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## ABSTRACTS

# SOME CORRECTIONS IN THE STRATIGRAPHY OF THE QUATERNARY OF LITHUANIA

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Recent studies of Pleistocene sediments by complex proxies enable some correction in Pleistocene sediment stratigraphy. Detection of the Brunhes / Matuyama boundary and Jaramillo subchron by palaeomagnetic studies makes possible a more detailed subdivision of the Lower Pleistocene sediments (Baltrūnas et al., 2013a, b). The lower part of the Šlavė section was distinguished by a mixed polarity zone which belongs to the Jaramillo subchron. The distinctly expressed lithological and textural boundary in the Daumantai-1 section fixates the Neogene / Quaternary boundary, which is proved by the palaeobotanical data. The determination of those two boundaries capacitates the correlation of the sediments studied with MIS 19. Below of the Brunhes / Matuyama boundary in the Daumantai-1 section and above the Jaramillo subchron, which was traced in the Daumantai-3 section, the MIS 20–31 sediments could be expected.

The abundance of Pliocene species and the species which were present in North and East Europe only during the Early Pleistocene indicates the older age of Middle Pleistocene Vindžiūnai Interglacial than of the Turgeliai one. The Snaigupėlė Interglacial deposits in the Snaigupėlė-705 borehole and Snaigupėlė outcrop are marked for different bedding conditions. Palaeomagnetic studies fixed the Blake event in the Snaigupėlė outcrop section.

Parallel geomagnetic and ESR geochronological research in the Netiesos section (Eemian Interglacial) capacitates to identify the palaeomagnetic Blake Event ESR dated at about 112 ka. The sediments overlying the Eemian interglacial layers according to IR-OSL data, lithological and geochemical investigations imply deposition during MIS 2–4 (Baltrūnas et al., 2013b).

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# THE ECOLOGICAL CHARACTERISTIC OF MIDDLE–UPPER FRASNIAN SPIRIFERID BRACHIOPOD OF SOUTHERN NOVAYA ZEMLYA

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Ecological classification of the brachiopod suggested by E. A. Ivanova (Ivanova, 1962) includes four types: anchor (with three subtypes), burrowing, cementating and free-lying (with three subtypes). The majority of the spiriferids belongs to the anchor type, the basic subtype (brachiopod is attached to the substrate by the pedicle), and the complicated subtype (brachiopod is attached to the substrate by the pedicle and leans on the inter-area at the same stage or the whole life).

In the Karskie Vorota Strait area (South of Novaya Zemlya) the Middle–Upper Frasnian spiriferid complex contains four genera: *Cyrtospirifer* (two species at different stratigraphic levels), *Theodossia* (seven species at different stratigraphic levels or in different outcrops), *Adolfia* (one species) and *Reticulariopsis* (one species).

Spiriferids *Theodossia* are presumably ascribed to a complicated subtype of the anchor type (Judina, 1993). These brachiopods have a small low-triangular inter-area, curved umbo and biconvex shell. E. A. Ivanova suggests that the brachiopods with such features (Ivanova proposes this supposition for *Euryspirifer*) could be situated on the substrate leaning on the umbo and attaching by the pedicle. The small species, by the supposition of J. A. Judina, could become superbenthos.

One of the most abundant spiriferid groups in the Frasnian of Novaya Zemlya is the *Cyrtospirifer*. These brachiopods are the typical representative of the complicated subtype of the anchor type. They have a triangular flat or slightly curved inter-area and a relatively small foramen. The form of inter-area depends on the substrate character, so its height and curve are very variable and its top may be bent sideways sometimes.

The genus *Adolfia* is presented in the Frasnian of the Karskie Vorota area by the only species *Adolfia multifida* Scupin., which reach more than 3 cm in width and have a slightly curved well developed inter-area. These features indicate that the species belong to the complicated subtype of the anchor type.

The only representative of the basic subtype of the anchor type in the presented complex is *Reticulariopsis*. These spiriferids have a very poorly developed inter-area. *Reticulariopsis* does not occur in association with other spiriferids in the studied sections.

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# PATTERNS OF DISTRIBUTION OF WENLOCK (SILURIAN) CONODONTS IN LITHUANIAN SECTION

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The Silurian herewith and Wenlock deposits generally overlap thick strata of Devonian, Permian, Triassic, Jurassic and Cretaceous sediments. Therefore, their study is carried out only on the basis of core samples of deep boreholes. Wenlock rocks are more than 100-meter-thick layers of sediments of different facies. In the western and south-western parts of Lithuania, they are presented with deep argilitic shale with rich graptolite fauna, and in the eastern sections they are composed of the lagoon red-dolomitic marl with marls with thin interbeds of laminated gypsum. Large diversity of facies and a dense network of wells create favourable conditions for the study of Wenlock conodonts.

Many years of research experience of Silurian conodonts allowed establishing some features of their distribution in the sedimentary basin at different taxonomic levels. If we consider the patterns of distribution of Wenlock conodonts in the sedimentary basin on the base of the genera level in terms of facies models developed by R. Einasto H. Nestor (1977) for the Baltic Silurian sedimentary basin, it is clearly seen that the genus *Dapsilodus* confined only to the fifth and parts of the fourth facial zones. Distribution of the conodonts of the genera *Pseudooneotodus* and *Decoriconus* are traced from the fifth to the third facial zones. Representatives of *Panderodus* genera are distributed in the fourth and third facial areas. The conodonts of *Walliserodus* genera are found only in the third facial zone. Most species of *Ozarkodina* genera are usually found in the rocks which pertained to the third and second facial zones. This distribution pattern of Wenlock conodonts gives rise to the argument that the conodonts species represented by apparatuses with conical forms lived in the deep part of the basin, with platform type elements in the shallow water.

During the last years, the author has made an attempt to calculate for each studied sample the percentage of each species, the percentage of platform type, and conical form conodonts apparatuses. Tracking the dynamics of said relations has shown that it has some connection with the stages of development of the Baltic Silurian sedimentary basin. It is important to note that, regardless of the depth of the basin, it is quite clearly highlighted in the sections in short intervals, which sharply reduced the percentage of conical conodonts despite the fact that they are confined to the deep part of the basin. Reported intervals, as shown by comparison with graptolite zones in different sections, were coeval. This circumstance gives one additional stratigraphic correlation tool in different facies of Silurian sections of Lithuania.

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# SEDIMENTOLOGY AND TAPHONOMY OF THE FRASNIAN-FAMENNIAN BOUNDARY BEDS IN THE KALNAMUIŽA VERTEBRATE FOSSIL SITE

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The Frasnian / Famennian boundary in Latvia has been until recently traced between the Amula Formation (Fm) below and the Eleja Formation above (Savvaitova, Žeiba, 1981), but the exact position of the boundary is still disputable since no conodonts have been found here. The first data on the Late Devonian vertebrate fossils from both formations, cropping out in a narrow belt in the Abava River basin, were reported by W. Gross (1942). Later the results of stratigraphic and paleontological studies of 1970s and 1980s were partly described; however, a detailed analysis of facies distribution and taphonomical peculiarities of vertebrate assemblages close to the supposed boundary has not been done. Aiming to precise the composition of vertebrate assemblage and sedimentary environment of taphocoenosis from the Eleja Fm, the detailed sedimentological and taphonomical studies were carried out in the outcrop at the left bank of the Amula River upstream the Kalnamuiža mill in 2012. Clayey, silty and sandy deposits, intercalating with rhythmically layered carbonates, dominate the section of the Eleja Fm at Kalnamuiža showing increased input of clay and sand in the northern part of the sedimentary basin. Facies vertical stacking and interpretation of sedimentary facies associations evidence the subtidal to intertidal flat with dominant siliciclastic deposition and the intertidal to supratidal flat with mixed siliciclastic and carbonate deposition during the formation of deposits of the Eleja Fm. Various features including tidal rhythmites demonstrate domination of tidal processes on the formation of sediments. Accumulations of vertebrate fossils in the lower part of the Eleja Fm coincide with the supposed local shallow depressions. Taphonomical peculiarities evidence short transportation, fast disarticulation of carcasses and two stages of orientation of vertebrate remains in the subtidal to intertidal flat, most probably due to tidal currents. Facies analysis demonstrates the signs of maximum regression within the upper part of the Eleja Fm.

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# CHALLENGES IN GEOLOGICAL TERMINOLOGY FOR THE NON ENGLISH-NATIVES

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Proper definition and use of terminology in geology, just as in any other science, is of paramount importance to avoid unnecessary misunderstandings. Most of geological terms are international and only few are specific to a language. The latter terms are inherited names of rocks and other geological features that have been existing in common language, like sand. Normally new terms, however, were based on Latin or (ancient) Greek – the languages that are not national or native to any present nation, thus they are neutral. A few terms become international from existing living languages, like Finnish "rapakivi", Swedish "gyttja", etc.

Current development of terminology, however, gets more English rather than international and this causes certain issues for geologists that do not have English as mother tongue and / or use other language in the geological activities.

