

New biostratigraphically important chitinozoans from the Kukruse Regional Stage, Upper Ordovician of Baltoscandia

Jaak Nõlvak and Garmen Bauert

Institute of Geology at Tallinn University of Technology, Ehitajate tee 5, 19086 Tallinn, Estonia; jaak.nolvak@ttu.ee, garmen.bauert@ttu.ee

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Abstract. Three new chitinozoan species, *Conochitina savalaensis*, *Conochitina viruana* and *Belonechitina intonsa*, are described. All these species are stratigraphically restricted to the Kukruse age (lowermost Sandbian, *Laufeldochitina stentor* chitinozoan Zone) and have been recorded in numerous East Baltic sections as well as from NE Poland and NW Ukraine and Sweden. Their short temporal range and relative abundance point to a great biostratigraphical value for regional correlations near the base of the Upper Ordovician.

Key words: chitinozoans, biostratigraphy, Upper Ordovician, Sandbian, Baltica.

INTRODUCTION

Chitinozoans are an important biostratigraphical tool for dating and correlating Ordovician sections. The data on the distribution of the new species described herein are based on more than 2000 samples, collected mainly from drill cores and processed for obtaining information on the biostratigraphy of chitinozoans. All the chitinozoan taxa encountered in the sections from this stratigraphical interval are not illustrated here (Fig. 1), but are available in papers listed below under ‘Occurrences’. The described species are restricted to the *Eisenackitina rhenana* chitinozoan Subzone of the *Laufeldochitina stentor* Zone (Nõlvak & Grahn 1993; Nõlvak et al. 2006). Their short temporal ranges in the proximity of the Darriwilian/Sandbian global stages boundary point to the great biostratigraphical value for correlation purposes. Figure 1 shows temporal ranges of these species in the Kerguta (565) and Savala drill core sections in central and northeastern Estonia, respectively, as well as their relative relationships to each other. As all findings of *Conochitina savalaensis* are limited to the commercially mineable kukersite oil shale beds A–F₂ in the Estonia oil shale deposit, NE Estonia (see Bauert & Kattai 1997), this species can be used for tracing coeval beds across the Palaeobaltic basin. All described specimens are stored at the Institute of Geology at Tallinn University of Technology.

SYSTEMATIC DESCRIPTIONS

Incertae sedis group CHITINOZOA Eisenack, 1931
Order PROSOMATIFERA Eisenack, 1972
Family CONOCHITINIDAE Eisenack, 1931, emend.
Paris, 1981
Subfamily CONOCHITININAE Paris, 1981
Genus *Conochitina* Eisenack 1931, emend. Paris et al.
1999

Conochitina savalaensis sp. nov.
Figure 2

1981 *Eisenackitina oelandica* (Eisenack 1955);
Grahn, fig. 15D.
2006 *Conochitina* sp. 1; Nõlvak & Bauert, pl. I,
fig. 1.

Derivation of name. The species name refers to the locality name Savala (a settlement in NE Estonia), which is the site of the Savala drill core.

Holotype. GIT 660-1666; Fig. 2A; Viljandi drill core, 373.8 m, Kukruse Regional Stage (RS).

Type locality and horizon. Viljandi drill core, 373.3–374.3 m, the Kiviõli Member of the Viivikonna Formation, lower part of the Kukruse RS, lowermost Sandbian.

