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Alleröd deposits at Zervynos on the Ūla River: geology, geochronology and malacofauna

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The paper contains results of new investigations of interstadial deposits at Zervynos on the Ūla River in southeastern Lithuania regarding sapropelite occurence, radiocarbon dating and malacological analysis. Organic deposits belong to a lake formation. The age of lake deposits is the Alleröd time. The Zervynos malacofauna consists of seven ecological groups, eurytopic water molluscs playing the main role (41%). Lake species and those of overgrowing and silting water make only 18%. Lake fauna is characterised by *Gyraulus laevis* (Alder) and *Armiger crista* (Linnaeus). Evolution of the Ūla River valley is related to the development of glaciokarst depressions.

Key words: malacofauna, sapropelite, radiocarbon dating, the Ūla interstadial, Zervynos, South Lithuania

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INTRODUCTION

The problem of the Ūla Interstadial remains still among the unsolved problems of the palaeography of the last glaciation of Lithuania and adjacent areas. This Interstadial has been distinguished by V. Gudelis (1958) as a stratigraphic unit between the Brandenburg-Frankfurt (Žiogeliai) and Pomeranian (Aukštaitija) stages. The stratotype of Ūla Interstadial deposits by organic deposits (sapropelites) in the Zervynos section in the Ūla River valley, Southern Lithuania is expressed (Fig. 1). According to P. Vaitiekūnas (Вайтекунас и др., 1970), these deposits occur in the sand of a lateral break-through valley at the depths of at least 17 m. Sapropelites with numerous mollusc shells are exposed on the bank scarps and the recent channel of the Ūla River. Pollen analysis –applied in the study of these deposits showed their interstadial nature (Кондратене, 1960; 1963). The first radiocarbon dating of deposits in Zervynos and Mančiagirė sections showed the absolute age of 16–18 thousand years BP, and this fully corresponded to V. Gudelis stratigraphic conclusions. However, radiocarbon dating performed later for Zervynos deposits by J. M.-K. Punning (Пиррус и др., 1967; Вайтекунас, Пуннинг, 1970), surprisingly, indicated a younger absolute age of sapropelites – conforming to Alleröd and Bölling interstadials. Thus, the geological / palaeontological study of occurrence conditions for the Ūla beds and radiocarbon dating of

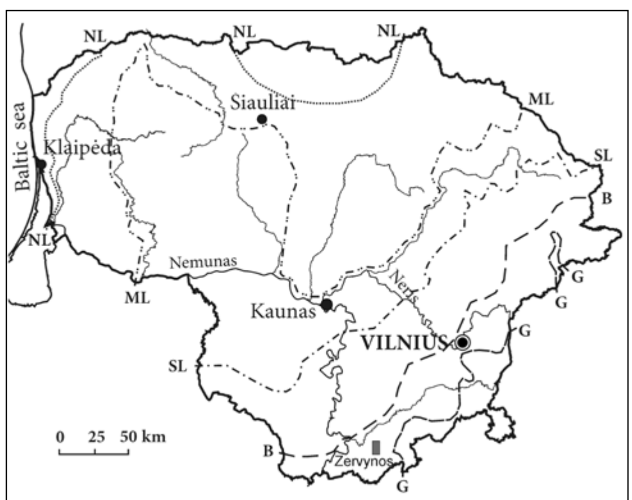

Fig. 1. Location of Zervynos section on the map. Limits of (Nemunas) ice cover during: G – Grūda stadial, B – Baltija stadial, SL – South-Lithuanian phasial, ML – Middle Lithuanian phasial, NL – North Lithuanian phasial

1 pav. Zervynų pjūvio padėtis žemėlapyje. Nemuno apledėjimo stadijų, fazių ribos: G – Grūdos stadijos, B – Baltijos stadijos, SL – Pietų Lietuvos fazės, ML – Vidurio Lietuvos fazės, NL – Šiaurės Lietuvos fazės

Table 1. **Radiocarbon dates of interstadial deposits at Zervynos in the Ūla River valley outcrops**
1 lentelė. **Zervynų apylinkių Ūlos slėnio atodangose interstadinių nuogulų radiokarboninės datos**

Section	Radiocarbon dates, years BP	References
Zervynos	16260 ± 640 (Mo-302)	Виноградов и др., 1963
Zervynos	18350 ± 950 (Vs-4)	Шулия и др., 1967
Mančiagirė	18350 ± 950 (Vs-4)	
Zervynos	11630 ± 120 (TA-188)	Пиррус и др.., 1967
Rudnia	11530 ± 10 (TA-190)	Вайтекунас, Пуннинг, 1970
Zervynos	12650 ± 130 (TA-191)	
Mančiagirė	13430 ± 140 (Vs-1047)	Šinkūnas et al., 2001
Kriokšlys	8350 ± 225 (Vs-1091)	
Zervynos	12130 ± 2780 (Vs-1092)	
Rudnia	11560 ± 380 (Vs-1094)	
Ūla-3	10160 ± 330 (Vs-1073)	
Zervynos (Ūla)	12900 ± 135 (IGSB-1096)	Gaigalas, 2007
Zervynos (Ūla-1)	14400 ± 300 (IGSB-1047)	

Table 2. **Mollusc fauna from sapropelites in Zervynos sections**
2 lentelė. **Zervynų pjūvių sapropelitų malakofauna**