Probably the most recent and often encountered change is introduction of the suffix "-stone", like in mudstone or dolostone. First of all, I was taught at university that the scientific term for a piece of any rock is "rock", not "stone", as stones are to make roads, hit somebody, etc. This might sound as a joke, and, however, when such English-based terms are necessary to translate to own language (one cannot use English in other languages), it is far from funny. It is a very serious job that requires an enormous amount of time to create a new or appropriately translate a term, introduce to local geological community and discuss until general acceptance.

This could (and should) be avoided by using the old style rules of coining new terms as well as should not be modified of existing ones without absolute need. For example, "dolomite" was for a rock and for a mineral, and it was very little confusion for many years, thus introduction of "dolostone" was not needed. The same is with "mudstone" – lutite. What about onlaps, offlaps and other "-laps", etc...

# SEA-LEVEL CURVES AND LONG-TERM LITHOLOGICAL CHANGES IN THE ORDOVICIAN OF BALTOSCANDIA AND SIBERIA: COMPARATIVE ANALYSIS

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The Russian and Siberian palaeocontinents were located far away from each other throughout the Early Palaeozoic and this creates an opportunity to test ideas about synchronous eustatic sea-level changes on both of them during the Ordovician. Despite obvious difficulties in precise worldwide chronostratigraphic correlations of the Ordovician depositional sequences, the shape of the sea-level curve for the Ordovician of Siberia demonstrates its general similarity with the sea-level curve for Laurentia, but not Baltica. The sea-level curve for the Ordovician of the North American platform assumes a prominent sea-level drop at the base of the Middle Ordovician and a long-term low stand during all the Dapingian and Darriwilian (80–100 m lower than in the Lower and Upper Ordovician). The sea-level curve for the Ordovician of the Siberian platform looks roughly the same. Sea-level curves for the Ordovician of the Gondwanan platforms (North Africa, Yangtze platform, South America, Avalonia) seem to share different patterns. The Middle Ordovician here represents a rather high stand interval. There are two different sea-level models for Baltica but a shallow-water model seems to fit better to the platforms rifted from the Gondwana paleocontinent. As a result, instead of one global sea-level curve for the Ordovician it would be probably more correct to suggest two semi-global curves for two big tectonic regions one of which includes the Siberian and North American platforms and the other combines the Baltica and Gondwanan platforms. This subdivision probably reflects the position of the main Ordovician lithosphere plates. The pattern of long-term lithological changes in the Ordovician of Siberia also demonstrates striking similarities with Laurentia. On both platforms the Ordovician succession starts with tropical stromatolite-bearing carbonates which abruptly change to siliciclastic deposits and terminate with cool-water carbonates. This kind of succession is unique for Laurentia and Siberia and differs markedly from Baltica or any other platform rifted and drifted from Gondwana.

# FRASNIAN PSAMMOSTEID ASSEMBLAGES FROM THE EASTERN PART OF THE MAIN DEVONIAN FIELD

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The stratigraphic and geographic distributions of psammosteid taxa were analysed for the Frasnian, beginning from the Pļaviņas Regional Stage (R. S.), in the eastern part of the Main Devonian Field (NW Russia). The psammosteid assemblage of the Pļaviņas RS (Snetnaya Gora – Pskov Beds) includes *Psammosteus asper* Obruchev, *Ps. cuneatus* Obruchev, *Ps. levis* Obruchev, *Ps. maeandrinus* Agassiz, *Psammosteus* sp. 1, *Karelosteus weberi* Obruchev. Such taxa occur in the Velikaya, Ostenka, Babina, Volkhov, Syas', Oyat', Svir', Svyatukha, Pid'ma rivers and Andoma Hill (Onega Lake).

The Dubnik and Daugava RS yielded the following psammosteid taxa: *Psammosteus megalopteryx* (Trautschold), *Psammosteus pectinatus* Obruchev, *Psammosteus* sp. 2, *Psammosteus* sp. 3. This assemblage was found in the sections of the Shelon', Syas', Red'ya, Perekhoda, Pasha rivers, Il'men' and Onega lakes (Andoma Hill).

The assemblage of the Snezha–Prilovat' RS contains the taxa: *Psammosteus falcatus* Gross, *Psammosteus tenuis* Obruchev, *Psammosteus* sp. 4, *Obruchevia heckeri* (Obruchev), Psammosteida indet. These psammosteids were reported from the Msta, Oskuya, Lovat', Psizha, Pasha, Oyat', Sondala rivers and Andoma Hill (Onega Lake).

Thus, the diverse species of genus *Psammosteus*, as well as one species of *Karelosteus* and *Obruchevia*, are common in the Frasnian vertebrate assemblages of the eastern part of the Main Devonian Field. But *Psammolepis* was not found there as reported earlier (Obruchev, Mark-Kurik, 1965). The *Psammosteus maeandrinus, Ps. megalopteryx* and *Ps. falcatus* psammosteid zones belong to the stratigraphic intervals: Pļaviņas, Dubnik–Daugava and Snezha–Prilovat'.

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# IGNACY DOMEYKO – THE FIRST EXPLORER OF JURASSIC FOSSILS IN CENTRAL ANDEAN CORDILLERAS, CHILE

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Ignacy Domeyko (Lith. Ignotas Domeika; 1802–1889), born in Novohrudak environs in a Polish speaking Lithuanian nobles family, graduated from Vilnius University (Mathematics) in 1822, and from École Supérieur des Mines in Paris (Geology and Mining Art) in 1837. In 1838, he departed for Chile where he worked for 46 years (Wójcik, 1995). As a geologist and mineralogist, Domeyko found a remarkable way to rely upon palaeontology data considered always absolutely reliable ones.

Already during his first year in Chile, in 1838, Domeyko used to make small trips in Coquimbo environs. In 1839, he arranged an expedition to Cordilleras, visited several important mines, and collected geological material. An intrigue came when at 8,000 feet in the mountains he found marine fauna (molluscs); fossils were also found during the 1840 and 1841 expeditions. The collection was sent by Domeyko to Paris, to Pierre Armand Dufrénoy, who was the Director of the Paris Mining School.

Dufrénoy passed the fossils to the palaeontologist Alcide d'Orbigny (1802–1855) who described these specimens, named them and published (d'Orbigny, 1842). These are the following species: Brachiopods – *Terebratula aenigma* d'Orb., *Terebratula ignaciana* d'Orb.; Cephalopods – *Nautilus domeykus* d'Orb.; Gastropods – *Turitella andii* d'Orb.; Bivalves – *Ostrea hemispherica* d'Orb., *Pecten dufrenoyi* d'Orb.; *Hippurites*? Describing Jurassic brachiopods d'Orbigny wrote: "Mr. Domeyko, a Polish engineer, recently sent Mr. Dufrénoy fossil shells collected in Coquimbo (Chile) environs. Among the shells there was a compact piece of limestone containing numerous Terebratulas belonging to two different genera. On the ground of investigations made by me of these shells, Mr. Dufrénoy thinks the rocks belong to the Jurassic". Ergo, d'Orbigny assisted Domeyko to prove the age of the Lower Jurassic (Liassic) stratigraphic stratum, one of the most important and basic layers in the geological history of the Andes (Grigelis, 2007).

Later, C. E. Bayle and H. Coquand described the Domeyko's Chilean collection from École des Mines in Paris in their work (1851). There were described 39 species of Mesozoic fossil fauna collected by I. Domeyko in the environs of Copiapó, Coquimbo, Chañarcillo, and Arqueros. Two new species were named after Ignacy Domeyko: *Ammonites domeykanus* Nob. and *Terebratula domeykana* Nob. This interesting collection could be in view in the future (Lauriat-Rage, 2002).

The famous scholar Ignacy Domeyko made a great contribution into the 19th century geology discoveries of Chilean Andes.

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# SMALL CARBONACEOUS FOSSILS (SCFS) FROM THE CAMBRIAN AND EDIACARAN OF THE BALTOSCANDIAN BASIN: PROSPECTS AND PRELIMINARY RESULTS

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Fossils from the Ediacaran and Cambrian document an explosive diversification of complex multicellular life. Even so, metazoan origins remain obscure, because fossils from this interval are often biologically enigmatic and difficult to place in a global chronology. To test hypotheses on the origins of animals and of Phanerozoic-type ecosystems, we have developed research into small carbonaceous fossils (SCFs). SCFs represent a category of gently-extracted organic-walled fossils that are too large and / or delicate to be routinely recovered using traditional palynology, but offer a rich complementary dataset for palaeobiology and biostratigraphy (Butterfield, Harvey, 2012). Previously, our focus has been on middle and late Cambrian (Series 3 and Furongian) SCFs from western Canada, which extend the known diversity and distribution of "Burgess Shale-type" taxa and "small shelly fossils" (via carbonaceous taphomorphs), and reveal otherwise "cryptic" Cambrian organisms. By extending our sampling to the Baltoscandian Basin, which preserves undeformed mudrocks from across the Ediacaran–Cambrian transition, we aim to establish the downward ranges of animal SCFs. Our preliminary results suggest a clear temporal trend. The File Haidar Formation from Gotland (Cambrian Stage 4) has yielded several metazoan SCFs that are familiar from coeval deposits in western Canada. In contrast, a somewhat older assemblage from the Lontova Formation of NE Estonia (Cambrian Stage 2) contains fewer metazoan SCFs, although robust sickle-shaped spines are extremely abundant at some horizons. Assemblages that are older still, from the earliest Cambrian and Ediacaran sub-surface successions in NW Estonia, lack recognizable metazoan SCFs but contain abundant tubular and sheet-like forms attributable to the problematic "vendotaenids". Overall, the Baltoscandian SCFs appear to support the traditional palaeontological reading of the Cambrian explosion, while offering detailed new data on the anatomy and distributions of the earliest Phanerozoic organisms.

