CPEG
Vilnius
2023

FIELD TRIP

3rd CROSSING THE PALAEONTOLOGICAL-ECOLOGICAL GAP – CPEG CONFERENCE

VILNIUS LANDSCAPES AND ECOLOGY



Hosted by:

Vilnius University
Nature Research Centre
Geological Society of Lithuania
Lithuanian Geological Survey

31 August 2023

Satkūnas J. 2023. Vilnius landscapes and ecology. Field trip guide. 3rd Crossing the Palaeoentological-ecological gap – CPEG. Conference. 31st August 2023. Nature Research Centre, Geological Society of Lithuania, Lithuanian Geological Survey. Vilnius, 2023. – 17 p.

AUTHOR dr. Jonas Satkūnas

FIELD TRIP GUIDE dr. Jonas Satkūnas

COVER DESIGN BY dr. Laura Gedminienė

COVER PHOTO BY Gytis Grižas

LAYOUT BY Indrė Satkūnienė

ORGANIZERS:

CPEG

Vilnius University

Nature Research Centre

SPONSORS:

Geological Society of Lithuania

Lithuanian Geological Survey under Ministry of Environment

Research Council of Lithuania

Go Vilnius

GeoBaltic

Sons of Drilling

GEO Consulting

Geotestus

Transmitting Science

Paleontological Society

Palaeontological Virtual Congress

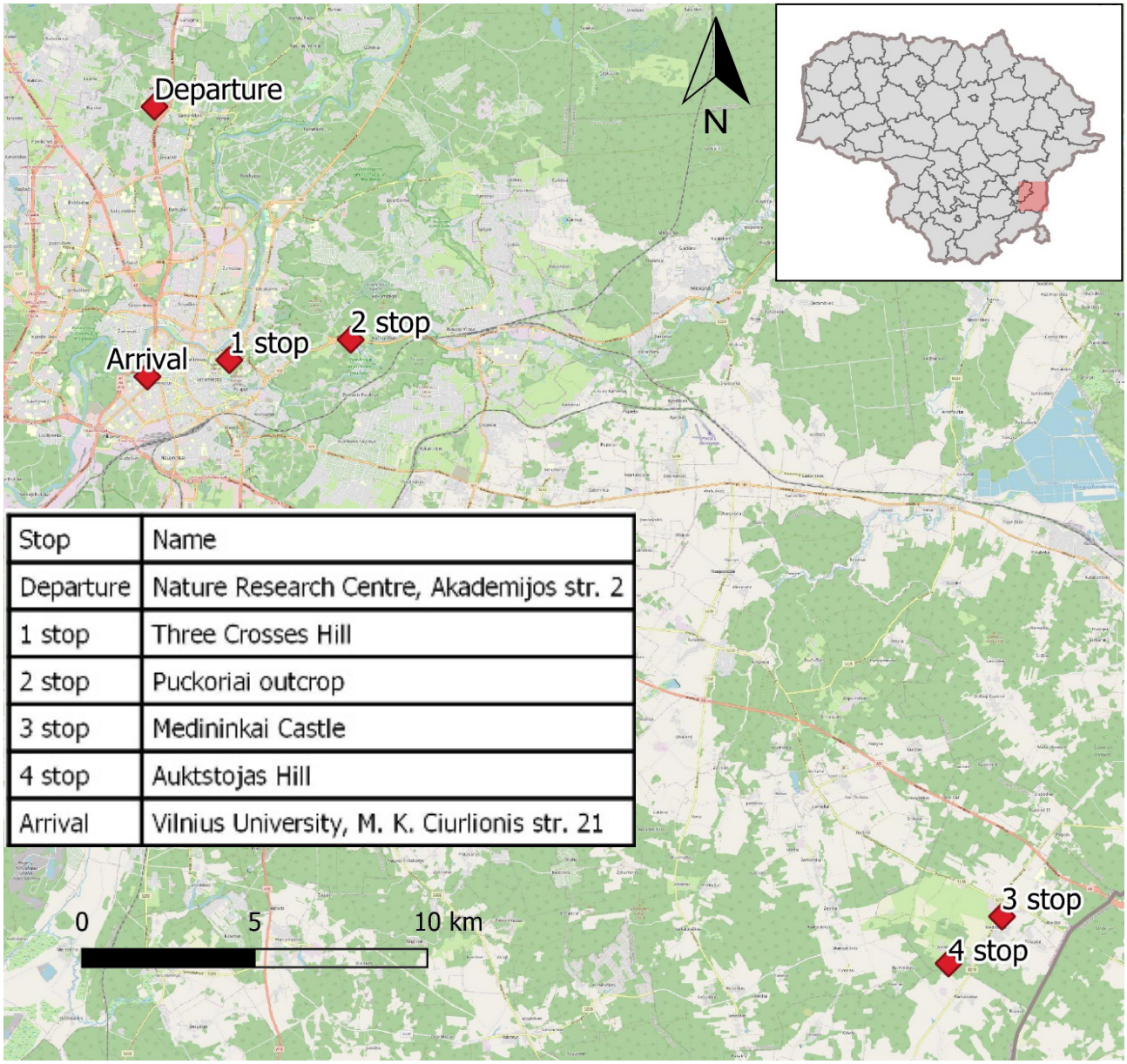
The Society of Vertebrate Paleontology

© Vilnius University, 2023
© Nature Research Centre, 2023
