SEDIMENTARY EVIDENCE OF PALEOVEGETATION AND HUMAN ACTIVITY AT POPE MANOR IN THE 17TH–19TH CENTURIES

LIECĪBAS NOGULUMOS PAR PALEOVEĢETĀCIJAS RAKSTURU UN CILVĒKA DARBĪBU POPES MUIŽĀ 17.-19. GS.

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Abstract

Sediments are an important archive, containing evidence of natural events and human activity in a given place. For this reason, a 49-cm-long sediment monolith of a section from the slope of an elevation at Pope, where the hunting castle is situated, was taken during archaeological excavations with the aim of finding out the environmental conditions during formation of the cultural layer. Samples were studied using a multidisciplinary approach, including sediment composition, granulometric and mineralogical composition analysis, as well as paleobotanical analysis of plant macroscopic remains and pollen analyses. The results obtained in all analyses complement each other and give the impression that naturally accumulated sediments were mixed by human activity. This is evidenced by their similar composition throughout the section. The results of analyses of macroscopic plant remains and pollen contained in the sediments indicate the environmental conditions at the time during the existence of the hunting castle at Pope. According to the data of paleobotanical analyses, and the considerable amount of grasses, especially weeds, the landscape was relatively open and cultivated.

Keywords: *sediment composition, cultural layer, palaeobotanical analysis, artefacts*

Introduction

The Pope uplift or Pope Island is a moderately undulating elevation on the north side of the Ugāle Plain in the Kursa Lowland. It is oriented in the WSW-ENE direction and rises 40 m above the surrounding Baltic Ice Lake plain, reaching 70.4 m above sea level (asl.) at its highest point. The top of the elevation is subdivided by elongated drumlin-like landforms. The Pope uplift has a very complicated geological formation and structure. It consists of deposits of natural origin, formed by Weichselian till and the glaciolimnic sediments of an ice-dammed lake. During the existence of the Baltic Ice Lake, the Pope uplift rose above the water level and became an island. The shoreline of the Baltic Ice Lake at the north end of Pope Island is characterised by a 30-metre-high ancient coastal erosion cliff. For the rest of the shorelines, the ridges are marked at a lower level. The territory of Pope manor

occupies the south-eastern part of the island, where the absolute height marks are 60 m asl., while the hunting castle was built at the top of the island's slope at an elevation of 57.7 m asl.

The aim of the archaeological research was to find possible evidence of previous habitation in the immediate vicinity of the oldest building at Pope manor – the hunting castle. In order to gain a broader insight into history, as well as archaeological research, information about the natural conditions in which the people of that time lived is also needed. Therefore, the aim of the research is, using a multidisciplinary approach, to find sedimentary evidence of the paleovegetal character and human activity at the hunting castle at Pope in the 17th–19th centuries. Field work includes sediment section description and sampling for laboratory analyses: sediment composition (LOI), granulometric (grain size), mineralogical, macroremain and pollen analysis.

Data and methods

In order to obtain information about the interaction between nature and humanity during the period of active use of the hunting castle, during archaeological research on 27 July 2019, a 49-cm-long sediment monolith was taken. Sediments for further analyses in the laboratory were obtained from the excavation site, located 4 m to the west of the west facade of the hunting castle building and 3 m from the slope of the ravine. (Figure 1). It was determined that sediment interval 0.80 m–1.30 m had formed during human activities and can be defined as a cultural layer. These sediments were studied.

Field work: The sediment sample monolith was taken from the excavation area in the B/1 square of profile A at a depth of 0.80–1.30 m from ground surface.

Figure 1**. Sampling site in the archaeological research area, measured 4 m to the west of the west façade of hunting castle building at Pope. The white arrow indicates the top of the sediment sample – monolith at a depth of 0.80 m** (authors' figure)

In order to have more information, the general characteristics of the whole section were also determined and described during the field work.

Top layer at a depth of 0–0.10 m: sod, saturated with clay brick/tile fragments, pebbles, 20th century fragments of iron objects. Exposed layer: dark grey soil, saturated in places with tile fragments. The first sediment layer is characterised by dark grey soil saturated with clay brick in some places and tile fragmen[ts], iron nails and screws (20th century), animal bones.