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# MIDDLE DEVONIAN VERTEBRATES FROM THE LEMOVZHA RIVER, NW RUSSIA

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D. V. Obruchev (1933) described the Narova Beds and mentioned the section along the Lemovzha River (south-westen part of Leningrad Region, NW Russia) as the most complete and typical for this stratigraphical interval. This section contains marls, mudstones, clays and sandstones of the Eifelian Narova (Narva) Regional Stage (RS), as well as sandstones of the Givetian Aruküla RS (Ivanov et al., 2012). The vertebrate assemblage of the Narova marl deposits includes psammosteids *Schizosteus splendens* (Eichwald), *S. striatus* (Gross); placoderms *Holonema* sp., *Homostius* sp. and *Byssacanthus dilatatus* (Eichwald); acanthodians *Archaeacanthus* sp. and *Haplacanthus* sp.; sarcopterygians *Thursius* sp., cf. *Gyroptychius* sp., *Glyptolepis*? *quadrata* Eichwald, Struniiformes indet. and *Dipterus arenaceus* Eichwald. The Aruküla vertebrate assemblage from typical sandy deposits contains the remains of psammosteids *Pycnosteus palaeformis* Preobrazhensky, *P. pauli* Mark, *Schizosteus striatus*; placoderms *Homostius* sp., *Actinolepis tuberculata* Agassiz, *Dickosteus* sp. and *Asterolepis estonica* Gross; various acanthodians; sarcopterygians *Glyptolepis* sp., *Dipterus radiatus* (Eichwald), Osteolepididae indet. The diverse acanthodians based on the scales were reported from both assemblages (Valiukevičius, 1985). The precise position of the boundary between the Narova and Aruküla RS has not been determined in the Lemovzha section. Obruchev (1933) attributed all sandstones above the marls to the Luga Beds (Aruküla RS). But the sandstones 1.5 m up to the marl top contain the vertebrate remains belonging to psammosteids *Schizosteus splendens, S. striatus*, *Pycnosteus pauli*; placoderms *Asterolepis* sp. and Coccosteidae indet.; chondrichthyans *Karksiodus mirus* Ivanov et Märss and *Karksilepis parva* Märss; acanthodians *Cheiracanthus brevicostatus* Gross, *Diplacanthus gravis* Valiukevičius, *Homacanthus* sp., *Rhadinacanthus* sp.; sarcopterygians *Glyptolepis* sp. and Osteolepididae indet. Psammosteids *S. striatus* and *P. pauli* occur in the Narova and Aruküla RS; but *S. splendens* is known only from the Narova RS (Mark-Kurik, 2000). However, acanthodian *Diplacanthus gravis* was found in the Aruküla RS (Valiukevičius, 2000).

It is possible that lower sandstone layers belong to the Narova RS and some acanthodian taxa were recorded earlier in the eastern part of the Main Devonian Field. Thus, the zonation based on psammosteids and acanthodians needs improvement.

# DEVONIAN CHONDRICHTHYANS OF THE BALTIC REGION

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The history of chondrichthyan (and putative chondrichthyan) discoveries in the Main Devonian Field goes two decades back. They have been discovered in the shallow-water deposits from the Early to Late Devonian of East Baltic countries, and the Leningrad Region of Russia. The number of localities with their remains has been significantly increased while the specimens from these sites are still very rare. The data are important in widening our knowledge about chondrichthyan diversity and distribution in the Devonian.

The fragment of squamation and isolated scales of putative chondrichthyan described as *Lugalepis multispinata* Karatajūtė-Talimaa are recorded in the Narova (Narva) Regional Stages (RS), Eifelian, Middle Devonian of several drill cores in Lithuania, Baltinava drill core in Latvia and in the Luga River outcrop in the Leningrad Region as well as from possibly the Ķemeri RS (Emsian, Early Devonian) of the Ventspils borehole, Latvia (Karatajūtė-Talimaa, 1997). The putative chondrichthyan *Karksilepis parva* Märss presented by the isolated scales occurs in the Burtnieki RS (Givetian, Middle Devonian) of the Karksi outcrop, Estonia (Märss et al., 2008) and in the Aruküla RS (Givetian, Middle Devonian) of the Lemovzha River, Leningrad Region. The Karksi outcrop also contains the elasmobranch teeth of *Karksiodus mirus* Ivanov et Märss (Ivanov et al., 2011) as well as the scales of typical chondrichthyans. The *Karksiodus* teeth were found in the Aruküla RS of the Aruküla cave (Mark-Kurik, Karatajūtė-Talimaa, 2004), and in the Aruküla and Burtnieki RS of Lemovzha, Kemka, and Oredezh rivers, and the Zaitsevo quarry in the Leningrad Region.

The elasmobranch teeth of *Protacrodus* sp. and *Protacrodus aequalis* Ivanov were recorded from the Famennian, Late Devonian of Latvia: respectively from the Kursa RS of 27 drill cores and from the Mūri RS of the Svēte River (Ivanov, Lukševičs, 1994). The teeth of *Phoebodus* cf. *Ph. rayi* Ginter & Turner, *Phoebodus* sp. and ctenacanthid scales were reported from the Joniškis RS (Famennian, Late Devonian) of the Gedvainiai and Indrišiūnai drill cores in Lithuania (Valiukevičius, Ovnatanova, 2005).

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# HIGHER PLANTS AND MIOSPORE ASSEMBLAGES OF BURTNIEKI REGIONAL STAGE (GIVETIAN), SOUTH ESTONIA (JOOSU QUARRY)

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Givetian plants of Estonia are attributed to just one locality in the sediments of Burtnieki RS in the Joosu quarry, with a single higher plant *Pseudosporochnus estonicus* described by K. Kalamees (1988). Miospores from Burtnieki deposits of Estonia have not been found.

The samples which we have analyzed were collected by E Mark-Kurik (in 1971) from the Joosu quarry numbering over 30 fragments of plants axes impressions and sporangia. E. Mark-Kurik, J. Nemliher (2003) related this section to the Abava Beds which are included into the Givetian Burtnieki RS, forming its third or upper part. This research is based on the detailed description of the section provided by V. Kuršs (1992). The survey revealed a diversity of the taxonomic composition of Abava Beds flora with a predominance of ferns from the Class Cladoxylopsida of the Division Polypodiophyta: *Pseudosporochnus verticillatus, P. chlupáči, P. estonicus*. We have also registered the single specimen of the Division Lycopodiophyta – *Precyclostigma* sp. and observed a great similarity with Givetian pseudosporochnids from Czech and Lower Givetian plants (Gi b) from Belgium and Joosu. The age of the Abava Mb deposits dated by macroflora is assumed as Givetian, or probably, Lower Givetian.

Dispersed miospores first extracted from the Abava Mb of flora-containing rocks are represented by a depleted assemblage with the predominance of small miospores (8–15 μ) with a simple exine (60%). Besides, there are miospores of the *Geminospora* (*G. micromanifesta*) genus and the typical Givetian species of the same genus: *G. compta, G. egregius* (10%) among which there is EX zone index – *G. extensa* that characterizes the Givetian stage. The number of typical Givetian species is less. Large miospores (more than 60 μ) with complicated morphology of the exine have not been fixed. The studied assemblage can be attributed to the *Geminospora extensa* miospore zone. The assemblage from Latvia (Salatzskaya Fm of Givetian) is characterized by the development of small miospores with a simple exine (Ozolinja, 1963) which agrees to the results of the present research. Therefore the age of the Abava Mb sediments dated by macroflora is most likely Lower Givetian and by miospores it can be determined as Givetian zone EX.

# BIO-CHEMOSTRATIGRAPHICAL CORRELATION OF UPPER SILURIAN SECTIONS ALONG THE WESTERN COASTS OF ESTONIA AND LATVIA: PROBLEMS AND SOLUTIONS

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This project was initiated for testing the ideas of ecostratigraphy that were popular in the 1980s–1990s of the last century. Unfortunately, not all initiators are among us now. Here we discuss five drill core sections located on the east coast of the Baltic Sea. Three of them, Kaugatuma and Ohesaare on the Sõrve Peninsula in Estonia and Kolka in the Kurzeme Region of Latvia, are located close to the Silurian shore and two more Latvian ones (Ventspils and Pavilosta) in the offshore area. The study interval embraces the entire Upper Silurian from the Paadla (Ludlow) to the Ohesaare Regional Stage (Pridoli) or, in terms of lithostratigraphy, the Torgu, Kuressaare, Kaugatuma (Äigu, Lõo), Ohesaare, Dubysa, Pagegiai (Mituva, Engure), Ventspils, Minija and Jura (Targale) formations. This terminology reflects changes in three main lithofacies associations, beginning from the shoreface: (1) different lime- and dolostones with marl intercalations representing a shallow carbonate shelf dominating in the Sõrve and Kolka sections; in the upper and middle parts of the Ventspils and the upper part of the Pavilosta core; (2) marls with limestone nodules and rare interbeds formed on the gentle slope of the carbonate shelf and occupying most of the lower part of the Ventspils core and the middle part of the Pavilosta core; (3) relatively deep-water graptolitic marls and argillites in most of the lower part of the Pavilosta core and a little in the bottom of the Ventspils core. Sporadic occurrences of macrofossils (stromatoporoids, tabulate corals, brachiopods, trilobites, graptolites) show a community pattern that is in harmony with changing facies. Microfossils (ostracodes and especially recently published chitinozoans, conodonts and microvertebrates) enable more perfect biostratigraphical zonations. Still, discrepancies between fossil group biostratigraphy remain. To understand them, we made 260 whole-rock carbon isotope analyses from the Ohesaare, Ventspils and Pavilosta cores. Integrated $\delta^{13}C$ data made it easier to trace several synchronous biostratigraphical datum planes through different facies boundaries.

