

## FACIES DISTRIBUTION OF EARLY CAMBRIAN MOLLUSCS IN ESTONIA

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**Abstract.** The helcionelloid mollusc *Anabarella* was recently found from the Kestla Member of the Lontova Formation in the Vanamõisa F-149 core at a depth of 123 m. The appearance of Early Cambrian molluscs *Aldanella* and *Anabarella* in Estonia was connected with the maximum expansion of the Cambrian palaeobasin on the East European Platform. In the Lontova Stage the molluscs occurred in the facies deposited in quiet hydrodynamic conditions which were typical of the maximum marine transgression characterized by extensive clay accumulation far from the coast.

**Key words:** Lower Cambrian, Estonia, sea level fluctuations, mollusc distribution, *Aldanella*, *Anabarella*.

### PALAEONTOLOGICAL RECORDS

The oldest known Estonian mollusc was first described by Öpik (1926) as *Pleurotomaria? kunda* from the Lower Cambrian Lontova Stage. Öpik questioned the generic assignment of this find based on a single pyritized internal mold. He recognized it as the oldest known gastropod and later (Öpik, 1956) as congeneric with *Pleurotomaria attleboroensis* Shaler & Foerste, 1888. Subsequently, Rozanov (1973) assigned new finds of this species from Estonia to the genus *Aldanella* Vostokova, 1962. In his opinion, the species from the Lontova Stage is very close to *Aldanella rozanovi* Missarzhevsky, 1966, very common in the Tommotian of the Siberian Platform. All later new finds of *Aldanella* from drill cores in Estonia and from Kunda (Lontova) quarry have been described by Posti (1978) and Lendzion & Posti (1983) as *Aldanella kunda* (Öpik, 1926). A recent identification of *Anabarella* (Helcionelloida) by Mare

Isakar from the Kestla Member of the Lontova Formation in the Vanamõisa F-149 core is a significant addition to the distribution of molluscs on the East European Platform (Lendzion, 1977; Føyn & Glaessner, 1979). Up to now it was thought that *Aldanella* predominated in eastern North America, northwestern Siberia, and on the East European Platform (Poland, Norway, Estonia), while *Anabarella* was most abundant in eastern Siberia and Mongolia, being rare in North America, Poland, and South China (Gubanov, 1998). Recently *Anabarella* was found also from the Estonian Lower Cambrian.

## GEOLOGICAL SETTING

The oldest Cambrian rocks in Estonia were formed during the Baltic stage of the basin development, in the pretrilobite Early Cambrian (Mens, 1981). The beginning of the Early Cambrian sedimentation in the studied area corresponds to the *Platysolenites antiquissimus* Zone in the current use (Mens et al., 1990) and/or to the *Asteridium tornatum*–*Comasphaeridium velvetum* Zone, distinguished by Moczyłowska (1991) in Poland and defined as the Lontova Stage over a large part of the East European Platform (Mens et al., 1990). The older deposits of the *Sabellidites cambriensis* Zone, characterized by the occurrence of the acritarch *Teophipolia lacerata* and *Retisphaeridium densum*, are lacking in Estonia (Paškevičene, 1980; Mens & Pirrus, 1997a).

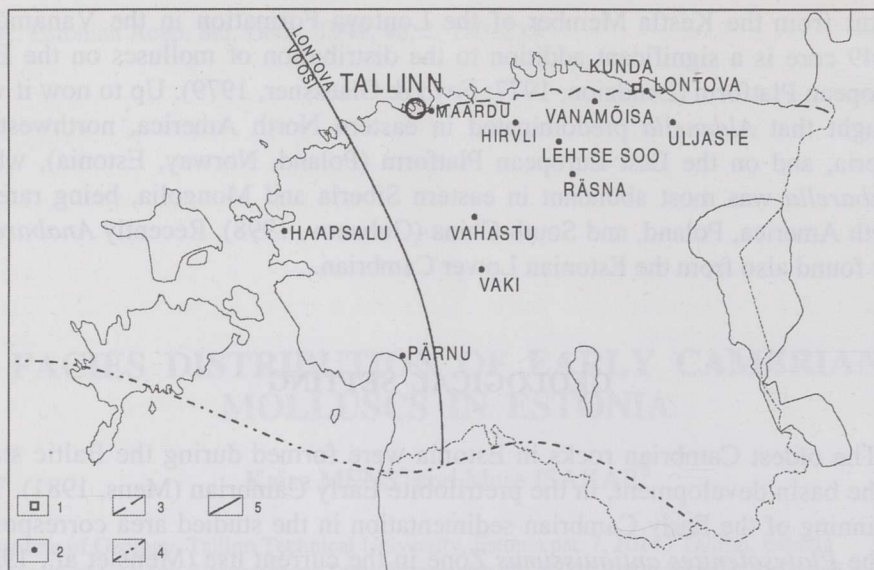
The Lontova deposits unconformably overlie stratigraphical units of different age, including those of the crystalline basement. In Lontova time sedimentation took place during a marine transgression that advanced from the east and most of present-day Estonia was submerged (Fig. 1) (Mens & Pirrus, 1997b). A relatively small amount of coarse clastic material and the small portion of sandstone in the basal beds of the stage (except the westernmost area) point to slow transgression and level relief of both the basin bottom and the surrounding source area.

