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Mackinneyella (Morozova and Lisitsyn, 1996) Fenestrate Genus Described for the First Time from the Devonian Deposits*

Hamed Yarahmadzahi[1#], Andrej Ernst[2], Zoya Tolokonnikova[3], Behrooz Sahebzadeh[4]
[1]Department of Geology, Young Researchers Club, Zahedan Branch, Islamic Azad University, Zahedan, Iran
[2]Institut für Geowissenschaften der Christian-Albrechts-Universität zu Kiel, Kiel, Germany
[3]Faculty of Physical Geography and Geology, Kuzbass State Pedagogical Academy, Novokuznetsk, Russia
[4]Farhangian University, Campus Shahid Motahari, Zahedan, Iran
Email: #hamed.yarahmadzahi@gmail.com

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ABSTRACT

Mackinneyella fenestrate genus has been reported first time from Lower Permian, Southern Urals (Russia) and then was found Lower Carboniferous to upper permian deposits from Australia, USA, Mongolia, China, Japan, Thailand and Tasmania. This genus is described for the first time from the Devonian deposits of the Kale Sardar section in Tabas area, Central Iran.

Keywords: *Mackinneyella*; Devonian; Kale Sardar Section; Tabas; Central Iran

1. Introduction

The Devonian represents an interesting transitional time in the evolution of bryozoans with switchover from Early Palaeozoic bryofaunas typically dominated by trepostomes to Late Palaeozoic bryofaunas in which fenestrates generally dominate [1,2]. These changes were apparently induced by a series of mass extinction events which led to shifts in the taxonomic composition of bryozoan faunas [3,4]. Despite their abundance and importance, Devonian bryozoan faunas in many areas remain scarcely investigated. The main reason for this is their complicated internal morphology whose study demands extensive preparation, mainly using oriented thin sections.

The order Fenestellida predominates among Paleozoic bryozoans, probably because of the aromorphic adaptations that arose at the very beginning of its evolution [5]. The differentiation of brood chambers, providing the development of larvae, also facilitated the domination of this group of bryozoans [6,7]. In the evolution of the order there were both long and short lived genera, the latter appeared and developed as ecologically specialized genera. The phenomenon of ecological specialization could also be due to the dominance of this group of bryozoans [5]. The above features, which are reflected in the morphology of fenestellid olonies, pose serious difficulties in determining their generic affiliation, as is evidenced by the heterogeneity of the species composition of the genera Fenestella Lonsdale [8], and Polypora McCoy [9]. The problem of heterogeneity of the genera of the order Fenestellida has not lost its topicality, despite a series of papers dealing with different aspects of this issue [10-16].

Upper Devonian deposits are widely distributed on the territory of Iran and well dated by conodonts, brachiopods and ammonoidea [17-20]. These sediments also contain various fossils, which have expanded the palaeontological characteristics of formations and are useful for biostratigraphy and palaeobiogeography. One of the most abundant groups in the Upper Devonian sediments of Iran is bryozoans. However, current knowledge about them is very scarce. Several bryozoan species were mentioned by Brice [21] from the Middle-Upper Devonian sediments of the Alborz Mountains: Fistulipora sp., Canutrypa francqana Bassler [22], Eridotrypella? sp., Leptotrypa? sp., Eostenopora sp., Eridotrypa sp., Polypora belgebaschensis Nekhoroshev [23], Rhombopora sp., as well as unidentified trepostomes, fenestrates and rhabdomesines. The species Canutrypa francqana Bassler [22] is known from the Eifelian to Frasnian rocks of France,

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#Corresponding author.

Germany and Poland [22,24-26]. Whereas the species Polypora belgebaschensis Nekhoroshev [23], was reported from the Givetian of Altai Mountains, Kuznetzk Basin[23,25]. From the Kuhe Kaftar locality in central Iran were reported Fistulipora spp. (2 species) and Isotrypa sp., Mistiaen [17] were reported. Two species were reported from the Famennian (Geirud Formation) of central Iran: Schulgina mutabilis Troizkaya [27], and Ascopora geirudensis Ernst and Mohammadi [28].