# DIFFERENTIATED APPROACH TO THE RISK ASSESSMENT OF GEOLOGICAL PROCESSES FOR VARIOUS MEMBERS OF THE BIOTA ON RUSSIA TERRITORY

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Assessment of the ecological role of these processes requires a differentiated approach to determining their impact on various representatives of the biota, as there are differences in the spatial distribution and in the list composition of life threatening natural processes. Not only the *anthropocentric approach*, where humans are the focus of the research, is needed, but also a *biocentric approach*, where the dominant place is occupied by representatives of wildlife and vegetation. This especially concerns sparsely populated areas, where engineering and environmental conditions are examined on preconstruction phases, particularly when laying pipelines in a remote area with a low population density.

An *anthropocentric approach* to the assessment of geological and other natural processes on the territory of Russia revealed that the mass deaths of people (onetime deaths of over ten people) occur in conjunction with a high rate of the development process, a high population density, and the lack of a population warning system, as well as protective structures. On the territory of Russia, mass deaths are possible following floods, earthquakes, tsunamis, and landslides (earthquakes in the Baikal rift zone, in Sakhalin and Primorye; tsunamis on Kamchatka; landslides in the Caucasus and Kamchatka). Many casualties can occur during catastrophic flooding in some areas of the Oka, Vyatka, Sosna, Lena, Yenisei, and Tobol rivers.

The *biocentric approach* to the assessment of geological and other natural processes involves consideration from the position of the existence of animals (the zoocentric approach) and plant growth (the phytocentric approach). The zoocentric approach has practically not been designed. The phytocentric approach to the assessment of geological processes determines them from the point of view of soil conservation. Unlike a human, who can use the achievements of civilization to mitigate or avoid adverse consequences, plants depend on soil conditions. The soil is a source of nutrient compounds and biophylic elements and its preservation and fertility is the main ecological criterion in assessing the phytocenoses status. For the territory of Russia the list of natural processes that occur with the destruction of soil and that threaten the mass destruction of plants includes droughts, tornadoes, heavy rains, dust storms, hail, mudslides, and fires in peat lands, which change the properties of the upper layers of the lithosphere due to thermal effects (soil covers are replaced by pyrogenic secondary formations).

Evaluation of the environmental consequences of modern processes requires a differentiated approach to their impacts on society and on the remaining biota.

# 90 YEARS SINCE FOUNDATION OF THE CHAIR OF GEOLOGY AND PALEONTOLOGY AT THE UNIVERSITY OF LATVIA AND CONTRIBUTION OF ERNST KRAUS AND NIKOLAI DELLE

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The University of Latvia (UL) named at that time "The Latvia Higher School" was founded on September 28, 1919 on the basis of the former Riga Polytechnic (founded in 1862). Two outstanding persons, B. Popov and E. Kraus, are related to the beginning of geological studies at UL. The chronologically earliest lectures (academic year of 1919–1920) related to some aspects of geology were provided by the lecturer of the Faculty of Chemistry, mineralogist Jānis Priede, within the courses of crystallography and mineralogy. Prominent mineralogist professor Boris Popov, the member of the Faculty of Chemistry since 1920, also lectured in geology until the Chair of Geology and Palaeontology has been founded in 1924. The first chairman, professor Ernst Kraus (1889–1970), was elected for this position for three times (in 1924, 1929 and 1935), but due to the complicated political situation in Europe and deep scientific interests in the tectonics of Alps left his position in 1935. Despite a relatively short period of active scientific, teaching and organizational work at UL, the results of Kraus' activities are rather impressive: he organised the Institute of Geology and Palaeontology (IGP), contributed to the foundation of the Geological Museum of UL ("Museum of Geology of Latvia" at that times), greatly promoted research activities of students, provided lectures in various fields of geology including applied aspects, and actively studied the geological structure of the Baltic States, mainly Latvia and Lithuania. The main scientific interests of E. Kraus in the regional geology of the Baltic area were related to the tectonic structure of the territory, structure, stratigraphy, paleogeography and ichnology of the Devonian deposits, but he also published some papers on the Tertiary and Quaternary deposits, Cambrian and Silurian rocks in the Daugavpils borehole, about gypsum and groundwater, etc. One of his students, Nikolai Delle (1899–1946), started his career in science in 1925 as a sub-assistant of IGP, and after the defence of the thesis in 1934 partly replaced E. Kraus teaching historical geology and palaeontology, and becoming the *privatdocent*, later docent of UL. In 1940 he became the Director of the Institute of Geology of UL. N. Delle devoted himself to the stratigraphy and regional geology of the Devonian deposits of Latvia, publishing 9 papers and becoming one of the most well-known geologists of Latvia in the first half of the twentieth century.

# STRATIGRAPHY OF FRASNIAN-FAMENNIAN BOUNDARY DEPOSITS IN THE SOUTH-EAST OF THE RUSSIAN PLATE (UPPER DEVONIAN, RUSSIA)

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The Frasnian-Famennian boundary deposits in the South-East Russian Plate (Volgograd Volga Region, Russia) are stripped by boreholes and subdivided into the Evlanovo (Ev), Livny (Lv), Volgograd (Vg) and Zadonsk (Zd) Regional Stage (RS). The section is represented by marine terrigenous and carbonate deposits. All RS on the investigated territory are characterized by brachiopod ostracod and miospore assemblages as well as by conodont complex determined in separate wells.

Ev RS corresponds to the Auroraspora speciosa–Verrucosisporites evlanensis local miospore Zone. It is characterized by the species *A. speciosa* (Naum.) Obukh., *V. evlanensis* (Naum.) Obukh., *Cristatisporites deliquescens* (Naum.) Obukh., *Membrabaculisporis radiatus* (Naum.), etc. Similar miospore assemblage was traced in Ev RS of the CR, CDF and the Pripyat Depression, in the middle portion of the Ukhta Formation of TPP and the lower part of the Amula Horizon of the MDF and Baltic Region (Raskatova, 1973; Devonian..., 1981; Decision..., 1990; Avkhimovitch et al., 1993; Rodionova et al., 1995; Obukhovskaya et al., 2000).

Lv RS is characterized by the Palmatolepis linquiformis conodont Zone (Galushin, Kononova, 2004) and the Chelinospora lepida–Grandispora subsuta local miospore Zone. The basic characteristic spore species *Grandispora subsuta* (Naz.) Obukh. (first appearance), *Chelinospora lepida* (Obukh.) Obukh., *Verrucosisporites evlanensis*, *Auroraspora speciosa*, *Cristatisporites deliquescens*, *C. imperpetuus* (Senn.) Obukh., *Diducites hopericus* (Naz.) Obukh. have been determined. On the whole, this miospore assemblage is similar to that determined in Lv RS of CR, CDF and the Pripyat Depression, in the upper part of the Ukhta Formation of TPP and the upper part of the Amula Horizon of MDF and the Baltic Region (Raskatova, 1973; Resolution…, 1984; Decision..., 1990; Devonian..., 1981; Avkhimovitch et al., 1993; Rodionova et al., 1995; Obukhovskaya et al., 2000).

Vg RS has the local distribution in depressions only and contains conodonts of the Pa. triangularis Zone (data of V. Khalymbadzha and G. Galushin) and the miospore of the Corbulispora viminea–Geminospora vasjamica (VV) Zone (Mantsurova, 1987; Nazarenko et al., 1993; Mantsurova et al., 2003). The basic characteristic species *Geminospora notata* (Naum.) Obukh. *var. microspinosus* Tchib., *G. vasjamica* (Tchib.) Obukh. & Nekr., *Corbulispora viminea* (Nekr). Obukh. (first appearance), *C. semireticulata* (Tchib.) Obukh., *Cymbosporites boafeticus* (Tchib.) Obukh., *Lophozonotriletes curvatus* Naum., *Lophotriletes multiformis* Tchib., *Punctatisporites famenensis* (Naum.) Obukh., *Pustulatisporites pullus* (Naum.) Obukh. are present here. VV Zone was followed in Vg RS of Eastern Regions of the Russian Plate and TPP, in the Domanovitchy Horizon of the Pripyat Depression, in the Eley Horizon (Kruoja and Šiauliai Formations) of MDF and the Baltic Region (Devonian..., 1981; Medianik, 1981; Resolution…, 1984; Decision..., 1990; Avkhimovich et al., 1993; Nekriata, 1999; Obukhovskaya et al., 2000).