The stratigraphical completeness and thickness of the Lontova Stage are variable. The rocks are thickest (c. 90 m) in northeastern Estonia, thinning southwards due to postsedimentation denudation (Kala et al, 1981).

The Lontova Stage is represented by siliciclastic rocks with a clear lateral replacement due to changes in depositional conditions. Argillaceous rocks are prevailing in eastern and central Estonia, while sandstones dominate in western mainland Estonia and on the islands of the West Estonian Archipelago. As a result, two formations have been distinguished in the Lontova Stage: the Lontova Formation in the east and the Voosi Formation in the west (Fig. 1) (Kala et al., 1981).

The Lontova Formation occurs in northern, eastern, and central Estonia (Fig. 1) and is represented by greenish-grey and variegated argillaceous rocks with interbeds of coarse- to fine-grained sandstone in the lower- and uppermost





**Fig. 1.** The distribution of the Lontova and Voosi formations and boreholes with mollusc finds. 1, outcrop; 2, borehole; 3, northern margin of the Ordovician cover; 4, southern extension limit of the Lontova Stage; 5, boundary between the Voosi and Lontova formations (by Mens & Pirrus, 1997a).

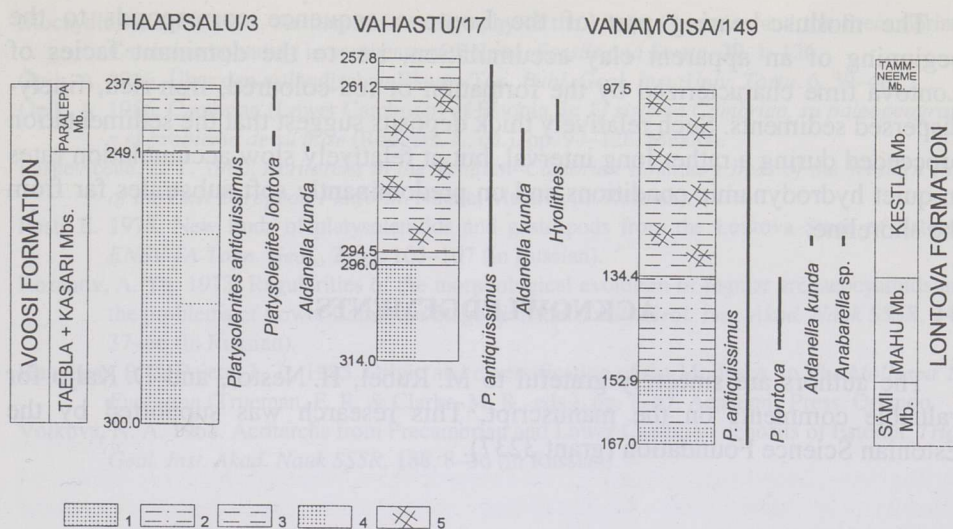
parts. According to the ratio of rock types, the formation is subdivided upwards into the Sämi, Mahu, Kestla, and Tammneeme members (Fig. 2) (Kala et al., 1981).

The Voosi Formation consists mostly of quartzose sandstone that is the dominant type of rocks on the islands of the West Estonian Archipelago. Argillaceous rocks are of minor importance and associate mostly with the upper part of the formation in mainland Estonia. The Voosi Formation comprises (from below) the Taebla, Kasari, and Paralepa members (Fig. 2) (Mens & Pirrus, 1997a).