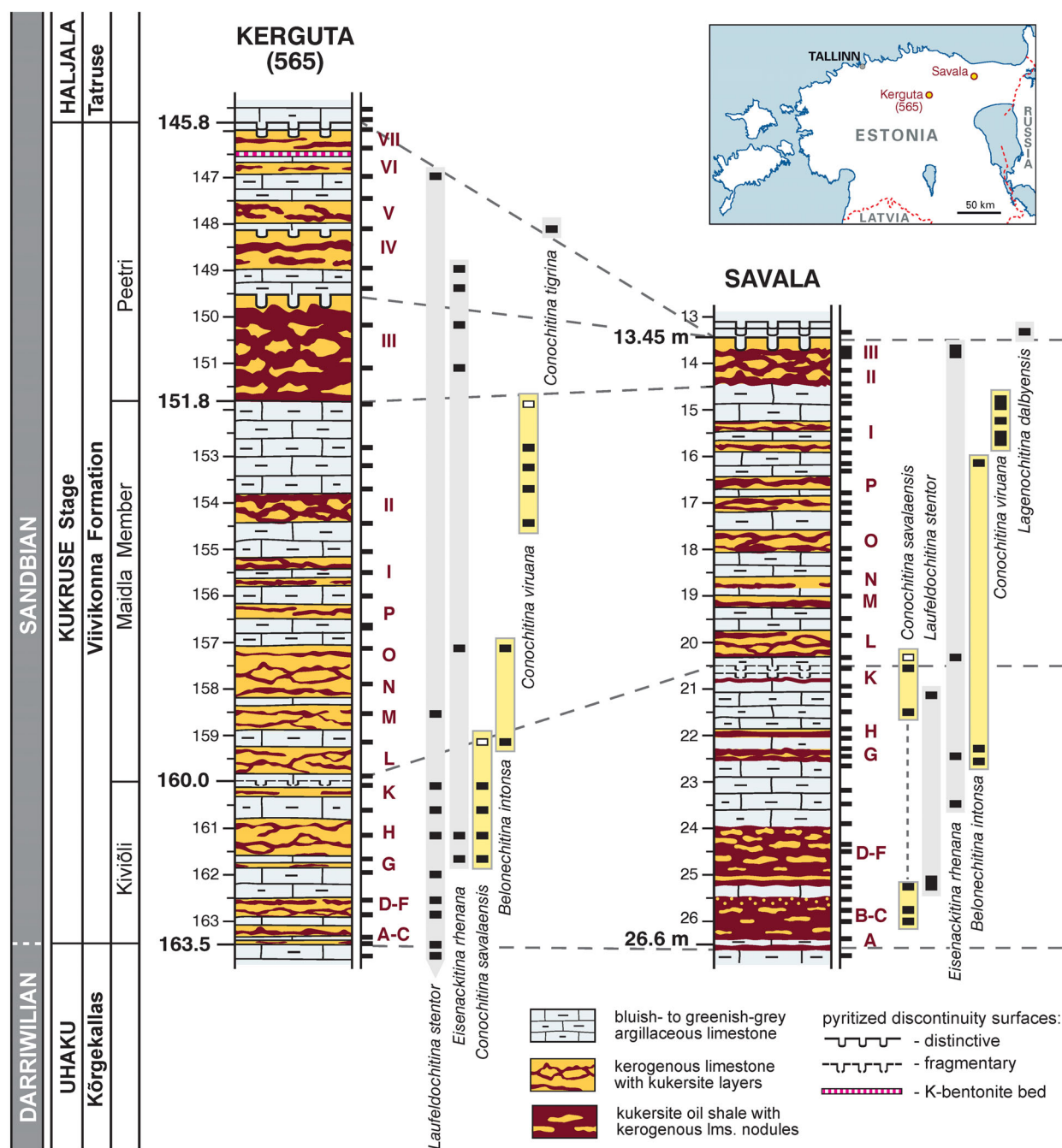


Fig. 1. Distribution of new and selected stratigraphically important chitinozoan species in the Kurguse Regional Stage in the Savala and Kerguta (565) core sections. A–P and I–VII are kukersite bed indexes. Empty boxes in the species range lines mean identifications with open nomenclature ‘cf’.

Dimensions (µm). Holotype: total length – L: 140; maximal chamber diameter – Dp: 67; diameter of neck (oral tube) – Dc: 40. The biometric data for 30 specimens from the Saare (K-20), Vihterpalu (1103), Virtsu (F-309), Kerguta (565) and Bliudziai (150) sections are: L: 92–202, mean 140; Dp: 54–82, mean 67; Dc: 32–48, mean 39.

Diagnosis. A short *Conochitina* species with a clear flexure and shoulder, both the slightly claviform chamber as well as the neck are of nearly equal length; the convex base shows a mucron and a concentric ridge; the vesicle wall has a microgranulous surface and the aperture is straight.