The second layer: in the central part, a stone structure is exposed, which covers the square crosses diagonally in a south-easterly direction. A row of boulders laid in red clay. The clay layer itself is visible on the east side of the square, with separate red clay fragments of bricks and tiles.

The third layer: on the east side, a layer of blue clay appeared under the red clay, in which there were tile fragments, some small glazed ceramic shards, dark green glazed fragments of kiln pots, and animal bones.

The fourth layer covers the cultural layer, and is characterised by reddish clay sand (thickness 0.2–0.3 m). It is exposed, and saturated with charcoal, bones and small fragments of tiles. These clays, levelling the area, are placed on top of a dark-grey uniform layer, in which there were no finds within the boundaries of the area. In part A of the area, the base soil – yellowish loam – was reached at 1.1–1.3 m deep.

Cultural sediment layer, depth 0.8–1.3 m: characterised by sand, int. 0.8–0.9 m with an admixture of orange-coloured Fe hydroxides; the lower part of the layer, which is with a small admixture of gravel grains, and is lighter and yellowish-grey has been studied in detail, applying a multidisciplinary approach.

Laboratory investigations

Loss on ignition (LOI) analysis is a widely used method to estimate the organic matter, carbonate and mineral content of sediments. The method is based on heating samples in muffle furnaces at +550 °C and +950 °C, which is currently accepted as a worldwide standard (Heiri et. al., 2001). After analysing the heating loss, the percentage ratio of organic substances accumulated in sediments and precipitated carbonates and mineral substances can be determined, which allows us to judge the environment in which the sediments accumulated, as well as the factors affecting them.

Analysis of the grain size composition of sediments show the amount of grain size particles that make up the composition of sediments, expressed as a mass percent of the total rock mass. Depending on the grain size, several sediment fractions can be distinguished. In this study, as part of the granulometric or grain size analysis, the sediment grain size fractions (mm) are: >1.0; 1.0– 0.5; 0.5–0.25; 0.25–0.1; 0.1–0.05. A set of sieves with mesh diameter >1.00 was used for sediment analysis, as well as 1.0–0.5; 0.5–0.25; 0.25–0.10; 0.10–0.05; <0.05 mm. Each fraction was weighed and data was processed in the MS Excel programme, creating grain size curves on a semi-logarithmic scale and determining the granulometric coefficients as first quartile, median and third quartile, or cumulative curve values at 25%, 50% and 75%.

The results of the mineralogical composition analysis of heating losses show that the composition of the sediments does not change significantly throughout the studied section; however, visually small differences can be observed, and therefore an analysis of the grain size and mineralogical composition of the sediments was carried out, and other materials found in the sediments were also determined.

Analysis of plant macroscopic remains was performed for nine samples with a sampling interval of 5 cm. The initial sediment volume of each sample is 20 millilitres. The generally accepted methodology (Birks, 2007) was used in the pre-treatment of sediments. Macroremains were soaked in water and collected in a sieve with a mesh of 0.25 mm. For the identification of macroremains a stereoscopic microscope, Zeiss Stemi-2000-C, was used, as well as modern seed collections and publications (Bojnansky & Fargašova, 2007; Cappers et al., 2006; Katz et al., 1965; Rasiņš, 1954).

The essence of spore-pollen analysis is that pollen accumulates with sediments. Therefore, spores and pollen in the relevant sedimentary layer provide evidence of the plant species of the relevant time (Galenieks, 1935). Pollen analysis was performed on 11 sediment samples at 3 cm intervals. Sediment samples were processed according to

internationally approved methodology (Bennett & Willis, 2002). The analysis was performed at a magnification of 400–1000 times using a light microscope, Axiostar plus. At the same time, other microfossils and charcoal dust were also detected and recorded, which can be an important indicator of human activity. Using the obtained results, a pollen percentage diagram was created in the TILIA programme.