The Lower Cambrian (so-called pretrilobite) stratigraphy and correlation are mainly based on acritarchs on the East European Platform (e.g. Volkova, 1968; Mens & Pirrus, 1977; Moczyłowska, 1991), whereas skeletal fossils are rare and scattered; representatives of *Sabellidites* and *Platysolenites* predominate.

Molluscs have been little used in Lower Cambrian stratigraphy of the East European Platform, particularly due to their rarity, facies control, and restricted geographical distribution. However, they are widely used in interregional correlation (e.g. Rozanov, 1973; Landing, 1992).

The Lontova Stage (= *Platysolenites antiquissimus* Zone) includes (from the base) the beds with *Sabellidites cambriensis*, *Platysolenites lontova*, *Aldanella kunda*, and *Platysolenites spiralis*, according to the first appearance of the



**Fig. 2.** The distribution of selected fossils in sections of the Lontova Stage. Diversification of fossils was connected with the prevalence of claystone (Kestla and Paralepa members). 1, sandstone; 2, silty claystone; 3, claystone prevalence; 4, uncured interval (poorly cemented sandstone); 5, variegated deposits.

corresponding taxa (Mens & Posti, 1984). This succession can be observed in the Lontova Formation as well as in the Voosi Formation, which provides a good basis for detailed biostratigraphical subdivision.

## PALAEOENVIRONMENT

The distribution of fossils, including molluscs, in the Lontova sequence shows a distinct facies control (Mens & Posti, 1984). According to palaeoecological data by Runnegar & Pojeta (1985), older Cambrian molluscs probably preferred shallow sublittoral environments. Representatives of Estonian molluscs seem to be completely absent in the nearshore environment characterized by fine-grained light-coloured sands, lack of pyritized trace fossils, and the occurrence of the *Skolithos*–*Planolites* ichnoassemblage. Such deposits of the Taebala Member of the Voosi Formation are interpreted here as the deposits of well-aerated high-energy conditions formed in a basin with a relatively flat bottom. Molluscs are also lacking in the Mahu and Kasari members characterized by interbedding of grey sand- and claystones. Sandstones are unsorted at some levels and yield flat small pebbles sporadically. Ichnofossils are represented by pyritized and *Planolites*-type forms. Such variable depositional conditions, accompanying the initial transgressive phase as well as the regressive phase (Tammneeme Member) in basin development, have been unfavourable for molluscs.



The mollusc-bearing part of the Lontova sequence corresponds to the beginning of an apparent clay accumulation, i.e. to the dominant facies of Lontova time characterized by the formation of red-coloured, iron-rich, finely-dispersed sediments. Such relatively thick deposits suggest that the sedimentation proceeded during a rather long interval, but at relatively slow accumulation rates in quiet hydrodynamic conditions and on predominantly soft substrates far from the shoreline.

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## VARAKAMBRIUMI MOLLUSKITE FATSIAALNE LEVIKUPILT EESTIS

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Eesti pretrilobiitse varakambriumi läbilõikes on molluskid esindatud kahe perekonnaga *Aldanella* ja *Anabarella*. Nende esinemist läbilõikes on oluliselt piiranud settimise tingimused, esmajärjekorras basseini hüdrodünaamika. Molluskitele kõige sobivamaks elukeskkonnaks oli rannast kaugemal asunud suhteliselt sügavaveeline rahulik settimisala, mis oli iseloomulik transgressiooni stabiilsele faasile Lontova eal.

## ФАЦИАЛЬНОЕ РАСПРЕДЕЛЕНИЕ РАННЕКЕМБРИЙСКИХ МОЛЛЮСКОВ В ЭСТОНИИ

Кайса МЕНС и Маре ИСАКАР

В дотрилобитовых нижнекембрийских отложениях Эстонии найдены моллюски двух родов – *Aldanella* и *Anabarella*. Их распределение как по площади, так и по разрезу определялось фациальной обстановкой осадконакопления, т. е. седиментацией тонкодисперсного материала в удаленных от берега глубоководных зонах с низкой гидродинамической активностью. Эти условия имели место в фазе максимальной лонтоваской трансгрессии.