Taxon	P. Šivickis (Кондратене, 1963)	V. M. Motuz (Вайтекунас и др., 1970)	
	Railway station	Railway station	Zervynos (Mančiagirė)
Valvata pulchella (Studer)			3
Lymnaea peregra (Müller)		1	
Lymnaea sp.			1
Valvata piscinalis (Müller)	+	15	2
Gyraulus albus (Müller)			2
Gyraulus cf. *acronicus* (Férussac)		1	
Hippeutis complanatus (Linnaeus)	+		
Sphaerium corneum (Linnaeus)		2	
Pisidium subtruncatum Malm	+	13	2
Pisidium pulchellum Jenyns		9	
P. milium Held		1	1
P. casertanum (Poli)		3	
Pisidium hibernicum Westerlund		1	
Pisidium sp.		1	+
Pisidium amnicum (Müller)		4	8
Anodonta sp.	+		+
Viviparus viviparus (Linnaeus)		2 covers	

sapropelites (Table 1) enable to interpret the lacustrine deposits belonging to the Alleröd Interstadial. Such understanding of the age of these deposits survived up to now (Šinkūnas et al., 2001). The organogenic and sandy lacustrine deposits in the Ūla outcrops are of the Late Nemunas (Weichselian) age. At the same time, interest to interstadial sediments of the Ūla River outcrops and the evolution of the river valley has increased.

The present paper contains results of new investigations of the Ūla beds concerning the sapropelite occurrence conditions, radiocarbon dating and malacological analysis of the deposits. Studies of Zervynos deposits were carried out in the valley of the Ūla River at the railway station in the 4-km long Zervynos–Mančiagirė profile. Here the river is running in a narrow 20–24-m deep canyon-shaped valley. The river bank scarps have quite a few exposures, which are annually affected by erosion.

PREVIOUS INVESTIGATION

The Zervynos sapropelites are in the focus of attention from their first record (Basalykas, 1955). During the last five decades, sapropelites have been found in the river channel, at the flood-plain floor and at higher levels within the 20–24-m sand thickness of the bedrock bank of the Ūla River. The stratotype beds of the Ūla Interstadial should correspond to the lacustrine sapropel occurring on a bedrock bank. P. Vaitiekūnas (Вайтекунас и др., 1970) presented, in fact, two exposures on the left bedrock bank, 23.0 and 19.3 m high, respectively 250 and 500 m down the river from the Zervynos railway station. These sections are also known as aleurite and sapropelite outcrops with mollusc shells at the Mančiagirė village. Our attempts, however, to detect lake deposits on the bedrock bank were not successful, in spite of purposeful prospecting and

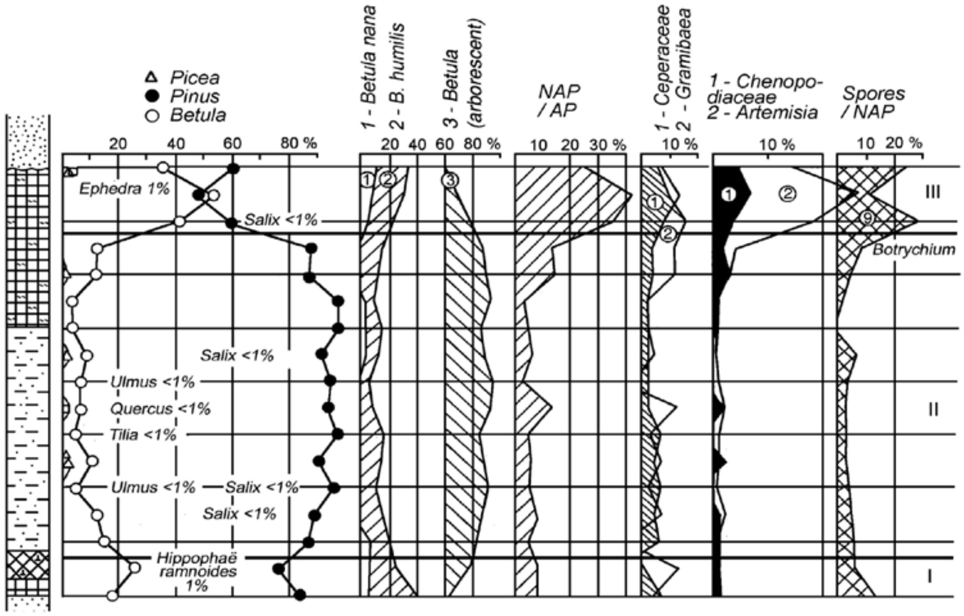

Fig. 2. Palynologic diagram of Zervynos section of interstadial Ūla sapropelites (Kondratienė, 1965)
2 pav. Ūlos interstadialo sapropelito pjūvio palinologinė diagrama (Kondratienė, 1965)

favourable outcropping of the valley slope. The "disappearance" of lake deposits on the "bedrock" bank is, in our opinion, caused by the fact that the margin of the lacustrine lens just touches the bedrock bank but does not intrude into it. The erosional impact of meltwater seems to have removed these deposits.

Spore-and-pollen spectra of organic deposits in the Zervynos section are characteristic of tree pollen prevalence: mainly pine accompanied by birch, rarer spruce, alder, willow, some broad-leaved species and a significant part of herbaceous pollen (Fig. 2). According to O. Kondratienė (Кондратене, 1963), the spore-and-pollen diagram made for Zervynos deposits is rather similar to those for lacustrine deposits in the Rudnia, Mančiagirė and Pamerkė sections, hence, they can be considered coeval. The similarity of the Zervynos and the Alleröd spore-and-pollen diagrams had been indicated also by M. Kabailienė (Gudelis, Kabailiene, 1958; Кабайлене, 1965).

