Reassessment of pore occlusion in some diatom taxa with revalution of *Placoneis* Mereschkowsky (Bacillaryophyceae: Cymbellales) and description of two new genera (#94129)

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Reassessment of pore occlusion in some diatom taxa with revalution of *Placoneis* Mereschkowsky (Bacillaryophyceae: Cymbellales) and description of two new genera

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In this paper, the history and taxonomy of *Placoneis gastrum*, the type species of the genus *Placoneis*, was discussed. We investigated the structure of pore occlusions in *Placoneis* and related genera. As a result, we propose a new classification for tectulum-like types of pore occlusions. The new classification is congruent with previously-published and newly-constructed phylogenies based on molecular data. Based on the different structures of the pore occlusions, species of *Placoneis* are transferred to *Witkowskia* gen. nov. Hence, 168 new combinations are introduced. A new diatom species, with a similar morphology to *Placoneis flabellata*, was discovered in Bắc Kạn Province, Vietnam. It is described in this paper as *Chudaevia densistriata* sp. nov. *Placoneis flabellata* is transferred to *Chudaevia* gen. nov. We also illustrate *Placoneis flabellata* herein and compare it to *Chudaevia densistriata* sp. nov. An unknown diatom, similar to *Placoneis coloradensis*, was discovered in Chukotka, Russia. It is introduced as *Placoneis elinae* sp. nov. below. Additionally, we discuss the distribution of some species of *Witkowskia* gen. nov. and *Chudaevia* gen. nov.

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Abstract

In this paper, the history and taxonomy of *Placoneis gastrum*, the type species of the genus *Placoneis*, was discussed. We investigated the structure of pore occlusions in *Placoneis* and related genera. As a result, we propose a new classification for tectulum-like types of pore occlusions. The new classification is congruent with previously-published and newly-constructed phylogenies based on molecular data. Based on the different structures of the pore occlusions, species of *Placoneis* are transferred to *Witkowskia* gen. nov. Hence, 168 new combinations are introduced. A new diatom species, with a similar morphology to *Placoneis flabellata*, was

discovered in Bắc Kạn Province, Vietnam. It is described in this paper as *Chudaevia densistriata* sp. nov. *Placoneis flabellata* is transferred to *Chudaevia* gen. nov. We also illustrate *Placoneis flabellata* herein and compare it to *Chudaevia densistriata* sp. nov. An unknown diatom, similar to *Placoneis coloradensis*, was discovered in Chukotka, Russia. It is introduced as *Placoneis elinae* sp. nov. below. Additionally, we discuss the distribution of some species of *Witkowskia* gen. nov. and *Chudaevia* gen. nov.

Introduction

Placoneis Mereschkowsky is a species-rich genus of diatoms with repeatedly revised taxonomy during the last century. It was erected in 1903 to include numerous species from *Navicula* Bory sensu lato with a single asymmetrical chloroplast. Mereschkowsky (Mereschkowsky, 1903) also studied the structure of plastids and pyrenoids among cymbelloid diatoms. Based on chloroplast morphology, he suggested that *Placoneis* should be included in the group Monoplacatae alongside cymbelloid and gomphonemoid diatoms. However, since its original description in 1903, *Placoneis* was consistently wrongly placed in *Navicula* sensu lato due to its naviculoid symmetry. It was not until 1987, when E.J. Cox highlighted this situation and described morphological similarities between species of *Placoneis* and cymbelloid diatoms (Cox, 1987). Besides, Round et al. (1990) placed *Placoneis* in the family Cymbellaceae that also included genera *Cymbella* Agardh*, Brebissonia* Grunow*, Encyonema* Krammer and *Gomphocymbella* O. Müller. Round et al. (1990) postulated that according to the frustule structure and protoplast characters *Placoneis* is closely related to *Cymbella* and *Gomphonema* Ehrenberg. Close relationships between *Placoneis* and members of Cymbellales D.G. Mann in Round et al. were later supported on the basis of morphological, phylogenetic and molecular analyses (Bruder & Medlin, 2007; Kermarrec et al. 2011, Kulikovskiy et al. 2014; Kezlya et al. 2020, 2021, 2022). The generitype of *Placoneis* – *P. gastrum* (Ehrenberg) Mereschkowsky – was chosen by Cox (Cox, 1987). Later, Cox (2003) studied the original material from Ehrenberg in search of *P. gastrum* but was unable to locate specimens. However, she identified some valves of *Navicula amphibola* P.T. Cleve and indicated that this species is morphologically similar to *P. gastrum*. Thus, she lectotypified *P. gastrum* from Donkin's (Donkin, 1873) material "since its modern usage can be traced back unequivocally to Donkin (1873)". On the contrary, Jahn (2004) found *P. gastrum* in Ehrenberg's type material and proved that the previous lectotypification was

illegal. Thus, in the modern conception *P. amphibola* (P.T. Cleve) Cox, designated from *Navicula amphibola* by Cox (2003), is treated as a junior heterotypic synonym of *P. gastrum* (Reichardt, 2018).

It is worth mentioning that Cox (Cox, 1987) described internal pore occlusions in *Placoneis* as volae. This term is treated differently by various taxonomists. For instance, Ross and Sims (1972) described vola as "a part of velum that consists of a number of elements projecting from the wall of the poroids or loculus but not fusing". D.G. Mann (1984), on the other side, understood vola as "a flap of silica, attached to the wall of the pore by a fairly broad base and extending most of the way across it, leaving only a curved slit". It is not clear, what definition of vola was used by Cox when she revaluated *Placoneis* (Cox, 1987), because the structure of pore occlusions in new generitype *Placoneis gastrum* was not illustrated with SEM microphotographs. In 2004 she tried to solve this confusion by proposing an idea to understand vola sensu Ross and Sims (Ross & Sims, 1972; Cox, 2004). Besides, two new types of pore occlusions were introduced in addition to three widely used velum types (cribrum, rota and vola): foricula (to replace vola sensu D.G. Mann) and tectulum. The latter term was established primarily to describe pore occlusions of *Placoneis*. So, tectulum is "an inner round or squarish flap-like covering, attached to the edges of an areola by several, regularly arranged, small struts" (Cox, 2004).

A new type of pore occlusion was discovered in an unknown species of *Placoneis* from Chukotka, Russia (described here as *Placoneis elinae* Kulikovskiy, Mironov, Genkal, Glushchenko & Kociolek sp. nov.). This type of occlusion is different from the tectulum and is described below as pseudotectulum. The same type of occlusion can be found in three species with similar morphology - *Placoneis amphibola*, *Placoneis coloradensis* Kociolek & E.W. Thomas and *Naviculadicta amphiboliformis* Metzeltin, Lange-Bertalot & Nergui Thus, *Witkowskia* Kulikovskiy, Mironov, Glushchenko & Kociolek gen. nov. is introduced in this paper to include all species of *Placoneis* that can be characterized by the presence of tectulum. In addition, we studied a species from South-East Asia, *Navicula flabellata* F. Meister, and another morphologically similar species, which is new to science. Both species possess a new type of pore occlusion, named below as paratectulum. To include the species with this unique type of pore occlusion, we describe *Chudaevia* Kulikovskiy, Mironov, Glushchenko & Kociolek gen. nov. with *Chudaevia densistriata* Kulikovskiy, Mironov, Genkal, Glushchenko & Kociolek

sp. nov. and propose a new combination *Chudaevia flabellata* (F. Meister) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov. In addition, we discuss the variety of pore occlusions among genera of the order Cymbellales.

Materials & Methods

List of slides is given in Table 1. The samples were treated with 10% hydrochloric acid to remove carbonates and washed several times with deionized water every 12 hours. Afterwards, samples were boiled in concentrated hydrogen peroxide (~37%) to mineralize the organic matter. They were washed again with deionized water four times at 12-hour intervals. After decantation and filling with deionized water up to 100 ml, the suspension has been spread onto cover slips and left to dry at room temperature.

Permanent diatom preparations were mounted in Naphrax® (Brunel Microscopes Ltd., Chippenham, UK; refractive index = 1.73). Light microscopic (LM) observations were performed with a Nikon Eclipse E600 equipped with Plan-apochromatic oil immersion objective x100 (n.a. 1.4) and a Nikon DS-5M digital camera, as well as a Zeiss Axio Scope A1 (Carl Zeiss Microscopy GmbH, Göttingen, Germany) microscope equipped with an oil immersion objective (Plan-apochromatic ×100/n.a.1.4, Nomarski differential interference contrast, DIC) and a Zeiss Axio Cam ERc 5s camera (Carl Zeiss NTS Ltd., Oberkochen, Germany). Valve ultrastructure was examined by means of a Hitachi S-4500 field emission scanning electron microscope (Hitachi Co., Ltd., Tokyo, Japan) and JSM-6510LV scanning electron microscope (JEOL Ltd., Tokyo, Japan) operated at 10 kV and 11 mm working distance. For scanning electron microscopy (SEM), parts of the suspensions were fixed on aluminum stubs after air drying. The stubs were sputter-coated with 50 nm of gold in an Eiko IB 3 (Eiko Engineering Co., Ltd., Hitachinaka, Japan).

The dataset consisted of concatenated 82 SSU rDNA, and 85 *rbc*L sequences, selected for available Cymbellales lineages and five diatom species from Rhopalodiaceae chosen as the outgroups (taxa names and Accession Numbers are given in Figure 1). The SSU rDNA and *rbc*L sequences were aligned separately using the G-INS-I algorithm in the Mafft ver. 7 software (RIMD, Osaka, Japan) (Katoh & Toh, 2010). The resulting data set comprised of 1,731, and 1,401 nucleotide sites for nuclear SSU rDNA, and plastid *rbc*L regions, respectively. After

removal of the unpaired regions, the aligned SSU rRNA gene sequences were combined with the *rbc*L gene sequences into a single matrix for concatenated SSU rDNA and *rbc*L.

The Bayesian inference (BI) method was performed using Beast ver. 1.10.1 software (BEAST Developers, Auckland, New Zealand) (Drummobd & Rambaut, 2007). The most appropriate partition-specific substitution models, shape parameter α and a proportion of invariable sites (pinvar) were recognized by the Bayesian information criterion (BIC) in jModelTest ver. 2.1.10 software (Vigo, Spain) (Darriba et al. 2012). This BIC-based model selection pro-cedure selected the following models, shape parameter α and a proportion of invariable sites (pinvar): GTR+G+I, α=0.4710 and pinvar=0.5970 for SSU rDNA; TPM1uf+G+I, α=0.3960, and pinvar=0.7310 for the first codon position of the *rbc*L gene; JC+I, pinvar=0.8690 for the second codon position of the *rbc*L gene; GTR+G+I, α=1.1260, and pinvar=0.2320 for the third codon position of the *rbc*L gene. However, the HKY model was applied instead of TPM1uf, and the F81 applied instead of JC as the most similar applicable options for BI. A speciation model was performed by a Yule process tree prior. Five MCMC analyses were run for 5 million generations (burn-in 1,000 million generations). The convergence diagnostics was performed in the Tracer ver. 1.7.1 software (MCMC Trace Analysis Tool, Edinburgh, United Kingdom) (Drummobd & Rambaut, 2007). The initial 15% trees were removed, the rest retained to construct a final chronogram with 90% posterior probabilities. The robustness of tree topologies was assessed by boot-strapping the data set with Maximum Likelihood (ML) analysis using RaxML software (Stamatakis, Hoover & Rougemont, 2008). The ML bootstrapping was performed with 1,000 replicas. Trees were viewed and edited using FigTree ver. 1.4.4 (University of Edinburgh, Edinburgh, United Kingdom) and Adobe Photoshop CC ver. 19.0 software.

Table 1:

List of the collected samples.

Results

Phylogeny of the Cymbellales is presented in Figure 1. The tree shows this order to be monophyletic. The genera *Cymbella* C.A. Agardh, *Didymosphenia* A. Schmidt, *Karthickia* Kociolek, Glushchenko & Kulikovskiy, *Encyonopsis* Krammer, *Encyonema* Kützing and *Cymbopleura* (Krammer) Krammer are represented in lineages that together represent a grade of

organization rather than a monophyletic clade. The clade of *Encyonema* species is the sister taxon to a clade comprised of *Geissleria* Lange-Bertalot & Metzeltin, *Paraplaconeis* Kulikovskiy, Lange-Bertalot & Metzeltin, & Witkowski*a* gen. nov., which together is sister to a clade of gomphonemoid diatoms, including *Gomphonella* Rabenhorst, *Reimeria* Kociolek and Stoermer, *Gomphonema* Ehrenberg and *Gomphoneis* P.T. Cleve. In the clade containing *Geissleria*, *Paraplaconeis* & Witkowski*a* gen. nov., which is strongly supported (Bayesian Post Priori = 0.98), each of these genera are also shown to be monophyletic with support ranging from strong to low for each.

Figure 1: Phylogenetic position of *Witkowskia* gen. nov., *Paraplaconeis* and *Geissleria* species based on Bayesian inference from an alignment of 90 sequences and 3132 characters (*rbc*L and SSU rRNA genes). Values of likelihood bootstrap (LB) from ML analyses below 50 are not shown. Values of Bayesian posterior probabilities (PP) below 0.9 are not shown. Strain numbers (if available) and GenBank numbers are indicated for all sequences.

***Placoneis* Mereschkowsky**

Type species: *Placoneis gastrum* (Ehrenberg) Mereschkowsky

Synonyms: *Navicula amphibola* P.T. Cleve 1891; *Placoneis amphibola* (Cleve) Cox 2003.

Description. Cells solitary, rectangular in girdle view, with a single H-shaped chloroplast. It consists of two elongated arms, connected by a narrow isthmus in the center of the valve. Valve outline variable, from linear-elliptic to lanceolate, apices acutely or broadly rounded, subcapitate, subrostrate, capitate or rostrate. Raphe often filiform, proximal raphe ends expanded and curved to the same or opposite sides. Distal raphe ends curved to the same side. In some species it seems that they are oppositely curved, but in SEM it is clear that one of the terminal fissures recurves and forms a hook-like ending. Intermissio present. Axial area usually narrow, central area variable. Isolated pores (stigmoids) may be present (up to 4 on the same valve). Their openings are round externally and round or oval internally. Striae uniseriate, sometimes shortened and more widely spaced in the central valve region. Areolae round externally and usually square internally. Areolae are occluded by pseudotectula.

Placoneis elinae **Kulikovskiy, Mironov, Genkal, Glushchenko & Kociolek sp. nov. (Figures 2–5)**

Holotype here designated: Slide no. 13899, Figure 3D, deposited in herbarium of MHA, Main Botanical Garden, Russian Academy of Science, Moscow, Russia.

Isotype. Slide no. 13899m, collection of Maxim Kulikovskiy at the Herbarium of the Institute of Plant Physiology, Russian Academy of Science, Moscow, Russia.

Type locality. Russia, NE Siberia, Chukotka Peninsula, small unnamed lake below Markovo Township (64°41.039′ N; 170°24.116′ E), *leg*. S.I. Genkal, 18 August 1980.

Etymology. The species name is dedicated to the wife of Andrei Mironov – Elina.

Distribution. The species is yet known only from its type locality.

Figure 2. A–D. *Placoneis elinae* sp. nov. (Fresh) Sample no. B445 (corresponds material in the slide no. 13899). Light microscopy. Live cells with chloroplast structure. Size diminution series. Scale bar = 10 μm.

Figure 3. A–H. *Placoneis elinae* sp. nov. Slide no. 13899. Light microscopy, size diminution series. (D). Holotype. Scale bar = 10 μm.

Description. LM (Figures 2A–D, 3A–E). Cells solitary. Chloroplast has a typical organization inherent in representatives of the genus, being a single H-shaped plastid, with one arm lying against each side of the girdle, connected by a narrow central isthmus (Figure 2A–D). Valves linear-elliptic to broadly linear-lanceolate. Valve ends rostrate to subcapitate. Length 44.5–74.0 μm, breadth 21.0–26.5 μm. The axial area is narrow at the poles, gradually becoming wider towards the center. Central area bowtie-shaped, formed by 3–5 shortened striae on each side. Raphe undulate, lateral, becoming filiform towards the central nodule. Proximal raphe ends expanded and rounded. Distal raphe ends extend to valve margin. Usually, four stigmoids are present in the central area. Striae distinctly radiate throughout the valve, 8.5–10.0 in 10 μm in the central portion, up to 11.0 in 10 μm near the apices. Areolae 14.0–21.0 in 10 μm, well-resolvable in LM, appear to be rectangular and slightly apically elongated (Figure 3A–H).

SEM, external view (Figure 4 A–E). Valve face is flat. Raphe undulate, raphe slit expanding near the proximal ends. Proximal raphe ends oval, slightly offset (Figure 4C, white arrows). Distal

raphe ends hook onto the valve and terminate on valve mantle (Figure 4E, white arrow). Four stigmoids are distinguishable at the end of striae, adjacent to the central area (Figure 4C, black arrows). Striae uniseriate, composed of rounded areolae, extending to valve margin (Figure 4E, black arrow). Unlike stigmoids, areolae in striae lie in regular, shallow, hourglass-shaped depressions (Figure 4C, white arrowhead). These depressions are less developed near the apices and on the valve margin (Figure 4D, E, white arrowheads). Due to depressions, areolae seem to be apically elongated in LM.

SEM, internal view (Figure 5A–E). The raphe is straight. Proximal raphe ends small, hook-shaped, deflected to one side (Figure 5B, black arrows). Distal ends terminating on small helictoglossae, slightly deflected to the opposite side from proximal raphe ends (Figure 5C, black arrow). Internal slits of stigmoids are relatively broad, aligned with striae (Figure 5B, white arrow). Stigmoids are not separated from the rest of stria. Rows of areolae are narrower than virgae, vimines very slender. Areolae rectangular or rectangular-elliptical, occluded by pseudotectula (Figure 5D,E, black arrows). Each pseudotectulum is formed by several elongated struts of irregular shape and orientation. It is very likely that struts are equipped with flap-like coverings, that demolished during the sample preparation.

