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Characteristic features of Muravian (Eemian) pollen succession from various regions of Belarus

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ABSTRACT. A comparative analysis of 9 pollen diagrams derived from 7 sections of the Muravian (= Eemian, Mikulinski) Interglacial deposits from several areas of Belarus were carried out. They were investigated by the author in various periods. Six diagrams from 4 sections are published for the first time. Distinct differences were revealed between sites from the Neman (the western Belarus) and Dnepr (the southeastern Belarus) drainage basins. These differences concern the Sozhski (= Wartanian, Moskovski) Late Glacial, the Muravian Interglacial and the Poozerski (Vistulian, Valdanski) Early Glacial phases of the vegetation development. Prevalence of *Pinus* along with decreasing *Picea* values are characteristic of the Sozhski Late Glacial pollen zone sz_i of the section from the Neman basin. *Larix* is present continuously up to the mr_5 zone. The Sozhski Late Glacial pollen zone from the southeastern part of Belarus in the section of the Dnepr basin is characterized by domination of *Picea* along with a high NAP percentage, while *Larix* appears for the first time only at the phase mr_8. Significant amounts of *Quercus* appear in the sections of the Neman basin earlier than elsewhere. Comparatively high contents of *Ulmus* are peculiar for these sections. Pollen of *Corylus* and *Carpinus* appear first in the Dnepr drainage basin. The other differences in results reflect a gradual transition from the vegetation of the Neman basin to the vegetation of the Dnepr basin.

KEY WORDS: pollen and spores, pollen zones, pollen stratigraphy, Muravian (=Eemian, Mikulinski) Interglacial, Belarus

INTRODUCTION

During the last several years a number of sites of Muravian (=Eemian, Mikulinski) deposits have been investigated by the author using pollen analysis. They are presented in Fig. 1:

– western Belarus at the Neman drainage basin (outcrops Pyshki, Knyazhevodtsy and Bogatyrevichi 1 and 2);

– southeastern Belarus at the Dnepr drainage basin (outcrops Loyev 1 and 2);

– central Belarus within the Minsk Upland (outcrop Khmelevka);

– northwestern Belarus in the flood plain of the Viliya river near the Vladyki village (borehole 4);

– southern Belarus in the northwestern part of the Pripyat Trough near the Sheteno village (borehole 4860).

The Pyshky, Bogatyrevichi and Loyev sections have been studied since the beginning of the 20th century by many scientists (Szafer 1925, 1932, Trela 1935, Tsapenko & Makhnach 1959, Voznyachuk 1961, Velichkevich 1982.

Shalaboda studied the sites of the Neman drainage basin in the seventies (Valchik & Shalaboda 1977, Shalaboda & Yakubovskaya 1978). The Loyev section has been investigated twice: in 1974 using the samples provided by Makhnach (Loyev 1) and later on the basis of Litviniuk's sampling Loyev 2). Six diagrams from 4 sections investigated by the author are published for the first time (Bogatyrevichi 1, Bogatyrevichi 2, Vladyki, Khmelevka, Loyev1, Loyev 2).

The studied deposits of the Neman and Dnepr drainage basins are represented by

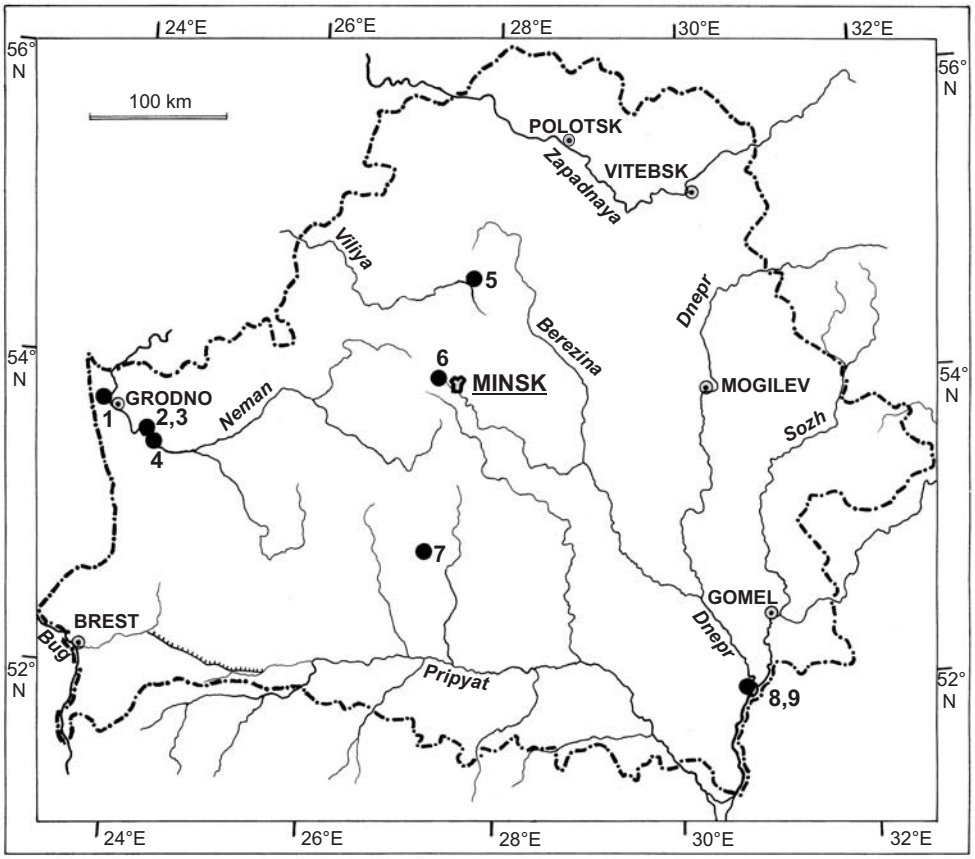

Fig. 1. Schematic map of the Muravian (Eemian) Interglacial sections of the Belarus investigated by the author. **1**. Pyshki, **2**. Bogatyrevichi 1, **3**. Bogatyrevichi 2, **4**. Knyazhevodtsy, **5**. Vladyki (borehole 4), **6**. Khmelevka, **7**. Sheteno (borehole 4860). **8**. Loyev 1, **9**. Loyev 2

oxbow and oxbow/lacustrine environment types (gyttja, peat, and interbedding of sand and sandy loams). Their thickness vary from 1.5 m (Bogatyrevichi 2) to 3.7 m (Pyshki). In northwestern and southern Belarus the cores went through lacustrine deposits (marl, diatomite) of 15.1 m thickness (Vladyki) and of 29.0 m thickness (Sheteno). Thin deposits (1.5 m) investigated in Khmelevka consist of peat which has been accumulated in a shallow lake. Thickness, absolute height of the section bases and pollen zones of the sites examined are given in the Table 1. Pollen diagrams (Figs 2–10) cover the Sozhski (=Wartanian, Moskovski)

