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ACRITARCHS FROM THE MIDDLE AND UPPER ORDOVICIAN OF ESTONIA AND THEIR STRATIGRAPHIC IMPLICATIONS

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Being generally abundant and well-preserved, Ordovician acritarchs from the Baltic region are attractive objects for palynologists since the pioneering works of Eisenack, (e.g. 1931, 1938). However, despite the fact that hundreds of articles are dealing with acritarchs from the Ordovician of Baltica, no biostratigraphic zonation based on acritarchs has been established so far.

During the Early Palaeozoic, the Estonian territory was a part of an extensive epicontinental basin covering the south-western part of the paleocontinent Baltica (Jaanusson, 1995; Torsvik & Cocks, 2013). Relatively complete Ordovician successions are described from the northern part of the Baltic region in Estonia, where all global and regional stages of the system can be distinguished. In this area, predominantly carbonate sediments were accumulating in shallow open-sea environments favorable for microphytoplankon. In early 1990s Uutela and Tynni, (1991) studied Lower Ordovician to lowermost Silurian acritarchs from the Rapla reference drill core, central Estonia, in order to document the microfossil composition of Ordovician rocks of Estonia and evaluate the stratigraphic potential of acritarchs, These authors described and illustrated more than three hundreds species and analysed their distribution stratigraphically. However, besides providing general palynological characterisation of the studied strata, they concluded that "…it was impossible to establish floristic zones with any degree of certainty by reference to the Rapla core alone without carrying out any comparative studies…" and "…further research in Estonia and elsewhere in Baltic region was called for in order to determine the real range of the occurrence of each species before it will be possible to present a zonation of the Baltic in terms of acritarchs…" (Uutela & Tynni, 1991, p. 17). There have been some more recent palynological studies in Estonia (e.g. Delabroye et al., 2011), but these have focused on limited stratigraphic intervals. In consequence, it has remained difficult to identify key acritarch taxa for the purpose of regional biostratigraphy.

The aim of our study is to provide new data on the stratigraphic and geographic distribution of Ordovician acritarchs in Estonia, thereby start filling a gap in our knowledge and creating a provisional acritarch biozones usable across Baltoscandia. For this two reference boreholes (Valga-10 and Viki, Fig. 1) representing the most complete sequences of the Middle and Upper Ordovician, were sampled and investigated for acritarchs. Both sections are biostratigraphically and chemostratigraphically well constrained and lithologically characterized (Põldvere, 2001, 2010; Hints, 2014; additional data available at http://geocollections.info).

The Valga-10 borehole is located in southern Estonia (57°48′24″ N, 26°04′65″ E). The penetrated Ordovician sediments of ca 112 m in thickness are represented by the Lasnamägi and Uhaku regional stages of the upper part of the Middle Ordovician and by the all nine regional stages (Kukruse, Haljala, Keila, Oandu, Rakvere, Nabala, Vormsi, Pirgu and Porkuni) of the Upper Ordovician.

