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Correlation of the Ordovician regional stages of the Baltic palaeobasin with new global stages

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The stages (*Brit.* series) – (Tremadoc, Arenig, Llanvirn, Llandeilo, Caradoc, and Ashgill) used in the United Kingdom were found to be unsuitable for the global stratigraphy, because their sections are breaking, located in a greatly dislocated region, not all boundaries of the stratigraphic units are clear, and correlative features are insufficient. Therefore the International Commission on Stratigraphy (ICS) (Subcommission on Ordovician) decided to use in the International Stratigraphical Scale (2000) only two of seven Ordovician stages, i. e. the first one – Tremadocian, and the 4th stage – Darriwilian. The later Scale (2004) contains also the 7th stage – Hirnantian. In the *Lethaia* seminar S.M. Bergström et al. (2006) presented additional three new stages: the 2nd – Floian, the 5th – Sandbian, and the 6th – Katian. They are approved by the ICS under the endorsement of the International Union of Geological Sciences (IUGS). Only the third stage remained unnamed, since its lower boundary, Global Standard Section Point (GSSP), is not determined yet. The Lower Ordovician consists of two stages, Tremadocian and Floian, which are the correlated Baltic palaeobasin regional stages of Pakerort and Latorp. The Middle Ordovician has also two stages: the unnamed lower one and the upper Darriwilian, which are compared to Volkhov, Kunda, Aseri, Lasnamägi and Uhaku regional stages. The Upper Ordovician is composed of three stages: Sandbian, Katian and Hirnantian, which are correlated with the major part of the Ordovician section in the Baltic palaeobasin, i.e. Kukruse (except for its lower part), Haljala Keila, Oandu, Rakvere, Nabala, Vormsi, Pirgu and Porkuni Regional stages. The GSSP of the Ordovician stages and their sites are given in Table.

Key words: Ordovician, global stages, correlation, regional stages, Baltic palaeobasin

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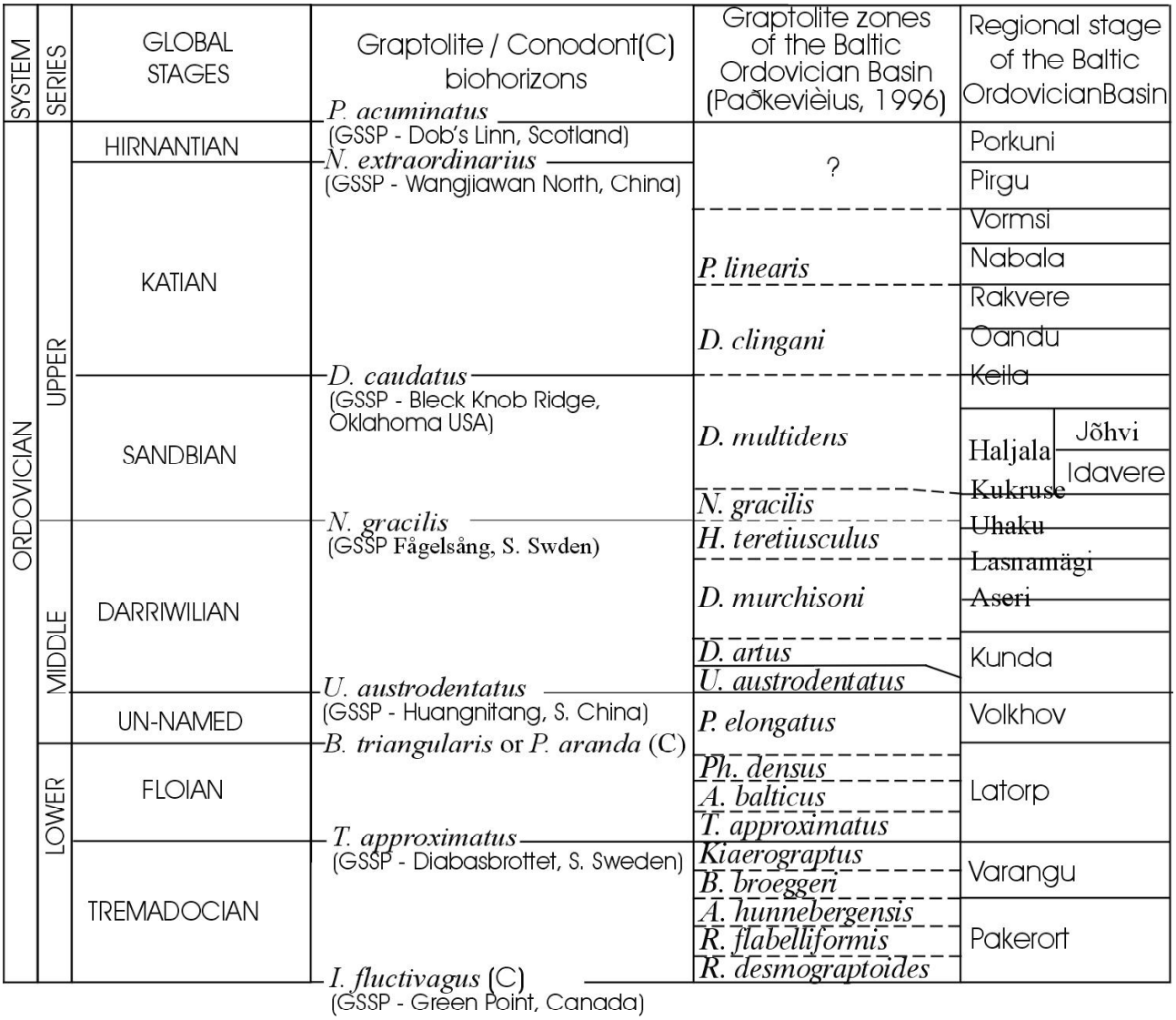
INTRODUCTION

