

The new and rare species of the testate amoebae (Amoebozoa: Arcellinida) from mountain lakes of Azerbaijan

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Summary

A new testate amoebae, *Awerintzewia minuta* sp. n. and two rare species, *Diffflugia serbica* Ogden and Živković, 1983, and *Diffflugia biconvata* Ertl, 1965 were found during a faunistic study of the testate amoebae in two high-mountain lakes in Azerbaijan. The morphology and biometrics of these testate amoebae were described by LM and SEM investigations. The genus *Awerintzewia* Schouteden, 1906 and two species: *Diffflugia serbica* Ogden and Živković, 1983 and *Diffflugia biconvata* Ertl, 1965 are reported for the fauna of the Caucasus for the first time.

Key words: testate amoebae, systematics, *Diffflugia*, *Awerintzewia*, Azerbaijan

Introduction

The fauna of testate amoebae of the Nakhichevan Autonomous Republic has not been studied extensively. Literary sources mention only four species of testate amoebae (*Arcella costata* Ehrenberg, 1847, *A. vulgaris* Ehrenberg, 1830, *Centropyxis aculeata* (Ehrenberg, 1838) and *Diffflugia corona* Wallich, 1864) from water reservoirs in the vicinity of Bichenek. The first information on the fauna of testate amoebae of the Western Azerbaijan was published by Veysig (1931) from Lake Goy-Gol. In the paper the author provided the data on 12 species of testate amoebae (*Arcella discoides* Ehrenberg, 1843, *Centropyxis laevigata* Penard, 1890, *C. aculeata* Ehrenberg, 1838, *Diffflugia scalpellum* Penard, 1899, *D. capreolata* Penard, 1902, *D. lemani* Blanc, 1892, *D. manicata* Penard, 1902, *D. lithoplites* Penard, 1902, *D. acuminata* Ehrenberg, 1838, *D. pyriformis* Perty, 1849, *D. elegans* Penard, 1890

and *D. constricta* Ehrenberg, 1841). In the early 21st century, Snegovaya and Alekperov (2005) carried out a research on testate amoebae in the Western Azerbaijan. As a result of this study, 70 species of testate amoebae were found, of which two new families, six genera, and 23 species were described.

As an outcome of recent processing of the available samples, a new species of testate amoebae from the genus *Awerintzewia* Schouteden, 1906 was discovered, as well as two rare species: *Diffflugia serbica* Ogden and Živković, 1983 and *Diffflugia biconvata* Ertl, 1965 were for the first time recorded in the fauna of the Caucasus; their descriptions are given below.

Material and methods

In the summer of 2016, we had a chance to visit two high-mountain lakes – Lake Batabat