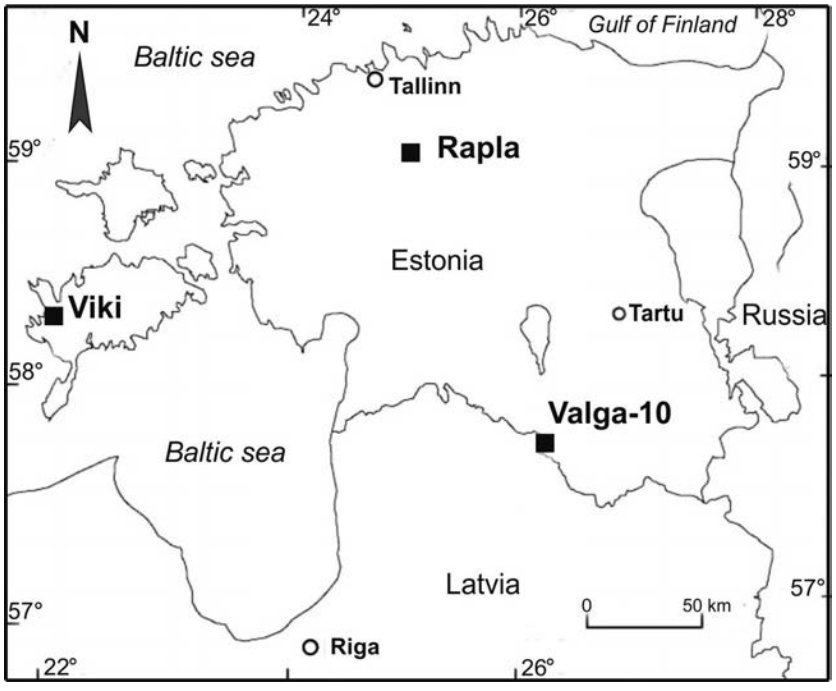

Fig. 1. Location of the studied and discussed boreholes in Estonia.

Plate

Middle and Late Ordovician acritarchs from the Valga-10 and Viki cores. All scale bars represent 20 μm.