The Ordovician as a separate system was approved during the International Geological Congress held in 1960 in Copenhagen. Its stratigraphical division into series and stages was changing; e. g., in the United Kingdom (UK) the distinguished series, such as Tremadoc, Arenig, Llanvirn, Llandeilo (in 1990s the latter was pieced together with Llanvirn), Caradoc, and Ashgill, were identified as series as well. Otherwise the Ordovician was divided in Russia, Lithuania and other European states. Here the Lower, Middle and Upper Ordovician were distinguished with the English series which were attributed to the stage rank. The boundaries of the series did not coincide with those used now. Harland et al. (1989) proposed to divide the Ordovician chronostratian scale into three subsystems: Canadian, Dyfed and Bala, keeping also the above-mentioned UK series. The IUGS Stratigraphical Scale (1989) also distinguished the Lower and the Upper Ordovician subsystems grouped into such North American series as Canadian, Champlainian and Cincinnatian, together with the UK series, and numerous stages. The IUGS International Commission on Stratigraphy (2000) proposed the stratigraphical scale in which the Ordovician was divided into 3 series / epochs: Lower / Early, Middle / Middle, and Upper / Later, with only two global stages meeting the international stratigraphy requirements, i. e. the first or the lower Tremadoc in the Lower Ordovician, and the fourth or the upper Darriwilian in the Middle Ordovician. The International Stratigraphical Scale published by the same Commission in 2004 showed the Ordovician supple-

Table. **New global stages biohorizons of the Ordovician and their correlation with regional stages of the Baltic basin**
Lentelė. **Naujieji pasauliniai ordoviko aukštai, biohorizontai ir jų koreliacija su Baltijos baseino regioniniais aukštais**



mented with one more stage – the seventh Hirnantian stage (Table).

NEW ORDOVICIAN STAGES

Bergström et al. (2006) presented three more global Ordovician series with their names – Floyan, Sandbian and Katian, which were approved by the International Commission on Stratigraphy and IUGS.

Floian Stage is named after the Swedish village of Flo situated about 5 km from the GSSP in Diabasbrottet locality. This is the upper or the 2nd stage of the Ordovician system in the lower Ordovician series. It covers the stratigraphic interval from the base of the *Tetragraptus approximatus* graptolite biozone to the base of the *Baltoniodus triangularis* conodont biozone or to the graptolite *Isograptus victoriae victoriae* biozone, or from the base of the *Proistodus proteus* conodont biozone to the base of *B. triangularis*.

Sandbian Stage forms the 5th Ordovician or the lower stage of the Upper Ordovician. Its stratotype GSSP (Fågelsång) is in the Sandby community, the name of which was applied to the stage in South Sweden (Skåne). This stage comprises the stratigraphical interval from the lower limits of the *Nemagraptus gracilis* graptolite biozone to the lower limits of the *Diplocanthograptus caudatus* graptolite biozone, or from the middle of the *Pygodus anserinus* conodont biozone which coincides with the base of the *Amorphognathus inaequalis* biozone. This stratigraphical level corresponds also to the middle part of the *Laufeldochitina stentor* Chitinozoa biozone and the start of Time Slice 5a (Webby et al., 2004). All beds of this stage were drilled just west of the Fågelsång area and described by R. Nilsson (1977).