Zd RS is characterized by the Pa. crepida conodont Zone (Galushin, Kononova, 2004) and the Cyrtospora cristifera–Diaphanospora zadonica (CZ) miospore Zone. *C. cristifera* (Luber)

Van Der Zwan, *D. zadonica* (Naum.) Avkh., *D. macrovaria* (Naz.) Nekr. & Avkh., *D. rugosa* (Naum.) Hass., *Auroraspora varia* (Naum.) Ahmed., *A. limpida* (Naum.) Avkh., *Convolutispora zadonica* (Nekr.) Obukh. & Nekr., *Kedoesporis angulosus* (Naum) Obukh., *G. notata var. microspinosus, P. famenensis*, *P. pullus*, *L. curvatus* species are characteristic of Zd RS. CZ miospore assemblage was traced in Zd RS of CR, CDF and TPP, in the Zd Superhorizon of the Pripyat Depression and the Joniškis Horizon of the Baltic Region (Raskatova, 1973; Devonian..., 1981; Resolution…, 1984; Decision..., 1990; Nekriata, 1999; Avkhimovitch et al., 1993; Rodionova et al., 1995; Obukhovskaya et al., 2000).

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# NEW EVIDENCE OF BARRIER REEF-LIKE BODIES IN THE SOUTHERN BALTIC SILURIAN BASIN BASED ON 3-D SEISMIC DATA

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A number of researchers interpreted the Silurian Baltic basin as a platform depositional system because of the presence of reefs. The limestones in the central facies belt, the so-called reef belt, in the Silurian Baltic basin are dominated by stromotoporoids with a variable content of tabulate and rugose corals and bryozoa as the main carbonate producing metazoan fauna elements and crinoids. For many decades, Gotland (Sweden) and Estonia were major research areas in Europe for Silurian reef-like carbonates. Similar reef-like build-ups have been interpreted from seismic data under the Baltic Sea. They acknowledge that these are not true barrier reefs but rather composed of several vertically stacked flat biostromes (Floden et al., 2001). Bičkauskas and Molenaar in their research of Pridolian carbonates conclude that patch (isolated) reefs are not excluded (Bičkauskas, Molenaar, 2008).The primary objective of the current study was to map one of the oil-potential reef structures located in the middle Lithuanian reef belt applying the 3D seismic acquisition method.

**Methods.** For the confident mapping of Silurian reef-like structures the following survey parameters were selected: orthogonal survey design, 14 active receiver lines, 200 m receiver line spacing, 40 receiver stations within a line, 50 m receiver station spacing, 560 active channels, 250 m source line spacing and 25 m source station spacing. The standard PSTM processing routine was applied with a special attitude to velocity analysis and residual static correction evaluation in order to achieve the highest possible definition of target objects. At the interpretation stage structural time and depth mapping of reef bodies were performed.

**Results.** The preliminary results show that a barrier reef-like structure (bank?) started to develop at the end of the Pagėgiai time (Ludfordian). The barrier favoured the evolution of the reef-like structures (northern and southern Bliūdžiai as well as Pavasaris). The growth of both barrier and patch (?) reefs continued during the early Minija time (lower Pridolian). At the end of the Minija time the barrier-reef structure started to disappear but the mentioned patch reef structures still existed. At the begining of the Jura time (late Prdolian) all mentioned structures almost disappeared. Such a picture illustrates that based on the 3-D survey results it is possible to draw guidelines for further and better understanding of the reef-like structures development as well as for better understanding of the sedimentary environments character during the Ludlow and Pridolian.

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# COMPREHENSIVE ANALYSIS OF SAND AND CLAY DEPOSITS FORMATION IN THE MIKULIN HORIZON OF ST. PETERSBURG SECTION

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Quaternary sediments in St. Petersburg lie on an uneven surface of pre-Quaternary rocks of the Vendian and Lower Cambrian Period. The formation of Quaternary strata occurred in a constantly changing paleogeographic environment and sedimentation, so there is a very wide range of both genetic and lithological varieties within its section.

The Mikulin interglacial time deserves special attention. The Mikulin era witnessed the accumulation of various marine and continental (lake, marsh) deposits. The climate of the Mikulin time was the most warm and humid, which influenced the development of organic life. Marine sediments were formed in a relatively deep, stagnant part of the basin with a unique composition of fauna and contain large amounts of organic matter, including bituminous. Lithologically they are represented by loam and clay, less often by fine-grained sands from dark gray to black in color, often with well-preserved organic remains. The content of organic matter in these rocks varies widely – from a fraction % to 20% or more, with organic matter having a high degree of decomposition. The Mikulin age and marine genesis of these layers were uniquely dated by sporal-pollen and diatom analysis. Accordingly, the geotechnical assessment of the Mikulin deposits for the purpose of forecasting the durability of buildings should take into account specific factors that will determine the change in the physical condition, strength and deformability of base rocks, including:

– High content of organic matter – as a leading factor in the creation of certain parameters of the redox conditions;

– Active microbiological activity, including the study of biochemical gasification processes, emergence of quicksand and thixotropic properties in sandy and loamy sandy sediments, increase in the aggressiveness of the underground environment, etc.

The evaluation of physical-chemical and biochemical conditions should be a compulsory element of a complex work that accompanies above ground and underground building and civil engineering. Practical examples of a number of sites in St. Petersburg illustrate the identification of hazardous areas associated with the processes of gasification.

# GROUND THERMAL PROPERTIES EVALUATION OF THE QUARTERNARY SECTION: BY EXAMPLE OF HIGH-TECH RESEARCH CENTER SITE

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By the Underground Law of Republic of Lithuania, before the extraction of geothermal energy resources, it is required to estimate the quantity and quality of the resource and to predict and avoid the possible negative impact for the natural environment during the extraction. However, these requirements are not well adapted for geothermal energy resources. So it is necessary to estimate the thermal properties and to perform the geothermal parameterisation of the geological sequence. This geological section investigation was performed during the construction of the High-Tech Research Centre in Mokslininkų Street in Vilnius. The main point of geological investigation was to identify the geological layers and evaluate the thermal properties of the whole Quaternary section. For this purpose a 150 m depth borehole heat exchanger (BHE) was erected and the geophysical investigations were performed: the Gamma-Gamma and the Electro resistivity carottages, and the thermal response test (TRT).

During the investigation a number of parameters were obtained in order to collect a proper description of the geological layers of the borehole. The identification of the geological structure was performed by gathering soil samples from the borehole during drilling and logging data on the natural gamma and electrical resistivity of the soils.

The borehole penetrated through the whole Quaternary layer to the Cretaceous. There is the Dzūkijos Formation of the Middle Pleistocene in the lower part of the investigated well. The Dzūkijos Formation is composed of 6 m of fliuvioglacial (sand) and 5 m of glacial (sandy loam) deposits. The Dzūkijos formation is covered by the Dainavos Formation of the Middle Pleistocene. The total thickness of the Dainava Formation is 31 m. It is composed of fliuvioglacial sand in the lower part in a layer thickness of 7 m with 17 m of glacial (loam, sandy loam) deposits with 2 fliuvioglacial sand interbeds in the upper part. The thickness of sand interbed variate forms 3 to 4 m. There is the Žeimena Formation on the top of the Dainava Formation in the investigated well. The total thickness of the Žeimena Formation is 62 m. There can be distinguished the Žemaitija Subformation in the lower part of the Žeimena Formation. The Žemaitijos Subformation is composed of fliuvioglacial sand. The thickness of the sand layer is 8 m. There is a 6 m thick layer of limnoglacial clay and glacial loam and sandy loam (depth 15 m) in the middle part of the Žemaitijos Subformation. The upper part of the Žemaitijos Subformation is composed of fliuvioglacial sand with two layers of glacial loam and sandy loam (1 m). The thickness of fliuvioglacial deposits is 33 m. There is distinguished Medininkai Subformation in the upper part of the Žeimena Formation. The lower part of the Medininkai Subformation is composed of glacial loam and sandy loam with limnoglacial clay interbed (2 m). The total thickness of glacial deposits is 23 m. The upper part of the

Medininkai Subformation is composed of fliuvioglacial sand. The thickness of the fliuvioglacial layer is 5 m. There was distinguished the Nemunas Formation of the Upper Pleistocene in the top of the investigated well. The Nemunas Formation is composed of limnoglacial clay (7 m) and fliuvioglacial gravel (8 m) of the Grūda Subformation. The Grūda Subformation marks the upper part of the Nemunas Formation in Lithuania. The lower and middle parts of the Nemunas Formation do not exist in the studied well. So, the total thickness of Quaternary deposits is 147 m.