Figure 4. A–E. *Placoneis elinae* sp. nov. Sample 13899 (corresponds material in the slide no. 13899). Scanning electron microscopy, external view. (A,B). Whole valve. (C). Central area. White arrows show the proximal raphe ends. Black arrows show the stigmoids. White arrowhead shows the areolar depression. (D) Valve mantle. White arrowhead shows less developed areolar depression. (E) Valve end. White arrow shows the distal raphe end. Black arrow shows the areolae extending to valve margin. White arrowhead shows less developed areolar depression. Scale bars (A,B) = 10 μm; (C) = 3 μm; (E) = 3.5 μm; (D) = 1.5 μm.

Figure 5. A–E. *Placoneis elinae* sp. nov. Sample 13899 (corresponds material in the slide no. 13899). Scanning electron microscopy, internal view. (A). Whole valve. (B). Central area. White arrows show the internal slits of stigmoids. Black arrows show the proximal raphe ends. (C). Valve end. Black arrow shows the distal raphe end.

(D,E). Areolae, occluded by pseudotectula. Black arrows show occlusions of areolae. Scale bars (A) = 10 μm; (B) = 3 μm; (C) = 2.5 μm; (D,E) = 1 μm.

Differential diagnosis. Morphologically, the new species is most similar to *Placoneis coloradensis*. However, *P. elinae* has more linear valve margins and more capitate apices. Also, the new species can be distinguished by a bowtie-shaped central area and shallow depressions of areolae (see Table 2). *Placoneis amphiboliformis* (Metzeltin, Lange-Bertalot and Soninkhishig) Vishnyakov (syn. *Naviculadicta amphiboliformis*) differs from *P. elinae* by less-protracted apices and elongated areolar openings without shallow depressions (see Table 2).

Table 2:

Comparison of morphological features of *Placoneis elinae sp. nov*., *Placoneis gastrum* and related species.

***Witkowskia* Kulikovskiy, Mironov, Glushchenko & Kociolek gen. nov.**

Type species: *Witkowskia neohambergii* (Glushchenko, Kezlya, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.

Description. Cells symmetrical, with variously rostrate to capitate apices. Girdle relatively shallow. Each cell has a single chloroplast with a central pyrenoid. The plastid is formed by two X-shaped plates connected by an isthmus (Kezlya et al. 2021: Figure 8A–C). Central area usually expanded. Isolated pores (stigmoids) may be present near the central area. Axial area narrow. Distal raphe endings curved to the same side of the valve (sometimes this feature is discernable only in SEM) (Kezlya et al. 2021: Figure 9A,C). In SEM, proximal endings appear to be straight externally and laterally deflected internally (Kezlya et al. 2021: Figure 9B,E). Striae uniseriate, often slightly radiate around the valve center, more or less parallel towards the apices, composed of small rounded poroids (Kezlya et al. 2021: Figure 9A,B). Areolar openings round to elongated externally, internally occluded by tectula – round or squarish flap-like coverings, equipped with several small struts. Struts are regularly arranged and directed perpendicular to the surface of the valve or may be slightly tilted relative to the areolar opening (Kezlya et al. 2021: Figure 9E,F).

Etymology. The genus is named in honor of Professor Dr Andrzej Witkowski (1955–2023), a prominent diatomist from Poland, for his contributions to understanding of diatom systematics, morphology and evolution.

***Chudaevia* Kulikovskiy, Mironov, Glushchenko & Kociolek gen. nov.**

Type species: *Chudaevia densistriata* Kulikovskiy, Mironov, Genkal, Glushchenko & Kociolek sp. nov.

Figure 6. A–K. *Chudaevia densistriata* sp. nov. Slide no. 02168. Light microscopy, size diminution series. (I). Holotype. Scale bar = 10 μm.

Description. The structure of the chloroplast is unknown. Cells symmetrical, linear-elliptic to elliptic. Valve apices rounded (in the post-initial valves) to rostrate. Axial area narrow, slightly expanded in the central part of the valve. Central area small, rounded to rhomboid, formed by shortened striae on each side. Raphe filiform to weakly. Proximal raphe ends drop-shaped, distal raphe ends extend to valve margin. A single isolated stigmoid located near the central raphe ends, slightly offset laterally relative to the axial area. Striae uniseriate, almost parallel at the central part of valve, then radiate throughout. Striae narrower than virgae. Areolae externally apically elongated, vimines with warty outgrowths. Areolae internally occluded by paratectula – flap-like coverings, equipped with 3–4 small struts. Struts regular, directed parallel to the valve surface.

Etymology. The genus is dedicated to our colleague, diatomist from Moscow State University, Dr Dmitry Alekseevich Chudaev**.**

***Chudaevia densistriata* Kulikovskiy, Mironov, Genkal, Glushchenko & Kociolek sp. nov. (Figures 6–8)**

Holotype here designated: Slide no. 02168, Figure 6I, deposited in herbarium of MHA, Main Botanical Garden, Russian Academy of Science, Moscow, Russia.

Isotype. Slide no. 02168m, collection of Maxim Kulikovskiy at the Herbarium of the Institute of Plant Physiology, Russian Academy of Science, Moscow, Russia.

Type locality. Vietnam, Bắc Kạn Province, Ba Bể Lake (22°33.083′N; 105°50.267′ E), *leg*. M.S. Kulikovskiy, 29 April 2015.

Etymology. The specific epithet refers to the dense striae arrangement.

Distribution. South-East Asia: Vietnam (Lake Ba Bể, type locality). East Asia: South Korea: Nakdong River estuary (as *Placoneis flabellata*) (Joh, 2013); Japan, Biwa Lake (as *Navicula diversipunctata* Hustedt) (Tuji, 2003).

Description. LM (Figure 6A–K). The structure of the chloroplast is unknown. Valves linear-elliptic to elliptic. Valve ends rounded (in the post-initial valves) to rostrate. Length 25.5–64.0 μm, breadth 15.0–19.5 μm. Axial area narrow, slightly expanded to the central part of valve. Central area rounded to rhomboid. In the center of valves are present irregularly shortened striae on each side. Raphe narrow, filiform, weakly lateral towards the ends. Proximal raphe ends drop-shaped. Distal raphe ends extend to valve margin. One stigmoid located closely to the central raphe ends, slightly offset laterally relative to the axial area; at the post-initial valves is weakly expressed. Striae almost parallel at the central part of valve, then radiate throughout, slightly undulated, 13–15 in 10 μm. Areolae not resolvable in LM (Figure 6A–K).
SEM, external view (Figure 7A–E). Valve face is flat. Raphe weakly lateral towards the ends. Proximal raphe ends small, with loop-like depressions that are slightly offset from each other (Figure 7B, black arrows). Distal raphe ends are heteromorphic: one is simple, the second – is hooked (Figure 7D,E, black arrows). Distal raphe ends terminate on valve mantle. Stigmoid isolated, round (Figure 7C, black arrow). Striae uniseriate, composed of rounded (at the central area, Figure 7C, white arrow) or elongated areolae (at the ends, Figure 7D, white arrow), extending to valve margin. Areolae 48–50 in 10 μm.
SEM, internal view (Figure 8A–E). The raphe is straight, located on a raised sternum (Figure 8A, black arrow). Proximal raphe ends are hook-shaped and deflected to one side, towards the stigmoid (Figure 8C, black arrows). Distal ends terminating on small helictoglossae and slightly deflected to opposite sides from proximal raphe ends (Figure 8D, white arrow). Stigmoid opening slit-like, located on raised central nodule (Figure 8A,C, white arrow). Slit opening of the stigmoid is also noticeable in LM with careful focusing. Areolae arranged in apically elongated series compared to the wide interstriae (virgae). Warty outgrowths are present between the areolae (the vimines bear small silica ridges interrupted in the middle). Areolae elliptical (rarely round) with 2–4 projections (struts) extending into the lumen of the openings, thus forming a paratectulum. The projections create an illusion of S-shaped opening of areolae (Figure 8 D,E,

black arrow). Areolar occlusions are similar to tectula but composed of struts that lie parallel to the valve surface (not perpendicular).

Figure 7. A–E *Chudaevia densistriata* sp. nov. Sample 02168 (corresponds material in the slide no. 02168). Scanning electron microscopy, external view. (A,B). Whole valve. Black arrows show the proximal raphe ends. (C). Cental area with a stigmoid. White arrow shows the rounded areolae. Black arrow shows the isolated stigmoid. (D,E). Valve ends. White arrow shows the elongated areolae. Black arrows show the heteromorphic distal raphe ends. Scale bars (A) = 10 μm; (B) = 5 μm; (C,D) = 1 μm; (E) = 0.5 μm.

Figure 8. *Chudaevia densistriata* sp. nov. Sample 02168 (corresponds material in the slide no. 02168). Scanning electron microscopy, internal view. (A,B). Whole valve. White arrow shows the slit of stigmoid. Black arrow shows the raphe on a raised sternum. (C). Central area. White arrow shows the slit of stigmoid. Black arrows show the proximal raphe ends. (D). Valve end. White arrow shows the distal raphe end terminating with a helictoglossae. Black arrow shows areolar occlusions. (E). Note areolae with paratectula and vimines with warty outgrowths. Black arrow shows areolar occlusion. Scale bars (A,B) = 5 μm; (B) = 5 μm; (C,D) = 1 μm; (E) = 0.5 μm.

Differential diagnosis. Morphologically, the new species is most similar to *Placoneis flabellata*. However, *Chudaevia densistriata* can be distinguished by the greater density of striae and more regular rhomboid central area (see Table 3). A species, detected and illustrated as *Navicula flabellata* by Moisseeva (1971), is morphologically similar to *Chudaevia densistriata* sp. nov. by valve outline, slightly undulated striae and the presence of stigmoid (see Table 3). Two finds of this species of this species beyond its type locality is similar to the material, described below (Table 3).

Table 3:
Comparison of morphological features of *Chudaevia densistriata* sp. nov., *Chudaevia flabellata* comb. nov. and finds identified with these species.

Moisseeva (1971) stated that in her material specimens of *N. flabellata* differ from Hustedt's illustrations (1937a) by more delicate striae (Moisseeva, 1971: p. 76). The compared species also differ in valve width (15.0–19.5 μm in *Chudaevia densistriata* sp. nov. against 13–15 μm in *Navicula flabellata* sensu Moisseeva). Striae density is also different (13–15 in 10 μm in *Chudaevia densistriata* sp. nov. against 15–16 in 10 μm in *Navicula flabellata* sensu Moisseeva). The species, illustrated by Tsoy (2017) and indentified as *Placoneis flabellata*, is also similar to the newly described species by valve outline, striae arrangement and the presence of a single stigmoid. (Table 3) (Tsoy, 2017: p. 290, Figures 56, 57). Additionaly, the species differ from each other in valve width (15.0–19.5 μm in *Chudaevia densistriata* sp. nov. against 22.1 μm in *Placoneis flabellata* sensu Tsoy).

Comments. Morphologically similar species are known from fossil sediments. Moisseeva illustrated *Navicula flabellata* from Pliocene fossil sediments of Primorsky territory, Golenki village (Moisseeva, 1971: p. 145, Plate XX, figure 13). Tsoy found *Placoneis flabellata* in the fossil sediments from the early Miocene of Yamato upland (The Japanese Sea) (Tsoy, 2017: p. 290, Figs 56, 57). Thus, we suggest that originally the species of this genus were widely distributed in water ecosystems across Asia, and nowadays *Chudaevia* gen. nov. is comprised of two recent species from Asia. Fossil specimens might represent another two species of this genus.

***Chudaevia flabellata* (F. Meister) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov. (Figure 9)**

Basionym: *Navicula flabellata* F. Meister 1932. Kieselalgen aus Asien. Berlin: Gebrüder Borntraeger: p. 36, fig. 94.

Synonym: *Placoneis flabellata* (F. Meister) Kimura, H. Fukushima and Ts. Kobayashi 2015.

Figure 9. A–I. *Chudaevia flabellata* comb. nov. Slides no. 00955 (A,D,E–I), 00996 (B,C). (A–G). Light microscopy, size diminution series. (H,I). Scanning electron microscopy, internal view. (H). Whole valve. White arrow shows the opening of stigmoid. Black arrows show the distal raphe ends terminating on helictoglossae. (I). Note areolae with paratectula and vimines with warty outgrowths. Black arrow shows the areolar occlusion. Scale bars (A–G) = 10 μm; (H) = 5 μm; (I) = 0.5 μm.

Description. LM (Figure 9A–G). The structure of chloroplast is studied in Kimura et al.. Valves linear-elliptic to elliptic. Valve ends acutely rounded, barely protracted, rostrate. Length 24.1–57.3 µm, breadth 12.9–16.0 µm. Axial area narrow, slightly expanded to the central part of valve. Central area rhomboid. In the center of valves are present irregularly shortened striae on each side. Raphe narrow, filiform, weakly lateral towards the ends. Proximal raphe ends drop-shaped. Distal raphe ends extend to valve margin. One stigmoid located closely to the central raphe ends, slightly offset laterally relative to the axial area; at the post-initial valves is weakly expressed. Striae almost parallel at the central part of valve, then radiate throughout, slightly undulated, 10–11 in 10 µm. Areolae not resolvable in LM.

SEM, internal view (Figure 9H,I). The raphe is straight, proximal raphe ends slightly deflected to one, towards the stigmoid. Distal ends terminating on small helictoglossae and slightly deflected to opposite sides from proximal raphe ends (Figure 9H, black arrows). Stigmoid opening elongated (Figure 9H, white arrow). Internal opening of the stigmoid is noticeable in LM with careful focusing. Areolae in striae are apically elongated, striae separated by wide interstriae (virgae). Warty outgrowths are present between the areolae, at the vimines. Areolae elliptical with 2–4 projections (struts) extending into the lumen of the openings, thus forming a paratectulum (Figure 9I, black arrow). Areolae 44–46 in 10 µm.

Distribution. South-East Asia: as *Navicula flabellata*, the species was illustrated from Vietnam, Saigon River (Meister, 1932); Indonesia, Musi River, Palembang (Schmidt, 1936, Hustedt, 1937a); Thailand, Nan Province, Nan River (Kunpradid, 2005). East Asia: Japan, Lake Aoki (Tsoy, 2017). As *Placoneis flabellata*, the species was illustrated from Indonesia, unnamed river in Batimurung, Sulawesi Island (Kimura, Fukushima & Kobayashi, 2015). We illustrate this species from Laos (Vientiane Province, periphyton of Nam Lik River; Khammouane Province, unnamed creek, Nahin village).

Comments. The original description of *N. flabellata* was proposed by F. Meister (1932) based on M. Voigt's samples from Vietnam. In that description, the presence of stigmoid is not mentioned. In spite of that, the stigmoid is resolvable (Meister, 1932: Figure 94). Later, F. Hustedt highlighted the presence of stigmoid in the species from Indonesia (Schmidt, 1936; Hustedt, 1937a: Taf. XVIII, Figure 17).

New combinations.

Witkowskia neohambergii **(Kezlya, Glushchenko, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis neohambergii* Kezlya, Glushchenko, Kulikovskiy & Kociolek in Kezlya, Glushchenko, Maltsev, Gusev, Genkal, Kociolek & Kulikovskiy 2021. Three New Species of *Placoneis* Mereschkowsky (Bacillariophyceae: Cymbellales) with Comments on Cryptic Diversity in the *P. elginensis*—Group. Water 2021, 13, p. 8, figs 8–9.

Witkowskia abiskoensis **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula abiskoensis* Hustedt 1942a. Diatomeen aus der Umgebung von Abisko in Schwedisch-Lappland. Archiv für Hydrobiologie 39(1), p. 118, fig. 36.

Synonym: *Placoneis abiskoensis* (Hustedt) Lange-Bertalot & Metzeltin in Metzeltin & Witkowski 1996.

Witkowskia abundans **(Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis abundans* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 166, pl. 73, figs 1–14; pl. 77, figs 1–3A.

Witkowskia abyssalis **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis abyssalis* Pomazkina & Sherbakova 2019 in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 192.

Synonym: *Placoneis abyssalis* Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia acuta **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis acuta* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 192.
Synonym: *Placoneis acuta* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia amoena* (Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis amoena* Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 224, pl. 124: fig. 1.

***Witkowskia anglophila* (Lange-Bertalot in Lange-Bertalot & Krammer) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula anglophila* Lange-Bertalot in Lange-Bertalot & Krammer 1987. Bacillariaceae, Epithemiaceae, Surirellaceae. Neue und wenig bekannte Taxa, neue Kombinationen und Synonyme sowie Bemerkungen und Ergänzungen zu den Naviculaceae. Bibliotheca Diatomologica 15: p. 121.

***Witkowskia antediluviana* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula antediluviana* Hustedt 1955a. Neue und wenig bekannte Diatomeen. VII. Berircht der Deutschen Botanischen Gessellschaft 68(3), p. 132, figs 2, 3.
Synonym: *Placoneis antediluviana* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia apicalicostata* (Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis apicalicostata* Metzeltin & Lange-Bertalot 2002. Diatoms from the "Island Continent" Madagascar. Iconographia Diatomologica 11, p. 53, pl. 30, figs 1–7.

***Witkowskia argentata* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis argentata* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 193.

Synonym: *Placoneis argentata* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia asymmetricus* (Glushchenko, Keslya, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis asymmetricus* Glushchenko, Keslya, Kulikovskiy & Kociolek in Kezlya, Glushchenko, Kociolek, Maltsev, Genkal & Kulikovskiy 2022. A new species of *Placoneis* Mereschkowsky (Bacillariophyceae: Cymbellales) from wet soils in southern Vietnam. Cryptogamie, Algologie 43(11), p. 180, figs 2–4.

***Witkowskia attenuata* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis attenuata* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 193.

Synonym: *Placoneis attenuata* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia australis* (Van de Vijver & Zidarova in Zidarova, Van de Vijver, Mataloni, Kopalova & Nedbalova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis australis* Van de Vijver & Zidarova in Zidarova, Van de Vijver, Mataloni, Kopalova & Nedbalova 2009. Four new freshwater diatom species (Bacillariophyceae) from Antarctica. Cryptogamie, Algologie 30(4), p. 301, figs 44–58, figs 62–64.