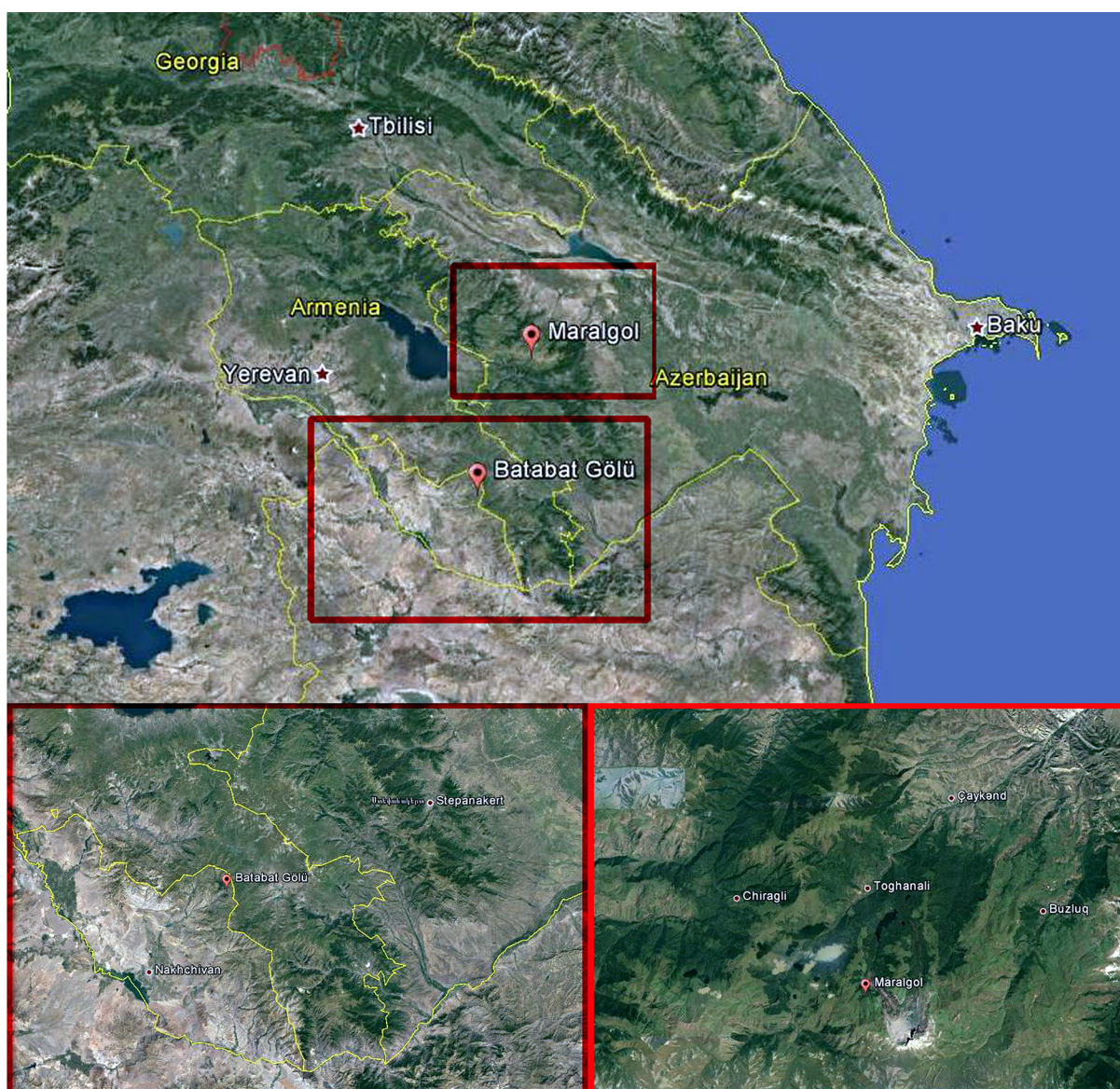


Fig. 1. Location of Batabat Lake and Maralgol Lake in Azerbaijan.

(Nakhichevan AR) and Lake Maralgol (West Azerbaijan), where the samples were taken (Fig. 1). Brief characteristics of these water reservoirs are given below.

Batabat is a mountain lake in Azerbaijan, situated in the mountains of the Shakhbuz district of Nakhichevan along the right bank of the upper river of Nakhichevan-chay, west of the Bichenek passing. The lake is located at the altitude of 2113 m above sea level, surrounded by alpine meadows, not far from the sources of the Kukuychay River (a tributary of Nakhichevan-chay). The lake is remarkable due to a floating peat island (Fig. 2).

Lake Maralgol is located in the Goygol region of Azerbaijan at the altitude of 1902 m a. s. l. The depth of the lake is 61.6 m, the length is 300 m, the width is 150 m, and the length of the coastline is 2282 m; the soil is sludgy. The lake feeds from three small rivers (Gasimov, 1972) (Fig. 2). The water transparency of the lake (Secchi depth) during the sampling period was 5.6 m.