The ground thermal properties were estimated using the data received from the thermal response test, which was executed *in-situ*. TRT is widely utilized to determine the ground thermal properties as well as the heat-transfer performance between the ground and the BHE. The thermal response of the borehole is the change occurring in its temperature when heat carrier fluid circulates through the borehole heat exchanger for a certain period of time. It is based on constant heat (or cool) flux extraction by means of the heat carrier fluid which circulates through the BHE system. The temperature data of the inlet and outlet fluid from the BHE are measured and logged. The study of the fluid temperature versus time enables the estimation of thermal properties in and around the borehole.

Analytical and numerical models are developed to evaluate the circulating fluid temperature data of TRT, which are described in detail by Gehlin (2002). The temperature field of the ground can be written as a function depending on the time and radius around a line source with a constant heat injection rate from a line along the vertical axis of the borehole in an infinite solid (Carlslaw, Jaeger, 1959). The thermal conductivity and thermal resistance of the investigated Quarternary section were evaluated using the method to determine ground thermal properties *in-situ* suggested by Mogensen (1983) and the numerical method developed by Eskilson (1987). The thermal properties of the investigated Quarternary section were estimated *in-situ*. The calculated mean of thermal conductivity (λ) is 2.208 W/mK and the thermal resistance value is 0.154 mK/W.

With this data we could look further in researching the correlation between the quality of the geothermal energy resource and the geological sequence. It will provide the possibility for the accurate interpretation of the geothermal potential of the structure using stratigraphical data.

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# DOLOCRETES IN THE MIDDLE TO UPPER DEVONIAN BOUNDARY BEDS IN LATVIA

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Dolomitic crusts of subaerial origin are studied in the siliciclastic deposits of the Amata Formation (Fm). Detailed documentation of deposits was done in the Vizuļi outcrop at the Amata River, exposures in ravines east from Sigulda, and outcrops at the Riežupe River. Lapped sections (30) and thin sections (20) were used to study the mineral composition, texture and microstructures of dolocretes.

The position of the boundary of the Middle and Upper Devonian in the Baltic States is still not clear. Vertebrate and miospore data indicate the Givetian age for the Gauja Fm (Ivanov, Lukševičs, 1996; Mark-Kurik et al., 1999) and well-founded conclusions are on the Frasnian age of the Pļaviņas Fm, but the placement of the Amata Fm is under discussion.

The siliciclastic Amata Formation consists of alternation of clays, siltstones and sandstones, in places with individual horizons, separate inclusions and aggregates of calcite and dolomite cement. The Amata Fm is covered by dolomitic marls and dolomites of the carbonate succession of the Pļaviņas Formation. In previous scientific studies (Lukševičs et al., 2012; Birger et al., 1979; Sorokin, 1978) the stratigraphical boundary between the Amata and Pļaviņas Fm has never been described as a regional unconformity (Figure 1B). Just during the last few years dolomite layers are supposed to be groundwater or pedogenic dolocretes (Stinkulis, Spruženiece, 2011). However, now by this research there are found out several features which extend rather far into the Baltic Devonian palaeobasin and are closely similar to those of well-known subaerial exposure surfaces and thereby unambiguously indicate subaerial exposure events during the Amata time.

In this study several types of dolomitic crusts such as massive, nodular, veiny, honeycomb dolocretes, *in situ* breccia, and microkarst features have been documented in the Amata Fm. Assemblage and distribution of dolocretes in the geological section indicate that carbonate crusts could be developed both in the phreatic and the vadose zone due to cyclic fluctuations of the groundwater table. Presence of both groundwater and pedogenic dolocretes within one hypsometric level and repeated distribution of different types of dolocretes – massive, nodular and honeycomb ones – within the upper part of the Amata Fm indicate more than one subaerial exposure event during the Amata time.

Dolocretes documented in this study suggest quite long and repeated episodes of subaerial exposure at the end of the Amata time. It is an additional argument to draw the boundary of the Middle and Upper Devonian between the Amata and Pļaviņas Fms.

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# INTEGRATED δ13C ISOTOPE AND GRAPTOLITE STRATIGRAPHY OF UPPER WENLOCK AND LOWER LUDLOW OF THE VILKAVIŠKIS-134 CORE, LITHUANIA

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The Vilkaviškis-134 well is located in the central Lithuania in the transitional facial zone of the Silurian Baltic basin, between deep facies in the west and shallow facies belt in the east. So, it is located in the crucial location which is perfect for correlation of sedimentary sequences between variable environments. In this study we researched the core material for the presence of graptolites, and also subdivided it stratigraphically based on the stable carbon isotopic examination.

In the investigated interval in several samples we found rare remains of graptolites. They were located in the lower part of the section. Zonal species *Pristiograptus* ex. gr. *dubius* (Suess) was found at the depth of 748.9 m. This species is not important for detailed biostratigraphy, because it is long raging. There are four findings of *Gothograptus nassa* (Holm) in the 736.8–714.3 m interval. This species is common in *parvus–praedeubeli* biozones which points that this part of the section belongs to the lower part of the Gėluva Regional Stage.

The samples for stable carbon isotope analyses were collected from the 780–630.4 m interval. The stable carbon isotopic analysis of the samples was performed in the Department of Geology of the University of Tartu.

The chemostratigraphic study has shown that in the lower part of the section (780–744.3 m interval) the $\delta^{13}C$ values were centered near zero and experienced some minor fluctuations, the values varied from −0.01‰ to +0.72‰. Subsequently, they rose rapidly to +3.67‰, reaching climax at the depth of 741.3 m, which is the maximum value in the whole studied portion of the section. We interpret this transition as signifying the beginning of the Mulde excursion during the Gėluva time. Passing this point the $\delta^{13}C$ values stabilize to +1.94‰ at 732.3 m depth and fall again to −0.04‰ at 717.3 m depth. We interpret this swing as signifying the first Homerian excursion. Though the trend is generally smooth, there is one exclusive value of $\delta^{13}C$ (−1.13‰) at 727.8 m. After that, the $\delta^{13}C$ values rise rapidly with minor fluctuations (and one more outlier (−1.39‰) at 702.3 m depth) to the maximal values of +2.47‰ at 696.3 m, and fall rapidly in the 727.8–670 2 m interval (from +2.47‰ up to 0.31‰), ending the second Mulde excursion episode. The values above decrease very rapidly to −2.81‰ at 654.7 m depth and rise again to 0.55‰ at the depth of 647.8 m, and finally drop to −1.32‰ at 639.6 m depth. In the uppermost part of the section at 639.6–630.4 m depth, the $\delta^{13}C$ values are stably negative and vary from −2.25‰ up to −1.1‰.

As mentioned, the highest $\delta^{13}C$ values in the 742.8–663.7 m interval could be interpreted as the Middle Homerian double positive carbon isotope excursion episode and the uppermost positive episode documented in this section could be one of the Lower Ludlow positive excursions. However, to confirm this proposition we need more detailed biostratigraphic data. The determination of conodont distributions promises interesting additions, and more rigorous constraints to the pattern found in the Vilkaviškis-134 well.

# CORRELATION OF GAUJA DEPOSITS WITHIN THE MAIN DEVONIAN FIELD (LENINGRAD REGION, RUSSIA; LATVIA; ESTONIA) BY MIOSPORE ASSEMBLAGES

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The eastern part of the Main Devonian Field, including the North-West of Russia and the Baltic countries, is a large territory of the Devonian deposits distribution. Miospore assemblage was studied from Gauja Fm in the Tolmachiovo section located in the Luga district of the Leningrad region. Dispersed miospores were isolated from the sandstone interlayers with clay concretions. Miospore assemblage is characterized by the dominance of the large number of species of the genus *Geminospora*: *G. micromanifesta, G. micromanifesta* var *limbata, G. notata, G. rugosa, G. punctata*. Small species of some genera (*Leiotriletes, Lophotriletes*, *Punctatisporites*) with a smooth exine partially covered with sporangial tissue have also been found. According to our researches, the general structure of miospore assemblage from Tolmachiovo is corresponded to the *Ancyrospora incisa–Geminospora micromanifesta* (IM) Subzone.

In Latvia Gauja Fm was characterized from the boreholes and outcrops by miospore assemblage V (Ozoliņa, 1963) and from the Lode clay pit by miospore assemblage A (Jurina, Raskatova, 2012). In Estonia miospores have been examined in details from the Lode Member (Gauja Fm) in the locality Küllatova (Mark-Kurik et al., 1999). The miospore assemblage from Tolmachiovo is similar in the composition of the above assemblages of stratigraphically important species in these areas. A distinctive feature of the assemblage from Tolmachiovo differing it from the assemblages V, A (Latvia) and from the Küllatova assemblage is the absence of megaspores in this assemblage.

These four miospore assemblages were compared to the *Ancyrospora incisa-Geminospora micromanifesta* (IM) Subzone. This Subzone was previously located at the base of the Frasnian stage (Avkhimovitch et al., 1993). At present time, the Stratigraphical Committee of Russia offers to draw the boundary of the Givetian and the Frasnian stages at the base of the Upper Timan Subhorizon of the East European Platform (Sobolev, Evdokimova, 2008). According to this decision, the IM Subzone is moved to the Givetian stage and characterizes its upper part.