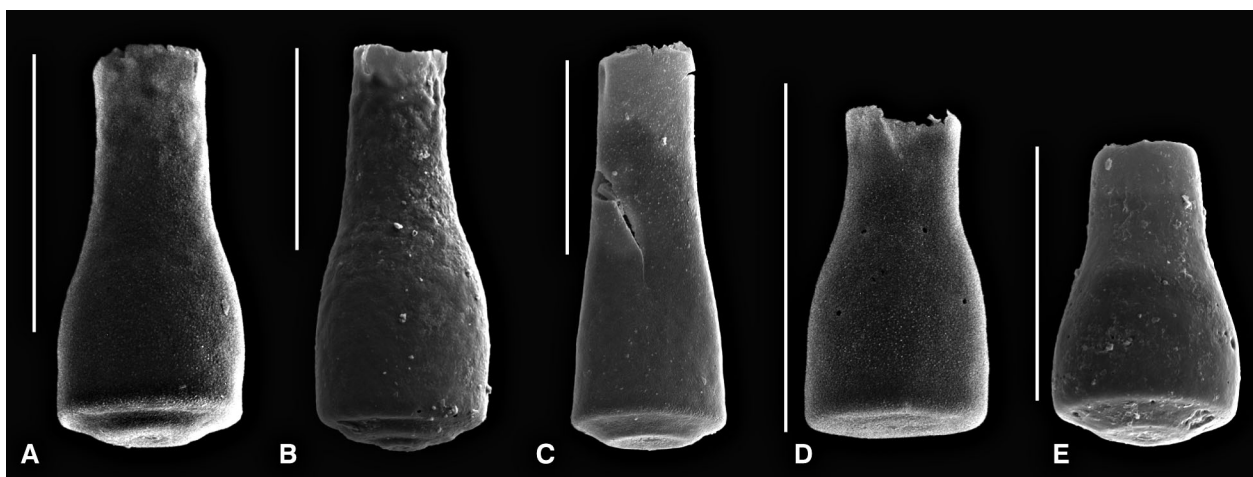


Fig. 2. *Conochitina savalaensis* sp. nov. **A**, holotype, GIT 660-1666, Viljandi: 373.8 m ($140 \times 67 \times 40 \mu\text{m}$); **B**, GIT 718-1, Viki: 342.7–342.8 m ($202 \times 86 \times 47 \mu\text{m}$); **C**, specimen with faintly developed flexure, GIT 718-2, Vihterpalu (1103): 34.3–34.4 m ($201 \times 79 \times 47 \mu\text{m}$); **D**, smallest specimen, GIT 660-1440, Rapla: 166.5 m ($92 \times 54 \times 34 \mu\text{m}$); **E**, GIT 718-3, Saare (K-20): 110.0–110.1 m ($116 \times 74 \times 37 \mu\text{m}$). The scale bars correspond to 100 μm .

Description. Rare specimens may have an inconspicuous flexure, however, both the chamber and the neck are more or less clearly differentiated, having the same length. The chamber walls are slightly convex, with the greatest width at about half the chamber length, the neck is cylindrical, with a straight aperture. The basal margin is broadly rounded. Some specimens have a rather flat base, without the concentric ridge developed, but then showing a central scar. At high magnifications the microgranulous outer surface is revealed.

Discussion. This species has some similarities with Silurian *Conochitina tuba* Eisenack, especially in some details of the base (see Laufeld 1974, fig. 36). However, *C. savalaensis* is smaller and its chamber and neck are more clearly differentiated. *Conochitina savalaensis* is to some extent close to *C. parva* in the vesicle shape and dimensions. However, important diagnostic details of the base remain unknown, because Umnova (1981) described *Conochitina parva* with only silhouette photos. According to Umnova, *C. parva* has an extended temporal distribution through the whole Middle Ordovician to the Kukruse Stage (Talsi core, Latvia). Our abundant records of *C. savalaensis* from the East Baltic, however, exhibit a limited temporal range, being restricted to the lower part of the *Eisenackitina rhenana* Subzone within the *Laufeldochitina stentor* chitinozoan Zone (Nölvak & Grahn 1993; Nölvak et al. 2006).

Occurrence. The previously published records of *C. savalaensis* are:

Conochitina savalaensis nom. nud.; Männil 1976, fig. 2; 1986, fig. 2.1.1; Modliński et al. 2002a, fig. 4, 2002b, fig. 3.

Conochitina nov. sp. A; Bauert & Bauert 1998, app. 14.

Conochitina sp. 1; Nölvak 1999, app. 6, 2002, fig. 4, 2003, app. 23, 2005, app. 27, 2008, app. 6, sheet 3, 2010, app. 6; Saadre et al. 2004, fig. 7; Nölvak & Bauert 2006, pl. I, fig. 1, app. 9; Hints et al. 2014, fig. 2.