Results and discussion

In the course of the archaeological excavations organised by Ventspils Museum (directed by A. Vijups, G. Skagale) in 2019, no structures related to the oldest (17th century) constructions except the hunting castle of the manor territory were found. The pile of stones which stands out in the centre of the excavations field diagonally in the south-north direction immediately below the top layer at a depth of 0.1 m in the western part of the field and continues in the ground, was formed by strengthening the edge of the slope with stones and clay and transforming the initially steep hills into a flat plane, where the oldest stone building at the manor is also situated. The time of construction of the building cannot be determined precisely, but it could hypothetically be in the 19th century. Most of the artefacts found in the course of the research are from the 19th-20th centuries; the oldest find is a fragment of a green-glazed stove tile with a flower vase motif, which is one of the 17th century motifs commonly found on tiles in Kurzeme. Fragments of black glazed stove tiles, a primitive iron key, and flintlock flint generally date from the 19th century.

A general dating of the cultural layer attributes it to between the 17th and the end of the 19th century, and the third and fourth layers to the 17th–18th century.

Laboratory investigations

The results of Loss on ignition (LOI) analysis, obtained during the LOI analysis, indicate a clear dominance of minerals in the sediment composition (96–97%) and a small amount of organic matter (2.5–3%), and less than 1% of carbonates (Table 1). According to the results of the analysis, the sediment composition does not show significant change throughout the studied section of cultural layer.

Table 1. **The composition (%) of the analysed sediments of the cultural layer section** (authors' calculations)

Sample no.	Depth from surface (from analysed sediment section top), m	Organic matter, %	Carbonates, %	Mineral matter, %
1	0.81 (0.1)	3.00	0.80	96.20
2	0.97 (0.17)	2.33	0.59	97.08
3	1.06 (0.26)	2.75	0.79	96.46
4	1.17 (0.37)	2.36	0.51	97.13

The results of the granulometric analysis show that the sediments at the western facade of the hunting castle at Pope are made up of sand of different degrees of coarseness; however, the grain size fractions of 0.25–0.10 mm, which, according to the classification, correspond to fine-grained sand (58%), are strongly dominant. There is a smaller proportion (19%) of the fraction 0.5–0.25 mm, which corresponds to medium-grained sand. Graphs were created for all the analysed samples, in which the variations of the grain size composition of the sediments and the cumulative curve were displayed. It should be noted that the created graphs are similar to the sample Pope 1 (Figure 2), which allows us to conclude that throughout the entire studied section the sediments are relatively well-sorted, and that their accumulation was probably influenced by water flows.