Table 1. The investigated sites

Section	Fig.	Absolute height of the base (m)	Thickness (m)	Pollen zones									
				sz_i	mr_1	mr_2	mr_3	mr_4	mr_5	mr_6	mr_7	mr_8	pz_s
Pyshki	2	100.3	3.7	■	■	■	■	■	■				
Bogatyrevichi 1	3	104	1.7						■	■	■		
Bogatyrevichi 2	4	104	1.5						■	■	■		
Knyazhevodtsy	5	102	1.6				■	■	■	■			
Vladyki	6	166.5	15.1					■	■	■	■		
Khmelevka	7	218	1.5						■	■			
Sheteno	8	93.5	29.0				■	■	■	■	■		
Loyev 1	9	112	2.1					■	■	■	■	■	■
Loyev 2	10	110.3	3.3	■	■	■	■	■	■	■	■	■	

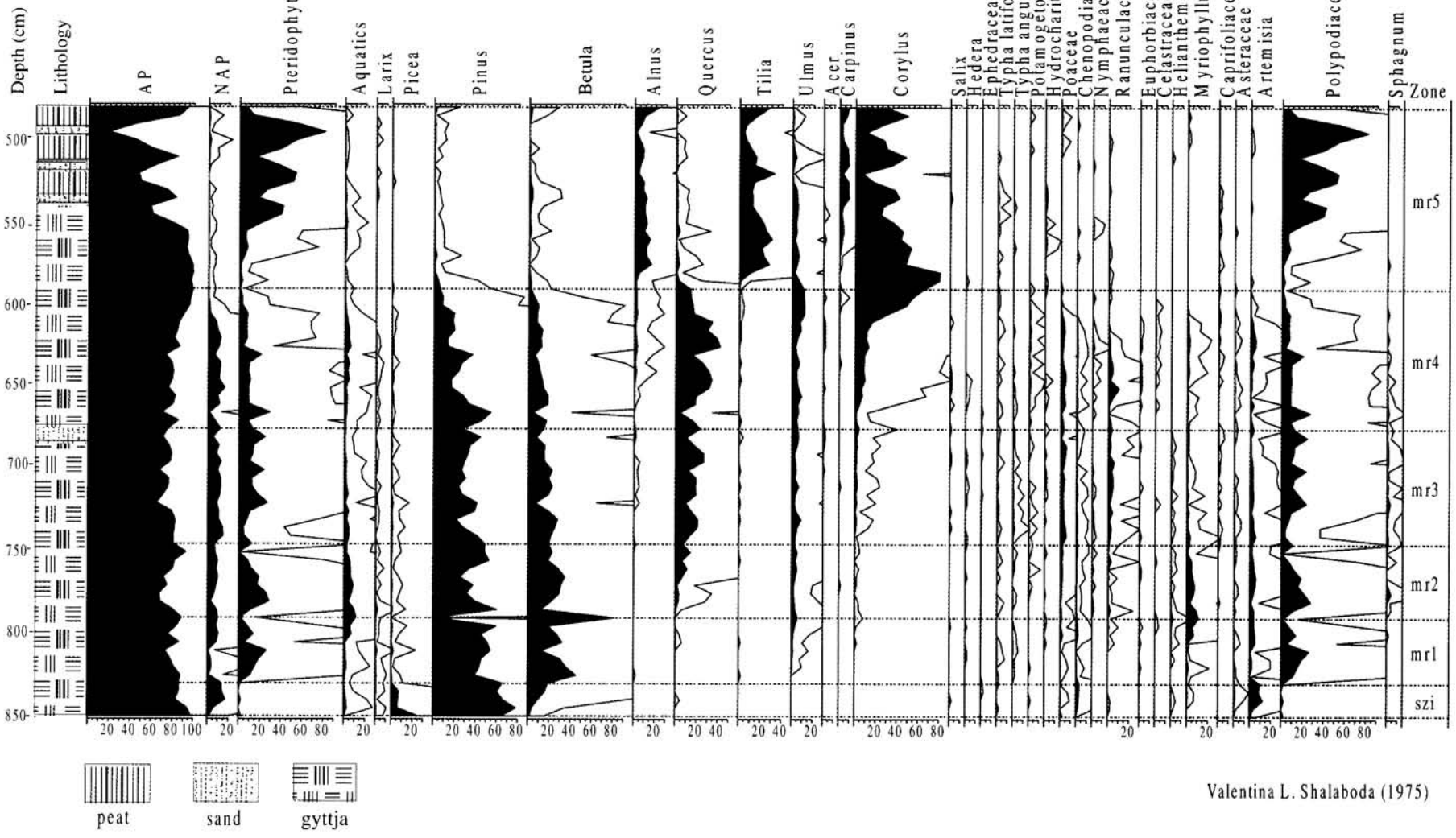

Fig 2. Pollen diagram of interglacial deposits from the Pyshki section (Lat/Lon. 53^{o}40'00"N/ 23^{o}45'00"E)