Witkowskia baicalensis **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**
Basionym: *Placoneis witkowskii* var. *baicalensis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 198.
Synonym: *Placoneis witkowskii* var. *baicalensis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia baikaloelginensis **(Kezlya, Glushchenko, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis baikaloelginensis* Kezlya, Glushchenko, Kulikovskiy & Kociolek in Kezlya, Glushchenko, Maltsev, Gusev, Genkal, Kociolek & Kulikovskiy 2021. Three New Species of *Placoneis* Mereschkowsky (Bacillariophyceae: Cymbellales) with Comments on Cryptic Diversity in the *P. elginensis*—Group. Water 2021, 13, p. 4, figs 2–4.

Witkowskia betulina **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis betulina* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 193.
Synonym: *Placoneis betulina* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia bicapitata **(Heinzerling) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis bicapitata* Heinzerling 1908. Der Bau der Diatomeenzelle mit besonderer Beruchsichtigung der ergastischen Gebilde und der Beziegung des Baues zur Systematic. Bibliotheca Botanica. Stuttgart 15(69), p. 71, pl. I, fig. 28.

Witkowskia bicuneus **(Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

549 **Basionym:** *Placoneis bicuneus* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of
550 Uruguay. Compared with other taxa from South America and elsewhere. Iconographia
551 Diatomologica 15, p. 170, pl. 71, fig. 1–7, pl. 76, fig. 1.
552
553 ***Witkowskia bona*** **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova)**
554 **Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
555 **Basionym:** *Placoneis bona* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova
556 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater
557 Biology 2019(1), p. 193.
558 **Synonym:** *Placoneis bona* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova
559 2018, nom illeg.
560
561 ***Witkowskia boris-skvortzowii*** **(Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy,**
562 **Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek**
563 **comb. nov.**
564 **Basionym:** *Placoneis boris-skvortzowii* Metzeltin, Kulikovskiy & Lange-Bertalot in
565 Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic
566 diatoms I. Iconographia Diatomologica 23, p. 225, pl. 132, figs 17, 18.
567
568 ***Witkowskia bukhchuluunae*** **(Metzeltin, Lange-Bertalot & Nergui) Kulikovskiy,**
569 **Glushchenko, Mironov & Kociolek comb. nov.**
570 **Basionym:** *Placoneis bukhchuluunae* Metzeltin, Lange-Bertalot & Nergui 2009. Diatoms in
571 Mongolia. Iconographia Diatomologica 20, p. 81, pl. 55, figs 7–13.
572
573 ***Witkowskia capitata*** **(Patrick) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et**
574 **stat. nov.**
575 **Basionym:** *Navicula exigua* var. *capitata* Patrick 1945. A taxonomic and ecological study of
576 some diatoms from the Pocono Plateau and adjacent regions. Farlowia. 2(2), p. 179, pl. 1, fig. 8.
577 **Synonym:** *Placoneis exigua* var. *capitata* (Patrick) Aysel 2005.
578

Witkowskia cattiensis **(Glushchenko, Kezlya, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis cattiensis* Glushchenko, Kezlya, Kulikovskiy & Kociolek in Glushchenko, Maltsev, Gusev, Genkal, Kuznetsova, Kociolek & Kulikovskiy 2020. *Placoneis cattiensis* sp. nov. – a new diatom (Bacillariophyceae: Cymbellales) soil species from Cát Tiên National Park (Vietnam). Phytotaxa 460(4): p. 241, figs 3–28.

Witkowskia centropunctata **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula centropunctata* Hustedt 1964. Die Kieselalgen Deutschlands, Österreichs und der Schweiz unter Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete. In: L. Rabenhorst (ed.), Kryptogamen Flora von Deutschland, Österreich und der Schweiz. Akademische Verlagsgesellschaft m.b.h. Leipzig 7(Teil 3, Lief. 4), p. 677, fig. 1678.

Synonym: *Placoneis centropunctata* (Hustedt) Metzeltin & Lange-Bertalot 1998.

Witkowskia chilensis **(Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis chilensis* Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich 2000. Diatoms of the Andes. From Venezuela to Patagonia/Tierra del Fuego and two additional contributions. Iconographia Diatomologica 9, p. 206, pl. 59, figs 8, 9.

Witkowskia clementioides **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula clementioides* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 285, pl. 8, figs 19, 20.

Synonym: *Placoneis clementioides* (Hustedt) Cox 1987.

Witkowskia clementis **(Grunow) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula clementis* Grunow 1882. Beiträge zur Kenntniss der fossilen Diatomeen Österreich-Ungarns. In: Beiträge zur Paläontologie Österreich-Ungarns und des Orients. II Band Pt 4. (Mojsisovics, E. & Neumayr, N. Eds). Wein: Alfred Hölder, p. 144, pl. 30, fig. 52.
Synonym: *Placoneis clementis* (Grunow) Cox 1987.

***Witkowskia clementispronina* (Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis clementispronina* Lange-Bertalot & Wojtal 2014. Diversity in species complexes of *Placoneis clementis* (Grunow) Cox and *Paraplaconeis placentula* (Ehrenberg) Kulikovskiy, Lange-Bertalot & Metzeltin. Beihefte zur Nova Hedwigia 143, p. 405, fig. 5.

***Witkowskia cocquytiae* (Fofana, Sow, Taylor, Ector & Van de Vijver) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis cocquytiae* Fofana, Sow, Taylor, Ector & Van de Vijver 2014. *Placoneis cocquytiae*, a new raphid diatom (Bacillariophyceae) from the Senegal River (Senegal, West Africa). Phytotaxa 161(2), p. 140, figs 1–10.

***Witkowskia composita* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis composita* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology, p. 193.
Synonym: *Placoneis composita* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia constans* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula constans* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, P. 284, pl. VIII, fig. 13.
Synonym: *Placoneis constans* (Hustedt) Cox 2003.

Witkowskia conveniens **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula conveniens* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 402, fig. 123.

Synonym: *Placoneis conveniens* (Hustedt) Metzeltin & Lange-Bertalot 1998.

Witkowskia coxiae **(Kociolek & Thomas) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis coxiae* Kociolek & Thomas 2010. Taxonomy and ultrastructure of five naviculoid diatoms (class Bacillariophyceae) from the Rocky Mountains of Colorado (USA), with the description of a new genus and four new species. Nova Hedwigia 90(1/2), p. 200, figs 23–29, figs 36–38.

Witkowskia cruciata **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis cruciata* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 193.

Synonym: *Placoneis cruciate* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia cuneata **(M. Möller ex Foged) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula dicephala* f. *cuneata* M. Møller ex Foged 1977. Freshwater diatoms in Ireland. Bibliotheca Phycologica 34, p. 78, pl. XXIX, fig. 6 (as '(M. Møller) fo. Nov.').

Synonyms: *Placoneis elginensis* var. *cuneata* (M. Møller ex Foged) Lange-Bertalot in Krammer & Lange-Bertalot 1985; *Placoneis cuneata* (M. Möller ex Foged) Potapova 2014.

Witkowskia dacostae **(Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis dacostae* Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, p. 196, pl. 77, fig. 1, pl. 90, figs 4–8.

***Witkowskia dahurica* (Skvortzow) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula dahurica* Skvortzow 1937. Bottom diatoms from Olhon Gate of Baikal Lake, Siberia. Philippine Journal of Science, Section C 62(3), p. 337, pl. 7, fig. 35; pl. 8, fig. 7.

Synonym: *Placoneis dahurica* (Skvortzow) Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019.

***Witkowskia demeraroides* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula demeraroides* Hustedt 1964. Die Kieselalgen Deutschlands, Österreichs und der Schweiz unter Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete. In: L. Rabenhorst (ed.), Kryptogamen Flora von Deutschland, Österreich und der Schweiz. Akademische Verlagsgesellschaft m.b.h. Leipzig 7 (Teil 3, Lief. 4), p. 676, fig. 1677.

Synonym: *Placoneis demeraroides* (Hustedt) Metzeltin & Lange-Bertalot 1998.

***Witkowskia densa* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula densa* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 284, fig. 28.

Synonym: *Placoneis densa* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia diaphana* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis diaphana* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 194.

Synonym: *Placoneis diaphana* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia dicephala* (Ehrenberg) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula dicephala* Ehrenberg 1838. Die Infusionsthierchen als vollkommene Organismen. Ein Blick in das tiefere organische Leben der Natur. P. 185, no figures.

Synonym: *Placoneis dicephala* (Ehrenberg) Mereschkowsky 1903.

***Witkowskia disparilis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis disparilis* (Hustedt) Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, p. 197, pl. 92, figs 1–6.

***Witkowskia distincta* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis distincta* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 194.

Synonym: *Placoneis distincta* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia diversipunctata* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov**

Basionym: *Navicula diversipunctata* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 275, fig. 5

***Witkowskia diminuta* (Pomazkina in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Placoneis vladimiri* var. *diminuta* Pomazkina in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 198.
Synonym: *Placoneis vladimiri* var. *diminuta* Pomazkina in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia edlundii* (Vishnyakov, Kulikovskiy, Dorofeyuk & Genkal) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis edlundii* Vishnyakov in Vishnyakov, Kulikovskiy, Dorofeyuk & Genkal 2016. New species and new combinations in the genera *Placoneis* and *Paraplaconeis* (Bacillariophyceae: Cymbellales). Botanicheskii Zhurnal, p. 1302, pl. I, fig. 13–25; pl. II, fig. 7.

***Witkowskia elegans* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis elegans* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 5, p. 174, pl. 75, figs 1–10.

***Witkowskia elegantula* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis elegantula* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 5, p. 74, pl. 75, figs 1–10.

***Witkowskia elenae* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis elenae* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 194.
Synonym: *Placoneis elenae* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom illeg.

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759 ***Witkowskia elginensis*** **(Gregory) Kulikovskiy, Glushchenko, Mironov & Kociolek comb.**
760 **nov.**
761 **Basionym:** *Pinnularia elginensis* Gregory 1856. Notice of some new species of British Fresh-
762 water Diatomaceae. Quarterly Journal of Microscopical Science, new series, London 4, p. 9, pl.
763 1, fig. 33.
764 **Synonym:** *Placoneis elginensis* (Gregory) Cox 1987.
765
766 ***Witkowskia elliptica*** **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et**
767 **stat. nov.**
768 **Basionym:** *Navicula exigua* var. *elliptica* Hustedt 1927. Fossile bacillariaceen aus dem Loa-
769 Becken in der Atacama-Wüste, Chile. Archiv für Hydrobiologie 18(2), p. 244, pl. 7, fig. 27.
770 **Synonym:** *Placoneis elliptica* (Hustedt) Ohtsuka 2002.
771
772 ***Witkowskia ellipticorostrata*** **(Metzeltin, Lange-Bertalot & Nergui) Kulikovskiy,**
773 **Glushchenko, Mironov & Kociolek comb. nov.**
774 **Basionym:** *Placoneis ellipticorostrata* Metzeltin, Lange-Bertalot & Nergui 2009. Diatoms in
775 Mongolia. Iconographia Diatomologica 20, p. 82, pl. 53, figs 1–5.
776
777 ***Witkowskia eugeniae*** **(Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy,**
778 **Glushchenko, Mironov & Kociolek comb. nov.**
779 **Basionym:** *Placoneis eugeniae* Sherbakova in Pomazkina, Rodionova & Sherbakova 2019.
780 Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater
781 Biology 2019(1), p. 194.
782 **Synonym:** *Placoneis eugeniae* Sherbakova in Pomazkina, Rodionova & Sherbakova 2019, nom.
783 Illeg.
784
785 ***Witkowskia exigua*** **(W. Gregory) Kulikovskiy, Glushchenko, Mironov & Kociolek comb.**
786 **nov.**

Basionym: *Pinnularia exigua* W. Gregory 1854. Notice of the new forms and varieties of known forms occurring in the diatomaceous earth of Mull; with remarks on the classification of the Diatomaceae. Quarterly Journal of Microscopical Science 2, p. 99, pl. IV, fig. 14.
Synonym: *Placoneis exigua* (W. Gregory) Mereschkowsky 1903.

***Witkowskia exiguiformis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula exiguiformis* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 283, fig. 23.
Synonym: *Placoneis exiguiformis* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia exiguioides* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula exiguioides* Hustedt 1955a. Neue und wenig bekannte Diatomeen. VII. Bericht der Deutschen Botanischen Gessellschaft 68(3), p. 131, fig. 1.
Synonym: *Placoneis exiguioides* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia explanata* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula explanata* Hustedt 1948. Die Diatomeenflora diluvialer Sedimente bei dem Dorfe Gaj bei Konin im Warthegebiet. Schweizerische Zeitschrift für Hydrologie 11(1/2), p. 202, 207, figs 7, 8.
Synonyms: *Placoneis explanata* (Hustedt) S. Mayama in S. Mayama & A. Kawashima 1998; *Placoneis explanata* (Hustedt) Lange-Bertalot in U. Rumrich, Lange-Bertalot & M. Rumrich 2000.

***Witkowskia extraordinaris* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Placoneis extraordinaris* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 194.
Synonym: *Placoneis extraordinaris* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. Illeg.

***Witkowskia fogedii* (Foged & Møller) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et nom. nov.**
Replaced synonym: *Navicula pseudoanglica* Foged & Møller in Foged 1968. Diatoméerne I en postglacial boreprøve fra bunden af Esrom sø, Danmark. Medd. Dansk Geol. Foren. København., Bd 18: 178, fig. 1 in appendix, nom. illeg.
Synonym: *Placoneis incerta* Vishnyakov 2016.

***Witkowskia fourtanieri* (Kociolek & Thomas) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis fourtanieri* Kociolek & Thomas 2010. Taxonomy and ultrastructure of five naviculoid diatoms (class Bacillariophyceae) from the Rocky Mountains of Colorado (USA), with the description of a new genus and four new species. Nova Hedwigia 90 (1–2), p. 204, figs 42–47, 52–56.

***Witkowskia gastriformis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula gastriformis* Hustedt 1935. Die fossile Diatomeenflora in den Ablagerungen des Tobasees auf Sumatra. "Tropische Binnengewasser, Band V". Archiv für Hydrobiologie, Supplement 14, p. 157, pl. 1, fig. 8.
Synonyms: *Navicula gastriformis* Hustedt in Schmidt et al. 1934, nom. invalid.; *Placoneis gastriformis* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia geitleri* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula geitleri* Hustedt 1937. Systematische und ökologische Untersuchungen über die Diatomeen-Flora von Java, Bali und Sumatra nach dem Material der Deutschen

Limnologischen Sunda-Expedition. Archiv für Hydrobiologie (Supplement) 15(2), p. 263, figs 1–3; pl. XVIII, fig. 34.
Synonyms: *Navicula geitleri* Hustedt in A. Schmidt et al. 1934, nom. invalid.; *Placoneis geitleri* (Hustedt) Vishnjakov in Vishnyakov, Kulikovskiy, Dorofeyuk & Genkal 2016.

***Witkowskia gelegma* (Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis gelegma* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 226, pl. 132, figs 19–21.

***Witkowskia gracilis* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis gracilis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 180, pl. 73, figs 15–17; pl. 76, fig. 3.

***Witkowskia granum* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis granum* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 194.
Synonym: *Placoneis granum* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia grata* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis grata* Pomazkina in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis grata* Pomazkina in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia habita* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula habita* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 399, fig. 116.
Synonym: *Placoneis habita* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia hambergii* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula hambergii* Hustedt 1924. Die Bacillariaceen-Vegetation des Sarekgebirges. Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland, Botanik, Stockholm 3(6), p. 562, pl. 17, fig. 2.
Synonym: *Placoneis hambergii* (Hustedt) Bruder in Bruder & Medlin 2007.

***Witkowskia humilis* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis humilis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 182, pl. 74, fig. 11–19; pl. 76, fig. 4.

***Witkowskia hustedtii* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov., stat. nov. et nom. nov.**
Replaced synonym: *Navicula exigua* var. *signata* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 287, fig. 14.
Synonym: *Placoneis significans* Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia ignita* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ignita* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.
Synonym: *Placoneis ignita* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom illeg.

Witkowskia ignorata **(Schimanski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula ignorata* Schimanski 1978. Beitrag zur Diatomeeflora des Frankenwaldes. Nova Hedwigia 30, p. 585, pl. 6, figs 1–9.
Synonym: *Placoneis ignorata* (Schimanski) Lange-Bertalot in U. Rumrich, Lange-Bertalot & M. Rumrich 2000.

Witkowskia inexplorata **(Krasske) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula inexplorata* Krasske 1939. Zur Kieselalgenflora Südchiles. Archiv für Hydrobiologie und Planktonkunde, Stuttgart 35(3), p. 392; pl. 12, fig. 6.
Synonym: *Placoneis inexplorata* (Krasske) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

Witkowskia insignita **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula insignita* Hustedt 1942b. Süßwasser-Diatomeen des indomalayischen Archipels und der Hawaii-Inseln. Nach dem Material der Wallacea-Expedition. Internationale Revue der gesamten Hydrobiologie und Hydrographie 42(1/3), p. 73, fig. 126, 139–141.
Synonym: *Placoneis insignita* (Hustedt) Cox 2003.

Witkowskia insularis **Sherbakova & Pomazkina in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis insularis* Sherbakova & Pomazkina in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis insularis* Sherbakova & Pomazkina in Pomazkina, Rodionova & Sherbakova 2019, nom. illeg.

***Witkowskia interglacialis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula interglacialis* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 286, pl. VIII (Kezlya et al. 2022), fig. 27.

Synonym: *Placoneis interglacialis* (Hustedt) Cox 2003.

***Witkowskia ivanii* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ivanii* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis ivanii* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019, nom. illeg.

***Witkowskia itamoemae* (Straube, Tremarin & Ludwig in Straube, Tremarin, de Castro-Pires, Marquardt & Ludwig) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis itamoemae* Straube, Tremarin & Ludwig in Straube, Tremarin, de Castro-Pires, Marquardt & Ludwig 2013. Morphology, ultrastructure and distribution of *Placoneis itamoemae* sp. nov. (Cymbellaceae) from Brazil. Phytotaxa 76(3), p. 56, fig. 1–24.