The present paper describes a *Mackinneyella* Morozova and Lisitsyn [14], from the newly studied Devonian deposits (Shishtu1 Formation) on which is situated in Tabas city (33˚39'51"N, 57˚08'56"E). Access to the outcrop is via the Tabas-Kharw main road and 22 km via the minor road of section 2 km from Niaz village (**Figure 1**).

2. Geological Setting

The Shishtu Formation was first described by Stöcklin [29] in Shotori Mountains. It comprises a sequence of several hundred metres of dark fossiliferous limestones and shales which are transitional from the underlying Bahram Formation of similar lithology and into the overlying Sardar Formation, respectively [30]. The Shishtu Formation is divided into two members, the lower Shishtu 1 and the upper Shishtu 2. The age of the Shishtu 1 member is considered to be Frasnian-Famennian [31,32], whereas Shishtu 2 is attributed to the Tournaisian to early Viséan [33]. In the Shotori Mountains theShishtu 1 member contains a remarkable unit of red brachiopod limestones (about 30 metres) called "Cepha-

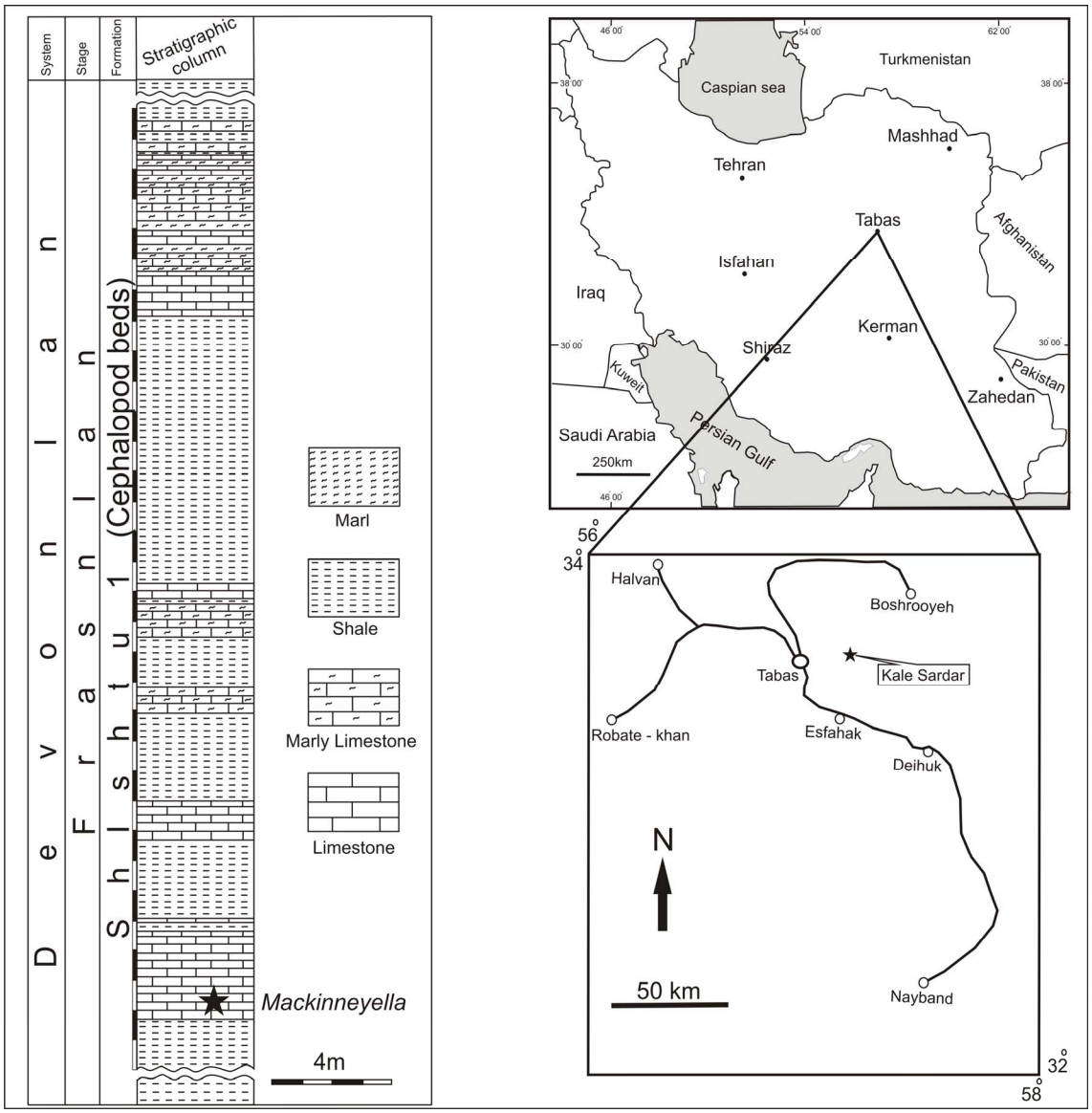

Figure 1. Geographic position of the Kale Sardar locality in the shotori range (eastern Iran) and the stratigraphic succession of the Shishtu Formation with the position of the *Mackinneyella* horizon.

lopod Beds" [29]. The age of the "Cephalopod Beds" is diachronous at different localities, and has been established as being the upper Frasnian to lower Famennian by conodonts Wendt [30]. Wendt [18] suggested including the Shishtu Formation in the Bahram Formation, because it does not represent a mappable entity. The bryozoan fauna described in present paper was recovered just below the "Cephalopod Beds" at Niaz section, in a limestone unit rich in corals and stromatoporoids. The "Cephalopod Beds" at the Niaz section have an upper Frasnian age, so the age of the bryozoan-bearing beds is estimated as being middle Frasnian. According to Schröder (pers. comm., 2010) the coral fauna consists mainly of thamnoporid corals, showing a ramose, branching growth, but only few Rugosa belonging mainly to the Phillipsastreidae. The genera Phillipsastrea d'Orbigny [34], Frechastraea Scrutton [35], and Hexagonaria Gürich [36], are represented by fragments of laminar to sub-spherical colonies, which are rather typical for a deeper water environment.