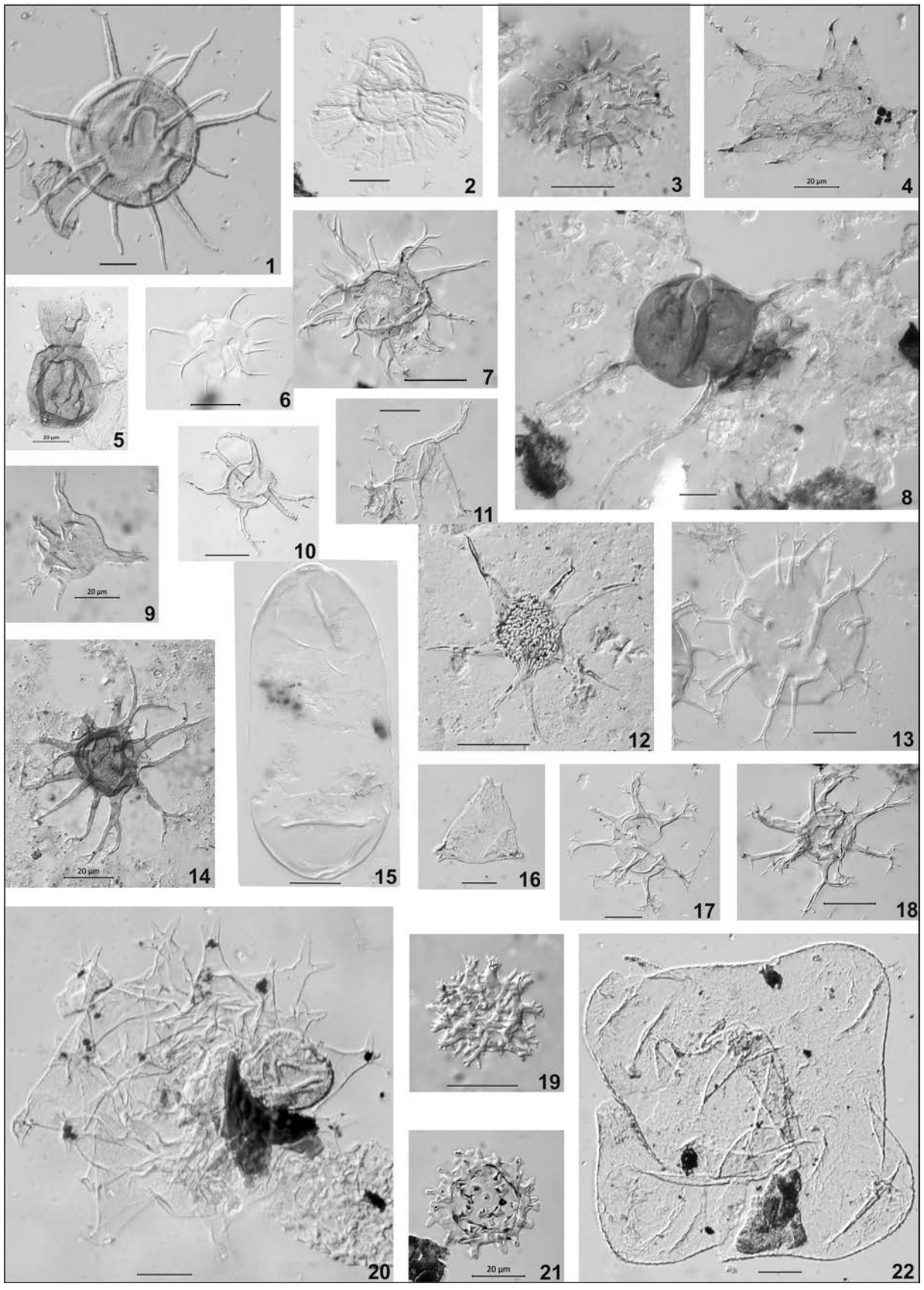

Fig. 1 – *Pachysphaeridium robustum* (Eisenack 1963) Fensome et al. 1990, Valga-10, slide VA-AC-14-51, EF: V24/2; **fig. 2** – *Pterospermopsis tranvikensis* (Tynni 1982) Uutela & Tynni 1991, Valga-10, slide VA-AC-14-50, EF: W25/1; **fig. 3** – Gen. *et* sp. *indet.* 1, Viki-1, slide VI-AC-14-21, EF: B24/4; **fig. 4** – *Gordonirundum tungustanum* Raevskaya & Servais, 2017, Viki-1, slide VI-AC-14-18, EF: P41/1; **fig. 5** – *Aremoricanium simplex* Loeblich & MacAdam 1971, Valga-10, slide VA-AC-14-51, EF: O24; **fig. 6** – *Cheleutochroa* sp., Viki, slide VI-AC-14-10, EF: D15/2; **fig. 7** – *Cheleutochroa gymnobrachiata* Loeblich & Tappan 1978, Viki, slide VI-AC-14-16, EF: LM31/4; **fig. 8** – *Orthosphaeridium rectangulare* Eisenack (1963) Eisenack 1968, Viki, slide VI-AC-14-21, EF: O25/2; **fig. 9** – *Evittia remota* (Deunff 1955) Delabroye & Vecoli 2011, Viki, slide VI-AC-14-22, EF: O33; **fig. 10** – *Evittia remota* (Deunff 1955) Delabroye & Vecoli 2011, Viki, slide VI-AC-14-18, EF: X18; **fig. 11** – *Evittia* sp., Viki, slide VI-AC-14-29, EF: D20/2; **fig. 12** – *Ferromia* sp. Viki, slide VI-AC-14-24, EF: XY27/3; **fig. 13** – *Excultibrachium concinnum* Loeblich & Tappan 1978, Viki, slide VI-AC-14-30, EF: TU46/4; **fig. 14** – *Cheleutochroa gymnobrachiata* Loeblich & Tappan 1978, Viki, slide VI-AC-14-22, EF: J15/1; **fig. 15** – *Navifusa ancepsipuncta* Loeblich 1970 ex. Eisenack et al. 1979, Viki, slide VI-AC-14-28, EF: R37; **fig. 16** – *Evittia pyramidalisiformis* Delabroye & Vecoli 2011, Viki, slide VI-AC-14-6, EF: V21; **fig. 17** – *Nexosarium* aff. *leherissei* Delabroye, Vecoli, Hints & Servais 2011, Viki, slide VI-AC-14-11, EF: D15/4; **fig. 18** – *Nexosarium* aff. *leherissei* Delabroye, Vecoli, Hints & Servais 2011, Viki, slide VI-AC-14-13, EF: X18/1; **fig. 19** – *Evittia porkuniensis* Delabroye, Vecoli, Hints & Servais 2011, Viki, slide VI-AC-14-16, EF: M36/2; **fig. 20** – *Hoegklintia visbyensis* (Eisenack 1959) Dorning 1981, Viki, slide VI-AC-14-2, EF: Z29/4; **fig. 21** – *Helosphaeridium tongiorgii* Delabroye, Vecoli, Hints & Servais 2011, Viki, slide VI-AC-14-7, EF: Q23/4; **fig. 22** – *Pulvinosphaeridium parvum*, Viki, slide VI-AC-14-2, EF: K23/3.