Katian Stage is the 6th Ordovician stage or the middle stage of the Upper Ordovician. The GSSP of its lower limits is located on the Black Knob Ridge, about 5 km NE from Atoka in SE Oklahoma. The stage is

named after Lake Katy which is now drained (at the southern end of the Black Knob Ridge) about 2 km SW from the GSSP. The Katy Stage comprises the stratigraphical interval from the lower limits of the graptolite *Diplocanthograptus caudatus* biozone to the lower limits of the graptolite *Normalograptus extraordinarius* biozone. The advantage of this stage is that its beds are well exposed on the Black Knob ridge which is sparsely vegetated and has a thin soil cover. According to conodonts, the lower limits of the biozone lie somewhat lower than the base of the *Plectodina tenuis* biozone in North America, and according to Chitinozoa the lower limits lie in the middle-upper part of the *Spinachitina cervicornis* biozone and close to the base of the Slice 5c time interval (Webby et al., 2004).

Only one 3rd Ordovician or lower middle Ordovician stage remained unnamed. The Subcommission on the Ordovician did not approve its name, because the GSSP of the lower limits for this stage are not determined yet, although its biostratigraphical boundaries have been defined (from *B. triangularis* to the *Undulograptus austrodentatus* base).

CORRELATION OF ORDOVICIAN STAGES WITH THE REGIONAL STAGES OF THE BALTIC PALAEOBASIN

The Baltic Ordovician palaeobasin and its cofacies, according to V. Jaanusson (1995), are widespread in the Baltic countries (Fig. 1). Previously (Männil, 1966; Paškevičius, 1972) these cofacies like Estonian, Lithuanian and Swedish–Latvian facial zones had been ascribed to the eastern Baltic countries. Later the Swedish–Latvian facial zone was re-named into the Livonian facial zone (Paškevičius, 1994). The tectonic structures such as the Middle Lithuanian depression, Lower Nemunas elevation, Jelgava depression and others (Пашкевичюс, 1958, 1972; Мянниль, 1966) were investigated in the mentioned facial zones (Fig. 2).

A rather precise correlation of the Ordovician global stages to the regional stages of the Baltic palaeobasin is possible, because among the other animal groups, the Baltic Ordovician basin was found to contain graptolites, which were studied, but their biozone remained unidentified (Пашкевичюс, 1972, 1996; Ульст, 1975; Мянниль, 1988), as well as conodonts, the zones of which have been distinguished (Viira, 1990), which are used as basis to define the boundaries of the Ordovician global stages.

Tremadocian Stage. Its lower biostratigraphical boundary is marked by the *Iapetognathus fluctivagus* biozone with its GSSP being the Green Point, Newfoundland, Canada. This stage is correlated to the Baltic Pakerort and Varangu regional stages. The correlation is based on the following graptolite biozones: *Rhabdinopora desmograptoides, Rh. flabelliformis* and *Adelograptus tenellus hunnebergensis* in the Pakerort stage, and *Bryograptus broeggeri* and *Kiaerograptus* in the Varangu stage. The lower boundary of the *Iapetognathus fluctivagus* biozone in the Baltic basin is not clear enough, because the lower boundary of the Pakerort stage is marked by the base of the *Cordylodus andresi* biozone, above which in the Pakerort stage there are *C. proavus*, C. *intermedius, C. lindströmi*, *C. angulatus–C. rotundatus* biozones, and upwards farther in the Varangu stage there is *Drepanoistodus deltifer* biozone (Viira, 1990) correlated with the Tremadocian stage.

Floian Stage. Its stratigraphical boundaries are mentioned above. It should be also noted that the GSSP of its base in Sweden, in the locality of Diabasbrottet, is marked by a graptolite biozone, i. e. the base of the *Tetragraptus approximatus* biozone and the base conodont *Paroistodus proteus* biozone. The regional stage of the Latorpian in the Livonian facies zone begins with the Zirni Member, Formation Zebre, and there graptolites of the Tremodocian Stage disappear. Conodonts of *P. proteus* appear is this stratigraphic level. There have been investigated the graptolite *Tetragraptus phyllograptoides* and *Acrograptus balticus* biozones in the upper part of the Zirni Member. They are found in the lower part of the Kalvene Zebre Member Formation. Graptolites of the *Phyllograptus densus* biozone were investigated above the mentioned graptolite biozones. The graptolites of *Ph. angustifolius elongatus* biozone start in the Kalvene Member. The upper boundary of the Kalvene Member is the boundary between the Latorpian and the Volkhovian Regional stages.