Altogether several hundred specimens have been found in strata of the lower Kukruse RS in Baltoscandia, including the following sections: in **Estonia** – Savala, from two intervals 20.4–21.4 m and 25.3–26.0 m; Kerguta (565), 161.1–161.6 m; Rapla, 166.5 m; Velise (F-97), 211.3–213.3 m; Ülemiste (2), intervals 17.1–17.7 and 20.1 m; Vihterpalu (375), 38.1 m; Ohesaare, 483–484.0 m; Männamaa (F-367), 167.8–168.1 m; Viki, 342.7–344.8 m; Viru underground mine and Kohtla opencast sections (Hints et al. 2007); in **Latvia** – Aizpute-41, 1065.1 m; Baldone, 868.4–869.8 m; Baltinava, 706.5–709.4 m; in **Lithuania** – Bliudziai (150), 1379.0–1379.6 m; Ukmerge, 594.0 m; in **Sweden** – Bödahamnborringen-1, 0.55–0.60 m (Grahn 1981); Tvären-2, 150.8–152.4 m (see Grahn et al. 1996, fig. 6 – can be reworked specimens); in **Poland** – Proniewiczze IG-1, 628.2–631.2 m; Kętrzyn IG-1, 1579.9–1580.4 m.

Conochitina viruana sp. nov.

Figure 3

2006 *Conochitina* sp. 2. Nölvak & Bauert, pl. I, fig. 2.

Derivation of name. From the county name Viru in NE Estonia.