The Viki borehole is located , situated in Saaremaa Island, western Estonia (58°21′03″ N, 22°04′47″ E), where the Middle and Upper Ordovician succession is ca 120 m, including very condensed strata of the Volkhov, Kunda and Aseri regional stages of the lower part of the Middle Ordovician.

Stratigraphy of the sections is based on a detailed analysis of the distribution of conodonts (by Peep Männik) and chitinozoans (by Jaak Nõlvak) and is tied to both regional and international stratigraphic scales. Despite the presence of some stratigraphic gaps, their duration has apparently been relatively short as suggested by the presence of nearly all conodont and chitinozoan zones for the region (Nõlvak et al., 2006).

The condensed strata of the Middle Ordovician are composed mainly of gray bioclastic limestones with thin marl interlayers and films. The Upper Ordovician deposits make up a thicker succession of more variable lithologies including bioclastic limestones, carbonate mudstones, marly limestones, dolostones, etc.

For palynological analysis, samples were taken from the most clay-rich intervals of the sections. 50 samples were collected from the Valga-10 borehole and 35 – from the Viki core. Only eight samples out of 85 turned to be barren. The obtained paleontological material is characterized by a high abundance and diversity as well as excellent preservation (Plate). Altogether more than 120 acritarch taxa were identified from the sections, including 5 new taxa. Based on the stratigraphic distribution of the recovered taxa 11 time-constrained acritarch assemblages were distinguished. They occur in both sections in the same sequence, although in the Valga-10 section, the first appearance of some taxa was recorded somewhat earlier than in the Viki section, which may be due to denser sampling in the former section. In order to select the stratigraphically most useful species detailed analysis of the new material together with previously published data from the Pirgu-Porkuni interval of the Valga-10 core (Delabroye et al., 2011), and with well-documented information from the Rapla borehole (Uutela & Tynni, 1991) was undertaken. As a result of this analysis, ten levels characterized by change of taxonomical composition of acritarchs were identified. The ranges of the selected taxa and provisional acritarch zonation are shown on Fig. 2. Although the suggested scheme is preliminary and needs to tested based on data from outside Estonia, this study is a step forward in creating the acritarch-based biostratigraphic standard for the Ordovician of Baltica.

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REFERENCES

Eisenack, A., 1931. Neue Mikrofossilien des baltischen Silurus. I. Paläont. Z., 13, 74-118.
Eisenack, A., 1938. Hystrichosphaerideen und verwandten Formen im baltischen Silur. Z. Geschiebeforschung, 14, 1-30.
Delabroye, A., Vecoli, M., Hints, O, Servais, T., 2011. Acritarchs from the Ordovician-Silurian boundary beds of the

Valga-10 drill core, southern Estonia (Baltica) and their stratigraphical and palaeobiographical implications. Palynology, 35 (1), 4-45.

Hints, O., Martma, T., Männik, P., Nõlvak, J., Põldvere, A., Shen, Y., Viira, V., 2014. New data on Ordovician stable isotope record and conodont biostratigraphy from the Viki reference drill core, Saaremaa Island, western Estonia. GFF, 136, 1, 100-104.

Jaanusson, V., 1995. Confacies differentiation and upper middle Ordovician correlation in the Baltoscandian Basin. Proceedings of the Estonian Academy of Sciences. Geology, 44, 73-86.

Nõlvak, J., Hints, O., Männik, P., 2006. Ordovician timescale in Estonia: recent developments. Proceedings of the Estonian Academy of Sciences. Geology, 55, 95-108.

Põldvere, A. (comp.), 2010. Viki Drill Core. Estonian Geological Sections Bulletin, 10. Geological Survey of Estonia, Tallinn. P. 1-56.

Põldvere, A. (comp.), 2001. Valga (10) drill core. Estonian Geological Sections Bulletin, 3. Geological Survey of Estonia, Tallinn. P. 1-50.