***Witkowskia izhboldinae* (Vishnyakov in Vishnyakov, Kulikovskiy, Dorofeyuk & Genkal) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis izhboldinae* Vishnyakov in Vishnyakov, Kulikovskiy, Dorofeyuk & Genkal 2016. Botanicheskii Zhurnal, 1301, pl. I, fig. 1–8, pl. II, fig. 1–6.

***Witkowskia jatobensis* (Krasske) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula jatobensis* Krasske 1951. Die Diatomeenflora der Açudas Nordostbrasiliens (Zur Kieselalgenflora Brasiliens II). Archiv für Hydrobiologie 44, p. 651; fig. 12.
Synonym: *Placoneis jatobensis* (Krasske) Metzeltin et Lange-Bertalot 1998.

***Witkowskia juriljii* (Miho & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis juriljii* Miho & Lange-Bertalot 2006. Diversity of the genus *Placoneis* in Lake Ohrid and other freshwater habitats of Albania. Proc. Int. Diatom. Symp. 18, p. 306, figs 27–35.

***Witkowskia lata* (Peragallo in Tempère & Peragallo) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat nov.**
Basionym: *Navicula dicephala* var. *lata* Peragallo in Tempère & Peragallo 1908. Diatomées du Monde Entier, Edition 2, 30 fascicules. Fascicule 2–7, p. 56; No. 103, 104.
Synonym: *Placoneis lata* (M. Peragallo) Lowe in Johansen, Lowe, Gómez, Kociolek & Makosky 2004.

***Witkowskia laticuneata* (Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis laticuneata* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 227, pl. 125, figs 1–3.

***Witkowskia latiuscula* (Grunow in Cleve & Grunow) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov. et stat. nov.**
Basionym: *Navicula gastrum* var. *latiusculum* ‘'*latiuscul"*) Grunow in P.T. Cleve & Grunow 1880. Beiträge zur Kenntniss der arctischen Diatomeen. Kongliga Svenska Vetenskaps-Akademiens Handlingar 17(2), p. 31.
Synonym: *Placoneis latiuscula* (Grunow) Kulikovskiy & Genkal in Kulikovskiy, Genkal & Mikheeva 2010.

Witkowskia likhoshwayae **(Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis likhoshwayae* Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 227, pl. 132, fig. 1.

Witkowskia linearis **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis linearis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis linearis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia lucinensis **(Lange-Bertalot in Hoffmann, Werum & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis lucinensis* Lange-Bertalot in Hoffmann, Werum & Lange-Bertalot 2011. Diatomeen im Süsswasser-Benthos von Mitteleuropa. Bestimmungsflora Kieselalgen für die ökologische Praxis. Über 700 der häufigsten Arten und ihre Ökologie, p. 501, pl. 47, figs 15–19.

Witkowskia ludmilae **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ludmilae* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis ludmilae* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia macedonica **(Levkov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis macedonica* Levkov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov 2007. Diatoms of Lakes Prespa and Ohrid, about 500 taxa from ancient lake system. Iconographia Diatomologica 16, p.110, pl. 98; pl. 99, figs 20–23.

Witkowskia maculata **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula placentula* var. *maculata* Hustedt 1945. Diatomeen aus Seen und Quellgebieten der Balkan-Halbinsel. Archiv für Hydrobiologie 40(4), p. 928, pl. XL, fig. 16.

Synonym: *Placoneis maculata* (Hustedt) Levkov in Levkov, Krstic, Metzeltin & Nakov 2007.

Witkowskia madagascariensis **(Lange-Bertalot & Metzeltin in Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis madagascariensis* Lange-Bertalot & Metzeltin in Metzeltin & Lange-Bertalot 2002. Diatoms from the “Island Continent” Madagascar. Iconographia Diatomologica 11, p. 54, pl. 27, figs 37–40; pl. 28, fig. 4.

Witkowskia magna **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis magna* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 195.

Synonym: *Placoneis magna* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019, nom. illeg.

Witkowskia maior **(Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis maior* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 228, pl. 124, figs 4–7.

***Witkowskia margaritae* (Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis margaritae* Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 229, pl. 128, figs 1–14; pl. 129, figs 1, 2; pl. 130, figs 1, 2.

***Witkowskia merinensis* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis merinensis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 183–184, pl. 72, figs 7–11.

***Witkowskia mira* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis mira* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.
Synonym: *Placoneis mira* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia miseranda* (Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis miseranda* Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 230, pl. 125, figs 10, 11; pl. 132, figs 13–15.

Witkowskia molesta **(Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis molesta* Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, p. 197–198, pl. 89, figs 6–9.

Witkowskia molestissima **(Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis molestissima* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 186, pl. 70, figs 14–21; pl. 77, fig. 4, 4A.

Witkowskia mollis **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis mollis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.

Synonym: *Placoneis mollis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019, nom. illeg.

Witkowskia nanoclementis **(Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis nanoclementis* Lange-Bertalot & Wojtal 2014. Diversity in species complexes of *Placoneis clementis* (Grunow) Cox and *Paraplaconeis placentula* (Ehrenberg) Kulikovskiy, Lange-Bertalot & Metzeltin. Beihefte zur Nova Hedwigia 143, p. 407, figs 14–28, 71–73.

Witkowskia navicula **(Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis navicula* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.
Synonym: *Placoneis navicula* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia neglecta* (R.M. Patrick) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**
Basionym: *Navicula elginensis* var. *neglecta* R.M. Patrick in Patrick & Reimer 1966. The diatoms of the United States exclusive of Alaska and Hawaii. Volume 1: Fragilariaceae, Eunotiaceae, Achnanthaceae, Naviculaceae. Monographs of the Academy of Natural Sciences of Philadelphia 13: p. 525; pl. 50, fig. 5.
Synonym: *Placoneis elginensis* var. *neglecta* H. Kobayasi in Mayama, Idei, Osada & Nagumo2002.

***Witkowskia neoexigua* (Miho & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis neoexigua* Miho & Lange-Bertalot 2006. Diversity of the genus *Placoneis* in Lake Ohrid and other freshwater habitats of Albania. Proc. Int. Diatom. Symp. 18, p. 302, 304, figs 1–11, 20–26.

***Witkowskia neotropica* (Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis neotropica* Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, p. 198–199, pl. 89, figs 1–5.

***Witkowskia nipponica* (Skvortzow) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**
Basionym: *Navicula similis* var. *nipponica* Skvortzow 1936. Diatoms from Biwa Lake, Honshu Island, Nippon. Philippine Journal of Science 61(2), p. 276, fig. 3: 2.

Witkowskia obtuseprotracta **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula obtuseprotracta* Hustedt 1964. Die Kieselalgen Deutschlands, Österreichs und der Schweiz unter Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete. In: L. Rabenhorst (ed.), Kryptogamen Flora von Deutschland, Österreich und der Schweiz. Akademische Verlagsgesellschaft m.b.h. Leipzig 7(Teil 3, Lief. 4), p. 767, fig. 1740.

Synonym: *Placoneis obtuseprotracta* (Hustedt) Li & Metzeltin in Gong, Li, Metzeltin & Lange-Bertalot 2013.

Witkowskia ohridana **(Levkov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ohridana* Levkov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov 2007. Diatoms of Lakes Prespa and Ohrid, about 500 taxa from ancient lake system. Iconographia Diatomologica 16, p. 111, pl. 97, figs 1–7.

Witkowskia opportuna **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula opportuna* Hustedt 1950. Die Diatomeenflora norddeutscher Seen mit besonderer Berücksichtigung des holsteinischen Seengebiets V–VII. Seen in Mecklenburg, Lauenburg und Nordostdeutschland. Archiv für Hydrobiologie 43, p. 436, pl. 39, fig. 21, 22.

Synonym: *Placoneis opportuna* (Hustedt) Chudaev & Gololobova2016.

Witkowskia ovillus **(Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ovillus* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 187–188, pl. 74, fig. 20–26.

Witkowskia paraelginensis **(Lange-Bertalot in U. Rumrich, Lange-Bertalot & M. Rumrich) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis paraelginensis* Lange-Bertalot in U. Rumrich, Lange-Bertalot & M. Rumrich 2000. Diatoms of the Andes. From Venezuela to Patagonia/Tierra del Fuego and two additional contributions. Iconographia Diatomologica 9, p. 208, pl. 60, fig. 17–20.

***Witkowskia paragelegma* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis paragelegma* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.

Synonym: *Placoneis paragelegma* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia paraundulata* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula exigua* f. *undulata* Hustedt 1942b. Süßwasser-Diatomeen des indomalayischen Archipels und der Hawaii-Inslen. Internationale Revue der gesamten Hydrobiologie und Hydrographie 42(1/3), p. 73, fig. 135.

Synonym: *Placoneis paraundulata* Ohtsuka 2002.

***Witkowskia parazula* (Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis parazula* Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 231, pl. 131, figs 14–17.

***Witkowskia parunculus* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula parunculus* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 398, fig. 115.

Synonym: *Placoneis parunculus* (Hustedt) Lange-Bertalot & Metzeltin in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia parvapolonica* (Lange-Bertalot & Wojtal) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis parvapolonica* Lange-Bertalot & Wojtal 2014. Diversity in species complexes of *Placoneis clementis* (Grunow) Cox and *Paraplaconeis placentula* (Ehrenberg) Kulikovskiy, Lange-Bertalot & Metzeltin. Beihefte zur Nova Hedwigia 143, p. 408, figs 29–44, 74–76.

***Witkowskia parvula* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis parvula* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.
Synonym: *Placoneis parvula* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia patagonica* (Maidana in Maidana, Aponte, Fey, Schäbitz & Morales) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis patagonica* Maidana in Maidana, Aponte, Fey, Schäbitz & Morales 2017. *Cyclostepanos salsae* and *Placoneis patagonica*, two new diatoms (Bacillariophyta) from Laguna Cháltel in southern Patgonia, Argentina. Nova Hedwigia Beiheft 146, p. 98, figs 21–40.

***Witkowskia paucimarensis* (Rodionova & Pomazkina in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis paucimarensis* Rodionova & Pomazkina in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.
Synonym: *Placoneis paucimarensis* Rodionova & Pomazkina in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia pellaifa* (Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis pellaifa* Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich 2000. Diatoms of the Andes. From Venezuela to Patagonia/Tierra del Fuego and two additional contributions. Iconographia Diatomologica 9, p. 210, pl. 60, figs 9, 10.

***Witkowskia perelginensis* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis perelginensis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 189, pl. 70, figs 6–13.

***Witkowskia poriphera* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula porifera* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 284, fig. 25.

Synonym: *Placoneis porifera* (Hustedt) Ohtsuka & Fujita 2001.

***Witkowskia potapovae* (Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis potapovae* Kociolek in Kociolek, Laslandes, Bennett, Thomas, Brady and Graeff 2014. Diatoms of the United States, 1 Taxonomy, ultrastructure and descriptions of new species and other rarely reported taxa from lake sediments in the western U.S.A. Bibliotheca Diatomologica 61: 23, pl. 28: figs 14–20; pl. 30: figs 3–4; pl. 31: figs 1–4.

***Witkowskia prespanensis* (Levkov, Krstic, Nakov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis prespanensis* Levkov, Krstic Nakov & Metzeltin in Levkov, Krstic, Metzeltin & Nakov 2007. Diatoms of Lakes Prespa and Ohrid, about 500 taxa from ancient lake system. Iconographia Diatomologica 16, p.112, pl. 99; figs 1–17, pl. 100.

Witkowskia pseudabundans **(Levkov in Levkov & Williams) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis pseudabundans* Levkov in Levkov & Williams 2011. Fifteen new diatom (Bacillariophyta) species from Lake Ohrid, Macedonia. Phytotaxa 30, p. 14, figs 92–95.

Witkowskia producta **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Placoneis radialis* var. *producta* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.

Synonym: *Placoneis radialis* var. *producta* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia pseudoclementis **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula pseudoclementis* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 400, fig. 107.

Synonym: *Placoneis pseudoclementis* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

Witkowskia pseudolacostris **(Skabitschewsky) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula pseudolacustris* Skabichevsky 1936. Neue und interessante Diatomeen aus dem nordlichen Baikalsee. Botanicheskii Zhurnal 21(6), p. 713, 721, pl. 2, fig. 19. **Synonym:** *Placoneis pseudolacustris* (Skabitschewsky) Kulikovskiy, Lange-Bertalot & Khursevich 2014.

Witkowskia pseudoporifera **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula pseudoporifera* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 406, fig. 117.

Synonym: *Placoneis pseudoporifera* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia radialis* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis radialis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 196.

Synonym: *Placoneis radialis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia regionalis* (Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis regionalis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.

Synonym: *Placoneis regionalis* Pomazkina & Sherbakova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia reimeri* (Kociolek & Thomas) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis reimeri* Kociolek & Thomas 2010. Taxonomy and ultrastructure of five naviculoid diatoms (class Bacillariophyceae) from the Rocky Mountains of Colorado (USA), with the description of a new genus and four new species. Nova Hedwigia 90(1/2), p. 201, figs 30–35, 39–41.

***Witkowskia rhombea* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis rhombea* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.

Synonym: *Placoneis rhombea* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019, nom. illeg.

***Witkowskia rhombelliptica* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis rhombelliptica* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 193–194, pl. 71, fig. 16–23, pl. 76, fig. 2.

***Witkowskia rostrata* (A. Mayer) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula dicephala* var. *rostrata* A. Mayer 1917. Beiträge zur Diatomeenflora Bayerns. Part II, Bacillariales von Dillingen a. Donau. Denkschriften der Königlich-Baierischen Botanischen Gesellschaft in Regensburg 13, p. 114, pl. 1, fig. 42a, b.

Synonyms: *Placoneis elginensis* var. *rostrata* (A. Mayer) Haworth & Kelly 2002; *Placoneis rostrata* (A. Mayer) Cox 2003.

***Witkowskia ruppeliana* (Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis ruppeliana* Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, 232, pl. 125: figs 4–9; pl. 126: figs 1, 2; pl. 127: figs 1–3.

***Witkowskia santaremensis* (Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis santaremensis* Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, 199–200; pl. 75, figs 18–24.

***Witkowskia scharfii* (Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot and M.U. Rumrich) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis scharfii* Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich 2000. Diatoms of the Andes. From Venezuela to Patagonia/Tierra del Fuego and two additional contributions. Iconographia Diatomologica 9, p. 211; pl. 59, figs 5–7.

***Witkowskia septentrionalis* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis septentrionalis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.

Synonym: *Placoneis septentrionalis* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia serena* (Frenguelli) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula serena* Frenguelli 1941. Diatomeas del Río de la Plata. Revista del Museo de la Plata, Nueva Serie, Sección Botánica 3, p. 255, pl. 2, figs 1–5.

Synonym: *Placoneis serena* (Frenguelli) Metzeltin in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia signata* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula anglica* var. *signata* Hustedt 1944. Neue und wenig bekannte Diatomeen. Bericht der Deutschen Botanischen Gessellschaft 61, p. 287, fig. 26.

Synonyms: *Navicula pseudanglica* var. *signata* (Hustedt) Lange-Bertalot Krammer & Lange-Bertalot 1985; *Placoneis anglophila* var. *signata* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia signatoides* (Metzeltin and Levkov in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis signatoides* Metzeltin and Levkov in Levkov, Krstic, Metzeltin & Nakov 2007. Diatoms of Lakes Prespa and Ohrid, about 500 taxa from ancient lake system. Iconographia Diatomologica 16, 114; pl. 90, figs 2–9.

***Witkowskia simplex* (Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis simplex* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.

Synonym: *Placoneis simplex* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

***Witkowskia sinensis* (Li & Metzeltin in Gong, Li, Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis sinensis* Li & Metzeltin in Gong, Li, Metzeltin & Lange-Bertalot 2013. New species of *Cymbella* and *Placoneis* (Bacillariophyta) from late Pleistocene fossil, China. Phytotaxa 150(1), p. 34, figs 40–43.

***Witkowskia solaris* (Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis solaris* Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1): p. 197.

***Witkowskia sovereigniae* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula sovereigniae* Hustedt 1955b. Marine littoral diatoms of Beaufort, North Carolina. Bulletin Duke University Marine Station 6: p. 25, pl. 8: figs 18–20.

Synonym: *Placoneis sovereignae* (Hustedt) Torgan & Donadel 2010.

***Witkowskia spinosa* (Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis spinosa* Metzeltin, Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 233, pl. 122: figs 1–4; pl. 123: figs 1, 2.

***Witkowskia subcapitata* (Grunow) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**

Basionym: *Navicula dicephala* var. *subcapitata* Grunow 1882. Beiträge zur Kenntniss der fossilen Diatomeen Österreich-Ungarns. In: Beiträge zur Paläontologie Österreich-Ungarns und des Orients. II Band Pt 4. (Mojsisovics, E. & Neumayr, N. Eds), p. 156, pl. 30: fig. 54.
Synonym: *Placoneis dicephala* var. *subcapitata* (Grunow) Mereschkowsky 1903.

***Witkowskia subclementis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula subclementis* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 400; fig. 108.
Synonym: *Placoneis subclementis* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

***Witkowskia subelegans* (Levkov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis subelegans* Levkov in Levkov & Williams 2011. Fifteen new diatom (Bacillariophyta) species from Lake Ohrid, Macedonia. Phytotaxa 30: p. 16, figs 97–113.

***Witkowskia subgastriformis* (Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula subgastriformis* Hustedt 1945. Diatomeen aus Seen und Quellgebieten der Balkan-Halbinsel. Archiv für Hydrobiologie 40(4), p. 928, pl. XLII (42), figs 13, 14. **Synonym:** *Placoneis subgastriformis* (Hustedt) Cox 2003.

Witkowskia subtilis **(Kulikovskiy & Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis subtilis* Kulikovskiy & Lange-Bertalot in Kulikovskiy Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 234, pl. 131: figs 23–28; pl. 134: fig. 6.