Mollusc shells represent a rather notable palaeontological target within sapropelites. Species diagnosis for shells from different sapropelite lenses by P. Šivickis and V. Motuz had been performed (Table 2).

In by the interpretation by V. Motuz (Вайтекунас и др., 1970), the complex of fossil mollusc shells in Zervynos (railway station and Mančiagirė) shows features of oxbow-lake deposits. Such a conclusion is based on the following findings: shells of *Valvata piscinalis* (Müller), two opercula of *Viviparus viviparus* (Linnaeus) and valves of *Pisidium amnicum* (Müller).

Thus, up to now, the understanding of geological conditions for occurrence of sapropelites, their absolute age and conditions of accumulation assumed sometimes mutually exclusive interpretations of the data (e. g., attributing sapropelites to alluvium), which made impossible to construct a common view of deposit formation. We have made an attempt to study this section with the purpose to adjust the view on the geological conditions of sapropelite occurrence and their genesis. Our investigations were based mainly on the study of mollusc shells most frequent in the deposits and providing information about the genesis and relative age of the deposits. For the study, mollusc shells were taken from two deposit sites (Zervynos-1 and Zervynos-1a).

ZERVYNOS-1 MOLLUSC FAUNA

Occurrence conditions for fauna-containing beds at the Zervynos-1 site are shown in Fig. 3. Mollusc shells are concentrated in the lower part of the sapropelite, thus forming a rather stable spreading interlayer at the contact with the underlying sand. The *Anodonta* valves represent a key element of the shelly bed, but they are very fragmented due to mechanical and chemical processes. Therefore, it is difficult to define their species. According to some conchological characteristics, all shells belong to the eurytopic species of *A. anatina* (Linnaeus). However, lack of valves does not allow a reliable definition of species; therefore, they are given in the register as *A.* cf. *anatina* (Linnaeus). The upper part of the sapropelite bed contains few or no shells.

The Zervynos-1 malacofauna contains 24 (2 terrestrial and 22 freshwater) taxa (Table 3). Terrestrial molluscs in this fauna are scarce. Two taxa and two specimens belong to a widely spread species, but making just 0.33% of the total 7281 specimens. Freshwater molluscs prevail in this fauna.

From the ecological point of view, Zervynos-1 fauna consists of seven ecological groups (Fig. 4). Eurytopic water molluscs are most abundant among the taxa (approximately 41%). Lake species and those of overgrowing and silting water bodies make up 18%. River molluscs of the Wc group are presented only by one taxon – *Pisidium amnicum* (Müller).

The ecological diagram is different (Fig. 5), if it is constructed taking into account all specimens of freshwater molluscs. Lake fauna is characterised mainly by *Gyraulus laevis* (Alder) (Fig. 6) and *Armiger crista* (Linnaeus).

Currently, *Gyraulus laevis* (Alder) inhabits shallow lakes, mainly the depths of 0.20–1.50 m in the zone of temperate and Boreal climate. This species was a typical representative of unstable Pleistocene natural conditions and appeared often at the early stage of lake formation. During transition phases, *G. laevis* (Alder) was spreading in great abundance, as a rule, together with *Armiger crista* (Linnaeus), *Lymnaea peregra* (Müller), *V. piscinalis* (Müller), *Sphaerium corneum* (Linnaeus). Fauna of such a composition is a facies analogue of loess terrestrial fauna

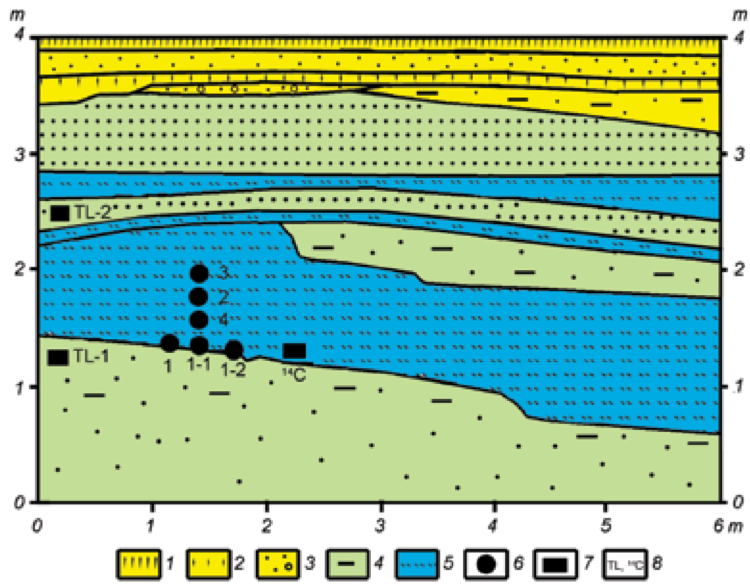

Fig. 3. Zervynos-1 section with mollusc fauna in sapropelite of the first terrace above the Ūla River flood plain. *1* – recent soil, *2* – buried alluvial soil, *3* – sand and gravel, *4* – silt, *5* – sapropelite, *6* – spots of sampling for malacological analysis, *7* – spots of sampling for absolute geochronology, *8* – TL – termoluminescence (TL–1: 23.8 ± 4.6 ka; TL–2: 33.6 ± 3.9 ka, Gdansk University by S. Fedorowicz) and ^{14}C – radiocarbon dates (IGSB-1096 (wood): 10900 ± 135 BP; 11000–10275 cal BC (68.3%), 11125–10600 cal BC (95.4%) calibrated age range; IGSB-1047 (carbonates of *Anodonta* shell): 12400 ± 300 ($\delta^{13}C$ = – 10.4‰), 1300–1215 cal BC (68.3%), 13475–1182 cal BC (95.4%) calibrated age range, Minsk laboratory by N. Mikhailov)