Samples were taken from Batabat Lake (Shakhbuz distr., Nakhichevan AR) (N39°32'27.39"; E45°47'09.17"; 2120 m a. s. l.) and from Maralgol Lake (Goygol district, West Azerbaijan) (N40°22'39.11"; E46°18'52.41"; 1920 m a. s. l.) in July



Fig. 2. Batabat Lake (A, B), Nakhichevan AR and Maralgol Lake (C, D), Goygol district, Azerbaijan.

2016 (Fig. 1). Specimens were caught in micro-capillary tubes and studied *in vivo* and by means of the glycerol preparations. For scanning electron microscopy (SEM) the cells were transferred to a cover glass with micro-capillary tubes, dried and then coated with gold. The shell morphology was examined using a scanning electron microscope JEOL JCM-6000 operating at 5–15 kV. Statistics were calculated using the program Sigma Plot 12.5 (X: arithmetic mean; M: median; SD: standard deviation; SE: standard error; CV: coefficient of variation (%); Max: maximum; Min: minimum; N: number of specimens).

Descriptions and discussion

Amoebozoa Luhe, 1913, emend. Cavalier-Smith, 1998

Order Arcellinida Kent, 1880

Suborder Diffugiina Bovee, 1985

Family Diffugiidae Wallich, 1864

Genus *Diffugia* Leclerc, 1815

Diffugia serbica Ogden and Živković, 1983 (Figs 3, 4)

Description. Slides B1–B2. The shell ovoid with pointed fundus and short neck, rounded aperture. The shell is relatively large, laterally compressed. It is covered with a mixture of small, large and flattened particles, forming the rough surface of the shell. The aperture is round, surrounded by the small and medium particles, with a small collar. Shell length 155–215 μm , width 78–96 μm , thickness 90–93 μm , aperture diameter 41–56 μm (Table 1). Our specimens differ from others by more rounded form and significantly smaller size of the aperture (Ogden and Živković, 1983; Mazei and Tsyganov, 2006). Common species in the sample, found in the summer.

Distribution: former Yugoslavia (Ogden and Živković, 1983; Ostojić et al., 2014), Belgium (Chardez, 1987), Bulgaria (Davidova et al., 2008; Todorov et al., 2008; Davidova, 2012; Davidova and Boycheva, 2015). In Azerbaijan this species was found in sediments of Batabat Lake (Shakhbuz distr., Nakhichevan AR). This is the first record of this species in the fauna of the Caucasus.

Diffugia biconvata Ertl, 1964 (Figs 5, 6)

Description. The shell egg-shaped, slightly flattened laterally with narrow equatorial area. Distal