Witkowskia subundulata **(Kezlya, Glushchenko, Kulikovskiy & Kociolek) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis subundulata* Kezlya, Glushchenko, Kulikovskiy & Kociolek in Kezlya, Glushchenko, Maltsev, Gusev, Genkal, Kociolek & Kulikovskiy 2021. Three New Species of *Placoneis* Mereschkowsky (Bacillariophyceae: Cymbellales) with Comments on Cryptic Diversity in the *P. elginensis*—Group. Water 2021, 13, p. 8, figs 6–7.

Witkowskia surinamensis **(P.T. Cleve) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula surinamensis* P.T. Cleve 1895. Synopsis of the Naviculoid Diatoms, Part II. Kongliga Svenska-Vetenskaps Akademiens Handlingar 27(3), p. 9; pl. 2, fig. 1. **Synonym:** *Placoneis surinamensis* (P.T. Cleve) Metzeltin & Lange-Bertalot 1998.

Witkowskia symmetrica **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**
Basionym: *Navicula constans* var. *symmetrica* Hustedt 1957. Die Diatomeenflora des Fluß-systems der Weser im Gebiet der Hansestadt Bremen. Abhandlungen der Naturwissenschaftlichen Verein zu Bremen 34(3), p. 289, figs 40, 41.
Synonyms: *Placoneis constans* var. *symmetrica* (Hustedt) Kobayasi in Mayama, Idei, Osada & Nagumo 2002; *Placoneis symmetrica* (Hustedt) Lange-Bertalot in Metzeltin, Lange-Bertalot & García-Rodríguez 2005.

Witkowskia tersa **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Navicula tersa* Hustedt 1956. Diatomeen aus dem Lago de Maracaibo in Venezuela. In: Ergebnisse der deutschen limnologischen Venezuela-Expedition 1952 (F. Gessner & V. Vareschi). Deutscher Verlag der Wissenschaften, Berlin 1, p. 166, fig. 38–39.
Synonym: *Placoneis tersa* (Hustedt) Metzeltin & Lange-Bertalot 1998.

***Witkowskia tsendeekhuui* (Metzeltin, Lange-Bertalot & Nergui) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis tsendeekhuui* Metzeltin, Lange-Bertalot & Nergui 2009. Diatoms in Mongolia. Iconographia Diatomologica 20, p. 83, pl. 55, fig. 1–6.

***Witkowskia tumidula* (Levkov in Levkov, Krstic, Metzeltin & Nakov) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis tumidula* Levkov in Levkov, Krstic, Metzeltin & Nakov 2007. Diatoms of Lakes Prespa and Ohrid, about 500 taxa from ancient lake system. Iconographia Diatomologica 16, p. 115; pl. 91, figs 11–15; pl. 92, figs 4–10; pl. 93, fig. 1.

***Witkowskia undulata* (Østrup) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. et stat. nov.**
Basionym: *Navicula dicephala* var. *undulata* Østrup 1918. Fresh-water Diatoms from Iceland. In: The Botany of Iceland, vol. II, part I. (Rosenvinge, L.K. & Warming, E. Eds), p. 25, pl. 3, fig. 33.
Synonyms: *Placoneis undulata* Lange-Bertalot & U. Rumrich in U. Rumrich, Lange-Bertalot & M. Rumrich 2000.

***Witkowskia uruguayensis* (Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis uruguayensis* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 197; pl. 78, figs 1–4.

Witkowskia vadosa **(Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis vadosa* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.
Synonym: *Placoneis vadosa* Pomazkina & Rodionova in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia vicina **(Hustedt) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula vicina* Hustedt 1952. Neue und wenig bekannte Diatomeen. IV. Botaniska Notiser, p. 407; fig. 128.
Synonym: *Placoneis vicina* (Hustedt) Metzeltin & Lange-Bertalot 1998.

Witkowskia vladimiri **(Pomazkina in Pomazkina, Rodionova & Sherbakova) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Placoneis vladimiri* Pomazkina in Pomazkina, Rodionova & Sherbakova 2019. Validation of 123 names of new diatom taxa from Lake Baikal. Limnology and Freshwater Biology 2019(1), p. 197.
Synonym: *Placoneis vladimiri* Pomazkina in Pomazkina, Rodionova & Sherbakova 2018, nom. illeg.

Witkowskia waernensis **(Foged) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**
Basionym: *Navicula waernensis* Foged 1964. Freshwater Diatoms from Spitsbergen. Tromsö Museums Skrifter, Universitetsforlaget, Tromsö/Oslo 11, p. 106, pl. 9, fig. 12.
Synonym: *Placoneis waernensis* (Foged) Lange-Bertalot & Metzeltin in Metzeltin, Lange-Bertalot & Nergui 2009.

Witkowskia witkowskii **(Metzeltin, Lange-Bertalot & García-Rodríguez) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis witkowskii* Metzeltin, Lange-Bertalot & García-Rodríguez 2005. Diatoms of Uruguay. Compared with other taxa from South America and elsewhere. Iconographia Diatomologica 15, p. 200, pl. 71, figs 8–15.

***Witkowskia yucatanensis* (Lange-Bertalot in Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis yucatanensis* Lange-Bertalot in Metzeltin & Lange-Bertalot 2007. Tropical Diatoms of South America II. Special remarks on biogeography disjunction. Iconographia Diatomologica 18, 233, pl. 114, figs 7–11.

***Witkowskia zimmermannii* (Metzeltin & Lange-Bertalot) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis zimmermannii* Metzeltin & Lange-Bertalot 1998. Tropical diatoms of South America I: About 700 predominantly rarely known or new taxa representative of the neotropical flora. Iconographia Diatomologica 5, p. 201–202; pl. 89, figs 10–13.

***Witkowskia zula* (Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski) Kulikovskiy, Glushchenko, Mironov & Kociolek comb. nov.**

Basionym: *Placoneis zula* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin & Witkowski 2012. Lake Baikal: Hotspot of endemic diatoms I. Iconographia Diatomologica 23, p. 235, pl. 131: figs 1–13.

Discussion

The taxonomic instability of the genus *Placoneis*, which is discussed in this article, is associated with insufficient morphological investigation of pore occlusions in the type species of *Placoneis* and, in general, with the adoption of a broader interpretation of the pore occlusions structure following Cox (2004). Primarily, this problem can be explained by the wide representation of species of the genus *Placoneis* and lack of studies on newly described genera: *Geissleria, Khursevichia* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy et al., *Ochigma* Kulikovskiy, Lange-Bertalot & Metzeltin in Kulikovskiy et al., *Rexlowea* Kociolek and E.W. Thomas, *Paraplaconeis*, as well as *Witkowskia* gen. nov. and *Chudaevia* gen. nov., introduced

here. In the second place, molecular investigations, carried out lately (Kulikovskiy et al. 2014; Kezlya et al. 2020, 2021, 2022), indicate that recently discovered genera are independent, but phylogenetically close to each other, and that will be discussed below.

Different types of pore occlusions, mentioned in this paper are listed in Table 4 with the genera, in which these types are present. The morphology of different pore occlusions is described below.

A type of pore occlusion, originally described as **tectulum** by Cox (2004) is "an inner round or squarish flap-like covering, attached to the edges of an areola by several, regularly arranged, small struts". Struts of tectulum are positioned perpendicular to the valve surface (Figure 10A). This morphological structure is quite invariable and can be found in most species of *Placoneis* sensu stricto. However, this type of pore occlusions does not occur in the type species of *Placoneis – P. gastrum*. Instead, in *P. gastrum* pores are occluded by a structure (Figure 10F) that can be described as a type of velum, formed by several (usually >10) elongated struts of irregular shape and orientation. Struts might be covered with thin flaps that break down during sample preparation. We propose a term "**pseudotectulum**" for this structure. In this case, tectulum, introduced by Cox (2004) is typical for diatoms from *Witkowskia* gen. nov. It should be noted that tectula also occur in the genus *Geissleria*, where tectula occlude areolae in striae (Figure 10I) and isolated pores at the valve poles (Figure 10J), but do not cover subpolar areolae (Figure 10E).

As the result, a lot of species, previously associated with *Placoneis* sensu lato, should be transferred to *Witkowskia* gen. nov. In this paper, we present the new combinations for 168 species and varieties, previously regarded as members of the genus *Placoneis*. *Witkowskia neohambergii* (bas. *Placoneis neohambergii* Glushchenko, Kezlya, Kulikovskiy & Kociolek) comb. nov. is selected as type species of the new genus, because its morphology and structure of pore occlusions was studied in detail in Kezlya et al. (2021).

Hence, *Placoneis* sensu stricto currently includes only four species with similar morphology: *Placoneis gastrum*, *Placoneis amphiboliformis*, *Placoneis coloradensis*, and *Placoneis elinae* sp. nov.

Another taxon described in this paper is *Chudaevia densistriata* sp. nov. The morphology of the new species is very similar to *Placoneis flabellata*. This taxon has been formerly regarded as the member of *Navicula* sensu lato until being placed it in the genus *Placoneis* based upon features

of chloroplast and raphe morphology (Kimura, Fukushima & Kobayashi, 2015). However, the organization of pore occlusions was poorly studied in that paper. The newly described species was found in the samples from Ba Bể Lake (Bắc Kạn Province, Vietnam). During SEM investigation of this species, a peculiar type of pore occlusions was discovered. To include the former member of *Placoneis*, *Placoneis flabellata*, and the new species from Vietnam, a new genus, *Chudaevia* gen. nov., is introduced. The representatives of the new genus can be recognized by the presence of **paratectulum** (Figure 10G). The paratectulum consists of 2–4 struts extending into the lumen of the opening, thus creating an illusion of S-shaped opening of areolae. Struts of the paratectulum lie parallel to the valve surface.

The genus *Paraplaconeis*, originally discovered in Lake Baikal (Kulikovskiy et al. 2012), has a relatively wide distribution in Eurasia, including the newly described species (Lange-Bertalot & Wojtal, 2014; Vishnyakov et al. 2016; Pomazkina, Rodionova & Sherbakova, 2019; Reichardt, 2021). Initially, this genus was separated from *Placoneis* sensu lato due to a different morphology of its pore occlusions. In *Paraplaconeis*, occlusions are formed by a singular projection of irregular shape (Figure 10B). It covers most of the areolar opening but does not reach the opposite side of areola. We suggest giving a term **foriculotectulum** for this type of pore occlusion. The Foriculotectulum differs from a foriculum by lacking a narrow base of the projection. It is specific for pentagon-shaped areolae of *Paraplaconeis*.

The genus *Ochigma* was also described from Lake Baikal. Diatoms of this genus are characterized by very large sizes and coarse areolae. Comprehensive investigation of morphology and pore occlusions structure was carried out subsequently. Pore occlusions (Figure 10C) in *Ochigma* are formed by irregularly shaped papillary outgrowths, that lie in a round shallow depression and surround the opening of areola. Interestingly, occlusions in *Ochigma* develop on the inner side of the valve. We propose naming this structure an "**oculus**".

Another genus described from Lake Baikal is *Khursevichia*. This genus of small-sized valves is characterized by pore occlusions (Figure 10D) that are relatively similar to tectula. However, each areola is formed by only 2–3 struts that lie in shallow circular depressions and surround a small opening of the areola. We propose the term **parvutectulum** for this type of pore occlusions.

The genus *Rexlowea* is a taxon with a few species known from Arctic zone (Kociolek & Thomas, 2010; Kociolek et al. 2018). This genus can be distinguished by a special type of pore

occlusions that we propose naming “pseudovola”. **Pseudovola** (Figure 10H) is a type of velum which is similar to a vola, but is formed by smaller projections, growing from the areolar walls. Also, projections of pseudovolae are less branched.

In comparison to previously described types of pore occlusions, that occlude all areolae in valves of genera listed above, the pore occlusions in *Geissleria* are more variable. Areolae of the genus *Geissleria* are very similar to areolae of dorsiventral cymbelloid diatoms, e.g., *Encyonema*. Particularly, in both taxa vimines are equipped with stubs and struts (Figure 10I). At the same time, this genus was described based on the presence of annulus. The **Annulus** (Figure 10E) should be treated as a structure, composed of subpolar areolae with large, elongated openings, possessing 4–10 silica outgrowths. Thus, the morphology of the annulus resembles a tectulum, however, the annulus is larger (usually discernible in LM) and can be found only in the subapical region of the valve. An annulus is typical for *Geissleria*. Additionally, valve poles in this genus are equipped with isolated pores, that are occluded by tectula (Figure 10J) (Kulikovskiy et al. 2014).

An important role of pore occlusions in understanding of diatom phylogeny was originally highlighted by Mann (1984). According to him, the structure of pore occlusions should be similar in monophyletic groups of diatoms. Cox (2004) recognized Mann’s ideas and introduced two new types of pore occlusions (vela), represented in several cymbelloid and naviculoid genera. It is important to mention that the term “velum” should be treated widely, so that cribrum, rota, vola, hymen, foriculum, etc. should be understood as variations of velum. Additional types of vela are suggested during our discussion above.

First phylogenetic studies of *Placoneis* suggested its close connections to cymbelloid diatoms (Bruder & Medlin, 2007; Kermarrec et al. 2011). Bruder & Medlin (2007) investigated the phylogeny of this genus and discussed the structure of pore occlusions, as well as morphological similarities between chloroplasts in *Placoneis* and cymbelloid taxa. Then, the phylogenetic relationships among cymbelloid diatoms was studied by Kulikovskiy et al. (2014). It was demonstrated that *Geissleria* is strongly associated with cymbelloid diatoms, but its closest relative is *Placoneis* (Kulikovskiy et al. 2014). Another related, however separate, clade is comprised of the species from the genus *Paraplaconeis*, studied in Kezlya et al. (2021). These previous studies, and the phylogeny reported herein, support the importance of the pore occlusions as a morphological character, which can be used to diagnose monophyletic groups.

The features listed in Table 4 appear as synapomorphies for each of the genera listed, some of which are currently included in molecular phylogenetic results. The feature of pore occlusion is essential for positioning of new taxa in the cymbelloid clade and for separation of genera with tectula in the broad sense. The importance of pore morphology is supported by molecular data which shows the genera *Witkowskia* gen. nov., *Paraplaconeis* and *Geissleria* monophyletic.

Table 4:

Different types of pore occlusions in *Placoneis* and related genera.

Figure10. A–J. Pore occlusions in several genera of diatoms. (A). Tectulum in *Witkowskia* gen. nov. (B). Foriculotectulum in *Paraplaconeis.* (C). Oculus in *Ochigma*. (D). Parvutectulum in *Khursevichia*. (E). Annulus in *Geissleria* (Kulikovskiy et al. 2014). (F). Pseudotectulum in *Placoneis*. (G). Paratectulum in *Chudaevia* gen. nov. (H). Pseudovola in *Rexlowea.* (I). Areolae with tectula in *Geissleria* (Kulikovskiy et al. 2014). (J). Isolated polar pores, occluded by tectula in *Geissleria* (Kulikovskiy et al. 2014). Scale bars (A,B,D,F) = 0.5 µm; (C,G,H) = 0.25 µm; (E,I, J) = 0.15 µm.

Conclusions

Our results highlight the variation in pore occlusions and their structure in the Cymbellales that has previously been assumed to be a single structure (tectulum). Six new structures are described herein and, with two other, previously described features (annulus and tectulum), these features can be used to diagnose genera within the Cymbellales. Based on the distribution of these features, we propose two new genera to help accommodate the variation in areolar pore occlusion structure. Congruence between the phylogenetic relationships within this order, and the morphological feature of the areolar occlusions within the genera of this group, offers a powerful combination of approaches to understand the relationships within this highly diverse and widely distributed group of freshwater diatoms. These results also offer a more fine-grained taxonomy, based on monophyletic groups, that offer new insights into the diversity and distribution, over both time and space, of this important lineage.

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Table 1(on next page)

Table 1: List of the collected samples

Information about the samples used in the current research

Slide no.	Locality	Coordinates	Substratum	Date of collection
Laos				
00955	Vientiane Province, Van Vieng Dustrict, Nam Lik River	18°36.808′ N; 102°24.605′ E	periphyton	24 November 2011
00996	Khammouane Province, unnamed spring	18°12.512′ N; 104°31.507′ E	periphyton	28 November 2011
Vietnam				
02168	Bắc Kạn Province, Ba Bể Lake	22°33.083′ N; 105°50.267′ E	benthos	29 April 2015
Russia				
13899	NE Siberia, Chukotka Peninsula, small unnamed lake below Markovo Township	64°41.039′ N; 170°24.116′ E	benthos	18 August 1980

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Table 2(on next page)

Table 2: Comparison of morphological features of *Placoneis elinae sp. nov*., *Placoneis gastrum* and related species.