© Geological Society of Lithuania, 2023
© Lithuanian Geological Survey, 2023

Contents

EXCURSION STOPS 1
Thermoerosional hills of Vilnius Castles 2
Vilnius mammoth – the last in the Baltic region 6
Pučkoriai outcrop 7
The boundary of maximum extend the Last (Weichselian) glaciation 10
Medininkai Castle 13
Juozapynė hill and Medininkai heights.....14
For notes.....15

EXCURSION STOPS



Stop	Name
Departure	Nature Research Centre, Akademijos str. 2
1 stop	Three Crosses Hill
2 stop	Puckoriai outcrop
3 stop	Medininkai Castle
4 stop	Auktstojas Hill
Arrival	Vilnius University, M. K. Ciurlionis str. 21

Thermoerosional hills of Vilnius Castles

Genesis of hills

The location of Vilnius castles is determined by peculiarities of topography and hydrography. The castles are located in cofluence of the Neris and Vilnia rivers.

This area is characterised by hilly topography with variety of landforms, formed by fluvial, suffosion, gravitational and erosional procesess (Fig. 1). The altitude of relief varies from 87 m a.s.l. in the cofluence of Vilnia and Neris rivers to 230 m of Rokantiškės hill, with difference of altitude of some 100 m in distance of 1 km in some places (Fig. 2).