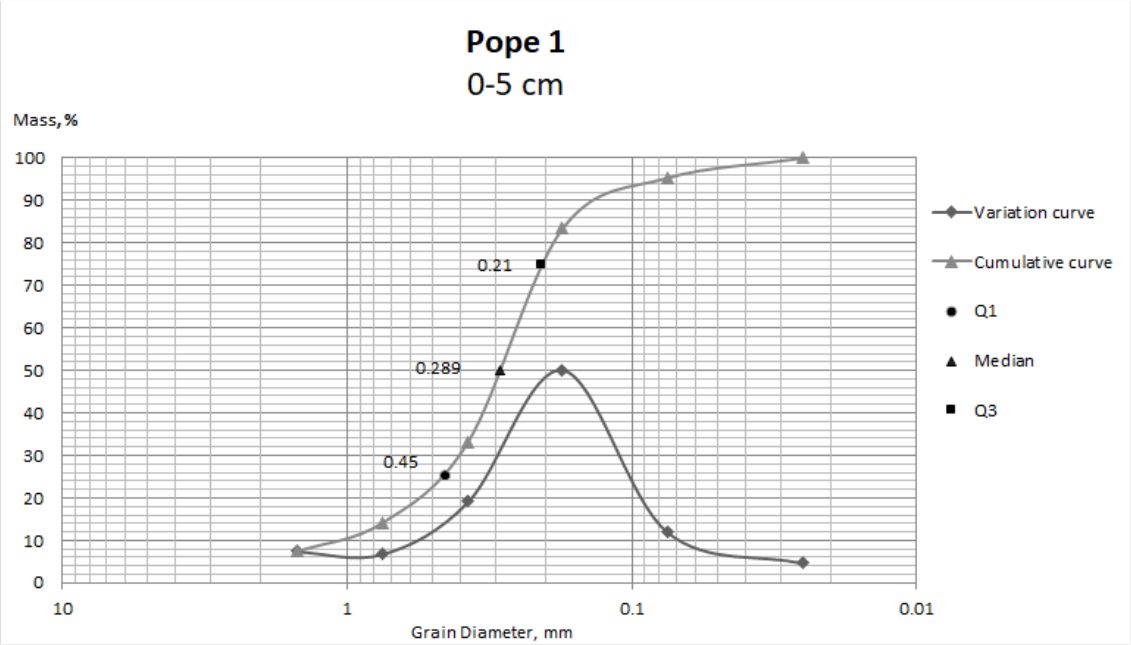

Figure 2. **Variations and cumulative curve of the grain size composition of the analysed sediment sample 1 (depth from the ground surface 0.8 m)** (authors' figure)

The aim of the mineralogical analysis was to clarify the general association of minerals, and therefore their belonging to a group – quartz, feldspar, mica, sedimentary rocks, crystalline rocks, calcined ($CaCO_3$) roots, artefacts, other (organic materials etc.) – was determined.

Quartz grains dominate (43–72%) in the sandy sediment samples. Their amount is significantly higher in the particle size fraction 1.0–0.5 mm than in the largest size fraction of > 1.00 mm. A relatively large share (31–46%) is made up of crystalline rocks, among which granites dominate (see Figures 3 and 4). However, there are also differences in their composition in different size fractions. The amount of crystalline rocks significantly decreases in the smallest fractions, while the amount of sedimentary rock debris directly increases.

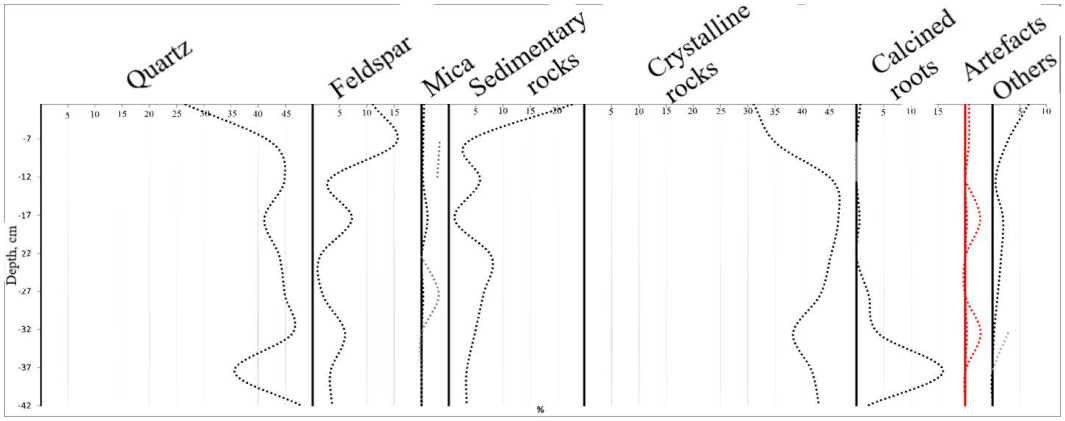

Figure 3. **Mineralogical composition of sediments, grain size fraction > 1.00 mm** (authors' figure)