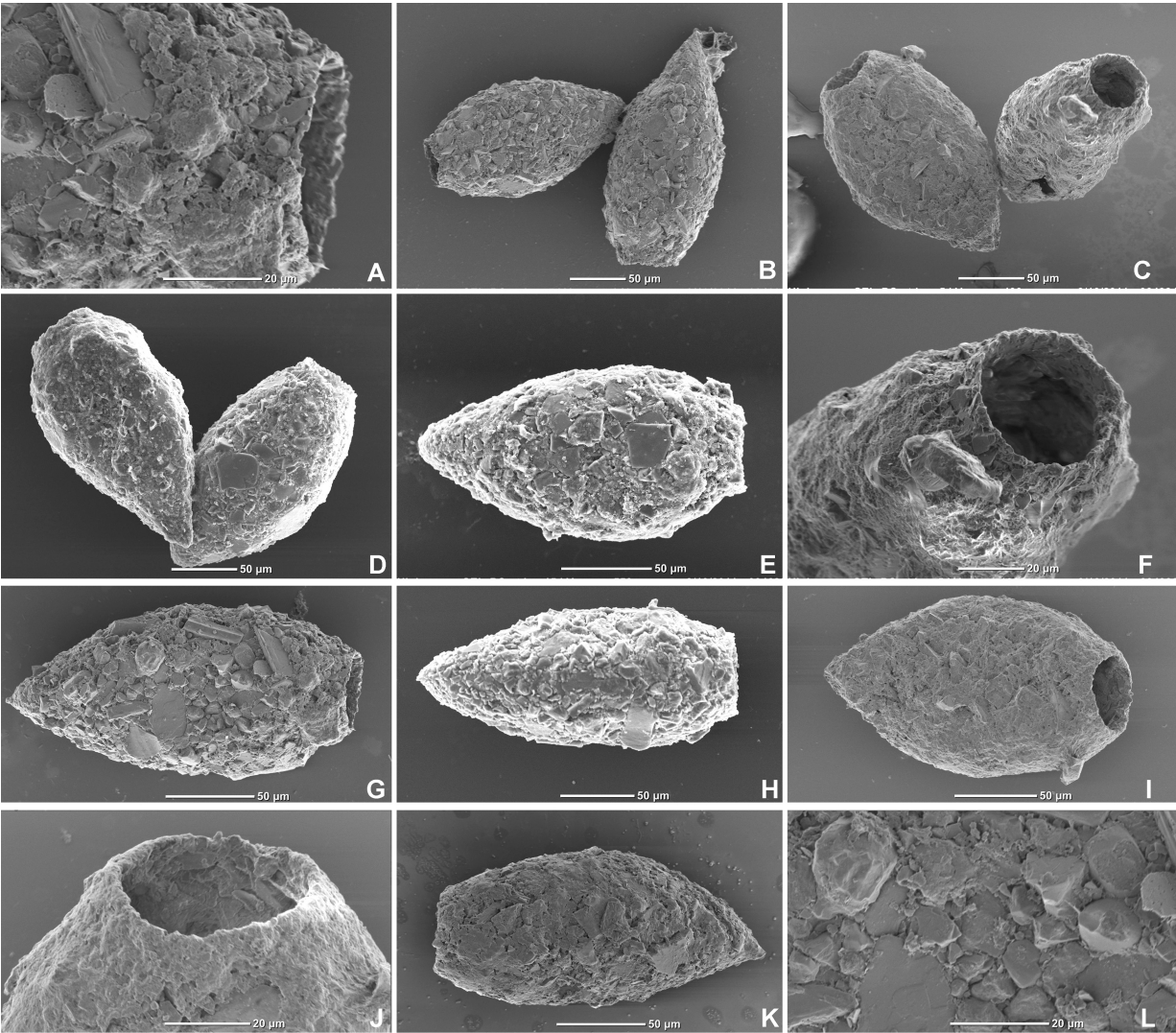


Fig. 3. *Diffflugia serbica* Ogden and Živković, 1983, SEM photographs. A, F, J – Apertural view; B-E, G, I, K – broad lateral view; H – narrow lateral view; L – shell surface.

end is narrowed. The surface of the test is covered with a mixture of grains of sand, of varying size and shape. The aperture is round in shape, surrounded by fine grains of sand. Shell length 83.5–93.45 μm, width 50.2–52.2 μm, aperture diameter 20.3–21.7

μm (Table 2). Our specimens differs from other by more elongated form and significantly smaller size of the shell and aperture (Ertl, 1965; Mazei and Tsyganov, 2006). Common species in the sample, found in the summer.

Table 1. Biometric characteristics of *Diffflugia serbica* Ogden and Živković, 1983.

Character	X	M	SD	SE	CV	Min	Max	N
Length of the shell	186.500	184.00	17.335	5.482	0.092	155.0	215.0	10
Width of the shell	87.0	87.5	6.831	2.160	0.079	78.0	96.0	10
Thickness of the shell	92.2	93.0	1.229	0.389	0.013	90.0	93.0	10
Diameter of the aperture	47.2	46.0	4.849	1.533	0.103	41.0	56.0	10