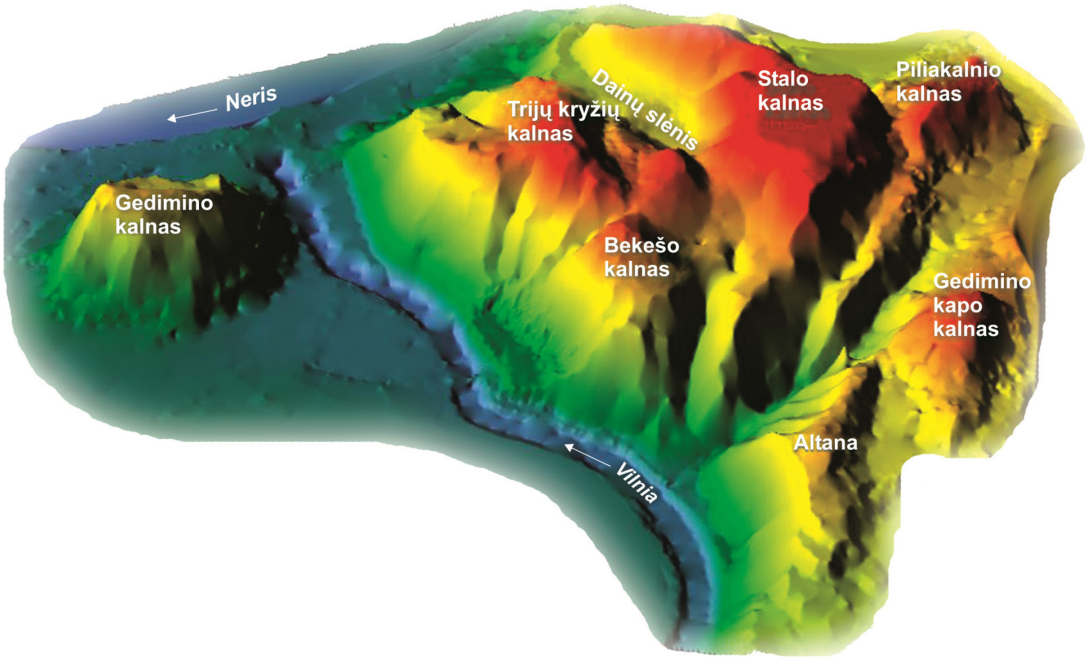


Fig. 1. *The Castles hills. Topography is dissected by ravines of different depth, which carved the sculpture of the assemblage of hills with steep slopes (30–45^0).*

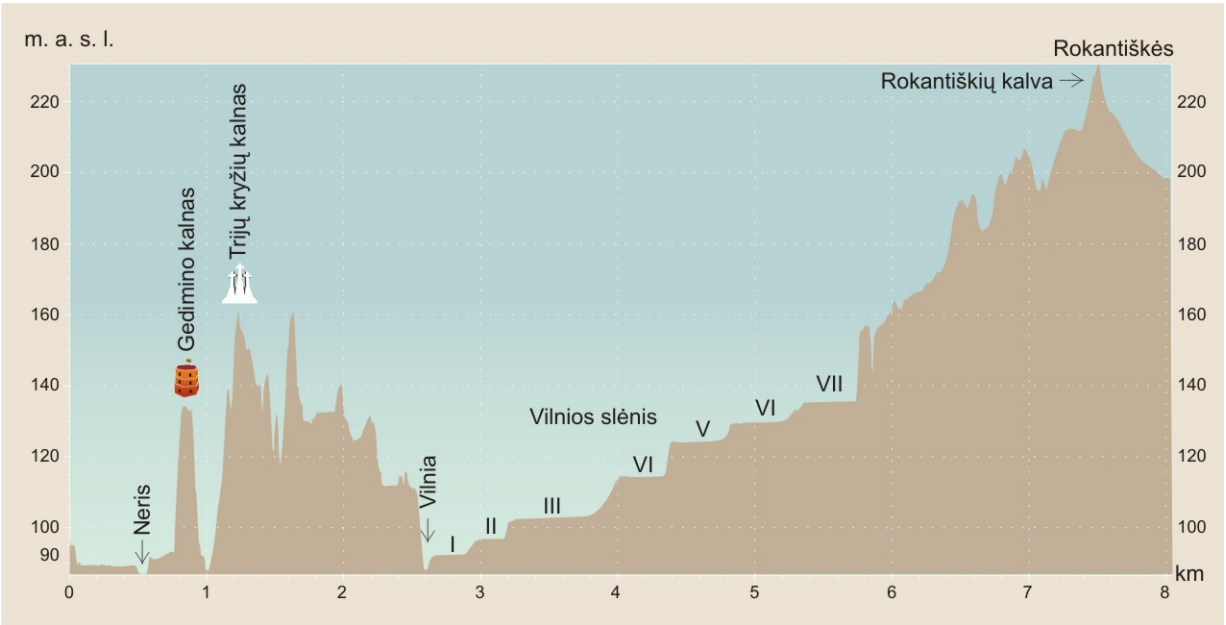


Fig. 2. *Generalized relief profile through Vilnia river valley from Rokantiškės to Gediminas Hill.*

Thickness of Quaternary in Vilnius city area varies from ca. 20 m in valleys of Neris and Vilnia to 200 m in higher places and in palaeoinsicions. Data of engineering geological investigations (eg. Gediminas Castle Hill, Fig. 3) show that the Castles hills are composed of Elsterial and Saalian glacial and glaciofluvial deposits. According to the recent geological map at a scale of 1:10 000 (Guobytė 2012) Vilnius downtown and castles are located in a plot of very margin of maximum advance of the Weichselian glaciation. However, it seems the impact of Weichselian ice sheet on Vilnius hills is expressed rather by periglacial phenomena, than accumulation and deformational impact. During the Last Glacial Maximum (LGM) the original area of castles likely was rather flat plateu of Saalian glacial formations.