New species are compared with related taxa by morphology and distribution

	***Pl. elinae* sp. nov.**	***Pl. coloradensis***	***Naviculadicta amphiboliformis***	***Pl. gastrum s.s.* lectotypus**	***Pl. amphibola***	***Pl. amphibola***	***Pl. gastrum***	***Pl. gastrum***	***Pl. gastrum***	***Pl. gastrum***
Note	Our material	Kociolek and Thomas data	Metzeltin et al. data	Reichardt data	sensu Cox	sensu Metzeltin et al.	sensu Jahn	sensu Kulikovskiy et al.	sensu Chudaev and Gololobova	sensu Lange-Bertalot et al.
Valve outline	Linear-elliptic to broadly linear-lanceolate	Linear-elliptic to broadly linear-lanceolate*	Elliptical	Elliptical to broadly-lanceolate*	Broadly lanceolate	Elliptical to broadly-lanceolate*	Elliptical, broadly lanceolate*	Elliptical, weakly dorsiventral	Elliptical, weakly dorsiventral*	Broadly lanceolate, slightly asymmetrical
Valve ends	Rostrate to subcapitate	Rostrate to subcapitate*	Rostrate to subrostrate	Broadly rounded, subrosrtate*	Broadly rounded, subrosrtate*	Broadly rounded, subrosrtate *	Rostrate to subrosrtate*	Rostrate to broadly rounded	Rostrate to broadly rounded*	Broadly protracted, obtusely rounded
Axial area	Narrow, slightly expanded to the central part of valve	Narrow, expanded to the central part of valve	Medium sized, slightly expanded to the central part of valve*	Narrow, slightly expanded to the central part of valve*	Narrow, not expanded*	Narrow, not expanded*	Narrow, not expanded*	Narrow, slightly arched	Narrow, slightly arched*	Narrow, slightly expanded to the central part of valve*
Central area	Bowtie-shaped, with 4 stigmoids	Rectangular, with several isolated areolae	Bowtie-shaped, stigmoids unresolvable*	Rectangular, with 4 stigmoids*	Rounded to diamond-shaped	Rectangular, with 4 stigmoids*	Transversely widened*	Roundish to rectangular	Small, roundish*	Transversely widened
Valve length, µm	44.5–74.0	65–80	34–63	40–56	30–60	34–63	42*	30–58	40.4–56.2	30–60
Valve breadth. µm	21.0–26.5	29–31	18–24	20–24	12–18	22–29	19*	15–20	17.3–19.3	12–18
Raphe	Undulate, filiform, lateral towards the	Undulate, lateral	Undulate, lateral*	Undulate, lateral*	Undulate, lateral, slightly curved*	Undulate, lateral*	Narrow, filiform*	Narrow, filiform, weakly arched	Narrow, filiform, weakly arched*	Narrow, filiform

	ends									
Striae	Radiate throughout. Present irregularly shortened striae on each side	Radiate throughout, parallel at the apices. Present 5–7 shortened striae on each side	Radiate throughout	Radiate throughout, parallel at the apices. Present 3–4 shortened striae on each side*	Radiate throughout. Present several shortened striae on each side	Radiate throughout, slightly curved. Present 3–4 shortened striae on each side*	Radiate throughout. Present several irregularly shortened striae on each side*	Radiate throughout. Present several irregularly shortened striae on each side	Radiate throughout. Present 3–4 irregularly shortened striae on each side	Radiate throughout, narrow. Present irregularly shortened striae on each side
Striae in 10 µm	8.5–10.0	5–6	(7) 8–10	7–9	8–10	n.d.	8.5–9.0	6–10	(6.8)6.9–7.0(8.4)	8–10
Areolae in 10 µm	14–21	n.d.	10–12	16	n.d.	n.d.	n.d.	n.d.	23.4–24.8	22–24
Distribution	Recent. Russia, Chukotka	Recent. USA, Colorado.	Recent. Central Asia. Mongolia, Baruun burkh River	Recent. Central Europe. Germany	Fossil and recent. Widely distributed.	Recent. Northern Europe. Norway, Spitzbergen, Bear Island	Recent and fossil. Mexico, Vera-Cruz. USA, Connecticut. Iceland, Husavic	Recent. Widely distributed	n.d.	Recent. Central Europe. Germany
References	This study	(Kociolek & Thomas, 2010)	(Metzeltin, Lange-Bertalot & Soninkhishig, 2009)	(Reichardt, 2018)	(Cox, 2003)	(Metzeltin, Lange-Bertalot & Soninkhishig, 2009)	(Jahn, 2004)	(Chudaev & Gololobova, 2016)	(Kulikovskiy et al. 2016)	(lange-Bertalot et al. 2017)

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Table 3(on next page)

Table 3: Comparison of morphological features of *Chudaevia densistriata* sp. nov., *Chudaevia flabellata* comb. nov. and finds identified with these species.

New species are compared with similar taxa by morphology and distribution

	***Ch. densistriata* sp. nov.**	***Ch. densistriata* sp. nov.**	***Ch. densistriata* sp. nov.**	***Ch. flabellata* comb. nov.**	***Ch. flabellata* comb. nov.**	***N. flabellata***	***N. flabellata***	***N. flabellata***	***N. flabellata***	***N. flabellata***	***P. flabellata***
Note	Our material	*Placoneis flabellata* sensu Joh	*N. diversipunctata* sensu Tuji	Our material	*Placoneis flabellata* sensu Kimura et al.	original description from Meister	Hustedt data	Haraguchi data	Kunpradid data	sensu Moisseeva	sensu Tsoy
Valve outline	Linear-elliptic to elliptic	Linear-elliptic to elliptic	Elliptical*	Linear-elliptic to elliptic	Oval, oval-lanceolate to broadly lanceolate	Elliptical	Elliptical*	Elliptical*	Elliptical*	Elliptical	Elliptical*
Valve ends	Rounded to rostrate	Rounded to rostrate	Rostrate*	Rostrate	Rostrate	Rostrate*	Rostrate*	Rostrate*	Rostrate*	Weakly protracted, rostrate	Rostrate*
Axial area	Narrow, slightly expanded to the central part of valve	Narrow, slightly expanded to the central part of valve	Narrow, slightly expanded to the central part of valve*	Narrow, slightly expanded to the central part of valve	Narrow, slightly expanded to the central part of valve	Narrow, slightly expanded to the central part of valve*	Narrow, slightly expanded to the central part of valve*	Narrow, slightly expanded to the central part of valve*	Narrow, slightly expanded to the central part of valve*	Very narrow	Narrow, slightly expanded to the central part of valve*
Central area	Rounded to rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid*	Rhomboid, with single isolated stigmoid*	Rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid*	Small, rhomboid, with single isolated stigmoid	Rhomboid, with single isolated stigmoid
Valve length, µm	25.5–64.0	34–49	42.6	24.1–57.3	(20) 26–50 (61)	27–33	38	27–33	39.7	15.0–19.5	39.3
Valve breadth, µm	15.9–19.5	15–20	20.2	12.9–16.0	(12) 12–16	12–14	15	11–12	16.1	13–15	22.1
Raphe	Narrow, filiform, weakly	Narrow, filiform, weakly	Narrow, filiform, weakly	Narrow, filiform, weakly	Narrow, filiform, weakly	Strong, straight	n.d.	Narrow, filiform, weakly	Narrow, filiform, weakly	n.d.	Narrow, filiform, weakly

	lateral towards the ends	lateral towards the ends	lateral towards the ends*	lateral towards the ends	lateral towards the ends*			lateral towards the ends*	lateral towards the ends*		lateral towards the ends*
Striae	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side*	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side*	The striae in the central part of the frustule are peculiar, reminiscent of *Navicula reinhardtii* Grun.	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side*	Expressed radial striae	Almost parallel at the central part of valve, then radiate throughout, slightly undulated Present irregularly shortened striae on each side*	Slightly undulated. Present irregularly shortened striae on each side	Almost parallel at the central part of valve, then radiate throughout, slightly undulated. Present irregularly shortened striae on each side
Striae in 10 µm	13–15	10–13	14	10–11	(8.5) 9.0–11.5 (13)	11–12	10*	11	10*	15–16	14
Areolae in 10 µm	48–50	n.d.	n.d.	44–46	(42) 43–47 (48)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Distribution	Recent. South-East Asia. Vietnam, Lake Ba Bể	East Asia. South Korea	Recent. Lake Biwa, Japan	Recent. South-East Asia. Laos	Indonesia	Recent. South-East Asia. Vietnam, Saigon River	Recent. South-East Asia. Indonesia, Musi River	East Asia. Japan, Lake Aoki	Recent. South-East Asia. Thailand, Nan Province, Nan River	Fossil. Pliocene. Primorsky Territory, Golenki village	Fossil. Early Miocene. Yamato Rise, Sea of Japan
References	This study	Joh, 2013	Tuji, 2003	This study	Kimura, Fukushim & Kobayashi, 2015	(Meister, 1932)	(Schmidt, 1936; Hustedt, 1937a)	(Haraguchi, 1997)	(Kunpradid, 2005)	(Moisseeva, 1971)	(Tsoy, 2017)

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Table 4(on next page)

Table 4: Different types of pore occlusions in *Placoneis* and related genera.

The table contains new and previously described types of pore occlusions found in *Placoneis* and related genera

Genus	Type species	Type of pore occlusions	Characteristic of pore occlusions
Witkowskia gen. nov.	***Witkowskia neohambergii*** (Glushchenko, Kezlya, Kulikovskiy and Kociolek) Kulikovskiy, Glushchenko, Mironov and Kociolek comb. nov.	Tectulum	Several regularly arranged small struts, extending in the areolar opening perpendicular to the valve surface
Chudaevia gen. nov.	***Chudaevia densistriata*** Kulikovskiy, Mironov, Genkal, Glushchenko and Kociolek sp. nov.	Paratectulum	2–4 struts extending into the lumen of the openings parallel to the valve surface
Paraplaconeis Kulikovskiy, Lange-Bertalot and Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	***Paraplaconeis kornevae*** Kulikovskiy, Gusev and Lange-Bertalot in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	Foriculotectulum	A singular projection of irregular shape covering most of the areola, leaving a small opening
Ochigma Kulikovskiy, Lange-Bertalot and Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	***Ochigma baicalensis*** Kulikovskiy, Lange-Bertalot and Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	Oculus	Irregularly shaped papillary outgrowths, lying in a round shallow depression around the areola
Khursevichia Kulikovskiy, Lange-Bertalot and Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	***Khursevichia galinae*** Kulikovskiy, Lange-Bertalot and Metzeltin in Kulikovskiy, Lange-Bertalot, Metzeltin and Witkowski	Parvutectulum	2–3 struts lying in shallow circular depressions around the areola
Geissleria Lange-Bertalot and Metzeltin	***Geissleria moseri*** Metzeltin, Witkowski and Lange-Bertalot in Lange-Bertalot and Metzeltin	Annulus	4–10 silica outgrowths surrounding the large areolar opening (in the subpolar area of the valve)
Placonei*s* Mereschkowsky	***Placoneis gastrum*** (Ehrenberg) Mereschkowsky	Pseudotectulum	Several (usually >10) elongated struts of irregular shape and orientation surrounding the areolar opening
Rexlowea Kociolek and E.W. Thomas	***Rexlowea navicularis*** Kociolek and E.W. Thomas	Pseudovola	Small projections growing from the areolar walls, not branching

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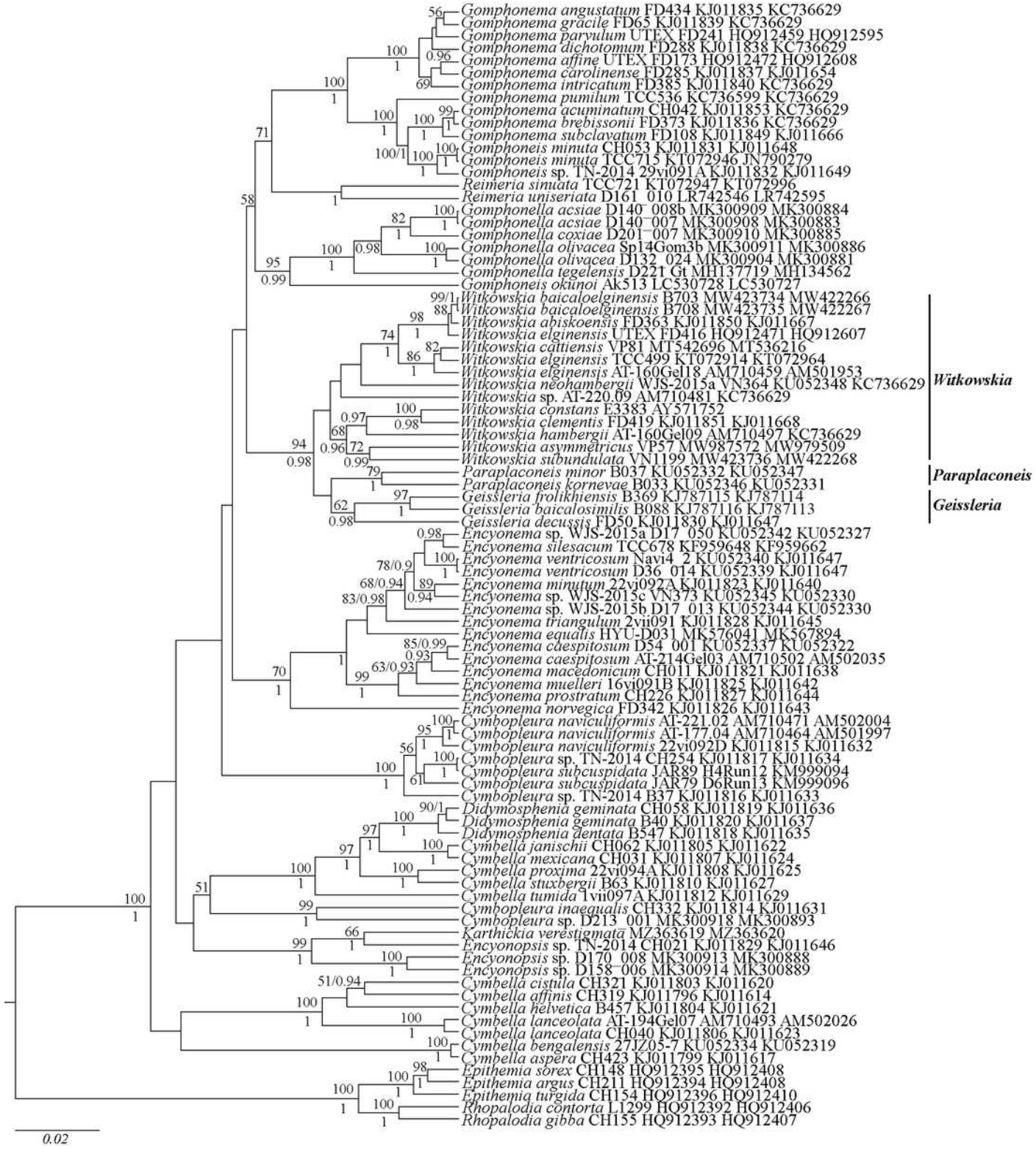
Figure 1

Figure 1: Phylogenetic position of *Witkowskia* gen. nov., *Paraplaconeis* and *Geissleria* species based on Bayesian inference from an alignment of 90 sequences and 3132 characters (*rbc*L, SSU rRNA genes).

Values of likelihood bootstrap (LB) from ML analyses below 50 are not shown. Values of Bayesian posterior probabilities (PP) below 0.9 are not shown. Strain numbers (if available) and GenBank numbers are indicated for all sequences.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Gomphonema gracile FD65 KJ011839 KC736629
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Gomphonema dichotomum FD288 KJ011838 KC736629
Gomphonema affine UTEX FD173 HQ912472 HQ912608
Gomphonema carolinense FD285 KJ011837 KJ011654
Gomphonema intricatum FD385 KJ011840 KC736629
Gomphonema pumilum TCC536 KC736599 KC736629
Gomphonema acuminatum CH042 KJ011853 KC736629
Gomphonema brebissonii FD373 KJ011836 KC736629
Gomphonema subclavatum FD108 KJ011849 KJ011666
Gomphoneis minuta CH053 KJ011831 KJ011648
Gomphoneis minuta TCC715 KT072946 JN790279
Gomphoneis sp. TN-2014 29vi091A KJ011832 KJ011649
Reimeria sinuata TCC721 KT072947 KT072996
Reimeria uniseriata D161_010 LR742546 LR742595
Gomphonella acsiae D140_008b MK300909 MK300884
Gomphonella acsiae D140_007 MK300908 MK300883
Gomphonella coxiae D201_007 MK300910 MK300885
Gomphonella olivacea Sp14Gom3b MK300911 MK300886
Gomphonella olivacea D132_024 MK300904 MK300881
Gomphonella tegelensis D221 Gt MH137719 MH134562
Gomphoneis okunoi Ak513 LC530728 LC530727
Witkowskia baicaloelginensis B703 MW423734 MW422266
Witkowskia baicaloelginensis B708 MW423735 MW422267
Witkowskia abiskoensis FD363 KJ011850 KJ011667
Witkowskia elginensis UTEX FD416 HQ912471 HQ912607
Witkowskia cattiensis VP81 MT542696 MT536216
Witkowskia elginensis TCC499 KT072914 KT072964
Witkowskia elginensis AT-160Gel18 AM710459 AM501953
Witkowskia neohambergii WJS-2015a VN364 KU052348 KC736629
Witkowskia sp. AT-220.09 AM710481 KC736629
Witkowskia constans E3383 AY571752
Witkowskia clementis FD419 KJ011851 KJ011668
Witkowskia hambergii AT-160Gel09 AM710497 KC736629
Witkowskia asymmetricus VP57 MW987572 MW979509
Witkowskia subundulata VN1199 MW423736 MW422268
Paraplaconeis minor B037 KU052332 KU052347
Paraplaconeis kornevae B033 KU052346 KU052331
Geissleria frolikhiensis B369 KJ787115 KJ787114
Geissleria baicalosimilis B088 KJ787116 KJ787113
Geissleria decussis FD50 KJ011830 KJ011647
Encyonema sp. WJS-2015a D17_050 KU052342 KU052327
Encyonema silesacum TCC678 KF959648 KF959662
Encyonema ventricosum Navi4_2 KU052340 KJ011647
Encyonema ventricosum D36_014 KU052339 KJ011647
Encyonema minutum 22vi092A KJ011823 KJ011640
Encyonema sp. WJS-2015c VN373 KU052345 KU052330
Encyonema sp. WJS-2015b D17_013 KU052344 KU052330
Encyonema triangulum 2vii091 KJ011828 KJ011645
Encyonema equalis HYU-D031 MK576041 MK567894
Encyonema caespitosum D54_001 KU052337 KU052322
Encyonema caespitosum AT-214Gel03 AM710502 AM502035
Encyonema macedonicum CH011 KJ011821 KJ011638
Encyonema muelleri 16vi091B KJ011825 KJ011642
Encyonema prostratum CH226 KJ011827 KJ011644
Encyonema norvegica FD342 KJ011826 KJ011643
Cymbopleura naviculiformis AT-221.02 AM710471 AM502004
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Cymbopleura sp. TN-2014 CH254 KJ011817 KJ011634
Cymbopleura subcuspidata JAR89 H4Run12 KM999094
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Cymbella mexicana CH031 KJ011807 KJ011624
Cymbella proxima 22vi094A KJ011808 KJ011625
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Cymbella tumida 1vii097A KJ011812 KJ011629
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Cymbopleura sp. D213_001 MK300918 MK300893
Karthickia verestigmata MZ363619 MZ363620
Encyonopsis sp. TN-2014 CH021 KJ011829 KJ011646
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Encyonopsis sp. D158_006 MK300914 MK300889
Cymbella cistula CH321 KJ011803 KJ011620
Cymbella affinis CH319 KJ011796 KJ011614
Cymbella helvetica B457 KJ011804 KJ011621
Cymbella lanceolata AT-194Gel07 AM710493 AM502026
Cymbella lanceolata CH040 KJ011806 KJ011623
Cymbella bengalensis 27JZ05-7 KU052334 KU052319
Cymbella aspera CH423 KJ011799 KJ011617
Epithemia sorex CH148 HQ912395 HQ912408
Epithemia argus CH211 HQ912394 HQ912408
Epithemia turgida CH154 HQ912396 HQ912410
Rhopalodia contorta L1299 HQ912392 HQ912406
Rhopalodia gibba CH155 HQ912393 HQ912407
0.02
Witkowskia
Paraplaconeis
Geissleria

Figure 2

Figure 2. A–D. *Placoneis elinae* sp. nov. (Fresh) Sample no. B445 (corresponds material in the slide no. 13899). Light microscopy. Live cells with chloroplast structure.