Torsvik, T.N., Cocks, L.R., 2013. New global palaeogeographycal reconstructions for the Early Palaeozoic and their generation. In: Harper, D.A.T., Servais, T. (eds). Early Palaeozoic Biogeography and Palaeogeography. Geological Society, London, Memoir, 38, 5-24.

Uutela, A., Tynni, R., 1991. Ordovician acritarchs from the Rapla borehole, Estonia. Bulletin of the Geological Survey of Finland, 353, 1–135.

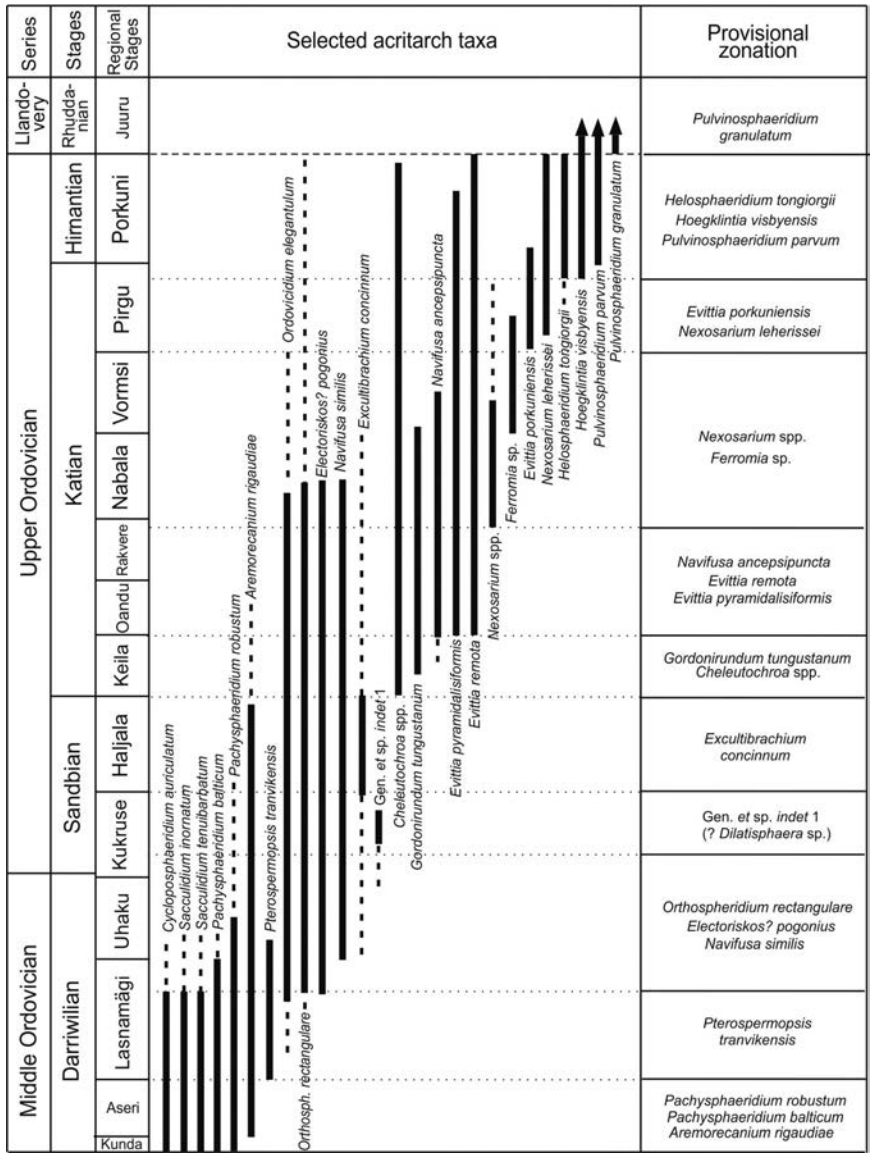

Fig. 2. Distribution of the selected acritarchs in the upper Middle and Upper Ordovician of Estonia, and suggested provisional stratigraphic zonation based on palynomorphs.