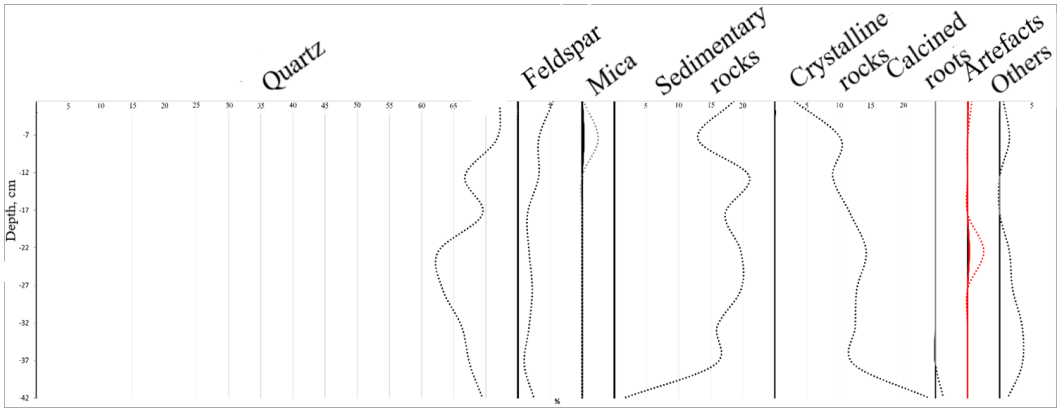

Figure 4. **Mineralogical composition of sediments, grain size fraction 1.00-0.5 mm** (authors' figure)

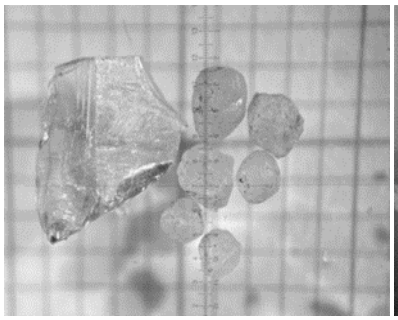

Figure 5. **Window glass fragment from the left, quartz grains from the right**

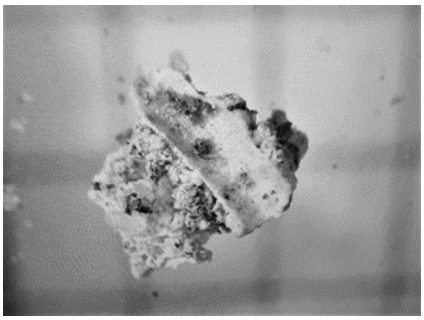

Figure 6. **Calcinated root, >1.00 mm**

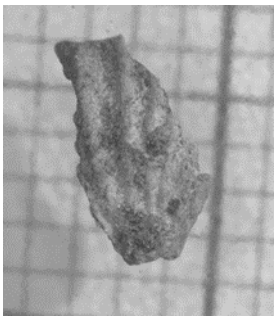

Figure 7. **Oyster shell fragment, > 1.00mm**

In total, 11 artefacts have been identified in the samples, most of which are fragments of window glass (6) (Figure 5). Glass fragments were found in Samples 1, 2, 4, 5 (0–10 cm and 15–25 cm deep). In the >1 mm fraction of the first sample, one red clay brick fragment and one possible building mortar fragment were found. Among the artefacts, organic matter formations were found – a fragment of a possible fish scale (at a depth of 0–5 cm) and a fragment of a possible oyster shell (at a depth of 29–34 cm) (Figure 7).

Starting from Sample 6 to Sample 9 (depth of 25–49 cm), but mostly in Sample 8, a relatively large proportion of calcinated roots was found (up to 15.9%) (Figure 6). Individual roots are cemented to quartz crystals. The accumulation of carbonate around the roots can be related to both biogenic processes (activity of bacteria, fungi or actinomycetes) and soil formation conditions.

Results of macroremain analysis show that the sediments are dominated by fine wood charcoal and well-preserved spherical black sclerotia of mycorrhizal fungi *Cenococcum geophilum* (Table 2). Occurence of *Cenococcon geophillum* is in peaty soils rich in organic substances (Gedda et al., 1999) in temperate climate belt regions and is a predominantly conifer mycorrhizal fungus (Benedict, 2011). Probably the presence of fungal sclerotia and small charcoal is associated with the time when deforestation of the area took place, as well as the intensification of soil erosion processes (Wohlfarth et al., 2002).