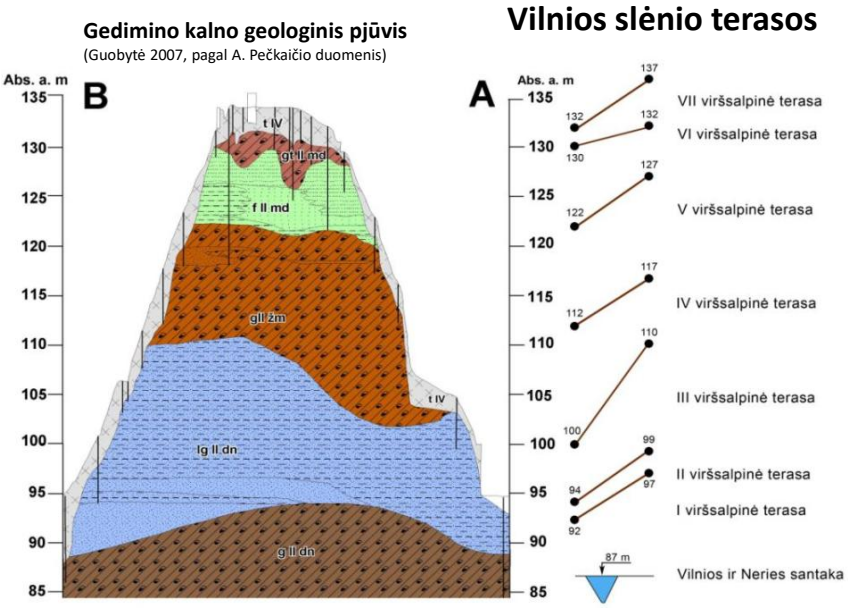


Fig. 3. *Gediminas Hill cross-section (Guobyte 2007) showing intercalation of tills and sandy-silty glaciofluvial and glaciolacustrine sediments of Elsterian–Saalian age. Upper part (thickness of 3–5 m) is composed by man-made (cultural) strata.*

Erosional phenomena naturally are determined by permanent and temporal water streams from precipitation and melting ice and snow. It is assumed, that precipitation at LGM and at begining of deglaciation was very low as a consequence of climate aridization and therefore surficial erosion was insignificant during this time. Furthermore, glacial meltwater was drained by Neris and Vilnia and formed higher terraces which were lower than top of the plateu of Castles hills (Fig. 2). The higher and rather well expressed are the 8th and 7th terraces of the Vilnia river and their altitudes are 130–140 m a.s.l., when the tops of hill of Vilnius castles at present reach 160 m a.s.l. It means that there was no direct erosional impact of meltwater for formation of upper reaches of the highest ravines.

Therefore, it is proposed that that main features of Vilnius castes hills were formed by periglacial thermal erosion – the movement of land masses due to thawing of permafrost. This phenomena is well known from regions of permafrost in present Arctic and Subarctic (Photo).

Depth of frozen ground in Vilnius is unknown, however it could be moted, that thickness of permafrost in north central Europe during the peak of the last cold stage of Weichselian could reached even 120–140 m (Delisle et al 2003). At a moment of climate change and begining of vanishing of Wechselian ice body, the masses of thawing ground became unstable and slided into opening valleys of Vilnia and Neris. The sequence of formation of thermoerosional ravines is proposed in the Fig. 4.

The typical thermoerosional valley is the Dainų (Songs) amphitheather which is of some 50–60 m wide and 200 m long. A distinctive feature of the thermoerosional ravines is that their mouths are descending down to levels of 8th–6th teraces. Later on, after permafrost has thawed, the erosional ravines with increasing precipitation were progressing and dissected original plateu into separate hills. The younger ravines are descending to the lowest terraces of Vilnia.

Also, in historical time people were reshaping slopes of hills for living and defence purposes. For example, the saddle, connecting Gedimino hill and and the Three Crosses existed (Fig. 5) until hitorical times, when the artificial channel for Vilnia river was dug and Gediminas Hill became separate hillfort.