3 pav. Ūlos I viršsalpinės terasos Zervynų sapropelito pjūvis su malakofauna. *1* – šiuolaikinis dirvožemis, *2* – palaidotas aliuvinis dirvožemis, *3* – smėlis ir žvirgždas, *4* – aleuritas, *5* – sapropelitas, *6* – pavyzdžių paėmimo vietos malakofaunos analizei, *7* – pavyzdžių paėmimo vietos geochronologiniams tyrimams, *8* – ėminiai analizėms: TL – termoliuminescencinei (TL–1: 23.8 ± 4.6 ka; TL–2: 33.6 ± 3.9 ka, Gdansko universiteto laboratorija, S. Fedorovičius) ir ^{14}C – radiokarboninei (IGSB-1096 (mediena) 10900 ± 135 BP; 11000–10275 cal BC (68.3%), 11125–10600 cal BC (95.4%) kalibruotas amžius BC; IGSB–1047 (karbonatai *Anodonta* geldelės) 12400 ± 300 ($\delta^{13}C$ = – 10.4‰) 1300–1215 cal BC (68,3%), 13475–11825 cal BC (95.4%) kalibruotas amžius, N. Michailovo laboratorija, Minskas)

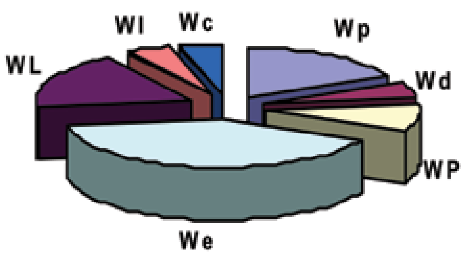

Fig. 4. Ecological diagram of molluscs in the Zervynos-1, taxons. Wd – water-boggy and amphibiotic molluscs; WP – molluscs of episodic reservoir; Wp – species of overgrown and silty reservoirs; Wl – molluscs of stagnant reservoirs and very slowly mowing waters; WL – species of lakes; We – everyecological water molluscs; Wc – species living in mowing water of weak flow

4 pav. Zervynų-1 profilio ekologinė moliuskų diagrama, taksonai: Wd – pelkių vandenų ir amfibiotiniai moliuskai, WP – epizodinių baseinų moliuskai, Wp – apaugančių ir dumblėjančių baseinų rūšys, Wl – stovinčių baseinų ir labai lėtai tekančių vandenų moliuskai, WL – ežerų rūšys, We – įvairios ekologijos vandenų moliuskai, Vc – rūšys, gyvenančios silpnai tekančiame vandenyje

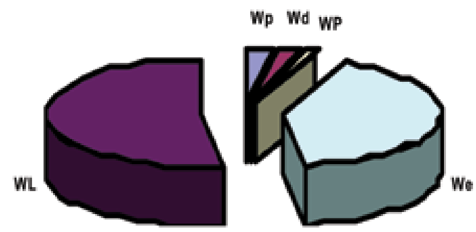

Fig. 5. Ecological diagram of freshwater molluscs in Zervynos-1, specimens (see Fig. 4)

5 pav. Zervynų-1 profilio gėlavandenių moliuskų ekologinė diagrama, vienetai (žr. 4 pav.)

Fig. 6. *Gyraulus laevis* (Alder) shell from Zervynos section deposits (sample 4)

6 pav. *Gyraulus laevis* (Alder) kriauklė iš Zervynų-1 pjūvio nuogulų (4-as ėminys)

Fig. 7. *Valvata piscinalis* (Müller) shells from Zervynos-1 section deposits (sample 4).

7 pav. *Valvata piscinalis* (Müller) kriauklės iš Zervynų-1 pjūvio nuogulų (4 ėminys)

Fig. 8. *Gyraulus acronicus* (Férussac) shells from Zervynos-1 section deposits (sample 1–1)

8 pav. *Gyraulus acronicus* (Férussac) kriauklės iš Zervynų-pjūvio nuogulų (1–1 ėminys)

Fig. 9. *Anodonta anatina* (Linnaeus)

9 pav. *Anodonta anatina* (Linnaeus)

Table 3. **Malacofauna of Zervynos-1 section, 2004**
3 lentelė. **Zervynų-1 pjūvio malakofauna, 2004**