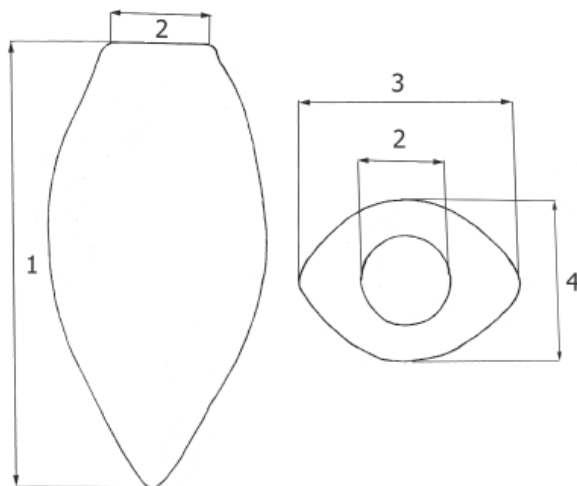


Fig. 4. Basic morphometric characters of *Diffflugia serbica* Ogden and Živković, 1983. 1 – Length of the shell; 2 – diameter of the aperture; 3 – width of the shell; 4 - thickness of the shell.

Distribution: Slovakia (Ertl, 1965). In Azerbaijan this species was found in the sediments of Batabat Lake (Shakhbuz distr., Nakhichevan AR). This is the first record of this species in the fauna of the Caucasus.

Family Heleoperidae Jung, 1942
Genus *Awerintzewia* Schouteden, 1906

***Awerintzewia minuta* sp. n. (Figs 7–9)**

Diagnosis. The shell dorsally ovate form, laterally slightly compressed, covered by the mixture of fine quartz particles, idiosomes almost invisible under grains of sand. The base of the fundus covered with larger particles, and closer to the aperture of the test, the shell has a fairly smooth structure. Aperture is round, bordered by small particles, with small lateral notches. The diameter of the aperture is 11.4–12.6 µm. Shell length 50.4–52.7 µm, width 31.4–39.5 µm (Table 3). Pseudopodia not observed. *Awerintzewia minuta* sp. n. differs from 2 known species of this genus by smaller cell size (Dekhtyar,

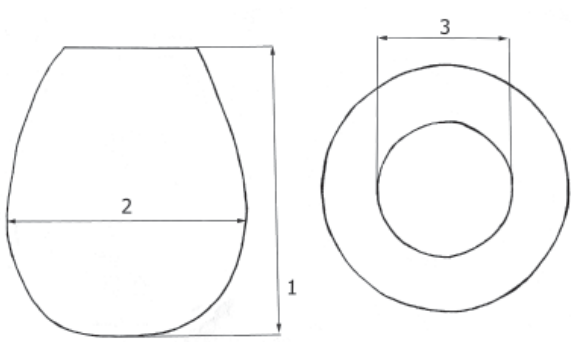


Fig. 5. Basic morphometric characters of *Diffflugia biconvata* Ertl, 1965. 1 c Length of the shell; 2 – width of the shell; 3 – diameter of the aperture.

1994; Mazei and Tsyganov, 2006). Common species in the sample, found in the summer.

Ecology. This species was found in the sediments of Maralgol lake (Goygol district, Azerbaijan). Common species in the sample, found in the summer.

Type location. Azerbaijan, Goygol district, N40°22'39.11"; E46°18'52.41"; 1920 m a. s. l., July 2016.

Etymology. The species is named according to its morphology – the small cell size.

Haplotype. The type specimen is stored in the collection of Dr. N. Snegovaya (Slides M1-M3), Institute of Zoology NAS of Azerbaijan.

Related species – similarities and differences. *Awerintzewia minuta* sp. n. differs from 2 known species of this genus – *A. cyclostoma* (Schouteden, 1906) Penard, 1920 and *A. levis* by smaller cell size (Dekhtyar, 1994; Mazei and Tsyganov, 2006) (Table 4).

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Davidova R. 2012. Biotopic Distribution

Table 2. Biometric characteristics of *Diffflugia biconvata* Ertl, 1965.