Thermoerosional circus in North Siberia (photo by A. Kizyakov) – result of thawing permafrost (left); Dainų valley – thermoerosional ravine (right).

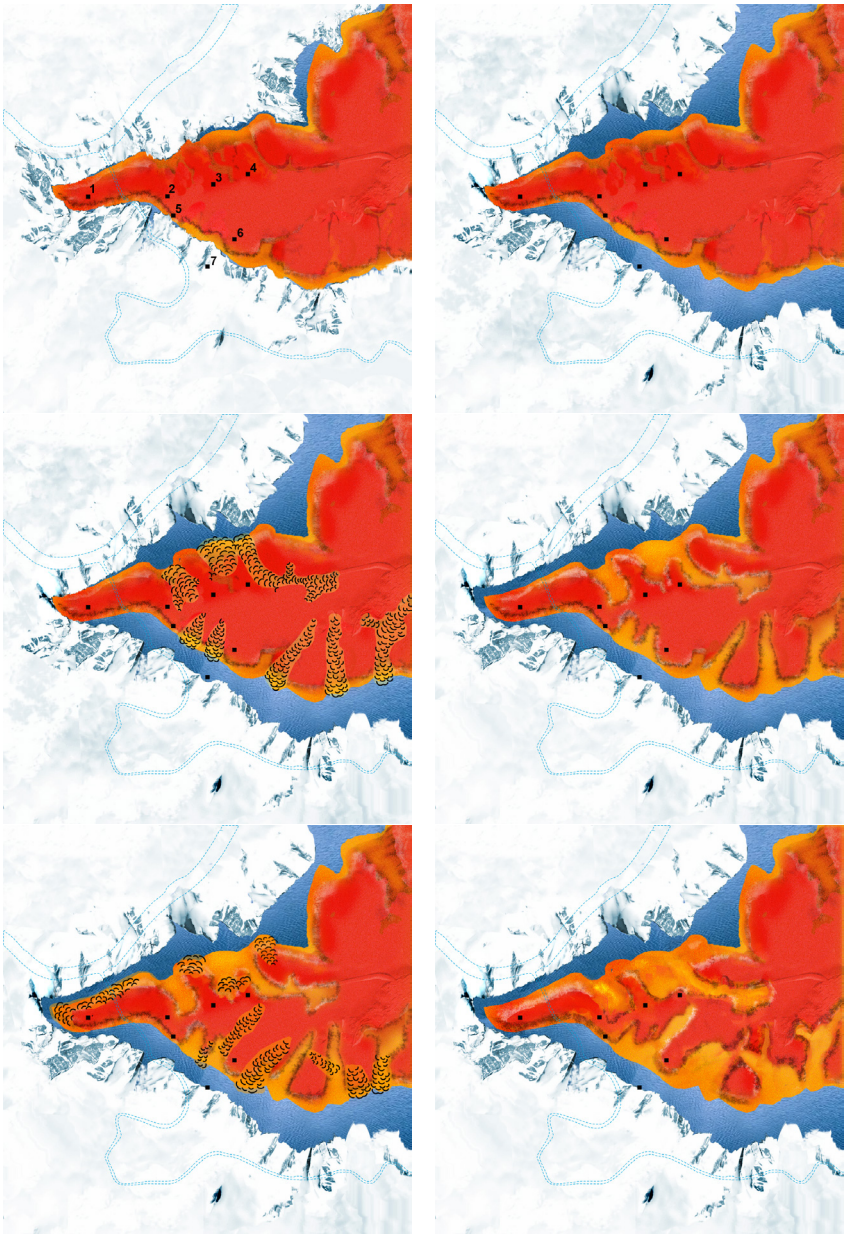


Fig 4. *Stages of development of thermoerosional ravines. A – the plateu of castles is under permafrost conditions at LGM; B – a gap forms inbetween land and ice; C – 1st stage of thermoerosion begins; D – highest thermoerosion ravines; E – second stage of thermoerosion; F – a „backbone“ framework of the castles hills is formed.*