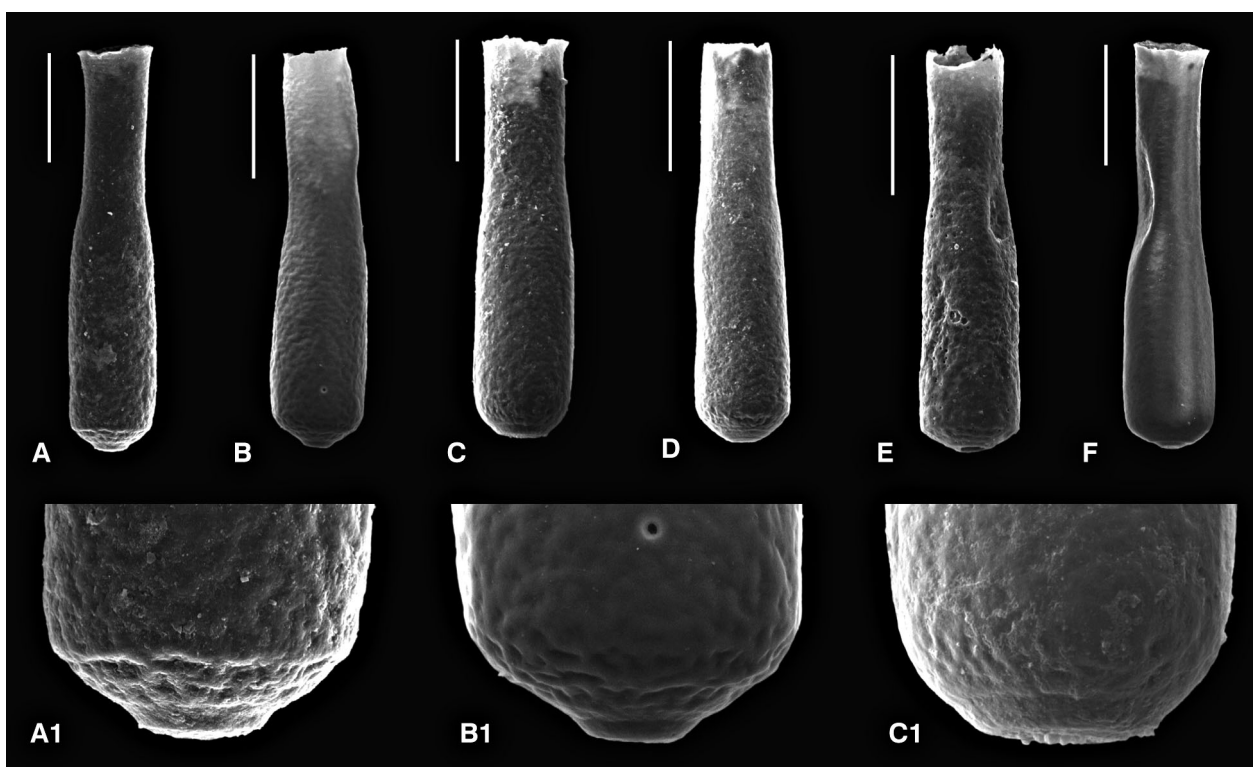


Fig. 3. *Conochitina viruana* sp. nov. **A, A1**, holotype, GIT 718-4, Velise (F-97): 209.20–209.28 m ($365 \times 80 \times 55 \mu\text{m}$); **B, B1**, GIT 718-5, Saare (K-20): 108.7 m ($321 \times 78 \times 52 \mu\text{m}$); **C, C1**, GIT 718-6, Saare (K-20): 108.4–108.5 m ($325 \times 79 \times 71 \mu\text{m}$); **D**, GIT 718-7, Saare (K-20): 109.6–109.8 m ($309 \times 74 \times 51 \mu\text{m}$); **E**, GIT 718-8, Velise (F-97): 209.2 m ($279 \times 71 \times 56 \mu\text{m}$); **F**, GIT 718-9, *Conochitina* cf. *viruana*, smooth specimen with gentle flexure, Virtsu (309): 248.3–248.4 m ($334 \times 76 \times 60 \mu\text{m}$). The scale bars correspond to 100 μm .

Holotype. GIT 718-4, Fig. 3A, Velise (F-97) core, 209.20–209.28 m, Kukruse RS.

Type locality and horizon. Velise (F-97) drill core, 208.8–209.7 m, Maidla Member, Viivikonna Formation, middle part of the Kukruse RS, lowermost Sandbian.

Dimensions (μm). Holotype: L: 365, Dp: 80, Dc: 55. The biometric data for 36 specimens from the Saare (K-20), Vihterpalu (1103), Kerguta (565) and Bliudziai (150) sections are: L: 256–384, mean 309; Dp: 68–92, mean 80; Dc: 40–71, mean 57.

Diagnosis. *Conochitina* species with a conspicuous flexure and shoulder, a rounded basal margin and a slightly foveolate vesicle wall surface.

Description. *Conochitina viruana* has usually a foveolate vesicle wall ornamentation, although rarely smooth specimens are encountered as well. The chamber is cylindrical. The basal margin is rounded. The neck is cylindrical and slightly flaring oralwards. The base is convex and shows two or three concentric ridges around the callus and scar.

Discussion. *Conochitina viruana* does not have such a well-developed flexure like *C. savalaensis*. It is distinguished from *Conochitina dolosa* Laufeld by a much smaller size and a specific foveolate ornamentation. Besides, the vesicle wall of *C. dolosa* is mostly smooth, the basal margin is rounded and without a flexure. However, transitional forms between *C. viruana* and *C. dolosa* do occur and we designated these as cf. *viruana* (Fig. 3F). Having a limited temporal range in strata overlying *C. savalaensis*, this species refers to the middle part of the *E. rhenana* Subzone within the *L. stentor* chitinozoan Zone (Nõlvak & Grahn 1993; Nõlvak et al. 2006).

Occurrence. The previously published records of *C. viruana* are:

Conochitina viruana nom. nud.; Männil 1986, fig. 2.1.1; Modliński et al. 2002a, fig. 4.

Conochitina nov. sp. B; Bauert & Bauert 1998, app. 14.

Conochitina sp. 2; Nõlvak 1999, app. 6, 2001, app. 8, 2003, app. 23, 2005, app. 27, 2008, app. 6, 2010,

app. 6; Saadre et al. 2004, fig. 7; Nölvak & Bauert 2006, pl. I, fig. 2, app. 9; Hints et al. 2014, fig. 2.

Besides the published occurrences, a few hundred specimens have been recorded in strata of the lower Kukruse RS from the following drill core sections: in **Estonia** – Savala, 14.6–15.5 m; Ohesaare, 480.8 m; Velise (F-97), 209.2 m; Vihterpalu (357), 36.5 m; in **Latvia** – Aizpute-41, 1064.0 m; Baldone, 867.5 m; Baltinava 701.0 m; in **Lithuania** – Bliudziai (150), 1377.2–1377.7 m; in **Poland** – Proniewiczze IG-1, 626.2 m.