Character	X	M	SD	SE	CV	Min	Max	N
Length of the shell	93.51	93.450	7.975	2.522	0.085	83.5	107.0	10
Width of the shell	51.61	51.90	0.694	0.219	0.013	50.2	52.2	10
Diameter of the aperture	21.58	21.7	1.022	0.323	0.047	20.3	21.7	10

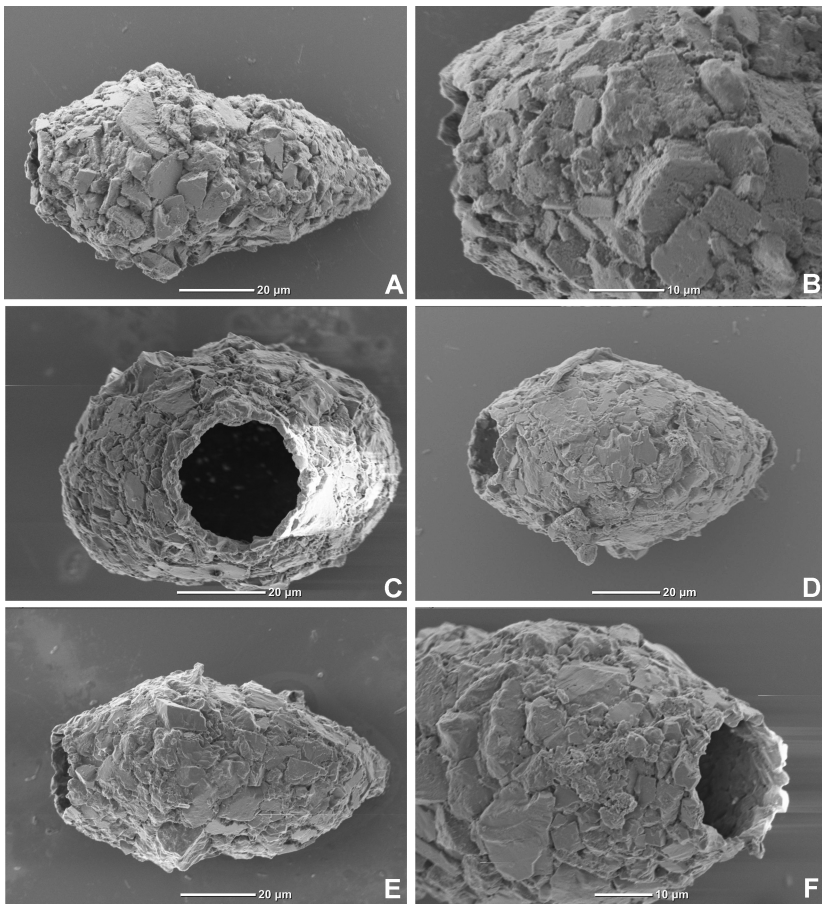


Fig. 6. *Diffflugia biconvata* Ertl, 1965, SEM photographs. A, E – Narrow lateral view; B, C, F – apertural view, D – broad lateral view.

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Mazei Y.A. and Tsyganov A.N. 2006. Freshwater

Table 3. Biometric characteristics of *Awerintzewia minuta* sp. n.

Character	X	M	SD	SE	CV	Min	Max	N
Length of the shell	52.92	52.7	1.399	0.442	0.026	50.4	53.4	10
Width of the shell	38.47	39.5	2.817	0.891	0.073	31.4	41.2	10
Diameter of the aperture	13.04	12.6	1.304	0.412	0.1	11.4	14.3	10