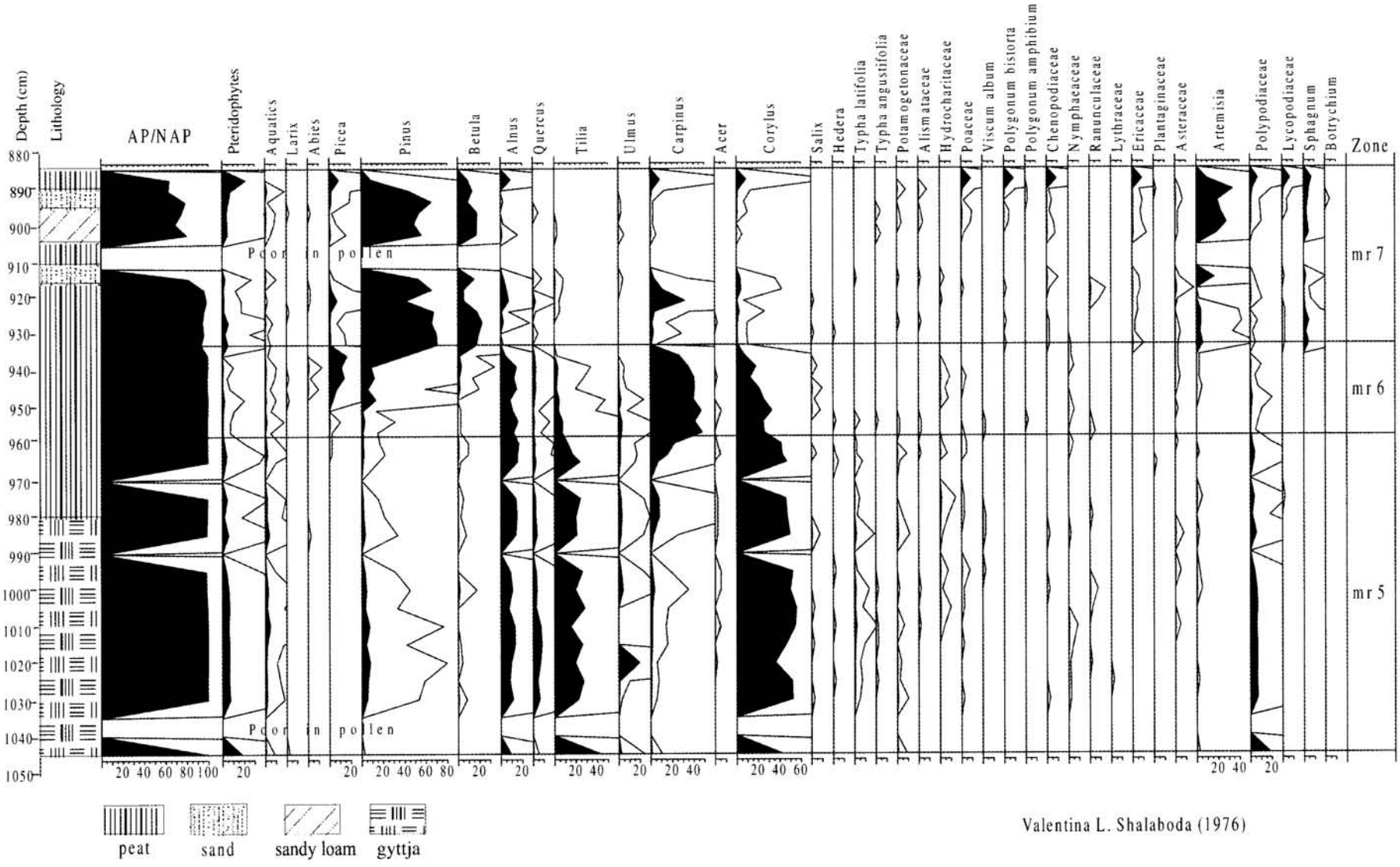

Fig. 3. Pollen diagram of interglacial deposits from the Bogatyrevichi 1 section (Lat/Lon. 53°30'45"N/ 24°11'00"E)

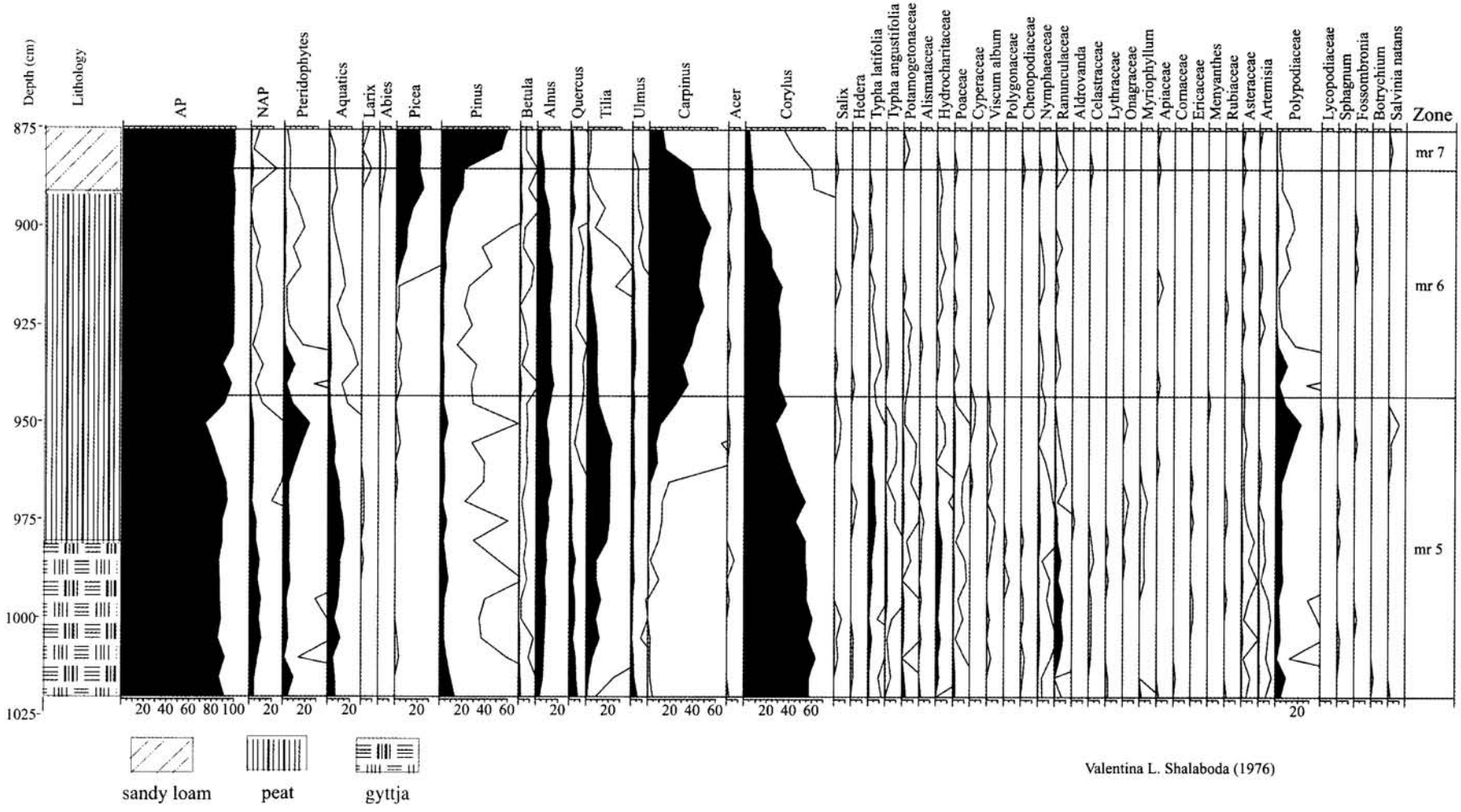

Fig. 4. Pollen diagram of interglacial deposits from the Bogatyrevichi 2 section (Lat/Lon. 53°30'45"N/ 24°11'10"E)