# CARBONATES IN THE HETEROCHRONOUS TILLS OF WESTERN AND SOUTH EASTERN LITHUANIA AS A CRITERION OF THEIR STRATIGRAPHICAL CORRELATION

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It is very important to use the same criteria for geological unit subdivisions and comparisons (Bitinas, 2011). The biostratigraphical principle as the main criterion in the stratigraphical subdivision of the Pleistocene sediments is not sufficient for the simple reason: the great deal of Pleistocene sediments lacks paleontological remains (Baltrūnas, 2002). The great deal of Pleistocene tills from Lithuania contains an elevated content of carbonate material. The tills of different age are different in the distribution of carbonate material quantities and dolomite and calcite ratio. The quantities and the ratio could be used for the sediments of the Pleistocene subdivision and correlation in Lithuania (Rudnitskaite, 1983).

**Methods.** The bulk content of carbonate material in the tills of different Pleistocene age was determined. More on the methodology could be found in literature (Sanko et al., 2008; Kabailienė et al., 2009). The dolomite and calcite ratio was calculated. For further heterochronous tills correlation the Van der Warden criterion was applied.

**Materials and results.** The carbonate analysis was applied for tills from 2 boreholes and 7 outcrops from Western Lithuania and 8 boreholes from South Eastern Lithuania. It was found that among carbonate group minerals calcite and dolomite dominate. Our results show that total carbonate content, calcite and dolomite quantities and their ratio, at some extent, could be utilised for tills correlation. The till of the Medininkai age seems to be a marker.

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# PLEISTOCENE CHRONOSTRATIGRAPHICAL CORRELATION CHART FOR BELARUS AND LITHUANIA

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During the scientific collaboration in the frame of the bilateral project "Geological Correlation and Palaeoenvironmental Reconstructions of the Cross-border Area of Belarus and Lithuania", new attempts were made to correlate the Pleistocene sediment layers between the countries as well as with the Marine isotope stages (MIS). As a result, the Pleistocene chronostratigraphical correlation chart of Belarus and Lithuania is presented.

The recent complex studies of the Pleistocene thickness of Lithuania enabled some corrections of the stratigraphaphic position of sediment layers. Palaeomagnetic investigations capacitated to detect the Brunhes / Matuyama boundary and Jaramillo subchron in the Daumantai and Šlavė sections. These findings contributed to some changes in the stratigraphy of the Lower Pleistocene of Lithuania (Baltrūnas et al., 2013; 2014). Though, the lowermost part of the Pleistocene sediment thickness is still the most problematic for the correlation.

More than 2 000 sediment sections in the territory of Belarus were revised and it was concluded that commonly four glacial and three interglacial horizons could be ascertained in the Pleistocene thickness. All of them stretch in the considerable area and have reliable stratigraphic criterions. Glacial horizons: Narevian, Berezinian, Pripetian and Poozerian could be correlated with Dzūkija, Dainava, Medininkai and Nemunas, respectively. Interglacial horizons Belovezhian, Alexandrian and Muravian correlate well with Turgeliai, Butėnai and Merkinė. Correlation of other sediment layers is more complicated.

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# DETERMINANTS OF CONODONT SURVIVAL DURING THE EARLY SHEINWOODIAN IREVIKEN EXTINCTION EVENT

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The Early Sheinwoodian or so-called Ireviken event is one of the most significant extinctions during the whole Silurian period. This episode of diversity loss left its mark on the whole range of different groups. The literature survey points that conodonts, graptolites and chitinozoans were affected most. Here we present results of the study where we investigated the effects of conodont species abundance parameters, and their habitat preferences, as reflected by the gamma logs, in species survival selectivity. The application of bivariate logistic regression on 34 species of conodonts revealed three variables which were statistically significantly associated with their odds of survival: spectral exponents describing degrees of autocorrelations in their abundance time series, skewnesses of species abundance distributions, and also their average environmental preferences, mostly determined by ancient water depths. The model selection analysis of multivariate logistic models constructed from this subset of variables revealed the best model, which included skewnesses of species local abundance distributions and their substrate preferences. A comparable pattern was uncovered by complimentary regression tree analysis. Other variables, such as mean abundance, and short-term variability in abundance, were judged as non-significant. Though, it is possible that it is a result of low statistical power of tests given small effect sizes of variables, and a small overall sample size, limited by the number of sampled species which were present in the region. Significant association of extinction risk with preferential existence in deeper environments points to open ocean causal mechanisms of biotic stress during the Early Sheinwoodian extinction. Significant positive correlations between skewnesses, and also values of spectral exponents with the survival probabilities, suggest important contribution of community and ecosystems processes, which controlled species abundance fluctuation patterns, in the selectivity of this mass extinction.

# PROBLEMS OF THE STRATIGRAPHY OF THE PLEISTOCENE OF BELARUS AND LITHUANIA IN THE LIGHT OF NEW DATA

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The most complicated stratigraphy is of the Lower Pleistocene. Very often the sediment layers are of local distribution, contain no any flora or fauna remains and a high percent of redeposited material. The detection of the Brunhes / Matuyama boundary by palaeomagnetic studies in the Belarus area below the Narevian till in the Brest horizon (Sanko, Moiseev, 1996) and in several sections of Daumantai thickness in Lithuania (Baltrūnas et al., 2013) allowed the correction of its position. In relation with the lowering of the Pleistocene / Pliocene boundary to 2.6 Ma, the sediments of the Olkhovskian, Dvoretskian and Brestskian horizons in Belarus are considered as Lower Pleistocene. They could be correlated with the Anykščiai and a part of the Daumantai layers.

The Middle Pleistocene marker horizons are Butėnai (Lithuania) and Alexandrian (Belarus) interglacials. The stratigraphical position of Vindžiūnai, Snaigupėlė interglacials and Kalviai glacial is under discussion. In this instance the correlation of the oldest Narevian horizon of Belarus with Dzūkija in Lithuania is reasonable. On the view of palaeontologists, the subdivision of Belovezhian horizon into three units – Belovezhian and Mogilovskian interglacials separated by Nizhninski glacial (Velichkevich et al., 1996) – makes reliable the correlation of the Turgeliai interglacial in Lithuania with Mogilovskian.

The Upper Pleistocene marker horizons are Merkinė (Lithuania) and Muravian (Belarus) interglacial sediments. The Nemunas glacial horizon correlates well with the Poozerian horizon in Belarus. More detailed subdivision of the Upper Pleistocene deposits is possible, but remains still problematic in both countries.

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# GEOLOGICAL AND GEOGRAPHICAL FEATURES OF THE REGION AS A FACTOR FORMING THE PLACE NAMES (ON THE EXAMPLE OF INGERMANLAND)

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The leading role in definition of the origin of geographical names still belongs to linguists. However, natural features of the district have considerable impact on formation of place names. Therefore, studying distribution of the toponyms in connection with geological and geographical features of the region, it is possible to determine some general consistent regularity that will help to resolve an issue of an origin of toponyms and in disputable situations. Ingermanland is the ethnocultural and historical region in the territory of the Leningrad region. Historically this region was an area of the mixed accommodation various Finno-Ugric and Russian tribes. The author analysed over 100 geographical names in the former Ingermanland's territory and proved the connection with natural features of the district. The relief and features of river's network appeared to be the most significant factors for formation of toponyms. Also, the character of the coastline of the Gulf of Finland and lakes and deposits developed in the area had influence on the toponym forming. The analysis of geological and geographical features was accompanied by studying of cartographic and archival materials for the purpose of identification of an initial pronunciation of toponyms. The received regularities allowed the author to analyse a series of toponyms of a disputable origin. For example, there are a lot of disputes by linguists, historians and regional specialists about the origin of the toponym – Kavelahta (basis from the Finnish "lahti" – gulf). This village is situated at some distance from Dudergofsky Lake (about 1 km to the southern coast). That is why it is not enough clear what is the origin of the place name directly indicating the coastal lake features. In this regard, now the version about existence of the large gulf of Dudegrofsky Lake in the recent past is widely spread (described village was situated on the coast of this gulf). However, geological data do not confirm legitimacy of this hypothesis. According to the author, the first part of the toponym was formed from the Finnish word "kävellä" – to go and was pointing to "pedestrian" availability of the gulf. Also, the whole series of toponyms with the root "savi": Savikino, Savkino, etc., developing not only within the Ingermanlan, but also across all the Leningrad region, probably has a petrographic substratum (Finnish "savi" – clay). As confirmation to this are numerous Slavic analogs of the specified names: Glinka, Glinka, and wide distribution of thin loams in the region. The established connection cannot only be a key to understanding of the toponym's origin, but also represents the indirect testimony of the paleolandscape's character in the region in historical time (a question which geologists usually do not concern).

# ABOUT PECULIARITIES OF THE COMPLEX OF ORTHAMBONITES PANDER – ORTHIS DALMAN OF LOST OUTCROPS ON THE PULKOVKA RIVER (LENINGRAD REGION)

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For a long time the genus *Orthambonites* Pander (1828) has been considered as the junior synonym *Orthis* Dalman (1830) [1]. Loss of type material did not permit to understand clearly and identify fully or distinguish between the initial descriptions. In 1941, Cooper conducted revision of the genus *Orthambonites* Pander and included in it only biconvex *Orthidae* with coarse ribs. Currently, these two species are distinguished [1], primarily in the form of shells: biconvex of *Orthambonites* Pander and from plano-convex to weakly concavo-convex of *Orthis* Dalman and position brachiophores: less divergent and widely divergent brachiophores, respectively. At the same time, *Orthis* Dalman (Volkhov–Kund age) in the Baltoscandia is represented by species *Orthis callactis*, and genus *Orthambonites* Pander (Kund age) within Baltoscandia contains 6 species (considered as local species). From the paleoecology's point of view [2] *Orthis callactis* was an inhabitant of the soft-substrate and the association *Orthambonites* was typical of the hard-substrate.