The stage left to be named. Its stratigraphical boundaries are shown in Table. The base of this stage is marked by *B. triangularis* conodont biozone; however, it has no GSSP yet. This stage is compared to the nearby Baltic Volkhov regional stage which contains the *Phyllograptus angustifolius elongatus* biozone. Earlier the Volkhov stage had been detached by the *Undulograptus austrodentatus* graptolite biozone equivalent to the *Asaphus expansus* trilobite biozone. J. Paškevičius (1972) attributed the *U. austrodentatus* to the overlying Kunda regional stage, because the Volkhov–Kunda boundary coincided with the Arenig–Llanvirn boundary. Presently, the *U. austrodentatus* biozone marks the beginning of the Darriwilian stage; therefore, if the Volkhov regional stage is made thinner, its upper boundary would coincide with the base of the Darriwilian stage.

Darriwilian Stage is distinguished in the stratigraphical interval between the base of the *Undulograptus austrodentatus* biozone (the GSSP of this stage is in the locality of Huangnitang, SE China) and the base of the *Nemagraptus gracilis* biozone. In the Baltic basin, four graptolite biozones, *U. austrodentatus, Didymograptus artus, D. murchisoni* and *Hustedograptus teretiusculus*, are distinguished in this interval (Пашкевичюс, 1996). They are correlated to the Kunda, Aseri, Lasnamägi and Uhaku regional stages and the lower part of the Kukruse regional stage. So, the correlation of the base of the Darriwilian stage with that of the Kunda regional stage (Šakyna Formation) is unchallenged. Moreover, such

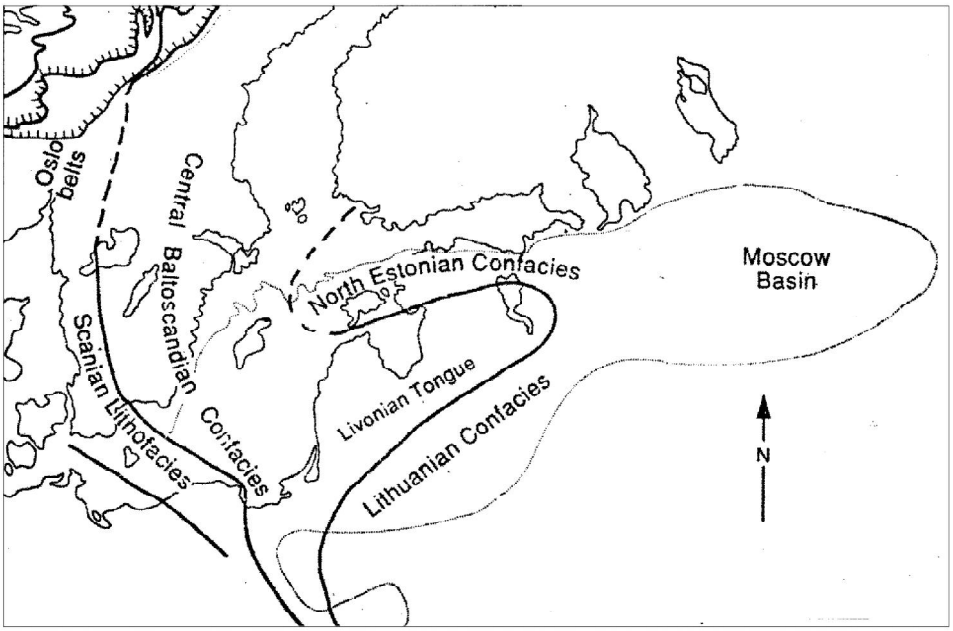


Fig. 1. Palaeobasin of the Baltic Ordovician and their cofacies

1 pav. Baltijos ordoviko paleobaseinas ir jo kofacijos (Jaanusson, 1995)