Subfamily BELONECHITININAE Paris 1981
Genus *Belonechitina* Jansonius 1964

Belonechitina intonsa sp. nov.
Figure 4

2006 *Belonechitina wesenbergensis* s.l. (Eisenack 1959); Nölvak & Bauert 2006, pl. IV, fig. 9.

Derivation of name. Latin ‘*intonsus*’, meaning unshaven, referring to the vesicle ornamentation type.

Holotype. GIT 544-41, Fig. 4A, Kerguta (565) core, 157.1–157.2 m, Maidla Member, Viivikonna Formation, Kukruse RS.

Type locality and horizon. Kerguta (565) core 157.1–159.1 m, Maidla Member, Viivikonna Formation, Kukruse RS, lowermost Sandbian.

Dimensions (µm). Holotype: L: 208; Dp: 67; Dc: 42. The biometric data for 37 specimens from the Saare (K-20), Vihterpalu (1103), Kerguta (565) and Bliudziai (150) sections: L: 160–264, mean 198; Dp: 66–96, mean 76; Dc: 36–64, mean 44.

Diagnosis. *Belonechitina* species with a cylindrical chamber and a cylindrical neck. The spines are distributed evenly over the entire vesicle surface. The spiny base is mostly convex and provided with a basal callus and scar. The basal margin is sharp.