In the Mining Museum an extensive collection of organic remains is kept, collected by an unknown author in 1866 from one of the lost outcrops of the Ordovician (outcrop on the Pulkovka River, south of St. Petersburg). The authors have previously defined *Orthis callactis* and the group *Orthambonites* Pander consisting of 4 morphological types. Also, the authors determined *Lycophoria nucella*, *Productorthis obtusa*, *Platystrophia dentate*, *Christiania oblonga* that indicate the Volchov–Aseri age of the deposits of the Pulkovka's valley. Some holotypes (species established by Pander) were from outcrops of the nearest vicinities of Pulkovo (or, very possibly, from the lost outcrops on the Pulkovka River). At the moment, many of them have been lost. In this regard, as well as taking into account the distribution of these genera in different facies and presence of *Orthambonites* Pander series of local species, it becomes an extremely curious feature of the systematic composition of brachiopods for this collection.

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# VERTEBRATES OF THE LOWER DEVONIAN POLAR AND PRE-POLAR URALS

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The greater part of the Lower Devonian on the territory of the western slope of the Circumpolar Urals is represented by regressive series of sedimentation. The last is of mainly terrigenous formations reffering to Pragian and Emsian stages. They are represented by Filippchuk series within Rybackaja and Pristan' suites (Pragian stage), as well as by Syv'ju ("Takata") suite (Emsian stage). Among the considered deposits the most ancient ones are quartz sandtones, aleurolites, argillites and sedimentacion dolomites of the Rybackaja suite (Tsyganko, 1997). They contain the remains of vertebrates *Turinia pagei* (Powrie), *Nikolivia elongata* Kar.-Tal., *Amaltheolepis* sp. nov., *Porolepis* sp., Arthrodira, Crossopterigii, Radotoniidae, *Nostolepis* sp., *Gomphonchus sandelensis* (Pand.). The interval of the section containing the given complex of vertebrates may be compared with the upper parts of the Dittonian of England. "Siegenian" of Ardennes and the lower part of Kemeri series of the Baltic, supposedly, corresponds to the Pragian stage of Czech Republic. Plant microfossils in these sections are represented by acritarchs *Leiopsophosphaera minuta* (Stapl.), *Trachypsophosphaera asemanta* Tschibr., *T. uspenskae* (Timof.) var. medius Tschibr., spores *Retusotriletes aff. plicatus* (Allen), *R. simplex* Naum., *R. medius* Naum. var. rugosus Naum., *Dictiotriletes paululus* Tschibr. and others. The thickness of rocks of the Rybackaja suite is 28–260 m.

The characteristic feature of the Pristan' suite is the absence of carbonate rocks and the red-brown colour of separate strata and packs of argillites, aleurolites, and sandstones. Here are found rare bones of the vertebrates *Porolepis* sp., *P. uralensis* Orb., Arthrodira. The scarcity of remains makes it possible only to suppose the correlation between the Pristan' suite and the upper part of Kemeri series of the Baltic. The plant microfossils are similar to those found in the Rybackaja suite. The thickness of sections in the Pristan' suite is 0–60 m.

The deposits of the Filippchuk suite in most sections are uncomfortably overlapped by non-carbonate sandstones, aleurolites, argillites and gravelstones of the Syvju ("Takata") suite. Some of them have alluvial genesis. The complex of plant spores being in the rocks of the suite evidences of its belonging to the Upper-Emsian sub-stage (evidently, its base): *Retusotriletes aff*. dubiosus McGregor, *R. rotundus* Streel, *R. stilifer* Tschibr., *R. naumovae* Tschibr., *Hymenozonotriletes endemicus* var. vanjaschkinensis Tschibr. and others. The findings of bones of vertebrates Lunaspididae (Wijdeaspis?) and Porolepis do not contradict the referring of the considered deposits to the Emsian stage (Karatajute-Talimaa, Tsyganko, 1997). The thickness of sections of the Syvju suite is 0–66 m. Higher, with wash-out, are bedded deposits of the upper parts of the Emsian stage belonging to the Kojva suite.

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# PROBLEMS AND SOLUTIONS TO PRESSING ISSUES OF THE CRETACEOUS SYSTEM (GLOBAL AND REGIONAL ASPECTS)

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Today in the process of renovation and development activities (based on the concept of GSSP and GSSA) ISC in general, and of the Mesozoic in the above privacy, including timber most relevant and urgent problems of stratigraphy is still stage division of the Cretaceous system. It consists of the following: 1) Despite the nearly 200-year history of the study of the Cretaceous system of the lower series and upper part (except for the Cenomanian, Turonian, Santonian and Maastrichtian) has the status of non-ratified; 2) Under the concept of GSSP ("gold spikes") boundaries of the Lower Cretaceous and partly Upper Cretaceous stages are not approved stratotypes; 3) Stages and substages of the Cretaceous system do not have a clearly defined scope and boundaries, making them illegitimate; 4) Discussing problem remains a boundary between Jurassic and Cretaceous systems, as well as the position of the Berriasian stage in ISC (system boundary should correspond to the boundary of the basal stage).

Based on the above said process of slowing down the decision on selecting events and places limitotypes (GSSP) is explained by the following factors.

1. The accumulation of sediments occurred in two different sedimentary basins – Tethyan and Boreal, differing in complex fossils, – it violates the main requirement when choosing and setting GSSP – high definition (global) correlation potential biotic events.

2. Currently under discussion sections – applicants for GSSP, located exclusively in the Western Mediterranean, within the development and predominantly Tethyan and Subtethyan deposits that are not acceptable for other areas – Boreal. In this case, for each section of existing areas the Stratotype certain area must be approved, and thus criteria (dated levels) for a global (inter-regional) correlation should be selected.

3. Insufficient degree of a comprehensive study of the region (Tethyan and Boreal regions), in the structure of the sedimentary cover which involves deposits of the Lower and Upper Cretaceous.

4. Low availability of research results at the international level.

Solutions: 1. Choosing major events and correlation levels. Inter-regional correlation system boundaries and lines should be based on the biostratigraphic method. In Cretaceous biotic selection events fall on different fossils groups. 2. Creation of parallel biostratigraphic scales. In addition to the scale of ammonite, scales for other fossils groups develop with a view to more precise fixability dating levels. 3. Application of physical and chemical stratigraphy to search for key episodes for the Boreal–Tethyan correlation of sections. 4. Conduct the search for effective correlation tools that will link with other regions of the Tethyan region.

# CHARACTERISTIC DIATOM COMPOSITION OF ANCYLUS–LITORINA STAGES IN GDANSK AND GOTLAND DEPRESSIONS (SE BALTIC SEA)

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Basins of different salinity were formed in the depression of recent Baltic Sea after the Last Glaciation, mainly because of emerging or closing straits with North Sea. Analysis of unicellular algae diatoms is used for stratigraphy of Late Glacial and Holocene sediments in the Baltic Sea. Every stage of the sea development has characteristic diatom compositions of certain environmental conditions. Transition from Ancylus Lake to the Litorina Sea stage was an important shift from freshwater environment to completely marine one. These stages left distinct sediments with characteristic diatom compositions.

The diatom composition was analyzed in two sediment cores from the south-eastern part of Gdansk and in two cores from the southern part of the Gotland depression. In both depressions one core was taken from the deep-water area and the next one was taken from the shallower marginal area of the depression.

According to diatoms, high Ancylus Lake level was distinguished in each of the four investigated cores. Freshwater planktonic species *Aulacoseira islandica*, *A. ambigua*, *Stephanodiscus rotula* predominate in sediments. Abrupt decrease of freshwater planktonic diatoms and increase of benthic *Martyana martyi*, *Fragilaria inflata*, *Navicula scutelloides* and *Diploneis domblittensis* revealed a clear Ancylus Lake regression phase only in the cores of a shallow marginal area of the investigated depressions. Ancylus Lake regression was not defined in the deep-water zone of investigated depressions. There freshwater planktonic diatoms prevail in sediments up to the brackish Litorina stage.

Gradually increasing amounts of brackish benthic diatoms (mainly *Diploneis didyma*, *D. smithii* f. *rhombica*, *D. interrupta*, *Grammatophora marina*) are characteristic of the Initial Litorina stage. The subsequent marine Litorina Sea stage is characterized by prevalence of planktonic marine and brackish diatoms (mainly *Pseudosolenia calcar–avis*, *Coscinodiscus* sp., *Actinocyclus octonarius*, *Chaetoceros* sp. resting spores). Characteristic brackish Initial Litorina and marine Litorina Sea diatom species complexes were found both in the sediments of deep-water and shallow marginal zones of Gdansk and Gotland depressions.