Seed coats are strongly eroded and thin (often only their fragments are found), which makes it difficult to determine whether the seeds belong to specific species. Predominant among plant remains are fat-hen (*Chenopodium album*) seeds (in 7 samples) (Table 2). White goosefoot is a widespread annual weed in gardens, found almost everywhere in loose and unshaded soils. In Sample 6, seeds of *Chenopodium hybridum* were found. Unlike the above-mentioned species, the bastard balanda *Ch. hybridum* (syn. *Chenopodiastrum hybridum*) is rarely found in Latvia (in gardens and lawns, and on roadsides and riverbanks (Petersone & Birkmane, 1958)).

As a result of sediment pollen analysis, three local pollen zones are separated in the diagram (Figure 8). In the lower interval of the monolith, 0.40–0.32 m, the pollen zone Pope 1 is subdivided. The main components of the pollen spectrum are pine (*Pinus*) and alder (*Alnus*), as well as cultivated land plants, including ruderal plants – Chenopodiaceae and nettles (*Urtica*) – and other annual plants, mainly cereals (*Poaceae*). The presence of microscopic charcoal dust was also found. Pollen from the ruderal herbaceous baland and nettle, as well as the presence of microscopic charcoal particles, probably indicate human presence in the area and a semi-open mixed tree forest landscape.

The sedimentary monolith in the middle interval of 0.32–0.22 m is in a separated pollen zone; the pollen composition indicates changes in the landscape. The proportion of pines in the composition of the forest is decreasing, but the share of

birches is increasing, as is the diversity of evergreens. The ratio of trees and herbaceous plants indicates a more open landscape compared to the lower interval analysed.

Table 2. **Results of plant macrofossils** (authors' calculations)

Plants	**Sample No.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
	Depth, cm	80–85	85–90	90–95	95–100	100–105	105–109	109–114	114–119	119–122	
Chenopodium album Fat-hen	seed	1	1	2	3	3		1	2		13
	charred seed	1									1
Ch. hybridum maple-leaved Goosefoot	seed						2				2
Ch. foliosum? leafy goosefoot	seed fr.						1	6	1		8
Ch. rubrum red goosefoot	charred seed							1			1
Chenopodium sp. goosefoot	seed fr.	6	5	14	4	5	6	3	9	6	58
Brassica campestris? wild turnip	seed	2	1								3
Galium? Bedstraw	charred seed							2			2
Stachys palustris marsh woundwort	seed	1									1
unknown	charred seed fr.								1		1
Total		**11**	**7**	**16**	**7**	**8**	**9**	**13**	**13**	**6**	**90**
Other											
Cenococcum geophilum ectomycorrhizal fungi	sclerotia	18	35	27	20	43	15	17	26	31	232
wood charcoal	fr. >3-5 mm	2	6	1	3	6	7		4		29
wood charcoal	fr. <1-3 mm	>50	30	50	50	>50	>50	20	>50	32	>382
CaCO3 incrustations around the root	fragments					*	*	*	*	*	

* - presence

In the upper interval of the sedimentary monolith (0.22–0.02 m) in the separated pollen zone Pope 3, the pollen composition has changed drastically compared to the previous zone. The birch pollen curve is falling, but the pine is climbing. The alder curve remains at the same level, with slight fluctuations at the top of the zone. The diversity of herbaceous pollen increases. Possible agriculture is indicated by the presence of cereal pollen, rye, barley and wheat, as well as an increase in the number of *Polygonacae* and *Chenopodiaceae* weeds, and nettles (*Urtica*), which, together with the increase in the curve of the amount of microscopic carbon particles, indicate relatively intense human activity in this area.

The preservation conditions for pollen in the analysed sediments were not favourable, so most of them are significantly corroded. However, a careful analysis revealed that some *Apiaceae* pollen probably belong to the *Carum carvi* species. It is thought that this plant grew in the vicinity of Pope manor. The seeds of this plant were used for pickling vegetables and baking bread, and added to cottage cheese and meat dishes. A continuous curve is also formed by the pollen of the rose family plants (*Rosaceae*), among which apple (*Malus* spp.) pollen can be tentatively recognised. In this zone, pollen from the family *Caprifoliaceae* also form a continuous curve, among which some are recognisable as elder tree (*Sambucus*) pollen. Taking into account that the elder tree has been cultivated on the territory of Latvia since the 17th century, it can be assumed that the pollen determined is the pollen of the black elder tree (*Sambucus nigra*) or red elder tree (*Sambucus racemose*).