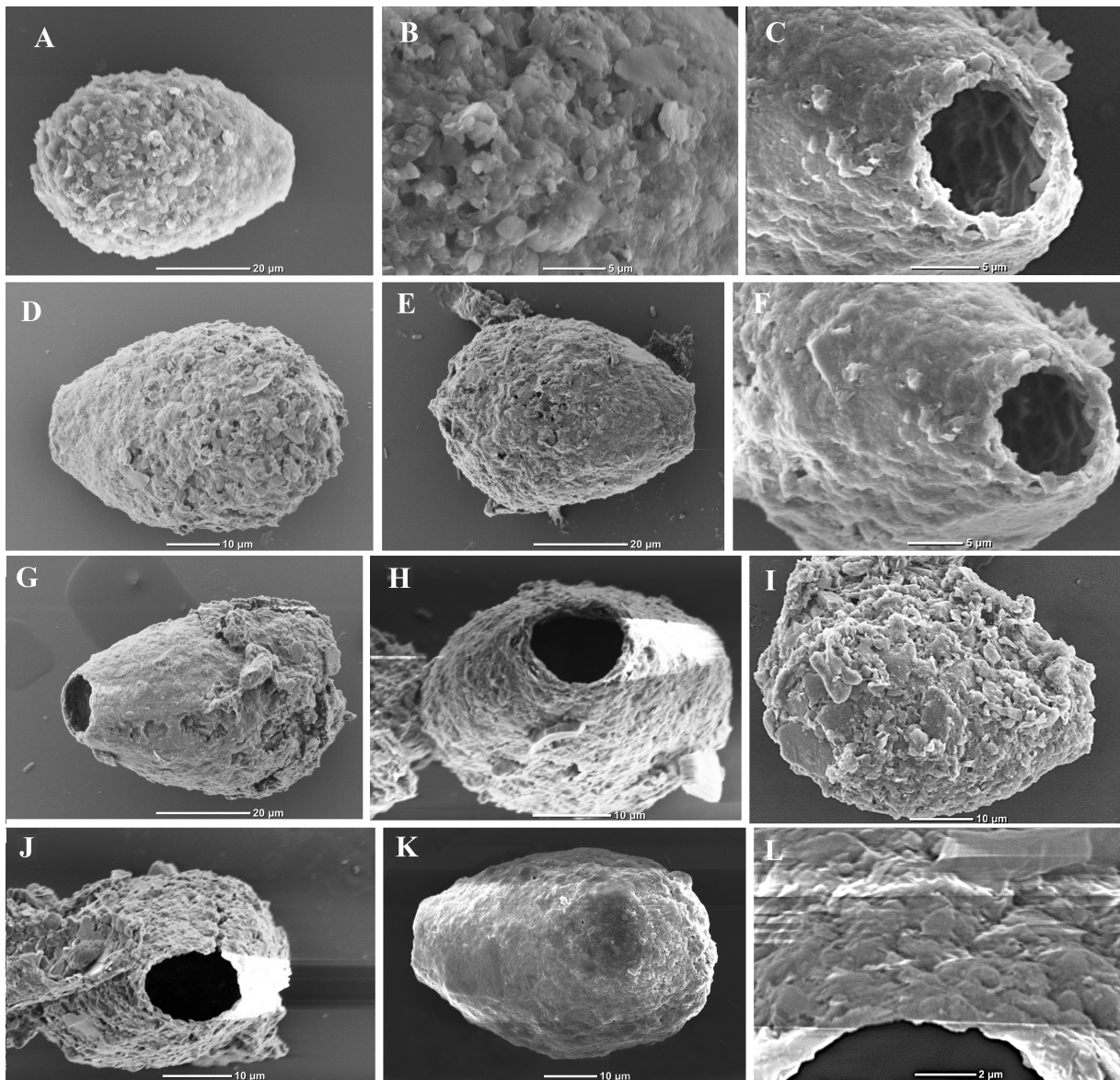


Fig. 7. *Awerintzewia minuta* sp. n., SEM photographs: A, D, E, I, G, K — broad lateral view, C, F, H, J, L — apertural view, B — shell surface.