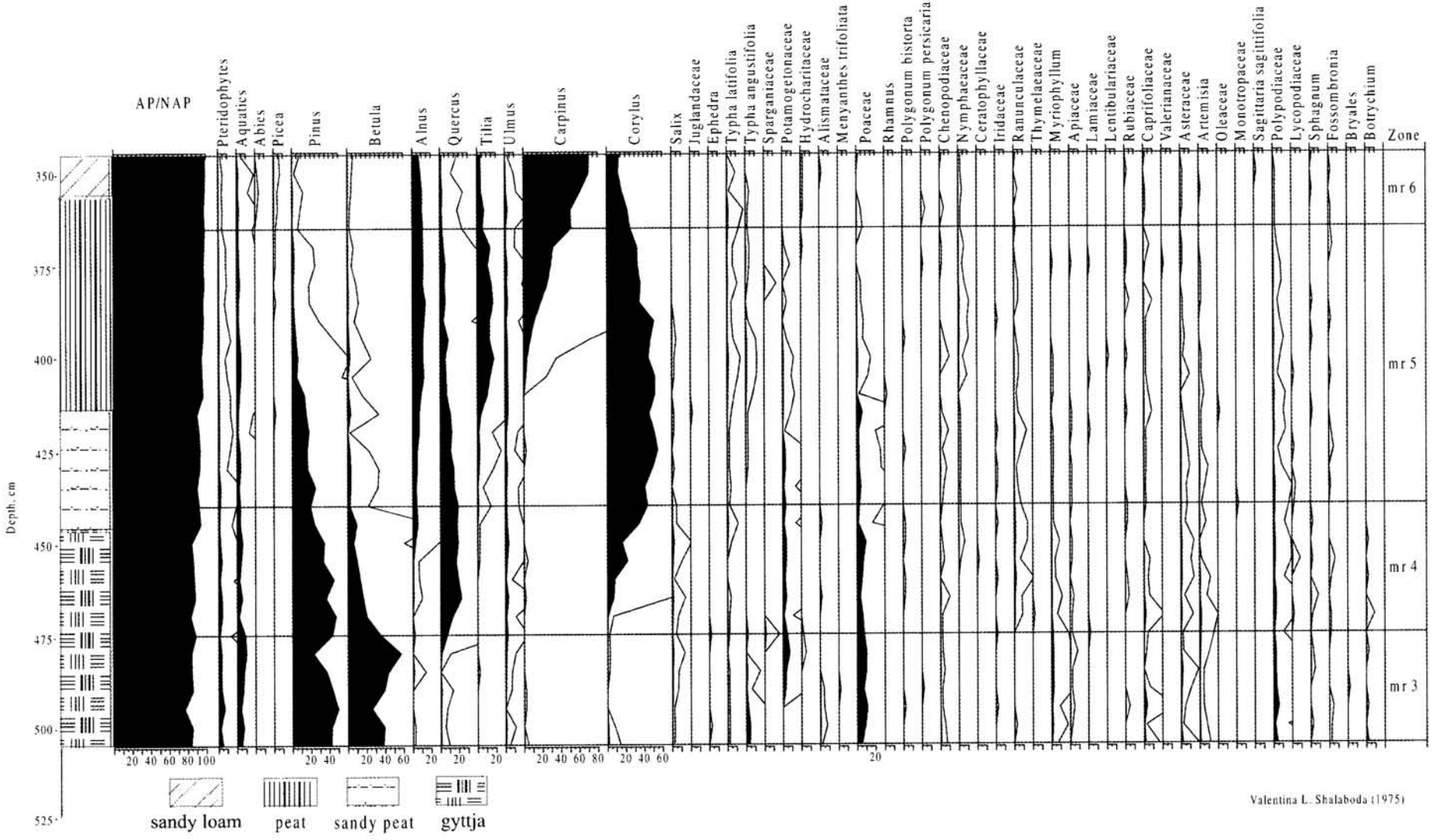

Fig. 5. Pollen diagram of interglacial deposits from the Knyazhevodtsy section (Lat/Lon. 53°27'45"N/ 24°17'00"E)

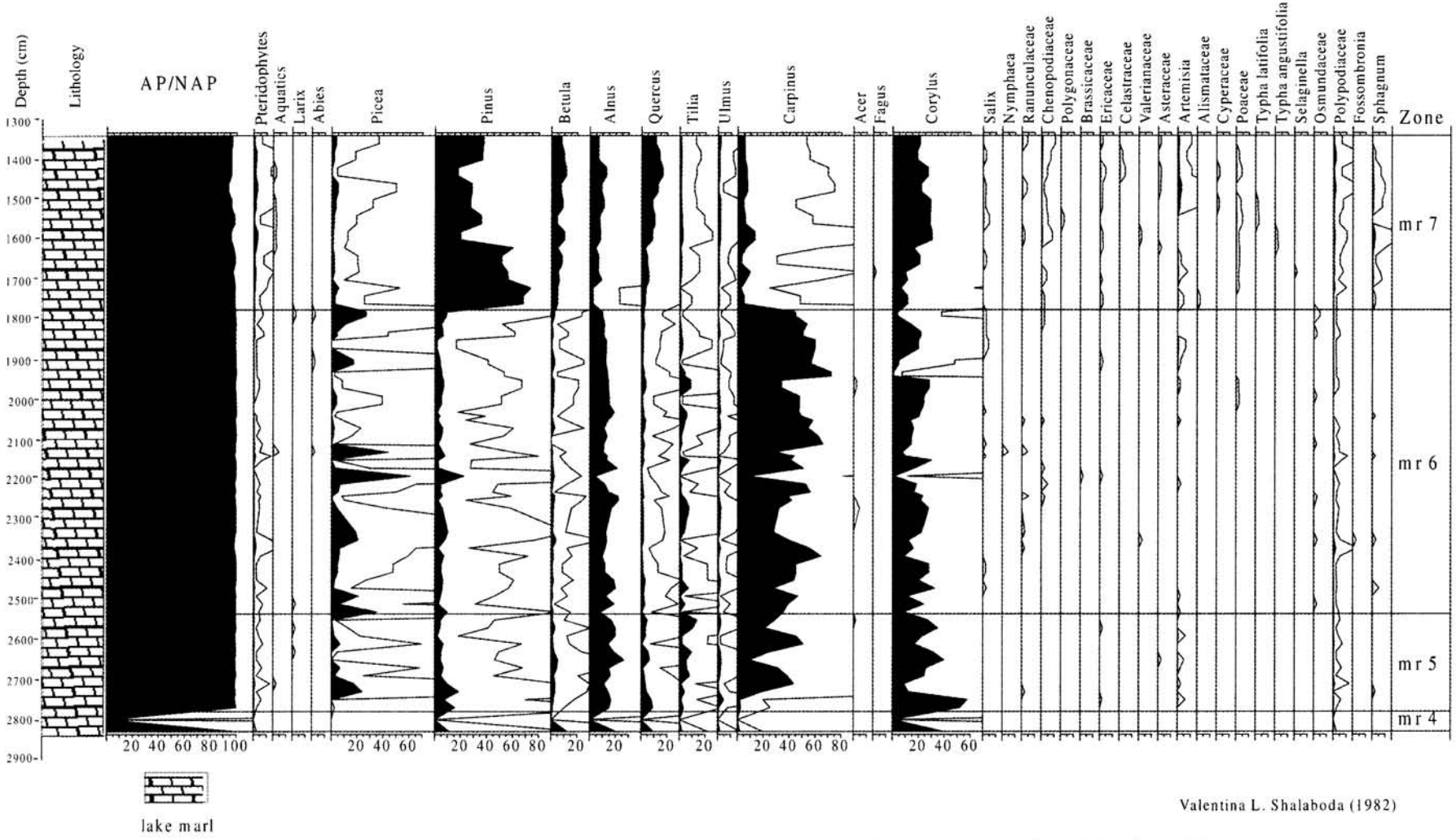

Fig. 6. Pollen diagram of interglacial deposits from Vladyki (borehole 4) Lat/Lon. 54°27'00"N/ 27°27'00"E)