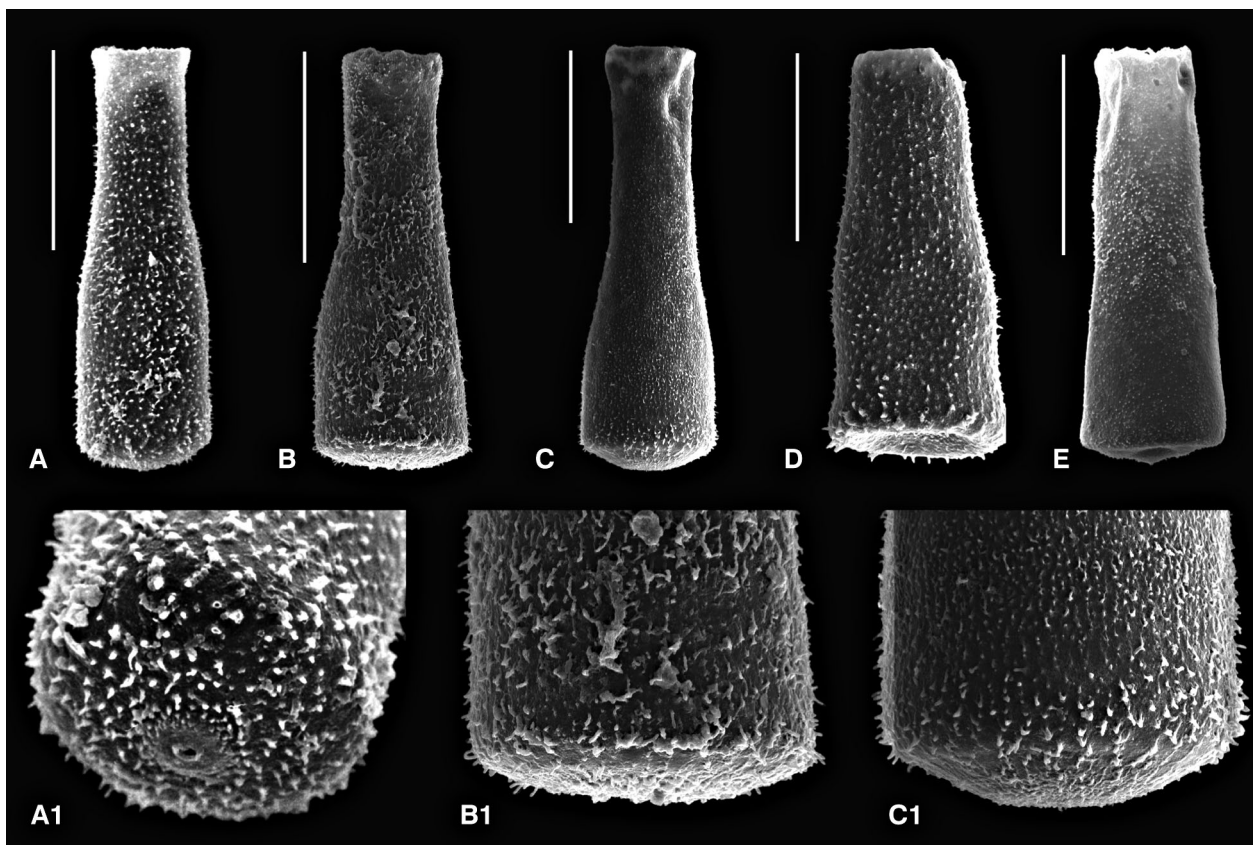


Fig. 4. *Belonechitina intonsa* sp. nov. **A, A1**, holotype, GIT 544-41, Kerguta (565): 157.1 m (208 × 67 × 42 µm); **B, B1**, GIT 718-10 Männamaa (F-367): 168.1 m (195 × 72 × 45 µm); **C, C1**, GIT 718-11, Männamaa (F-367): 168.1 m (241 × 77 × 51 µm); **D**, GIT 718-12, *Belonechitina* cf. *intonsa*, Vihterpalu (1103): 32.0–32.1 m (196 × 95 × 50 µm); **E**, GIT 718-13, Saare (K-20): 109.2–109.3 m (201 × 73 × 46 µm). The scale bars correspond to 100 µm.

Description. *Belonechitina intonsa* has sometimes a subcylindrical chamber, whereas the maximum chamber diameter is observed near the basal margin. The vesicle wall and the base are covered with short simple spines of similar length. In cases of poor preservation (when the spines are removed) it may be difficult to distinguish *B. intonsa* from *C. viruana*.

Discussion. The ratio of a chamber length to the neck is mostly around 2:1, however, in rare cases the neck can be longer than the chamber (Fig. 4C). Sometimes atypical specimens with a concave base are encountered (Fig. 4D). This may be related to poor preservation and the respective findings are designated here as cf. Simple spines may be rather short in some specimens (similar to tubercules) and the flexure may be rather inconspicuous (Fig. 4E). *Belonechitina intonsa* has some similarities with *B. wesenbergensis brevis* (Eisenack), however, the latter has a distinctively subconical chamber and has so far been encountered only in considerably younger strata. The overall shape of *B. intonsa* is similar to *B. villosa* (Grahn), but the vesicle of the latter species is less ornamented, being covered by fewer and longer spines. It can be distinguished from elongated forms of *C. savalaensis* by having an ornamentation. *Belonechitina intonsa* is considerably larger than *B. britannica* Vandenbroucke (2008) and has mostly a more distinctive shoulder and flexure and shorter spines. The distribution of *B. intonsa* is limited to the strata of the Kukruse RS.

Occurrence. The previously published records of *B. intonsa* are:

Belonechitina sp. nov. A; Bauert & Bauert 1998, app. 14.

Belonechitina sp. 1; Modliński et al. 2002a, fig. 4; Nõlvak 2003, app. 23, 2005, app. 27; Saadre et al. 2004, fig. 7.

Belonechitina wesenbergensis s.l.; Nõlvak & Bauert 2006, pl. IV, fig. 9.

The other drill cores from where *B. intonsa* has been recorded in the Kukruse RS strata are: in **Estonia** – Tartu (453), 336.6 m; Viljandi, 372.3 m; Männamaa (F-367), 168.1 m; Rapla, 166.5 m; Velise (F-97), 209.2 m; Savala, 22.5 m; Viki, 341.1–342.2 m; Valga (10), 407.8 m; in **Latvia** – Baldone, 862.3 m; Kandava-25, 934.6 m; in **Lithuania** – Bliudziai (150), 1376.3–1378.6 m; in **Sweden** – Tvären 2, 150.8 m; Grötlingbo, 440.0 m; in **Ukraine** – Kovel-1, 262.9–271.8 (?275.0) m.

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Uued biostratigraafiliselt olulised kitiinikud Baltikumi Kukruse lademest (Ülem-Ordoviitsium)

Jaak Nõlvak ja Garmen Bauert

On kirjeldatud kolme uut kitiinikuliiki, mille levik piirdub Ülem-Ordoviitsiumi Kukruse lademesse kuuluvate Eesti, Läti, Leedu, Ida-Poola, Loode-Ukraina ja Rootsi kihtidega, mis korreleeruvad kitiinikutsooniga *Laufeldochitina stentor*. Uute liikide piiratud stratigraafiline levik ja sage esinemine näitavad nende väärtust Ülem-Ordoviitsiumi basaalsete kihtide liigestamisel ning korreleerimisel Baltoskandias.