Study of Bryozoans from the Geirud Formation in Central Alborz

By: M. Mohammadi*, A. Ernest** & M. Yazdi***

* Department of Geology, University of Isfahan, Iran

** Institut für Geowissenschaften der Christian-Albrechts-Universität zu Kiel, German

تاریخ پذیرش: ۱۳۸۷/۰۴/۲۹

تاریخ دریافت: ۱۳۸۷/۰۲/۰۷

چکیده

در مطالعه سازند جیرود (دونین بالایی) در البرز مرکزی دو گونه از بریوزوئرها بررسی شده است. سازند جیرود با ستبرای حدود ۳۴۰ متر و تناوبی از رخساره‌های سیلیسی آواری و سنگ آهک ۱-۲ واحد گدازه آندزیتی، رخنمون‌های مناسبی در البرز مرکزی دارد. این مطالعه در مقطع تیپ سازند جیرود در دره جیرود و دو دره لالون و زایگون در نزدیکی آن در شمال تهران انجام شده است. (شکل ۱). در بعضی از لایه‌های آهکی، گونه‌های بریوزوئرهاى فامنین یافت شده است. گونه *Tropostoma Schulgina mutabilis* TROIZKAYA, 1975 اولین بار در لایه‌های دونین بالایی قزاقستان یافت شده است. گونه‌ای از جنس آسکورپا (*Ascopora* sp.) اولین گونه شناخته شده از جنس قبلی از *Ascopora* TRAUTSCHOLD, 1876 habdomesine genus است. این تحقیق اولین مطالعه بریوزوئرهاى سازند جیرود در البرز مرکزی است.

کلید واژه ها: دونین، بریوزوئرها، سازند جیرود، دیرینه زیست جغرافیا.

Abstract

Two bryozoan species are described from the Geirud Formation (Upper Devonian) of Central Alborz. The Geirud Formation is a sequence of nearly 340 meters of alternating siliciclastics and limestone and 1-2 andesitic lava units, with extensive exposures in the Central Alborz mountains. The study comprises the Type Section of the Geirud Formation in the Geirud valley and two sections in Zaigun and Lalun valleys near the Type Section, all in northern Tehran (Fig.1). In some calcareous beds we found bryozoan species from Famennian. *Tropostoma Schulgina mutabilis* TROIZKAYA, 1975 is known from the Upper Devonian (Famennian) of Central Kazakhstan. The *Ascopora* .sp. is the earliest known representative of habdomesine genus *Ascopora* TRAUTSCHOLD, 1876. This is the first study on the bryozoans of the Geirud Formation in Central Alborz.

Keywords: Devonian, Bryozoa, Geirud Formation, taxonomy, palaeobiogeography.