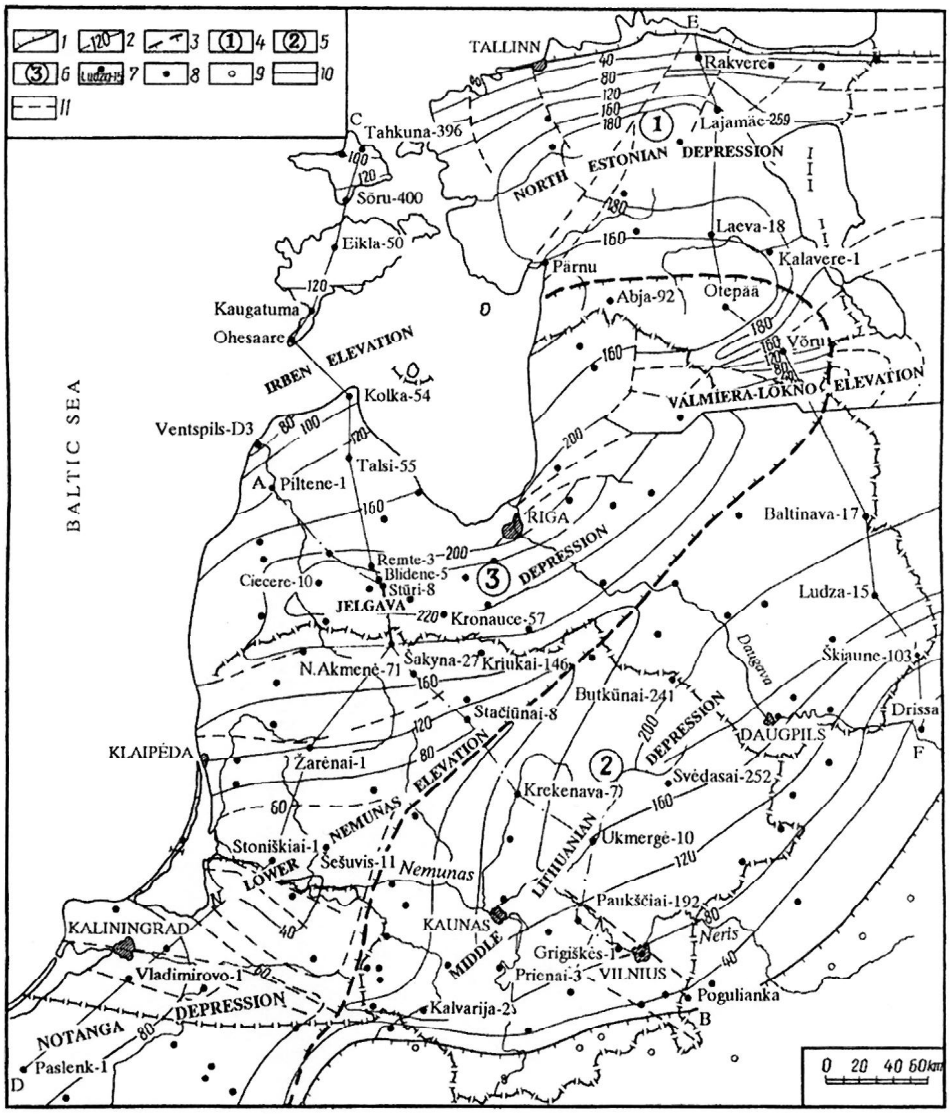


Fig. 2. Distribution of Ordovician rocks, their thickness, structural and facial zonation of the eastern Baltic Palaeobasin: *1* – denudational boundary of the Ordovician rocks, *2* – isopachs (m), *3* – structural-facial boundary, *4* – Estonian facial zone, *5* – Lithuanian facial zone, *6* – Livonian facial zone, *7* – stratotypes and other major boreholes, *8* – boreholes drilled through the Ordovician, *9* – boreholes without Ordovician strata, *10* – tectonic faults, *11* – tectonic faults supposed.

2 pav. Rytinės Baltijos paleobaseino dalies ordoviko uolienų paplitimas, jų storis, struktūrinės ir facijų zonos: *1* – ordoviko uolienų denudacinė riba, *2* – izopachitės (m), *3* – struktūrinė-facinė riba, *4* – Estijos facijų zona, *5* – Lietuvos facijų zona, *6* – Livonijos facijų zona, *7* – stratotipiniai ir kiti svarbesni gręžinių pjūviai, *8* – gręžiniai, pragręžę ordoviko sluoksnius, *9* – gręžiniai, kuriuose nėra ordoviko, *10* – tektoniniai lūžiai, *11* – spėjami tektoniniai lūžiai

correlation is confirmed by the base of the *Eoplacognathus? variabilis* biozone.

Sandbian Stage. Its stratigraphical interval has been described above. Its base coincides with the base of the *Nemagraptus gracilis* biozone. The GSSP of this stage is in Fågelsång, Sweden. Two graptolites zones, *N. gracilis* and *Diplograptus multidens*, are distinguished in this interval. They are correlated to the Kukruse (without its lower part), Haljala, Jõhvi and Keila regional stages, where the studies on the above-mentioned biozone graptolites had been carried out (Пашкевичюс, 1996). These regional stages are compared to the Sandbian stage. The base of this stage in the Kukruse regional stage is discussed in the paragraph dealing with the Darriwilian stage. The base of the Sandbian stage and the middle of the Kukruse regional stage are marked by the middle part of the *Pygodus anserinus* biozone, therefore the upper part of this biozone and the *Amorphognathus tvaerensis* biozone are correlated to the Sandbian Stage and the above-mentioned Baltic regional stages.