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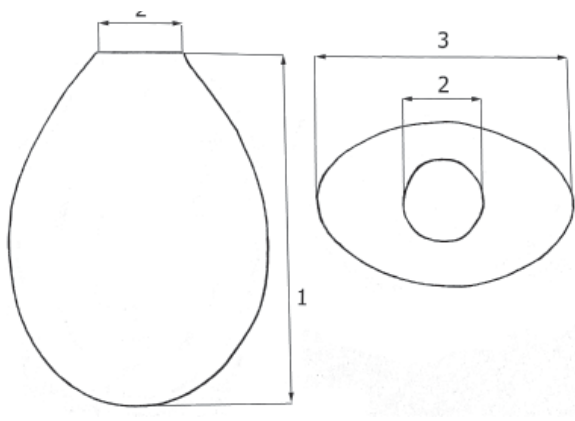


Fig. 8. Basic morphometric characters of *Awerintzewia minuta* sp. n. 1 – Length of the shell; 2 – width of the shell; 3 – diameter of the aperture.

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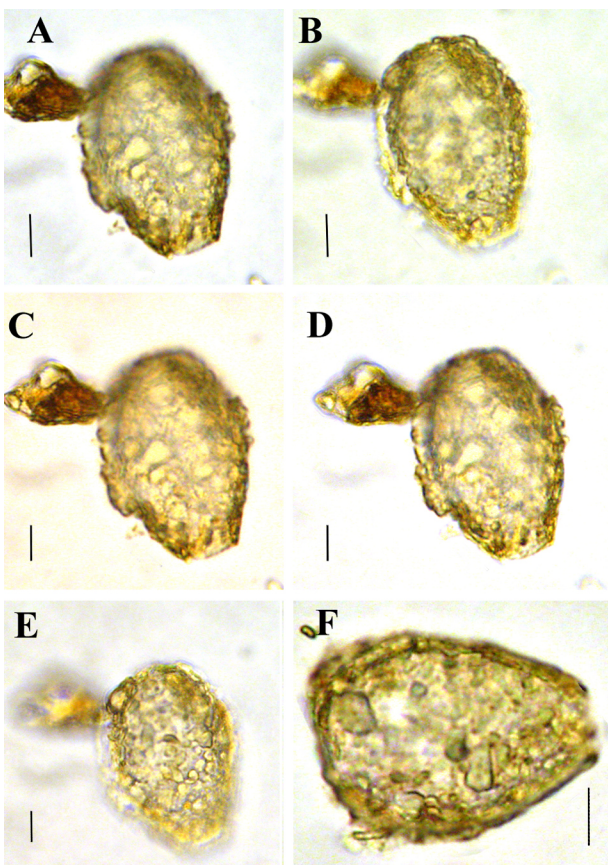


Fig. 9. *Awerintzewia minuta* sp. n., light microscope photographs. A-F – lateral view. Scale bars: 10 μ m.

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Table 4. Diagnostic characters of species from the genus *Awerintzewia* Schouteden, 1906.

Characters	<i>A. minuta</i> sp. n.	<i>A. cyclostoma</i>	<i>A. levis</i>
Shell size, μ m, shell surface	Length 50.4–53.4 μ m, width 31.4–41.2 μ m; shell of dorsally ovate form, laterally slightly compressed, covered by the mixture of fine quartz particles, idiosomes almost invisible under grains of sand. The base of the fundus covered with larger particles, and closer to the aperture of the test the shell has a fairly smooth structure.	Length 135–180 μ m, width 120–132 μ m; shell large, of trapezoidal form, covered with large grains of sand.	Length 168–192 μ m, width 120–129 μ m; shell large, of ovoid form, flattened, incorrectly rectangular plates cover the shell, grains of sand singly occurred.
Aperture form and size, μ m	The aperture is round, bordered by small particles, with small lateral notches, 11.4–14.3 μ m in diameter.	The aperture is broadly oval with small lateral notches, the edge of the aperture consists of thin small plates, 40–52 μ m in diameter.	The aperture relatively small, wide elliptic, with smooth margin, without lateral excisions.
References	This paper	Dekhtyar, 1994; Mazei and Tsyaganov, 2006	Dekhtyar, 1994; Mazei and Tsyaganov, 2006

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