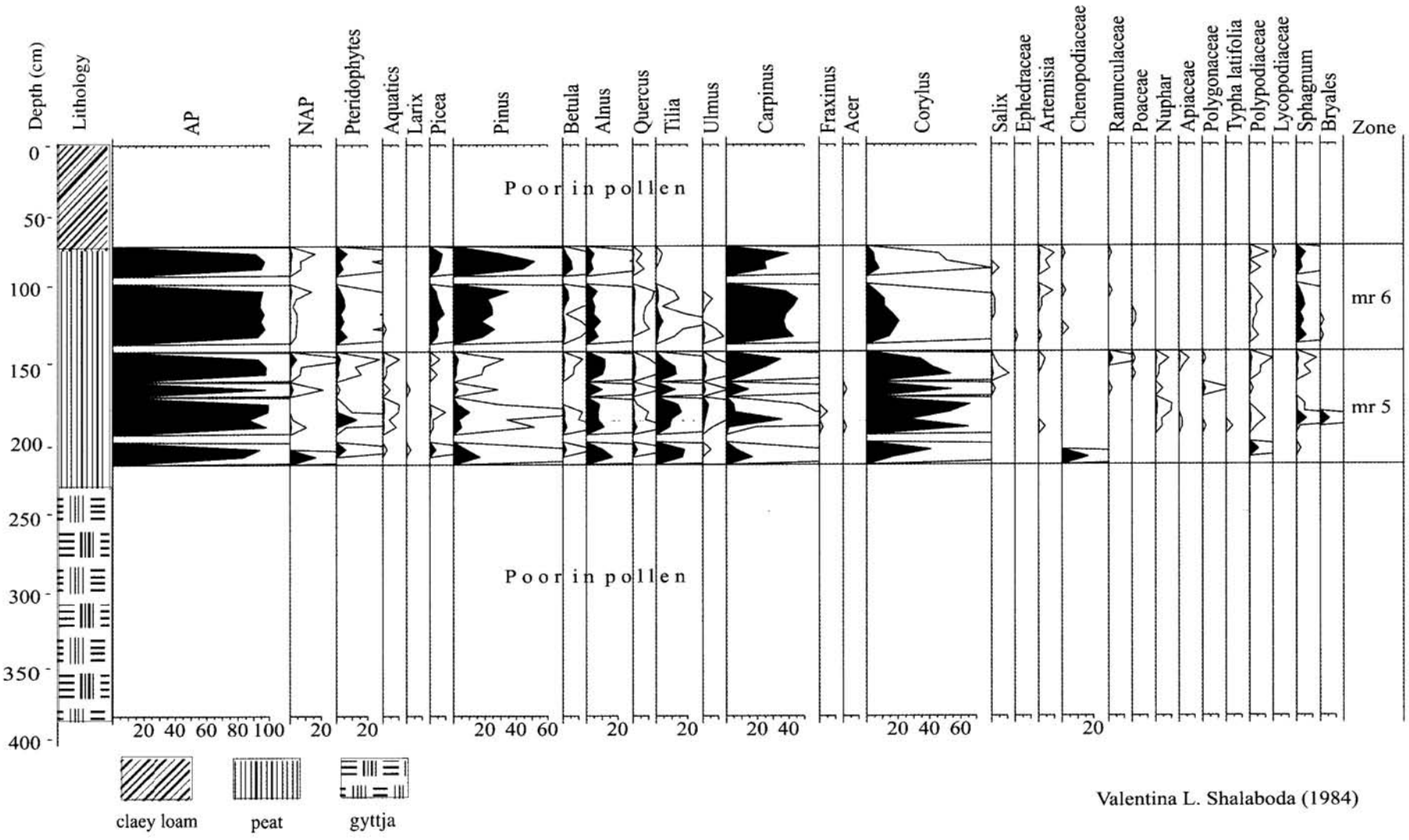

Fig. 7. Pollen diagram of interglacial deposits from the Khmelevka section (Lat/Lon. 54°00'00"N/ 27°15'00"E)

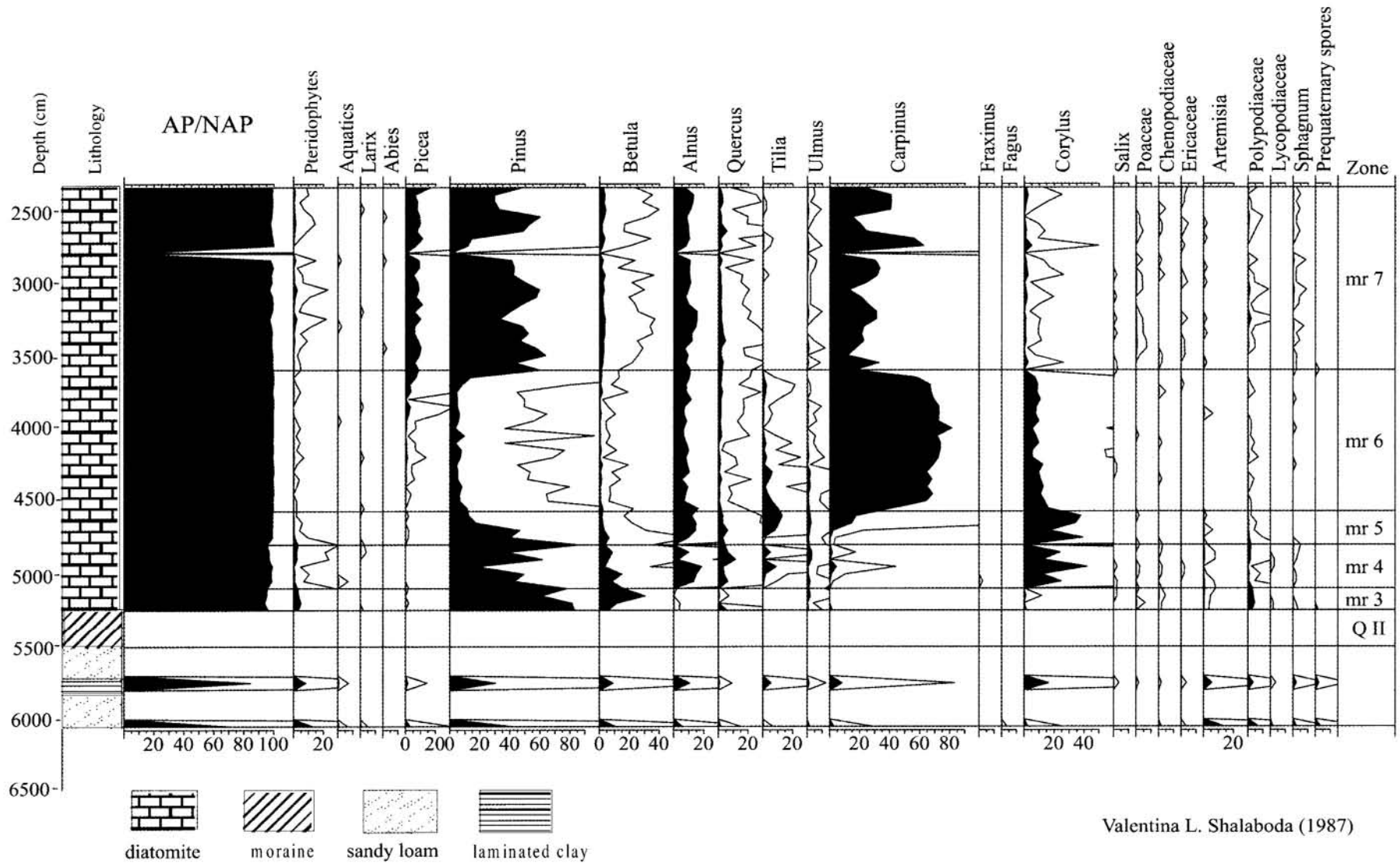

Fig. 8. Pollen diagram of interglacial deposits from Sheteno (borehole 4860) Lat/Lon. 52°47'00"N/ 27°12'00"E)