Katian Stage stratigraphical interval is given above. The GSSP of the base Katian stage and of the *Diplocanthograptus caudatus* biozone is at the Black Knob Ridge, North America. The correlation of this base to the base of the Baltic Oandu regional stage is relative, since this zonal graptolite species has not yet been found in the Baltic Ordovician. However, it is known that *D. caudatus* is widely spread in the *Dicranograptus clingani* biozone in the UK (Scotland) and Ireland. The correlation of the Baltic Ordovician Oandu regional stage to the *D. clingani* biozone is unchallenged. The precise time when *D. caudatus* appeared in the *D. clingani* biozone is, however, not yet determined, therefore the identification of the base of the Katian stage is provisory. The base of the Katian as well as of the Oandu regional stages, plays an important role in palaeogeography, since a significant stratigraphical gap of Haljala–Keila times is situated in the eastern periphery of the Baltic Ordovician basin, followed by the Oandu time largest transgression (Лашков, Пашкевичюс, 1989), and its deepening caused formation of the Mossen black clay (argillite) in the western part of the basin. The thickness of the Katian stage, judging from the section of the Baltic Ordovician basin, is very large and comprises five regional stages: Oandu, Rakvere, Nabala, Vormsi and Pirgu. This contrasts with, e. g., the Hirnantian stage. Two graptolite zones – *Dicranograptus clingani* and *Pleurograptus linearis* – have been distinguished in the Baltic basin's Oandu and Vormsi regional stages. Upwards the graptolites are rare, their biozones have not been investigated (shallow water facies). According to the conodonts, two more biozones – *Amorphognathus superbus* and *A. ordovicicus* – which correlate to the Katian stage have been distinguished.

Hirnantian Stage covers the stratigraphical interval from the base of the *Normalograptus extraordinarius* biozone (its GSSP is in Wangjiawan North Section, China) to the *Parakidograptus acuminatus*, i. e. the Ordovician–Silurian boundary, with its GSSP being in Dob's Linn (Scotland). This is the smallest stratigraphical interval. The base of the Hirnantian Stage in the Baltic palaeobasin is the *N. extraordinarius* biozone, which is not approved, but it has a very good complex of brachiopod and trilobite fauna (*Dalmanella testudinaria, Eoplectodonta hirnantensis, Hirnantia sagittifera, Cliftonia oxoplecioides, Dalmanitina mucronata*, etc.) which has been investigated in the Krekenava Formation and the Piltene Member (Пашкевичюс, 1972; 1996) and is attributed to the Porkuni regional stage. Thus, on the ground of the above faunal complex, the Porkuni regional stage is correlated to the Hirnantian stage. The above-mentioned Hirnantian fauna is of cosmopolitan type, it is known not only in the U. K., Lithuania and Latvia, but also in Poland, Czech Republic, Asian states, etc. Therefore, distinguishing the global Hirnantian stage is unchallenged. The upper boundary of the Hirnantian stage is marked by the base of the *P. acuminatus* biozone. There are no graptolites of this biozone in the Baltic region (shallow facies). This boundary is correlated to that between the Ordovician Porkuni and the Silurian Juuru regional stages. In Lithuania and Latvia it lies between the Ordovician Piltene and Silurian Rovėja or Puikula members (the Hercynian faunal complex disappears in the Piltene Member).

CONCLUSIONS

Up to now, the stratigraphy of global units (series and stages) for the Ordovician has not yet been finally stabilised. Recently it has been divided into the subsystems (1989), in other states the British rank of series was replaced by a state's rank (Tremadoc, Arenig, etc. series). Because the British series, except for Tremadoc, do not correspond to the global requirements of stratigraphy, the ICS Subcommission on the Ordovician (2004, 2006) revised the setup of the Ordovician series and stages and introduced the Global Standard Section and Point (GSSP) for the lower boundaries of the stages.

Now the Ordovician is divided into three global series: Lower (with the conodont *I. fluctivagus* biozone base of the Tremadocian stage), Middle (with the conodont *B. triangularis* biozone base of the stage that is to be named) and Upper Ordovician (with graptolite *N. gracilis* biozone base of the Sandbian stage).

The Tremadocian stage lower boundary coincides with the lower boundary of the conodont *I. fluctivagus* biozone and is correlated to the base of the Kallavere Formation of the Pakerort regional stage in the Baltic region or the base of the *Cordylodus andresi* biozone.

The Floian stage begins from the lower boundary of the *T. approximatus* biozone and is compared to the lower boundary of the Latorp regional stage (the base of the *Tetragraptus phyllograptoides* biozone) or the lower boundary of the Hunneberg substage.