According to Alavi [37], Golonka [38], Aghanabati [39], Wendt [18,30], Palaeozoic sediments in northern Iran represent a fragment of Luarussia (Turan Plate). Fusion of the Iranian Plate (northern Gondwana) and Turan Plate (southern part of Eurasia) occurred during the Mesozoic as a consequence of closure of Palaeothetic Ocean due to subduction [40]. Therefore, the northern edge of Alborz Mountains is regarded as a collision suture zone. The studied territory represented shallow shelf of the continental slope during the Frasnian [18].

3. Material and Methods

The preparatory and analytic techniques employed in our study are standard ones for such investigations [41,42]. Quantitative aspects, however, require discussion. The measured morphological parameters utilized in examination of fenestrata bryozoans reported here are similar to those of other studies [41-44].

Bryozoans were investigated in thin sections using a transmitted light microscope. Statistics were summarized with arithmetic mean, sample standard deviation, coefficient of variation, and minimum and maximum value. The studied material includes 25 standard thin sections referring to sample numbers DSH 1-25. The thin sections are housed at the Faculty of Basic Sciences, Islamic Azad University, Zahedan Branch.

4. Systematic Palaeontology

By Andrej Ernst

Phylum: Bryozoa Ehrenberg [45]

Class: Stenolaemata Borg [46]

Order: Fenestrata Astrova and Morozova [47]

Suborder: Fenestellina Astrova and Morozova [47]

Family: Acanthocladiidae Ulrich [48]

Genus: *Mackinneyella* Morozova and Lisitsyn [14]

Type species: *Polypora ornamentata* Shulga-Nesterenko [49], by subsequent designation by Morozova and Lisitsyn [14]. Lower Permian, Southern Urals (Russia). **Plate 1**; **Table 1.**