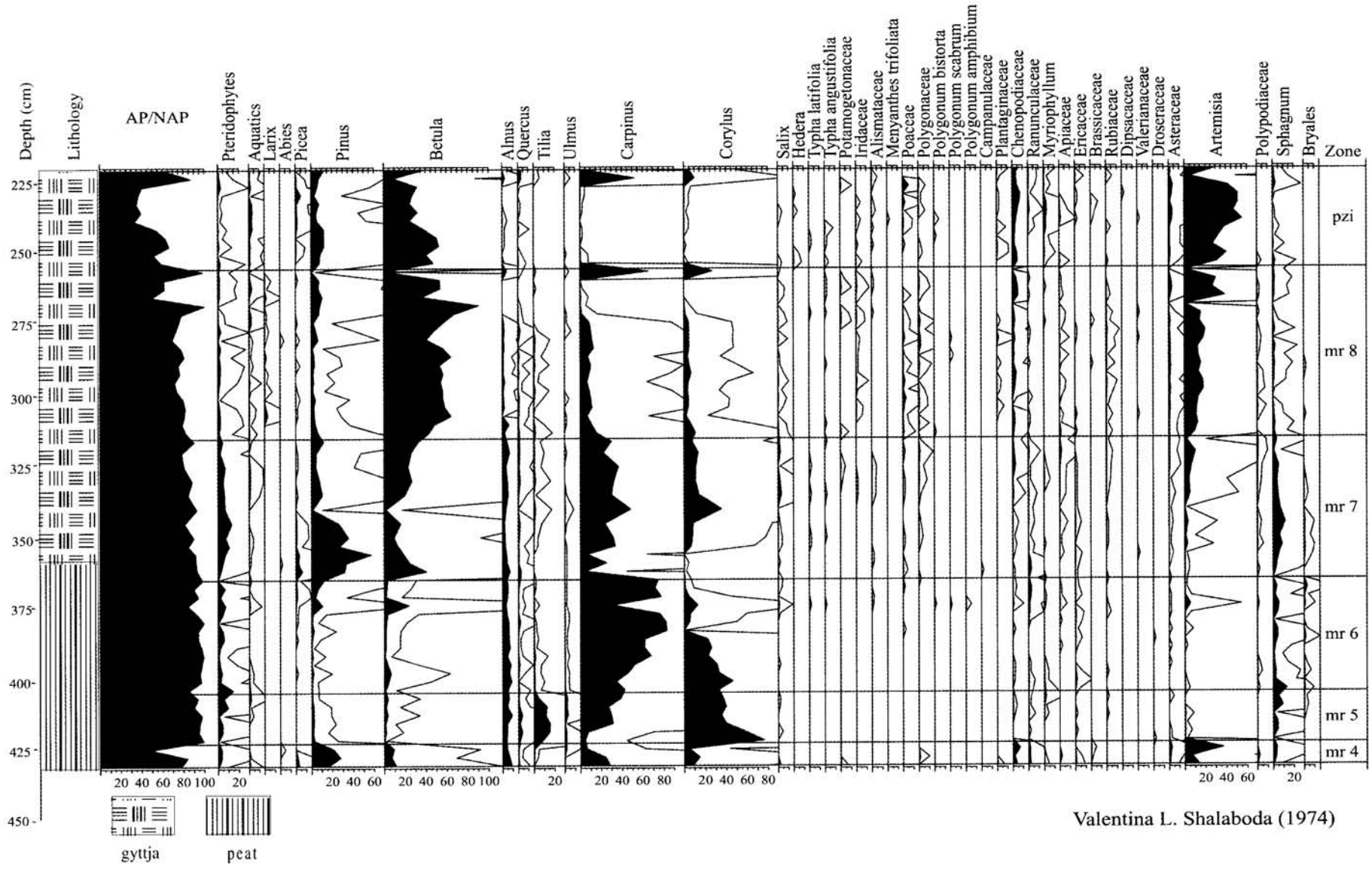

Fig. 9. Pollen diagram of interglacial deposits from the Loyev 1 section (Lat/Lon. 51°56'00"N/ 30°45'00"E)