Size diminution series. Scale bar = 10 µm.

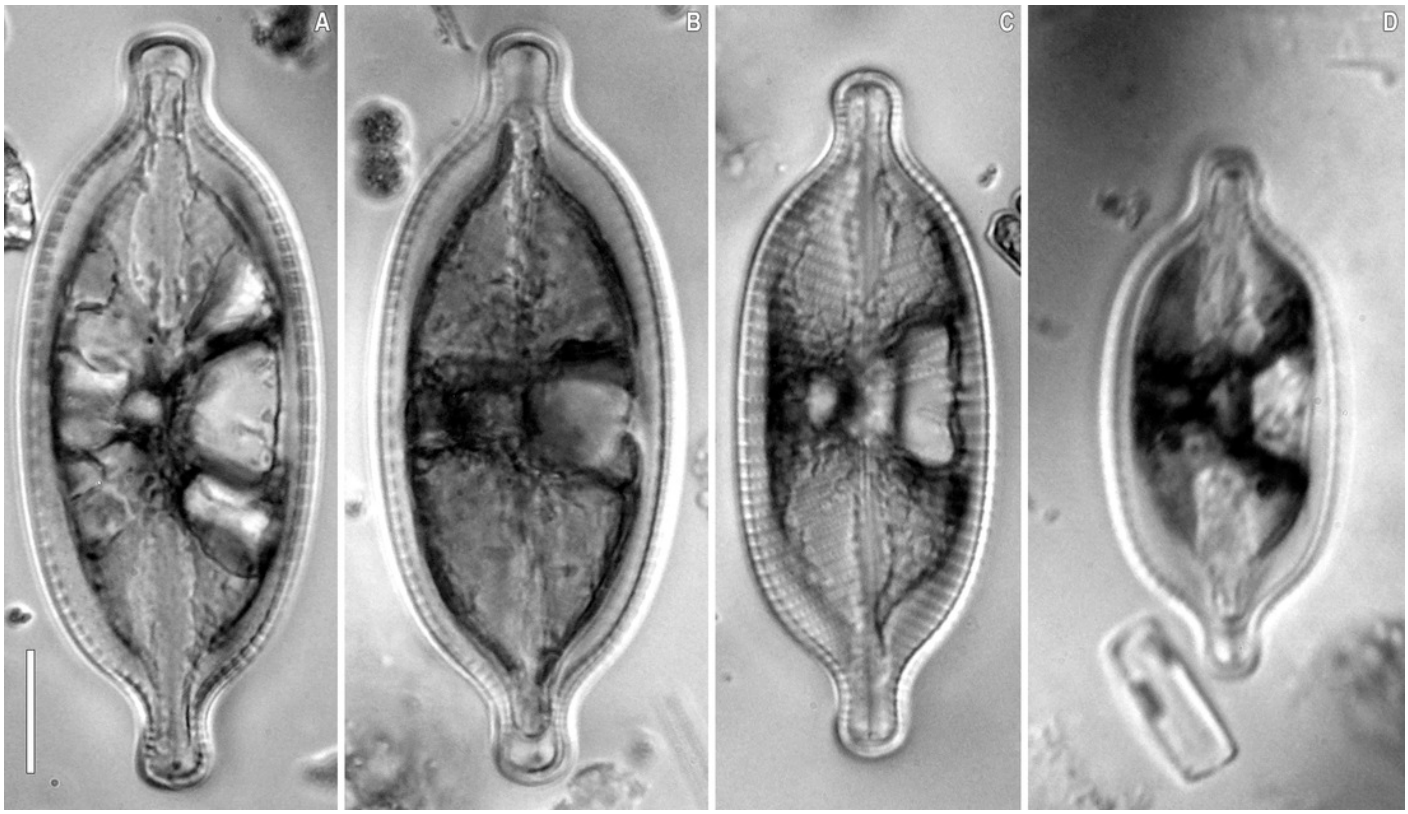
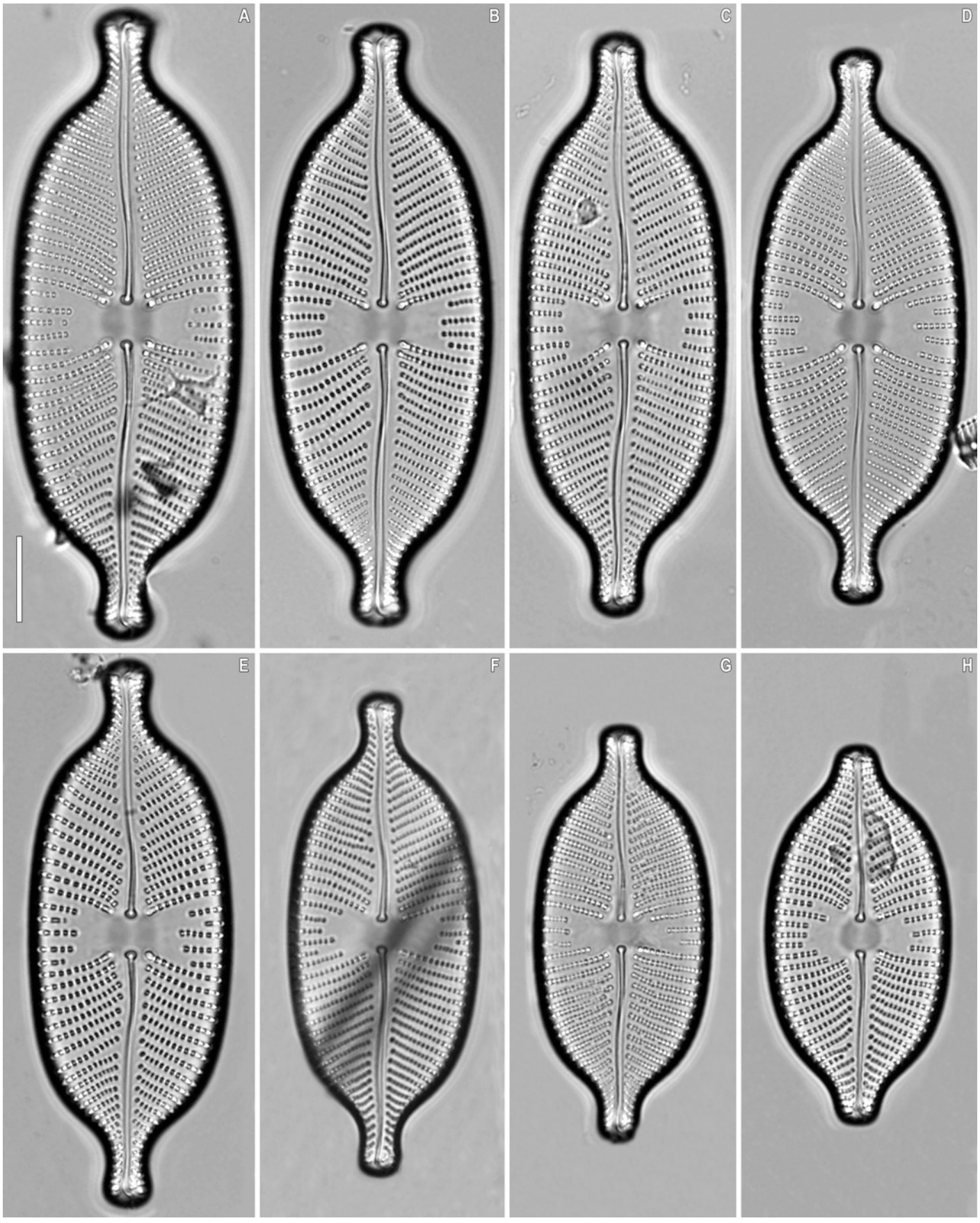


Figure 3

Figure 3. A–H. *Placoneis elinae* sp. nov. Slide no. 13899. Light microscopy, size diminution series.

(D). Holotype. Scale bar = 10 µm.


A
B
C
D
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H

Figure 4

Figure 4. A–E. *Placoneis elinae* sp. nov. Sample 13899 (corresponds material in the slide no. 13899). Scanning electron microscopy, external view.

(A,B). Whole valve. (C). Central area. White arrows show the proximal raphe ends. Black arrows show the stigmoids. White arrowhead shows the areolar depression. (D) Valve mantle. White arrowhead shows less developed areolar depression. (E) Valve end. White arrow shows the distal raphe end. Black arrow shows the areolae extending to valve margin. White arrowhead shows less developed areolar depression. Scale bars (A,B) = 10 µm; (C) = 3 µm; (E) = 3.5 µm; (D) = 1.5 µm.

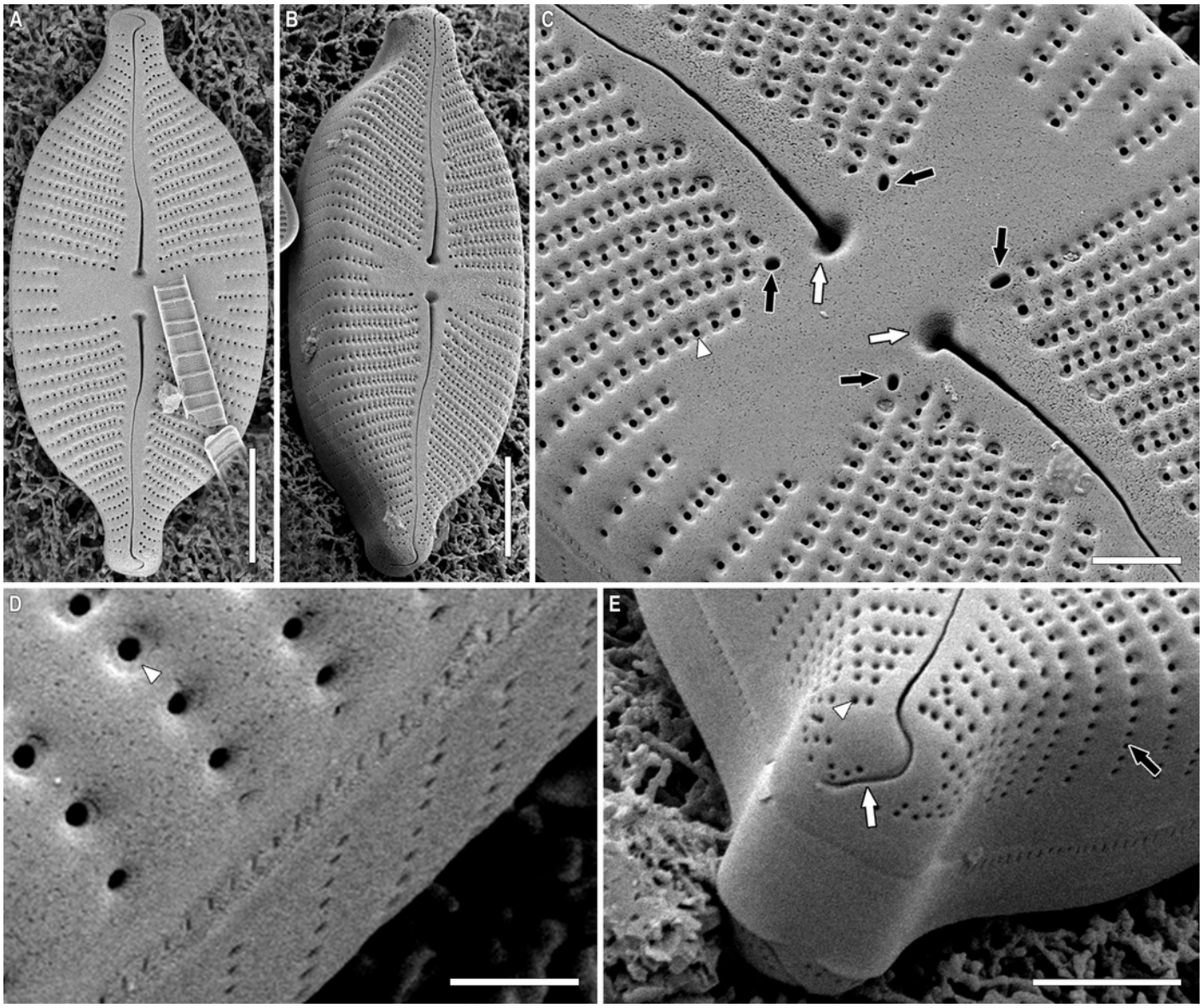
A
B
C
D
E

Figure 5

Figure 5. A–E. *Placoneis elinae* sp. nov. Sample 13899 (corresponds material in the slide no. 13899). Scanning electron microscopy, internal view.

(A). Whole valve. (B). Central area. White arrows show the internal slits of stigmoids. Black arrows show the proximal raphe ends. (C). Valve end. Black arrow shows the distal raphe end. (D,E). Areolae, occluded by pseudotectula. Black arrows show occlusions of areolae. Scale bars (A) = 10 µm; (B) = 3 µm; (C) = 2.5 µm; (D,E) = 1 µm.

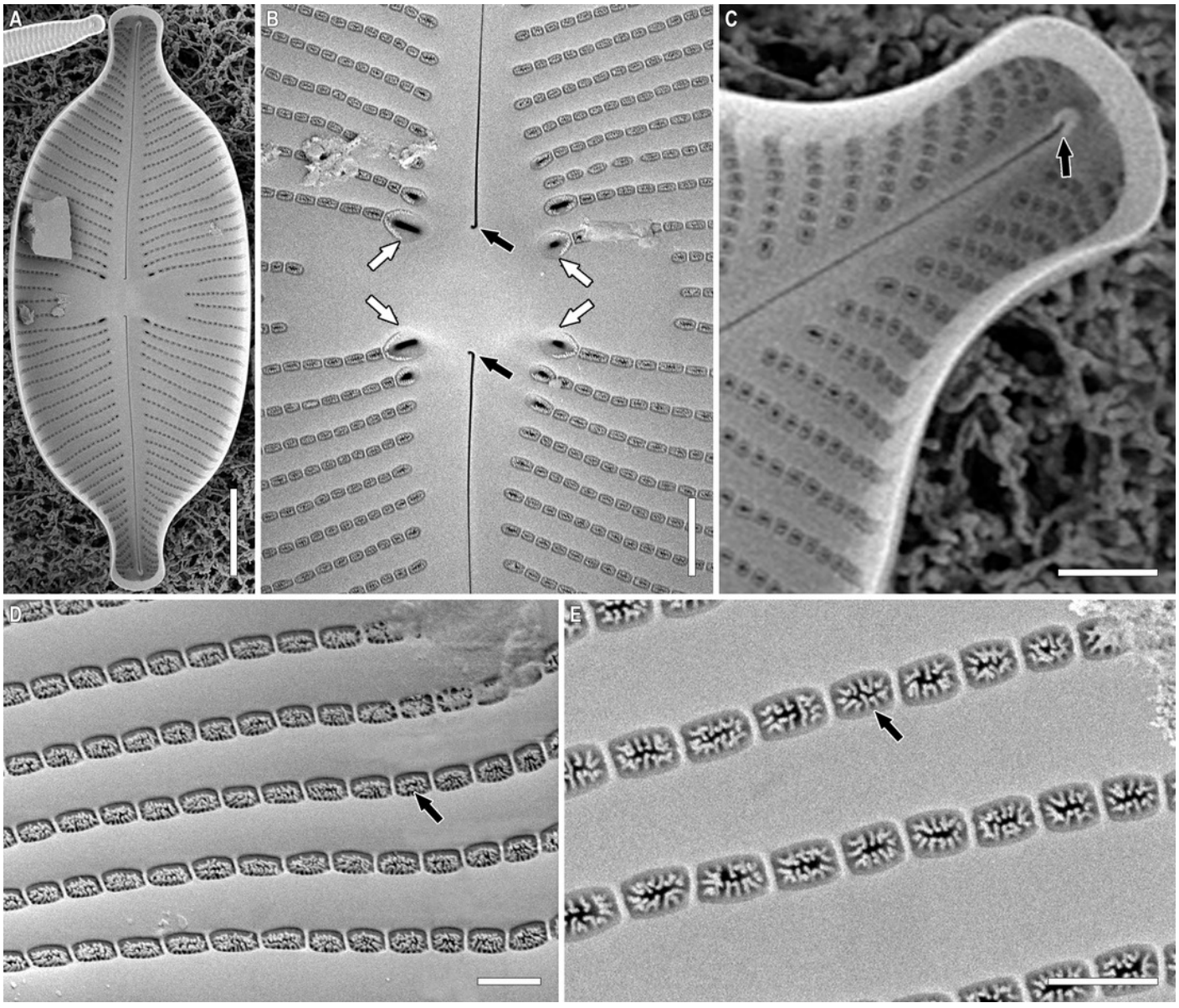
A
B
C
D
E

Figure 6

Figure 6. A–K. *Chudaevia densistriata* sp. nov. Slide no. 02168. Light microscopy, size diminution series.

(I). Holotype. Scale bar = 10 µm.