E	Species	Samples					
		1	1–1	1–2	4	2	3
5	*Pupilla* cf. *muscorum* (Linnaeus)	1					
7	*Limacidae* gen (large)			1			
10	*Valvata cristata* (Müller)	36	52	46	36		
10	*Lymnaea* ex gr. *peregra* (Müller)	58	56	45	33	5	
10	*Segmentina nitida* (Müller)	7	6	10	6	1	
10	*Sphaerium lacustre* (Müller)	2	2		1		
10	*Pisidium obtusale* (Lamarck)	21	9	8	8		
10	*P. obtusale lapponicum* Sandberger	2	1	2	3		
11	*Valvata piscinalis* (Müller)	152	320	189	290	11	12
11	*V. piscinalis antiqua* Sowerby	3	2	2	2		
11	*Lymnaea auricularia* (Linnaeus)	5	2	5			
11	*Gyraulus laevis* (Alder)	391	312	301	155	1	
11	*Gyraulus acronicus* (Férussac)		4				
11	*Armiger crista* (Linnaeus)	675	575	700	611	4	1
11	*Acroloxus lacustris* (Linnaeus)		3	2			
11	*Sphaerium corneum* (Linnaeus)	30	25	26	40	12	
11	*Pisidium henslowanum* (Sheppard)		3		2		
11	*Pisidium subtruncatum* Malm	3	3	11	1		
11	*P. milium* Held	10	17	13	1		
11	*P. casertanum* (Poli)	700	26	6	5	5	5
11	*Pisidium* sp.	15	40	20	10		
12	*Anodonta* cf. *anatina* (Linnaeus) – fragments	200	300	240	300	1	
12	*Pisidium amnicum* (Müller)	8					
12	*P. nitidum* Jenyns	12	2	1			
	Total	**2331**	**1760**	**1628**	**1504**	**40**	**18**

with *Vertigo parcedentata* (Braun) and *Columella columella* (Martens) (Sparks, West, 1968).

Another species often found in the Zervynos-1 fauna was *Armiger crista* (Linnaeus). It inhabits mainly water bodies with stagnant water and rich water vegetation. It does not descend lower than 3 m, the optimum depth being 1.5 m. A specific feature of the life cycle of this lacustrine species is its close relationship to water vegetation it feeds on and fixes its cocoons.

The second place, according to specimen numbers, is taken by the eurytopic group of molluscs represented mainly by *Valvata piscinalis* (Müller), *Pisidium casertanum* (Poli) and *Anodonta* cf. *anatina* (Linnaeus) is taken. Shells of *Valvata piscinalis* (Müller) occur especially often (Fig. 7). This species inhabits freshwater bodies of all types, but their maximum is observed in lakes, hence, it is commonly attributed to the lacustrine species. *V. piscinalis* (Müller) feeds mainly on fine plant detritus. Depths optimal for this species range within 1.5–2.0 m, but its specimens can descend lower, beyond the zone of water vegetation. Presence of this species in the bodies rich in water vegetation is explained by their necessity to search for shelter and the dislike of sudden disturbing of water. The life expectancy of this mollusc is two years, and during this period it performs vertical migration. During a warm season, *V. piscinalis* (Müller) lives fixed on plants or lies on a silty bottom, and buries itself in the silt or sapropel during the cold season of the year.

The quantities of mollusc specimens in other ecological groups are rather low. The group of river molluscs (Wc) with a single species of *Pisidium amnicum* (Müller) should be also mentioned. This species inhabits running water, but it occurs also in lakes, river backwaters and oxbow lakes. In lakes, it occupies a certain area in the littoral and partly sublittoral zones. It inhabits both sand and silt bottom. Water flow strength and water body size do not play a significant role in the spreading of this species.

It should be mentioned, however, that there was no typical rheophil *Viviparus viviparus* (Linnaeus) detected in the river mollusc group – it had been defined earlier by V. Motuz in the Zervynos malacofauna by two valves and played a decisive role in determining the alluvial (oxbow) genesis of deposits containing fauna (Вайтекунас и др., 1970). These specimens seem to be attributed to the recent ones, because they could get into the washing with river water, or they might be fixed to sapropel and enlisted into the register of molluscs. Fossil opercula of *V. viviparus* (Linnaeus), as a rule, do not remain intact, contrary to valves which can be diagnosed both by fragments and by young specimens.

Thus, a brief ecological analysis of the Zervynos-1 malacofauna enables to attribute the deposits with mollusc fauna (sapropelites) to lacustrine deposits, even though these deposits occur at low depths and on the Ūla River bank. With this conclusion, we would like to spotlight the lithological peculiarities of the deposits overlying the sapropelite (see Fig. 3). The bed consists of (from the base upwards) fine sandy loam to aleurite and sapropelite, fine and very fine silted sand of horizontal layering. The top part of the section (the upper 0.5 m) was found to have a lens of sand with gravel, as well as buried soil. In general, the sections correspond to a lacustrine, not alluvial, type of bed structure. Alluvial deposits are notable for a gradual increase in grain size of the deposits with the depth. Therefore, the 4-m high scarp of the Ūla River bank shows no alluvial deposits, except for a 0.5 m cover composed of sand with gravel, as well as buried and recent soil. The buried soil is a subaerial formation sometimes occurring in alluvial deposits.

The age of fauna and fauna-containing deposits was determined according to the following climato-stratigraphic parameters. The Zervynos-1 fauna contains a representative of cold waters, *Pisidium obtusale lapponicum* Sandberger, which allows to attribute this bed to the glacial (Nemunas, Poozerian) epoch. Currently this form inhabits only arctic and subarctic zones, but in the Pleistocene, during colder periods, it was probably a common representative in the area of Belarus and South Lithuania.