Material: DSH 1-25

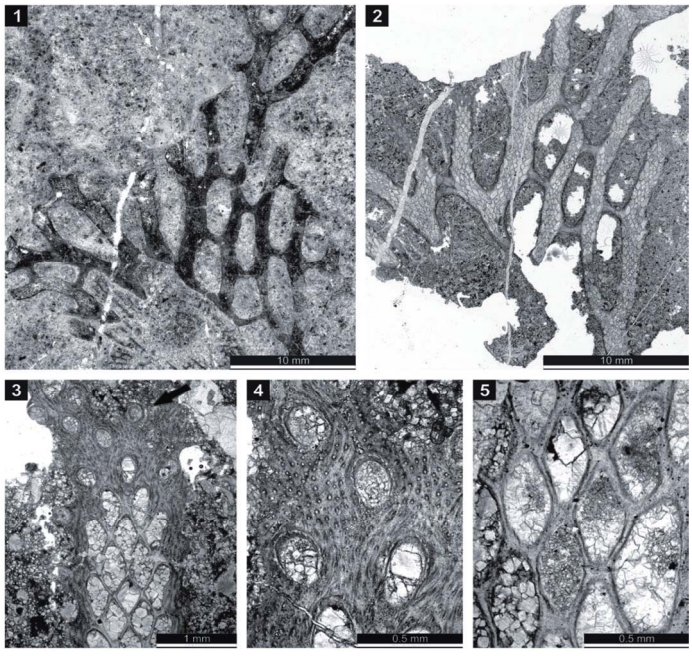

Plate 1. (1)-(5) ***Mackinneyella*** **(Morozova and Lisitsyn, 1996); (1) General view of the colony; (2) Tangential thin section of the colony; (3), (4) Shallow to middle tangential thin section showing autozooecial apertures and chambers; (5) Middle tangential thin section of the branch showing autozooecial chambers.**

Table 1. Measurements of *Mackinneyella* Morozova and Lisitsyn [14]. Abbreviations: N = number of measurements; X = mean; SD = standard devition; CV = coefficient variation; MIN = minimal value; MAX = maximal value.

Feature	N	X	SD	CV	MIN	MAX
Branch width, mm	10	3.2	0.805	25.06	1.1	4.0
Dissepiment width, mm	6	1.7	0.195	11.21	1.5	2.0
Fenestrule width, mm	9	1.7	0.316	18.54	1.4	2.3
Fenestrule length, mm	7	5.0	1.252	25.07	3.2	6.8
Distance between branch centres, mm	9	3.1	0.341	11.17	2.6	3.7
Distance between dissepiment centres, mm	4	5.0	0.858	17.08	3.8	5.6
Aperture width, mm	20	0.16	0.012	7.73	0.13	0.18
Aperture spacing along branches, mm	20	0.65	0.052	8.00	0.57	0.75
Aperture spacing diagonally, mm	20	0.42	0.046	11.00	0.36	0.52
Autozooecial chamber width, mm	20	0.24	0.025	10.42	0.20	0.29

Diagnosis: Reticulated colonies of various shape consisting of broad linear, essentially parallel branches joined by dissepiments; dissepiments narrow, perpendicular or at oblique angle to branches, regularly spaced at large distance; fenestrules elongate oval, sub-rectangular, or irregular in shape; keels and superstructure absent; autozooecia arranged in 5 - 6 rows on branches; chambers slightly elongate, proximally recumbent on budding plate, rhomboidal or rounded hexagonal in mid tangential section, long axis parallel with branch axis; hemisepta and diaphragms absent; granular skeleton present in basal plate and axial wall but locally absent in transverse and lateral autozooecial walls; extrazooecial skeleton laminated, traversed by abundant, moderate-size microstyles.

Remarks: *Mackinneyella* Morozova and Lisitsyn [14], differs from Polypora M'Coy [9], in having 5 - 6 autozooecial rows on branches instead of 3 - 4 and shape of autozooecia in mid tangential section: rhombic vs.hexagonal.

Stratigraphic and geographic range: Upper Devonian-Upper Permian; worldwide.

5. Conclusion

In this study, *Mackinneyella* Morozova and Lisitsyn[14], Fenestrate genus has been reported first time from Lower Permian, Southern Urals (Russia) and then was found Lower Carboniferous to upper permian deposits from Australia, USA, Mongolia, China, Japan, Thailand and Tasmania. This genus is described for the first time from the Devonian deposits of the Kale Sardar section in Tabas area, Central Iran.

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