The lower boundary of the Stage left to be named is compared to the lower boundary of the conodont *B. triangularis* biozone that is correlated to base of the

Volkhov regional stage or a somewhat higher lying base of the *Ph. angustifolius elongatus* biozone.

The Darriwilian Stage lower boundary coincides with the lower boundary of the *Undulograptus austrodentatus* biozone. In the Baltic region, it is correlated to the base of the Šakyna Formation of the Kunda regional stage with the *U. austrodentatus* biozone distinguished.

The Sandbian Stage lower boundary is compared to the lower boundary of the *Nemagraptus gracilis* biozone that is equivalent to the base of the Kukruze regional stage (without lower part) in the Baltic region at the boundary between the *H. teretiusculus* and *N. gracilis* biozones.

The Katian Stage lower boundary coincides with that of the *D. caudatus* biozone and is relatively correlated with the base of the Alvitas Formation of the Oandu regional stage, from which the *D. clingani* biozone begins.

The Hirnantian stage lower boundary is considered to be that of the *N. extraordinarius* biozone, which is correlated to the base of the Krekenava Formation of the Porkuni Regional stage where the Hirnantian faunal complex appears. The upper boundary of this stage coincides with the base of the *Parakidograptus acuminatus* biozone, or the boundary between the Piltene and Rovėja or Puikula members.

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BALTIJOS PALEOBASEINO ORDOVIKO REGIONINIŲ AUKŠTŲ KORELIACIJA SU NAUJAIS PASAULINIAIS AUKŠTAIS

Santrauka

Ordoviko sistemos pasaulinių padalinių stratigrafija dar galutinai nesutvarkyta. Šiuo metu Tarptautinė stratigrafijos komisija yra patvirtinusi visus 3 ordoviko skyrius ir 6 aukštus iš 7. Viršutinė ordoviko riba žymima tarp ordoviko hirnančio aukšto ir silūro landoverio skyriaus.

D. Britanijos serijos – tremadokis, arenigis, lanvirnis, karadokis ir ašgilis, išskyrus pirmąjį – tremadokį, kuris gavo aukšto rangą, pasaulinei stratigrafijai pasirodė nepriimtinos, kadangi jų uolienos neturi gerų nepertraukiamų pjūvių, dažnai jų ribos neaiškios, nepakankami serijų koreliacijos požymiai. Todėl Tarptautinėje stratigrafinėje skalėje (2000) iš 7 aukštų buvo pateikti tik du: pirmasis – tremadokis ir ketvirtasis – darivilis. Vėlesnėje tarptautinėje skalėje (2004) viršutinis

ordovikas buvo papildytas septintuoju – hirnančio – aukštu. Tarptautiniame paleontologijos ir stratigrafijos žurnale „Lethaia“ S. M. Bergströmas ir kt. (2006) pateikė dar tris naujus pasaulinius aukštus: antrąjį – flojį, penktąjį – sandbį ir šeštąjį – katį. Jų apatinės ribos pagrįstos graptolitų ir konodontų biozonų apatinėmis ribomis, nurodyti jų sratigrafiniai intervalai, taip pat vietovių apatinės ribos pasauliniai standartinio pjūvio taškai (PSPT) (žr. lentelę).

Apatinį ordoviką sudaro du aukštai: tremadokis ir flojis. Tremadokio apatinę ribą žymi konodontinės *Iapetognatus fluctivagus* biozonos apatinė riba. Tremadokio aukštas koreliuojamas su Baltijos paleobaseino Pakerorto ir Varangu regioniniais aukštais. Flojo aukšto apatinė riba sutampa su graptolitų *Tetragraptus approximatus* biozonos apatine riba. Flojo aukštas yra gretinamas su Latorpo regioniniu aukštu.

Vidurinis ordovikas taip pat susideda iš dviejų aukštų: trečiojo, dar neįvardyto, ir darivilio. Trečiojo aukšto apatinė riba sutampa su konodontinės *Baltoniodus trianguliaris* biozonos apatine riba, ji dar nekalibruota Pasauliniu standartinio pjūvio tašku (PSPT0), todėl aukštas neįvardytas. Trečiasis aukštas yra koreliuojamas su Volchovo regioniniu aukštu (be *Undulograptus austrodentatus* arba *Asaphus extensus* biozonų). Darivilio aukšto apatinę ribą žymi graptolitų *autrodentatus* biozonos apatinė riba. Darivilio aukštas yra gretinamas su Kundos (su *austrodentatus* biozona), Azerio, Lasnamiagio ir Uhaku regioniniais aukštais.