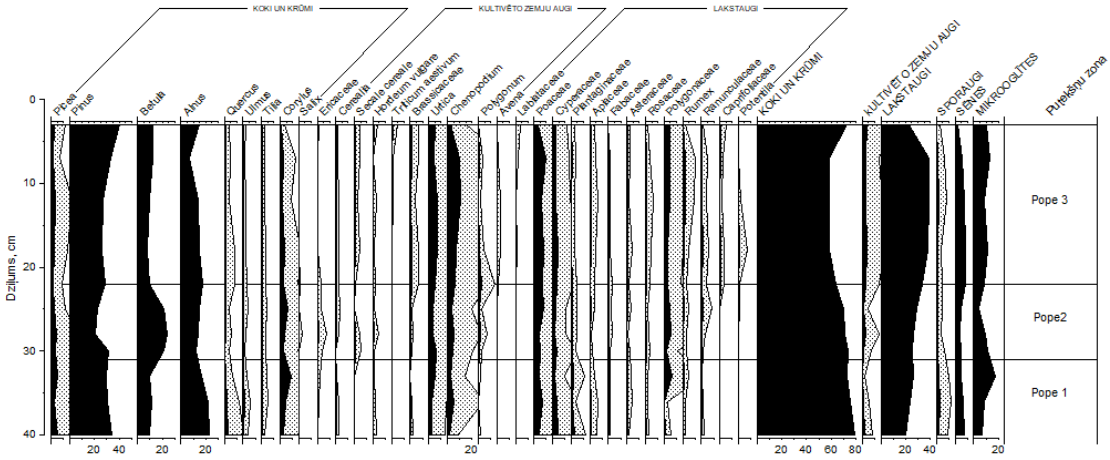

Figure 8. **Pollen percentage diagram of the sediments from the hunting castle at Pope** (authors' figure)

The results of the pollen analysis allow us to conclude that, during the accumulation of sediments of the analysed cultural layer, there was agriculture on the site, and that the landscape has become more and more open, except for the upper 5 cm, where the proportion of tree pollen, especially pine, increases.

Conclusion

The 49-cm-long sample of the sediment section from the hunting castle at Pope – the monolith, taken as part of the archaeological excavations, was studied using a multidisciplinary approach, applying sediment composition, grain size and mineralogical composition analysis, as well as paleobotanical analysis – plant macroscopic remains and pollen analyses. The results obtained in all the analyses complement each other and give the impression that the sediments had naturally accumulated in an environment affected by some water flow, but were later mixed by human activity. The results of the analyses of macroscopic plant remains and pollen contained in the sediments indicate a considerable amount of grass, especially weeds,

showing that the landscape was relatively open and cultivated during the manor's existence.

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Kopsavilkums

Arheoloģisko izrakumu ietvaros paņemtais Popes Medību pils nogāzes nogulumu griezuma 49 cm garais paraugs - monolīts pētīts, pielietojot multidisciplināru pieeju, izmantojot nogulumu sastāva, granulometriskā un mineraloģiskā sastāva analīzes, gan arī paleobotāniskās analīzes – augu makroskopisko atlieku un putekšņu analīzes. Visās analīzēs iegūtie rezultāti papildina viens otru un sniedz priekšstatu par to, ka nogulumi dabiski ir uzkrājušies ūdens ietekmētā vidē, tomēr vēlāk tie cilvēka darbības rezultātā ir sajaukti. Par to liecina to līdzīgais sastāvs visā griezumā. Kā rāda paleobotānisko analīžu dati un ievērojamais zālaugu, it sevišķi nezāļu daudzums, ainava muižas darbības laikā ir bijusi salīdzinoši atklāta un apstrādāta.

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