The Zervynos-1 fauna belongs to rather rich freshwater faunas of the interstadial type. It is the complex consisting of *Gyraulus laevis* (Alder), *G. acronicus* (Férussac), *Anodonta* cf. *anatina* (*Linnaeus*) and *Pisidium obtusale lapponicum* Sandberger which gives the interstadial feature to this fauna reflecting a lower warmth level of the area than in the Holocene. Especially characteristic is the prevalence of *Gyraulus laevis* (Alder) in the Zervynos-1 fauna. This species usually occurs in Holocene fauna together with *Gyraulus albus* (Müller). Their proportion presents the palaeogeographic coefficient indicating the level of lake water coolness. One more representative of the *G. acronicus* (Férussac) complex (Fig. 8) is attributed to the Boreal–Alpine type, although now it inhabits the holarctic area. In Belarus and Lithuania, it seems to belong to a group of glacial relicts and therefore is rather rare in the recent fauna.

The *Anodonta* cf. *anatina* (Linnaeus) species plays a significant role in the fauna under study (Fig. 9). Representatives of the genus *Anodonta* are now spread in Europe and Siberia, while species of the genus *Unio* from the same *Unionidae* family occupy only the European space. Different areas of the genera confirm their different climatic tolerance. The *Anodonta / Unio* ratio, as the coefficient of *Gyraulus laevis / G. albus*, should be considered as one more indicator of the freshwater coolness level in the temperate zone of Europe in the Pleistocene and Holocene. Unfortunately, such calculations are not easy to perform according to fossil shells of *Anodonta* and *Unio* because of their severe fragmentation in the fossil matter, rare occurrence of both genera in one association, different ecological specialisation, etc. The *Anodonta / Unio* ratio in the recent fauna of molluscs in Central Europe is not favourable for the latter genus. The same ratio seems to have been typical of the Holocene optimum. At the beginning of the Holocene, the role of the genus *Anodonta* became apparently more important. In the late-glacial malacofauna, the genus *Anodonta* prevailed in the temperate zone of the Russian Plain (Даниловский, 1955). The occurrence of the genus *Unio* representatives in late-glacial faunas of Belarus is controversial. Indications on the occurrence of *Unio* shells in the late-glacial deposits of Komarishky in Belarus (Вознячук, Калечиц, 1971) seem unconvincing, because their definitions were performed according to the fragments of valves. J. Urbansky and I. V. Danilovsky indicated only the species *Anodonta* in the same Komarishky late-glacial fauna. Anyhow, only molluscs of the genus *Anodonta* represented the *Unionidae* family in the Zervynos late-glacial malacofauna in Lithuania. All this allows considering *Anodonta* the key genus of late-glacial (interstadial) malacofauna in Lithuania.

The fauna under study differs from Holocene freshwater faunas of Central Europe by a simpler structure, absence of typical Holocene molluscs such as *Bithynia tentaculata* (Linnaeus), *Gyraulus albus* (Müller) and representatives of the genus *Unio*.

Thus, the climato-stratigraphic characterisation of Zervynos-1 fauna as well as occurrence peculiarities of fauna-containing deposits undoubtedly confirm their Poozerian late glacial age. Taking into account the fact that this fauna belongs to the interstadial type, it should be dated as Bölling or Alleröd fauna. The Alleröd age of fauna seems to be more reasonable. Additional arguments can be taken from the studies of one more fauna (Zervynos-1a) which contains representatives of forest (broad-leaved) communities.

Sapropelite clearings in the area are located down the Ūla River about 100 m from Zervynos-1 site. Sapropelites here rise in thickness, their lower part occurring under the river water level (Fig. 10).

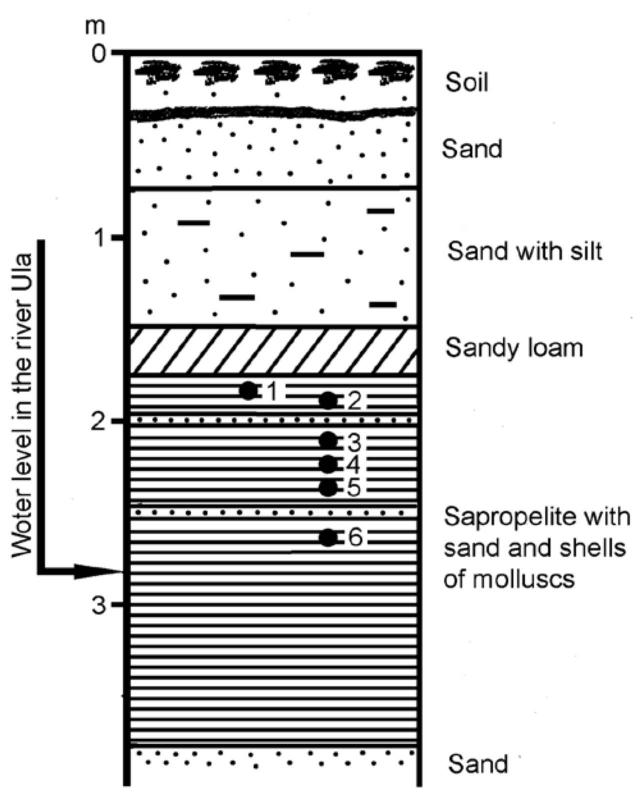

Fig. 10. Section of Zervynos-1a. Numbers show sampling points for malacological analysis

10 pav. Zervynų-1a pjūvis. Skaičiais pažymėtos ėminių malakologinei analizei vietos

Table 4. **Mollusc fauna of Zervynos-1a section, 2004**
4 lentelė. **Zervynų-1a pjūvio moliuskai, 2004**