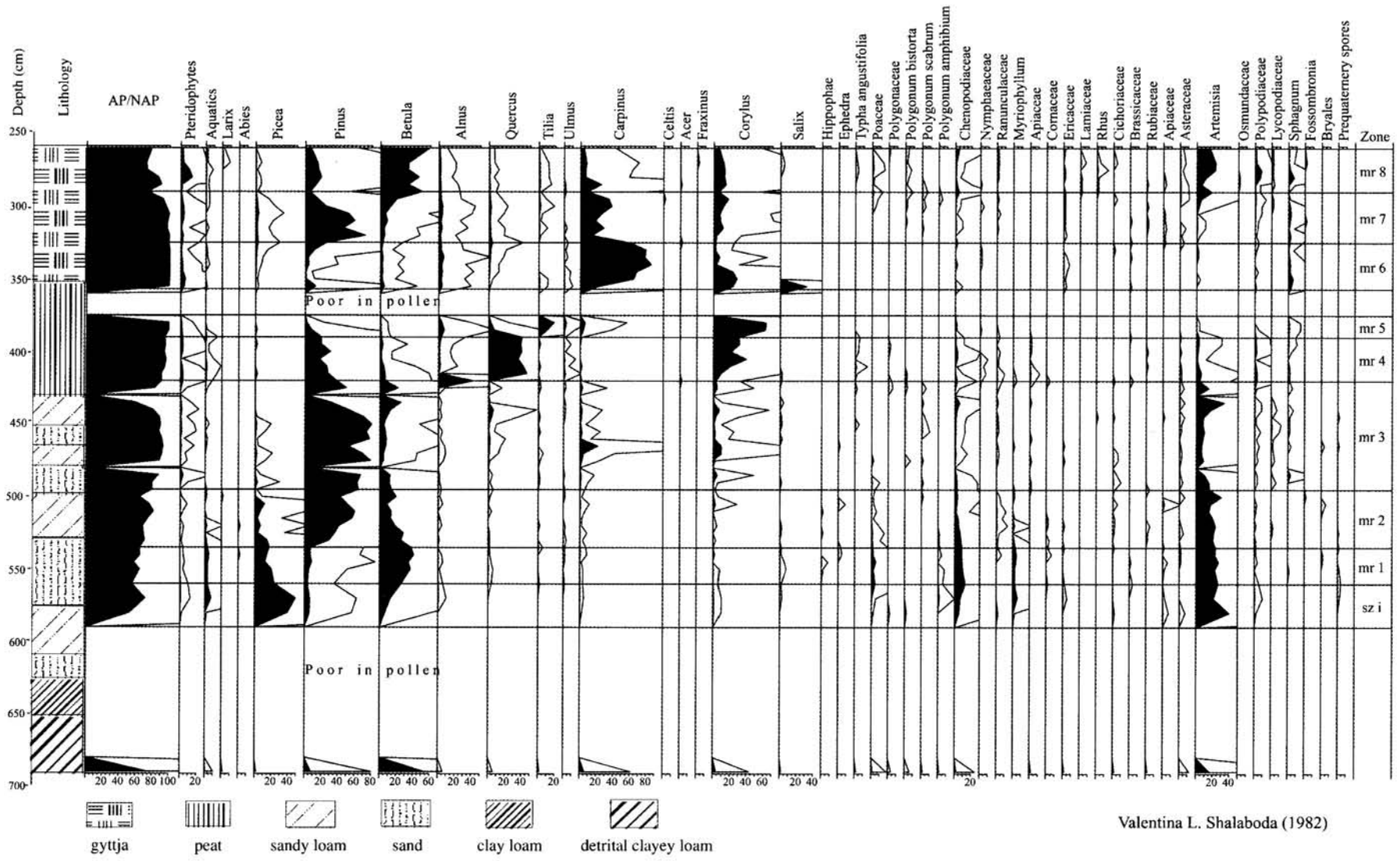

Fig. 10. Pollen diagram of interglacial deposits from the Loyev 2 section (Lat/Lon. 51°56'10"N/ 30°45'00"E).

Late Glacial (pollen zone sz_i), the whole Muravian (=Eemian, Mikulinski) Interglacial (pollen zones mr_1 – mr_8) the beginning of the Poozersky (=Vistulian, Valdanski) Early Glacial (pollen zone pz_s) and illustrate some regional peculiarities.

Spore-pollen analysis revealed the regional features of the vegetation communities forming. The percentages of all the AP and NAP taxa have been calculated of the total pollen sum AP+NAP (AP = pollen sum of trees and shrubs; NAP = pollen sum of upland herbs). The percentages of the pteridophytes and aquatics have been calculated of the total pollen sum. Indication of the pollen zones has been fulfilled according to the scheme of Makhnach et al. (1981) with some corrections based on more recent investigations.

Below is given a short description of the resemblance and differences of the pollen zones beginning from the Sozhski Late Glacial.

DESCRIPTION OF THE POLLEN ZONES

SOZHSKI (=WARTANIAN, MOSKOVSKI) LATE GLACIAL

sz_i — *Picea*-NAP-*Betula* / *Pinus-Picea*-NAP-*Betula*

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

Domination of the conifer species and herbs is characteristic of this zone as a whole. Along with that a high percentage of the NAP among which *Artemisia* and Chenopodiaceae are especially notable. In the southeast of Belarus, *Picea* and *Betula* prevail and *Alnus*, *Corylus* and *Carpinus* occur as a slight admixture. In the west, *Pinus* is the dominant taxon, *Picea* and *Betula* are abundant and *Larix* is usual. *Artemisia* prevails among the NAP.

MURAVIAN (=EEMIAN, MIKULINSKI) INTERGLACIAL

mr_1 — *Betula*

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

In general a dominance of *Betula* and conifer trees pollen is peculiar for this zone. In the southeast of Belarus *Betula* and *Picea* are dominants. Slight admixtures of *Pinus*, *Alnus* and *Corylus*, first appearance of the broad-leaved forests and abundant NAP (*Artemisia*, Chenopodiaceae and Poaceae) are observed. In the west a high percentage of *Betula* and *Pinus* along with the presence of *Larix* are recorded. In addition a significant amount of Polypodiaceae is fixed.

mr_2 — *Pinus*

Loyev 2 (Fig. 10) and Pyshki (Fig. 2).

In general, a dominance of *Pinus* is peculiar for this zone. The southeastern region differs from the others by a still high value of the NAP and higher content of *Pinus* along with a significant composition of *Picea* and *Betula*. In the west, the portions of *Pinus* and *Betula* are approximately equal, *Quercus* appears in noticeable amounts, *Larix* and *Picea* are present continuously and the NAP is less abundant.

mr_3 — *Pinus-Betula-Quercus* / *Pinus-Betula-Carpinus*

Loyev 2 (Fig. 10), Pyshki (Fig. 2), Knyazhevodtsy (Fig. 5) and Sheteno (Fig. 8).

In general, a domination of *Pinus* and *Betula* as well as a significant participation of the NAP at the background of the permanent *Quercetum mixtum* occurrence are characteristic of this zone. Among the peculiarities of the pollen spectra of the Loyev 2 section is an essential percentage of *Carpinus* and *Corylus*. In the Pyshky section (western Belarus), this zone is characterized by roughly equal amounts of *Quercus* and *Betula* as well as by significant percentages of *Ulmus*. In the Sheteno section (southern Belarus) increased values of *Pinus* are recorded.

mr_4 — *Quercus-Pinus-Corylus*

Loyev 1 (Fig. 9), Loyev 2 (Fig. 10), Pyshky (Fig. 2), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8) and Vladyki (Fig. 6).

Maximum of *Quercus* along with an increasing percentages of *Corylus* and decreasing participation of *Pinus* is a common feature of this zone over the whole study area. In the Loyev 2 section worthy of note are close values of *Quercus* and *Pinus* and low values of *Carpinus*. In Sheteno, an increased *Pinus* content and significant amount of *Alnus* are fixed. The proportion of *Corylus* increases from the southeast to the west. In the Pyshki section, this zone is characterized by the maximum of *Ulmus* and by still occurring *Larix* and *Picea*.

mr_5 — *Corylus-Tilia-Alnus*

Loyev 1 and 2 (Figs 9, 10), Pyshki (Fig. 2), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8), Vladyki (Fig. 6), Bogatyrevichi 1 and 2 (Figs 3, 4) and Khmelevka (Fig. 7).

This zone is distinguished in all of the studied sections. Arboreal spesies dominate while the herb plants are few. Synchronous maxima of *Tilia* and *Alnus*, preceded by the maximum of *Corylus* are characteristic of this zone. In most sections these events take place against a background of an increasing role of *Carpinus* with the exception of the Pyshky section, where *Carpinus* has relatively low values. In Pyshki, an occurrence of *Quercus*, an increasing portion of Polypodiaceae and sporadic grains of *Pinus*, *Betula*, *Larix* are observed in this zone. In Bogatyrevichi 1 and 2 and Vladyki, increase of Polypodiaceae values and sporadic grains of *Pinus*, *Betula*, *Ulmus* were recognized. In Sheteno this zone is thin, the maximum of *Tilia* is not distinct and synchronous to the decline of *Pinus* and growing role of *Carpinus*. In Khmelevka the pollen-abundant samples alternate with the pollen-deficient ones, although a certain regularity of the pollen zone sequence is observed. In Loyev 1 and 2 this zone is also not thick and a *Tilia* maximum is insignificant, being attended by decrease of *Pinus* and *Quercus*. Content of *Alnus* and *Betula* is poor. *Carpinus* has low values in Loyev 2 but in Loyev 1 its values exceed 40%. In Vladyki high values of *Picea* are present.

mr_6 — *Carpinus*

Loyev 1 and 2 (Figs 9, 10), Knyazhevodtsy (Fig. 5), Sheteno (Fig. 8), Vladyki (Fig. 6), Bogatyrevichi 1 and 2 (Figs 3, 4) and Khmelevka (Fig. 7).