Viršutinį ordoviką sudaro trys aukštai: sandbis, kačis ir hirnantis. Sandbio aukšto apatinę ribą žymi graptolitų *Nemagraptus gracilis* biozonos apatinė riba. Sandbis yra koreliuojamas su Kukrūzės (išskyrus jo apatinę dalį, kuri dar priskiriama *Hustedograptus teretiusculius* biozonai), Haljalos, ir Keilos regioniniais aukštais. Kačio aukšto apatinė riba atitinka graptolitinės *Diplocantograptus caudatus* biozonos apatinę ribą. Kačio aukštas yra gretinamas su Oandu (sąlyginai), Rakverės, Nabalos, Vormsio ir Pirgu regioniniais aukštais. Hirnančio aukšto apatinė riba yra tapatinama su graptolitų *Normalograptus extraordinarius* biozonos apatine riba. Hirnančio aukštas yra koreliuojamas su Porkunio regioniniu aukštu. Ordoviko ir silūro riba sutampa su graptolitų *Parakidograptus acuminatus* biozonos apatine riba.

Иозас Пашкевичюс

КОРРЕЛЯЦИЯ ОРДОВИКСКИХ РЕГИОНАЛЬНЫХ ЯРУСОВ БАЛТИЙСКОГО ПАЛЕОБАССЕЙНА С НОВЫМИ ГЛОБАЛЬНЫМИ ЯРУСАМИ

Р е з ю м е

Стратиграфия глобальных подразделений (ярусов) ордовикской системы окончательно еще не разработана. В настоящее время международной стратиграфической комиссией утверждены 3 отдела: нижний, средний и верхний, а также 6 ярусов из 7. Нижний ордовик начинается тремадоком, средний – третьим ярусом (без названия) и верхний – сандбием, заканчивается ордовик гирнантским ярусом. Верхняя граница системы проводится между гирнантским ярусом ордовика и лландоверийским отделом силура.

Британские серии: тремадок, арениг, лланирн, карадок и ашгилл, за исключением тремадока, оказались неприемлемы для глобальной стратиграфии, так как они находятся в сильно дислоцированном регионе, нет глубоких, непрерывных разрезов, их границы зачастую не ясны и у них недостаточно корреляционных признаков. Поэтому уже на международной стратиграфической шкале (2000) из 7 ярусов были указаны только 2: первый тремадокский и четвертый даривильский. В 2004 г. на Международной стратиграфической шкале указан седьмой – гирнантский ярус. На семинаре международного журнала „Lethaia“ С. М. Бергстромом и др. (2006) были представлены еще три новых яруса: первый флоийский, пятый скандвийский и шестой катийский. Их границы обоснованы граптолитовыми и конодонтовыми биозонами, указаны биостратиграфические интервалы ярусов, а также точки глобального стандартного разреза (ТГСР), их местонахождение (см. табл.).

Нижний ордовик состоит из двух глобальных ярусов: тремадокского и флоийского. Нижняя граница тремадока совпадает с нижней границей конодонтовой биозоны *Iapetognathus fluctivagus*. Тремадокский ярус коррелирует с пакеройтским и варагуским региональными ярусами Балтийского палеобассейна. Нижняя граница флоийского яруса соответствует нижней границе граптолитовой биозоны *Tetragraptus approximatus*. Флоийский ярус сопоставим с латорпским региональным ярусом.

Средний ордовик также включает в себя два яруса: нижний или третий (еще без названия) и верхний или четвертый, даривильский. Нижняя граница третьего яруса совпадает с нижней границей конодонтовой биозоны *Baltoniodus tranguliaris*, также без ТГСР. Данный ярус коррелирует с волковским региональным ярусом, без зоны *Undulograptus austrodentatus* или *Asaphus expansus*. Нижняя граница даривильского яруса соответствует нижней границе биозоны *Undulograptus austrodentatus*. Этот ярус соответствует региональным ярусам Кунда, Азери, Ласнамяги и Ухаку.

Верхний ордовик состоит из трех ярусов: сандвийского, катийского и гирнантского. Нижняя граница сандвийского яруса проводится по нижней границе граптолитовой биозоны *Nemagraptus gracilis*. Сандвийский ярус сопоставляется с региональными ярусами Кукрузе (без нижней его части), Галяла и Кейла. Нижняя граница катийского яруса соответствует нижней границе граптолитовой биозоны *Diplocanthograptus caudatus*. Катийский ярус коррелирует с региональными ярусами Оанду (условно), Раквере, Набала, Вормси и Пиргу. Нижняя граница гирнантского яруса проводится по нижней границе граптолитовой биозоны *Normalograptus extraordinarius*. Гирнантский ярус сопоставляется с поркунским региональным ярусом. Граница ордовика и силура идет по нижней границе граптолитовой биозоны *Parakidograptus acuminatus*.