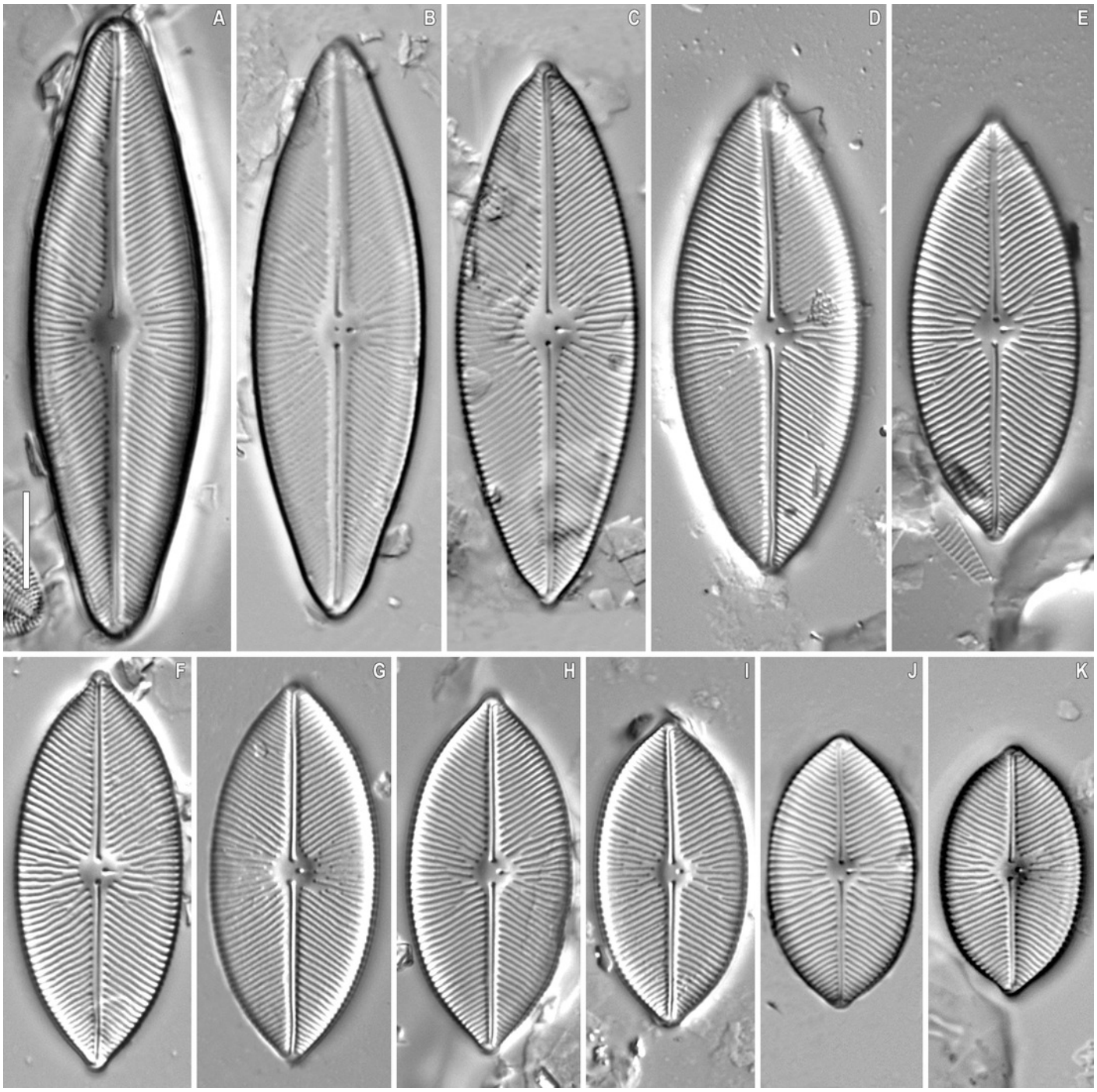

Figure 7

Figure 7. A–E *Chudaevia densistriata* sp. nov. Sample 02168 (corresponds material in the slide no. 02168). Scanning electron microscopy, external view.

(A,B). Whole valve. Black arrows show the proximal raphe ends. (C). Cental area with a stigmoid. White arrow shows the rounded areolae. Black arrow shows the isolated stigmoid. (D,E). Valve ends. White arrow shows the elongated areolae. Black arrows show the heteromorphic distal raphe ends. Scale bars (A) = 10 µm; (B) = 5 µm; (C,D) = 1 µm; (E) = 0.5 µm.

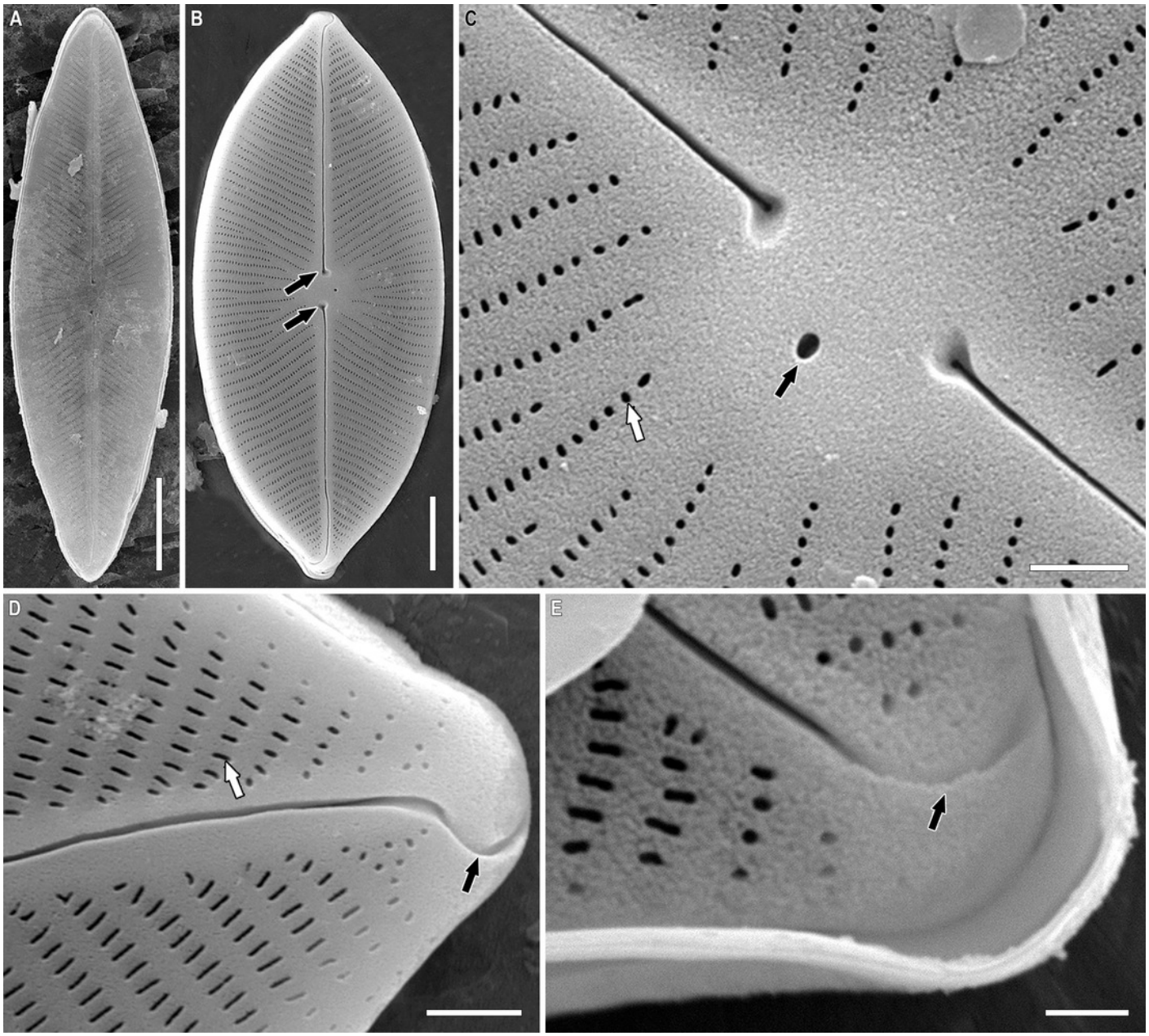
A
B
C
D
E

Figure 8

Figure 8. *Chudaevia densistriata* sp. nov. Sample 02168 (corresponds material in the slide no. 02168). Scanning electron microscopy, internal view. (A,B).

(A,B). Whole valve. White arrow shows the slit of stigmoid. Black arrow shows the raphe on a raised sternum. (C). Central area. White arrow shows the slit of stigmoid. Black arrows show the proximal raphe ends. (D). Valve end. White arrow shows the distal raphe end terminating with a helictoglossae. Black arrow shows areolar occlusions. (E). Note areolae with paratectula and vimines with warty outgrowths. Black arrow shows areolar occlusion. Scale bars (A,B) = 5 µm; (B) = 5 µm; (C,D) = 1 µm; (E) = 0.5 µm.

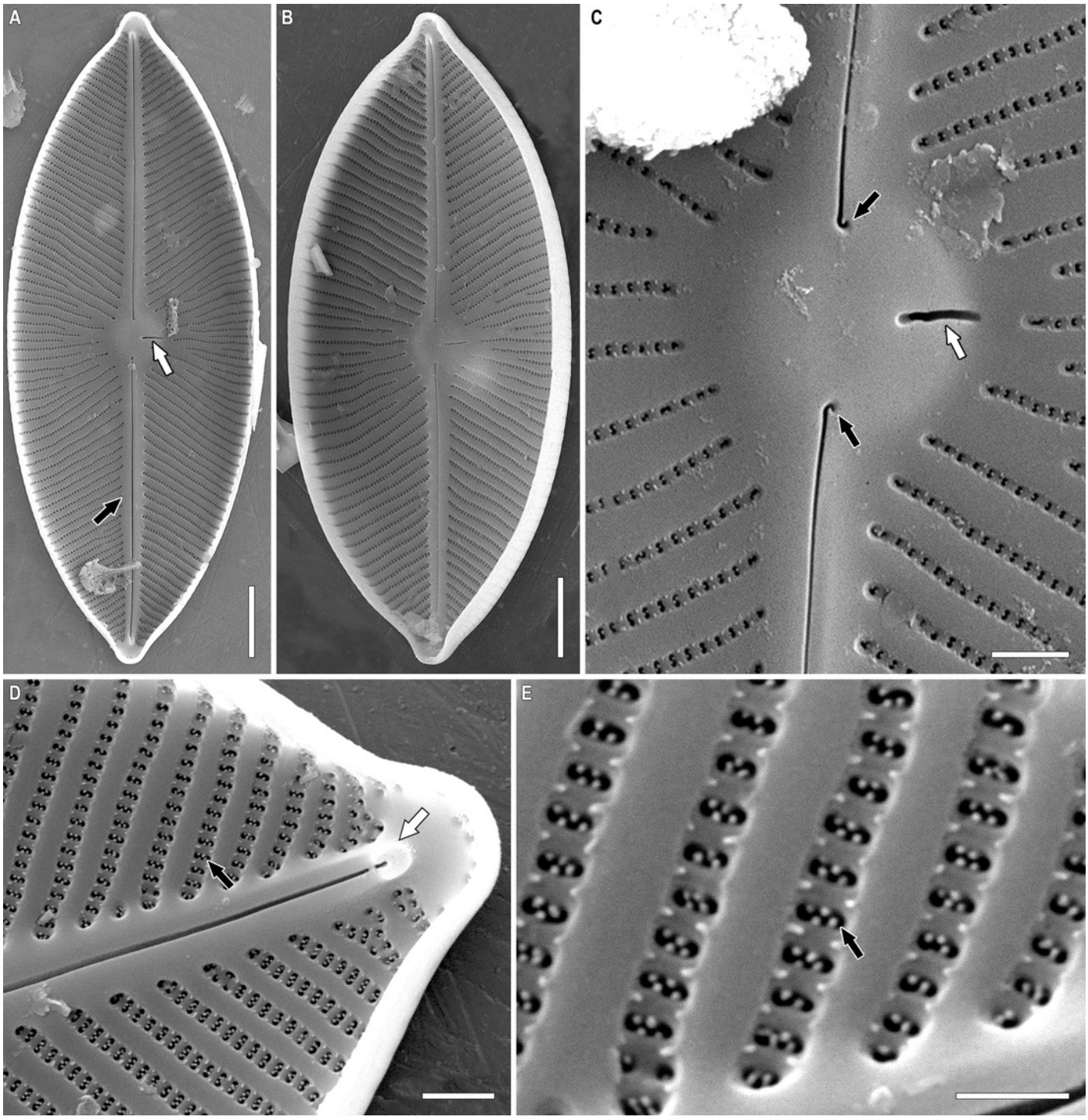
A
B
C
D
E

Figure 9

Figure 9. A–I. *Chudaevia flabellata* comb. nov. Slides no. 00955 (A,D,E–I), 00996 (B,C).

(A–G). Light microscopy, size diminution series. (H,I). Scanning electron microscopy, internal view. (H). Whole valve. White arrow shows the opening of stigmoid. Black arrows show the distal raphe ends terminating on helictoglossae. (I). Note areolae with paratectula and vimines with warty outgrowths. Black arrow shows the areolar occlusion. Scale bars (A–G) = 10 µm; (H) = 5 µm; (I) = 0.5 µm

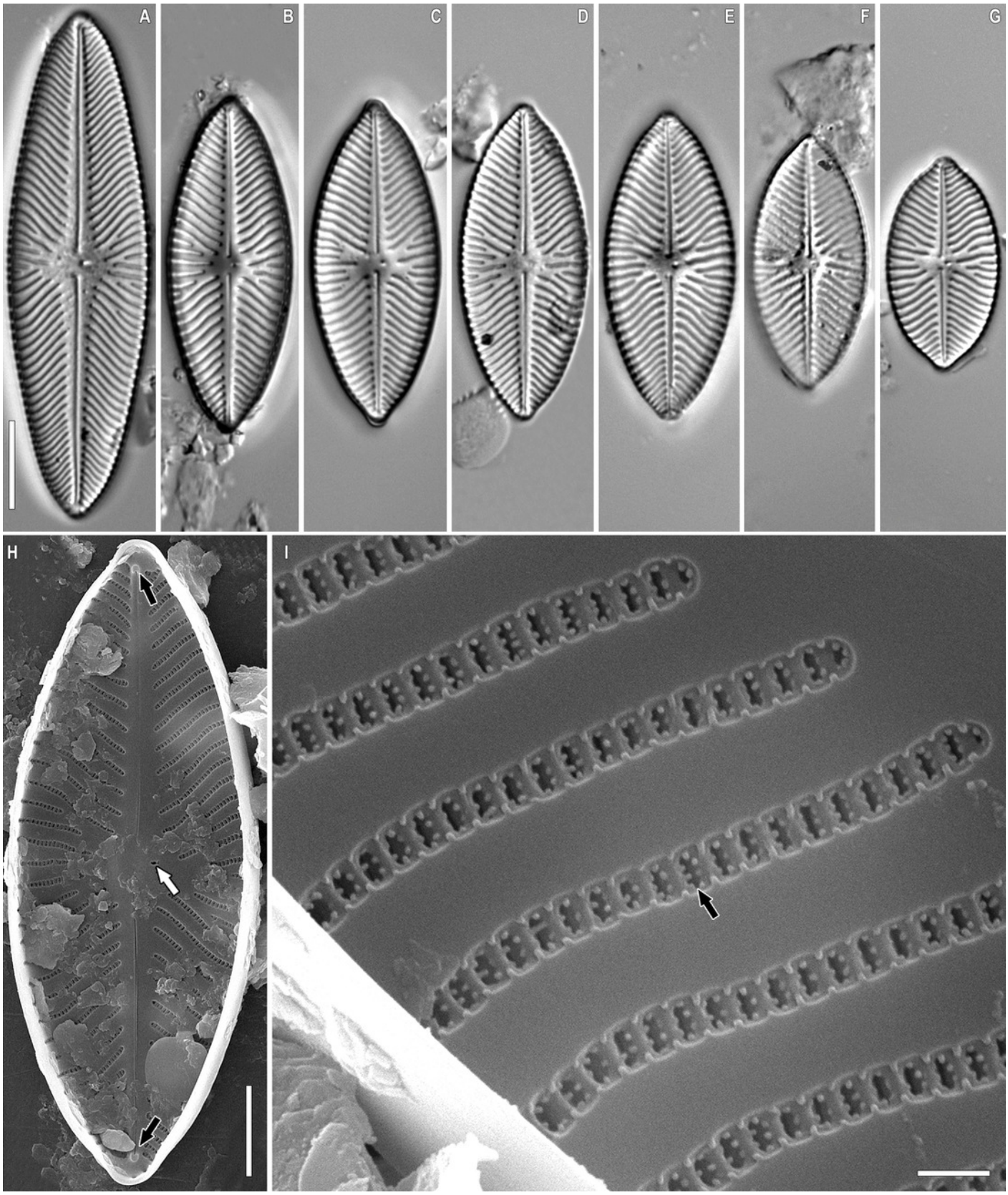
A
B
C
D
E
F
G
H
I

Figure 10

Figure10. A–J. Pore occlusions in several genera of diatoms.

(A). Tectulum in *Witkowskia* gen. nov. (B). Foriculotectulum in *Paraplaconeis.* (C). Oculus in *Ochigma*. (D). Parvutectulum in *Khursevichia*. (E). Annulus in *Geissleria* (Kulikovskiy et al. 2014). (F). Pseudotectulum in *Placoneis*. (G). Paratectulum in *Chudaevia* gen. nov. (H). Pseudovola in *Rexlowea.* (I). Areolae with tectula in *Geissleria* (Kulikovskiy et al. 2014). (J). Isolated polar pores, occluded by tectula in *Geissleria* (Kulikovskiy et al. 2014). Scale bars (A,B,D,F) = 0.5 µm; (C,G,H) = 0.25 µm; (E,I, J) = 0.15 µm.