E	Species	Samples				
		2	3	4	5	6
1	*Vertigo pusilla* Müller			1		
7	*Limacidae* gen (large)				1	2
10	*Lymnaea* ex gr. *peregra* (Müller)	1	1	1	3	
10	*Pisidium obtusale* (Lamarck)			1	1	
11	*Valvata piscinalis* (Müller)	62	50	80	84	72
11	*Gyraulus laevis* (Alder)	7	1	8	8	
11	*Gyraulus acronicus* (Férussac)		2			
11	*Armiger crista* (Linnaeus)				1	1
11	*Sphaerium corneum* (Linnaeus)	50	15	5	10	
11	*Pisidium milium* Held				2	
11	*P. casertanum* (Poli)	380	300	300	130	125
12	*P. amnicum* (Müller)	2	8	2	5	
	Total	**502**	**377**	**398**	**245**	**200**

ZERVYNOS-1A MOLLUSC FAUNA

Mollusc shells in the deposits of Zervynos-1a occur not only in the lower underwater part, but also in the upper subaerial part of the section. The composition of molluscs determined according to the upper part of the section is presented in Table 4. The malacofauna is of one type; hence, it is coeval with that discussed above. The leading position in freshwater fauna by the eurytopic *Pisidium casertanum (Poli)* species characterised by a high adaptability to environmental conditions is taken. Being a dweller of shallow water bodies, it found in lakes, rivers and springs. It can survive under extreme conditions, such as food deficiency, scarce lime, seasonal dry-off of a water body, and a wide range of temperature oscillations. In lakes, the mollusc reaches depths of 60 m and prefers the sand-silt bottom.

To have a vision of the environment when the sapropelites were being accumulated in the fossil lake, it is important to use the finding of the thermophilic *Vertigo pusilla* Müller species. Features of a forest and mesophilic animal are combined in this species which is observed partly in lighted mixed and broad-leaved forests and partly in damp shadowy biotopes. It is more rare in meadows. It settles at grass roots, on tree trunks, under leaves, pieces of wood and stones. It prefers biotopes drier and more sun-warmed than other representatives of the genus *Vertigo* Müller.

GLACIOKARST LAKES AND EVOLUTION OF ŪLA RIVER VALLEY AT STRETCH

Evolution of the Ūla River valley in the Zervynos–Mančiagirė area is closely related to glacial hollow and thermo-karst or glacio-karst depressions formed in the hollow in the place of dead ice blocks. The hollow was filled with ice during the maximum (Brandenburg, Grūda) stage of the last glaciation. The WNW direction of the hollow coincides with that of the glacier at its last stage. Now the Ūla River has, in general, inherited this hollow and marks the movement direction of the Brandenburg glacier. With ice degrading, dead ice bodies remained in this glacier hollow as a relative depression. The active melting of the glacier during the Pomeranian (Aukštaitija) stage caused formation of a huge ice-marginal streamway along which meltwater was flowing westwards across the present-day areas of Poland and Germany. The Ūla River glacial hollow, which was on the ways of this stream, was filled with about 17-m thick sand. The Alleröd warming caused melting of buried ice in the glacier hollow, and sapropelite began accumulating on its bottom. At Mančiagirė, the lakeshore coincided with steep banks of the hollow. Stagnophilic mollusc fauna soon inhabited these lakes. Then followed a cold period related to Late Dryas, when the lakes got shallow and were disappearing, and the marginal parts of the lake lenses were partly buried. In the central parts, the lake deposits by terrigenous deposits composed of laminated sandy loam, aleurite and fine silty sand were covered.

In the Holocene, the former lake basins as the lowest part of the hollow by a river were connected. The further evolution of the river was related to an isostatic elevation of the area and back-wearing going on from the erosion base that, in the case of the Ūla River, was the water level in the rivers Merkys and Nemunas. The rapid incision of the Ūla River made it impossible for accumulative terraces to appear and the channel to meander freely. Appearance of river terraces was also hindered by the fact that the river channel banks, at long ranges, were composed of clayey lake deposits resistant to erosion. All this lead to the development of a winding river channel related to the formation of the basic river network on the basis of streams between the former thermal karst sinkholes. Due to lateral erosion, the river only sometimes had rounded off the winding pattern, which lead to the formation of incised meanders. Such a course of meander development is confirmed by a rapid change in the fall of channel bottom height. A low falling was observed at the sites where lake deposits are outcropping on the channel banks, whereas a higher falling is related to the sites where the river cuts through the sand deposits occurring between the former lake basins.

CONCLUSIONS

In the Holocene history of the Ūla River, there was a period with a weak incision of the river when a thin alluvial bed (no more than 0.5 m), including buried soil, had been accumulated at the 4-m level of the river at the Zervynos-1 site.