This zone is present in eight examined sections. Its common feature is the maximum of *Carpinus*, the presence of *Picea* and, increase of its percentage by the end of the zone. In Knyazhevodtsy rare grains of *Abies* are met and *Betula*, *Ulmus*, *Quercus* are present. In Bogatyrevichi 1 and 2 a significant amount of *Pinus* and sporadic grains of *Larix* and *Abies* are registered at the end of the zone. The percentages of *Corylus* and *Tilia* become lower. In Sheteno, *Alnus*, *Corylus*, *Pinus* and *Quercus* are continuously present, the role of *Tilia* falls and of *Picea* increases. In Vladyki, the values of *Alnus*, *Corylus*, *Pinus*, *Betula*, *Quercus* and *Tilia*, remain more or less stable while amounts of *Picea* fluctuate. Arboreal species dominate but Polypodiaceae are also present. In Khmelevka, the portions of *Corylus* and *Tilia* fall, *Alnus*, *Picea*, *Betula* and *Quercus* remain at the former level, and the role of *Pinus* becomes more significant. Arboreal pollen dominates, although a small percentage of spores is fixed with *Sphagnum* and Polypodiaceae prevailing among them. In Loyev 1 and 2, values of *Alnus* and *Betula* are permanent, *Picea* appears for the first time and then becomes more abundant in spectra while the portion of *Corylus* decreases. Arboreal pollen prevails. A low portion belongs to spores of which *Sphagnum* and Polypodiacae dominate.

mr_7 — *Pinus-Carpinus-Corylus* / *Pinus-Corylus-Quercus-Carpinus*

Loyev 1 and 2 (Figs 9, 10), Sheteno (Fig. 8), Vladyki (Fig. 6) and Bogatyrevichy 1 and 2 (Figs 3, 4).

This zone is defined in six studied sections. It is characterized by the maximum of *Pinus* and by the second (small) peak of *Carpinus*. In Bogatyrevichi 1, *Betula*, *Picea*, *Corylus* and *Alnus* are present, *Quercus*, *Tilia* and *Ulmus* are rare, and the NAP values (*Artemisia*, Ericaceae, Poaceae) are abundant. *Sphagnum* and Polypodiaceae prevail among spores. In Sheteno, *Betula*, *Picea*, *Corylus* and *Alnus* are present, sporadic grains of *Quercus* and *Ulmus* are recorded, and an appearance of the NAP (Poaceae) is observed. *Sphagnum* and Polypodiaceae dominate among spores. In Vladyki, *Corylus*, *Alnus*, *Quercus* and *Betula* show a rather essential percentages, *Picea* is present, *Tilia* and *Ulmus* are rare, and an appearance of the NAP (*Artemisia*, Chenopodiaceae) is fixed. *Sphagnum* and Polypodiaceae prevail among spores. In Loyev 1 and 2, *Betula*, *Picea*, *Corylus* and *Alnus* are present, sporadic grains of *Quercus* and *Ulmus* are met, and the NAP values (*Artemisia*, Ericaceae and Chenopodiaceae) are enough high. *Sphagnum* and Polypodiaceae prevail among spores.

mr_8 — *Betula* – NAP

Loyev 1 and 2 (Figs 9, 10).

This zone can be seen only in two sites. Its peculiar feature is a high content of *Betula* and the *NAP* accompanied by still preserved role of the broad-leaved species, and by the first appearance of *Larix*.

POOZERSKI (=VISTULIAN, VALDANSKI) EARLY GLACIAL

pz_s — NAP – *Betula*

Loyev 1 (Fig. 9).

This zone is distinguished in only one section, and high percentages of *Betula* in combi-

nation with NAP are characteristic of the zone. Pollen of the broad-leaved trees is rare.

CONCLUSIONS

All the studied deposits are referred to the Muravian time corresponding to the Eemian Interglacial. The revealed regional variations enable the elucidation of the stages of the vegetation development in Belarus.

The most distinct differences can be seen when the Pyshki and Loyev sections are compared. The Sozhski Late Glacial pollen zone sz_i has been stated in Loyev 2 and Pyshki sections. The Poozerski Early Glacial pollen zone pz_s has been stated in Loyev 1 section.

It was stated that the lakes of the Muravian (Eemian) age were the most numerous in Belarus during the phases mr_5 (the maximum of *Tilia*) and mr_6 (the maximum of *Carpinus*). Shallow lakes existed even within uplands in small depressions of relief (Khmelevka).

Worthy of note is a rather significant percentage of *Picea* (mr_6 – mr_7) in the western (Bogatyrevichi), northwestern (Vladyki) sections and its stable (although not high) values in the southern section (Sheteno), and very few amounts in the southeast sections (Loyev 1 and 2).

The pollen spectra of Sozhski Late Glacial (sz_i zone) are characteristic of Loyev and Pyshki sections. Within the zone sz_i in the Loyev 2 section, *Picea* achieves its maximum content, and in the Pyshki section *Picea* is also abundant. According to carpological data of Velichkevich (1982), the cones of *Picea obovata* prevail in the sediments of this horizon in Loyev 2 section. In the Pyshky section the cones of *Picea* sp. were found in the same horizon (Shalaboda & Yakubovskaya 1978).

The transition from the Sozhski Late Glacial to the Muravian Interglacial was gradual. In the Loyev 2 section, pollen of the arboreal species of the interglacial appears for the first time at the background of a rather high percentage of the NAP, *Artemisia,* Chenopodiaceae and Poaceae being the dominants among the latter. Rare grains of *Quercetum mixtum* appear first in the southeastern sections, although the noticeable percentage of this pollen is recorded in the older pollen zones in the diagrams derived from the western sections. A significant difference in the *Tilia* contents is observed between the studied sections. Its maximum amounts fall to the pollen spectra of the western sections. Amounts of *Corylus* decrease from the west to the southeast.

Any reconstruction and description of the forests of the period under consideration have been deliberately avoided. Nevertheless, the composition of the pollen spectra enables to distinguish the dominant taxa for each zone and to correlate the different sections.

It seems that an increased portion of hornbeam pollen at the background of high values of the pine pollen (mr_7) should not be considered as the second optimum. Most probably there took place a cooling with a gradual shift of dominants in the pollen spectra. *Pinus* with *Carpinus* were the dominant taxa in the sections of the western (Bogatyrevichi), southern (Sheteno) and southeastern (Loyev) parts of the study region, and *Pinus* with *Corylus* and *Quercus* in those of more northern areas (Vladyki). It should be mentioned a resemblance of the pollen spectra of the Loyev, Sheteno, Vladyki sections and of the Polish section Szwajcaria (Borówko-Dłużakowa 1975). The second climatic optimum is not distinguished by the author in the Belarusian sites what is in agreement with Mamakowa's opinion regarding this problem in Polish sites (Mamakowa 1989).

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