The data presented above on the geological setup, formation conditions of organic deposits in the Ūla River valley in the Zervynos–Mančiagirė area, their geochronology and palaeontological remains allow the following conclusions:

1. Organic deposits belong to a genetic group of lake formations, as is indicated by the lacustrine type of deposits (aleurite, sapropelite) and shells of lake molluscs contained in them.
2. The lithological resemblance of lake deposits, the same sequence of their deposition, similarity of pollen spectra (Кондратене, 1960; 1963) and the same type of mollusc fauna (*Anodonta*) make the ground to affirm that these lake deposits are coeval.
3. The relative age of lake deposits is thought to be Alleröd, as indicated by the latest radiocarbon datings, similarity of Zervynos spore-and-pollen diagrams with those of Alleröd (Кабайлене, 1965), and the interstadial character of mollusc fauna.
4. Stratotype deposits of the Ūla (Žiogeliai-Aukštaitija) Interstadial in the Zervynos section should be kept invalid, since they are of another (Alleröd) age.
5. Investigation of lake deposits occurrence conditions at the Zervynos–Mančiagirė site confirmed an intensive melting of dead (buried) ice and formation of thermo-karst or glacio-karst depressions in the lower parts of the relief (glacial hollows) in the Lithuanian area of the last glaciation.
6. The evolution of the Ūla River valley at the length under study is closely related to the development and disappearance of thermo-karst (glacio-karst) depressions. Another reason for the intensive incision of the valley was the isostatic movement which caused formation of incised meanders. The Ūla River at the length studied had not formed a floodpain in a classical sense, with channel deposits settled on the bottom. The square places observed at different heights (3 and 4 m) do not belong to the floodplain, since they represent an erosional bottom of a glacial hollow. Some sites situated close to the above-mentioned ones had been described earlier in the Belarussian area (Kalicki, Sanko, 1997).

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ALERIODO NUOGULOS ZERVYNOSE PRIE ŪLOS: GEOLOGIJA, GEOCHRONOLOGIJA IR MALAKOFAUNA

Santrauka

Straipsnyje pateikta medžiaga apie Ūlos slėnyje tarp Zervynų ir Mančiagirės randamų „Ūlos stratotipinių“ nuogulų geologinę sandarą, susidarymo sąlygas, geochronologiją ir malakofauną. Aiškinama, kad nors organogeninės nuogulos ir slūgso Ūlos upės slėnyje, tačiau jos priklauso ežerinei genetinei grupei. Tai patvirtina jų litologinė sudėtis (sapropelitas) ir surastos moliuskų fosilijos. Malakofaunos sudėtyje vyrauja šaltų vandenų moliuskai (*Pisidium obtusale lapponicum* ir *P. lilljeborgi*), gyvenę vėlyvajame ledynmetyje.

Pradžioje aprašomos nuogulos buvo priskiriamos Ūlos tarpstadialui, t. y. laikotarpiui tarp Nemuno apledėjimo Žiogelių ir Aukštaitijos fazių. Tačiau mūsų duomenys leidžia patvirtinti nuomonę (Пиррус и др., 1971), kad jos yra jaunesnės ir susidarė aleriodo atšilimo metu. Taigi Ūlos (Žiogelių–Aukštaitijos) tarpstadialo stratotipinės nuogulos Zervynų pjūvyje buvo išskirtos nepagrįstai. Zervynų pjūvio sapropelitai susikaupė termokarstinės arba glaciokarstinės kilmės ežero duburyje. Ežerėlis dabartiniame Ūlos upės slėnyje susijungė su kitais termokarstiniais (glaciokarstiniais) duburiais vėlyvajame ledynmetyje ir holoceno pradžioje veikiant upės regresyviai erozijai. Galimas dalykas, kad intensyvų upės įsigraužimą skatino izostatiniai judesiai. Tyrinėtoje atkarpoje Ūlos upė turi erozines terasas, įrėžtas vėlyvojo ledynmečio rinoje. Panašūs atvejai surasti Baltarusijoje (Kalicki, Sanko, 1997).

Александр Санько, Альгирдас Гайгалас

АЛЛЕРЁДСКИЕ ОТЛОЖЕНИЯ В ОКРЕСТНОСТЯХ ЗЯРВИНОС НА РЕКЕ УЛА: ГЕОЛОГИЯ, ГЕОХРОНОЛОГИЯ И МАЛАКОФАУНА

Резюме

Приводятся материалы по геологическому строению, условиям формирования „уласких стратотипических“ отложений в долине р. Ула на участке Зярвинос–Манчягире, их геохронологии и палеомалакофауне. Показано, что органогенные отложения, хотя и залегают в пределах долины р. Ула, но принадлежат к группе озерных образований, о чем свидетельствует их литологический состав (сапропелиты) и содержащиеся в них озерные раковины моллюсков. В малакофауне ведущую роль играли холодноводные моллюски (*Pisidium obtusale lapponicum* и *P. lilljeborgi*) позднеледникового периода. Первоначально возраст рассматриваемых отложений расценивался как улаский межстадиальный, т. е. интервал между жёгяльской и аукштайтской фазами нямунского (поозерского) оледенения. Однако наши исследования позволяют принять иную точку зрения (Пиррус и др., 1967) о том, что время формирования уласких слоев более молодое – аллерёдское. Следовательно, стратотипические отложения улаского (жёгяльско-аукштайтского) межстадиала в разрезе Зярвинос следует признать невалидными. Накопление сапропелитов в разрезе Зярвинос происходило в термокарстовой или гляциокарстовой озерной котловине. Эволюция рассматриваемого отрезка долины реки Ула в позднеледниковье и в начале голоцена была связана с эрозионной работой реки по соединению серии термокарстовых (гляциокарстовых) понижений. Не исключено, что интенсивное врезание долины было обусловлено также изостатическими движениями. Река Ула на рассматриваемом участке имеет эрозионные террасы, расположенные на дне позднеледниковой ложбины. Подобные участки долины были описаны ранее на территории Беларуси (Kalicki, Sanko, 1997).