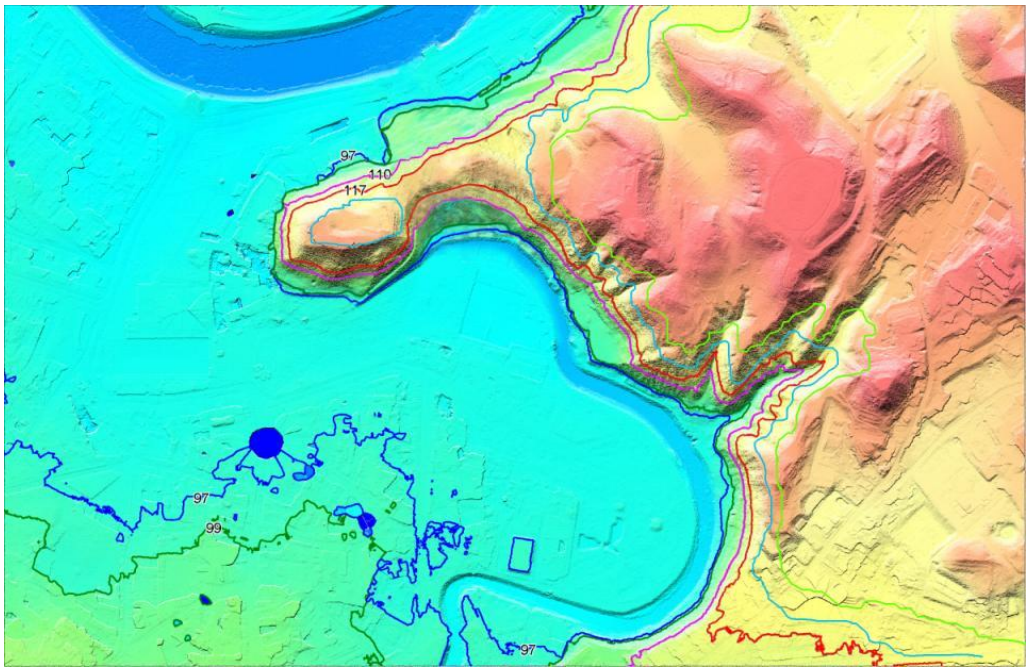


Fig. 5. *Hills of Vilnius castles during forming of the first terrace of Vilnia. Slopes are being modified by erosional procesess. Gediminas castle hill is still connected by saddle with massif of Three Crosses.*

Development of terraces of Vilnia river is closely connected with drainage of the lacustrine and glaciolacustrine systems in Mickūnai depression. It is assumed that Vilnia river was draining the palaeolake in Mickūnai depression during Eemian Interglacial and Pleni-Glacial. Present valley of Vilnia evoved during the drainage of the Mickūnai glaciolacustrine basin since LGM.

Due to steep slopes of hills the slope deformations and landslides are happening since historical past up to present. Landslides are usually accelerated and trigerred by meteorological and human factors. (Satkūnas et al 2008). For instance, in the Livonian chronicles dated 1396, is mentioned that western slope of Gediminas hill slided down and destroyed estate of Monvydas the Voivod of Vilnius, causing deaths of 15 people. Also, it is known, that Bekes hill with part of the tower of the grave slided to Vilnia valley in 1838. Remaining part of the Bekes grave and tower colapsed in 1843 (Michelevičius and Sarcevičius 2012).

References

Delisle G., Caspers G. And Freud H. 2003. Permafrost in north-central Europe during the Weichselian: how deep? In Permafrost. Phillips, Springman and Arenson (eds). Swets & Zeitlinger, Lisse, ISBN 90 5809 5827.

Guobytė R. 2012 Vilniaus miesto kvartero geologinis ir geomorfologinis žemėlapiai M 1:10 000 ir jų aiškinamasis raštas. Lietuvos geologijos tarnyba.

Michelevičius D. and Sarcevičius S. Modern geophysical, geological and cartographical methods for prospecting of the Vilnius Kreivoji castle // Geologijos akiračiai. ISSN 1392-0006. Vilnius, 2012, No.1.

Palaeolandscapes from Saalian to Weichselian, South Eastern Lithuania. Field trip guide of International Field Symposium Peribaltic 2013. Editors: Satkūnas J. and Guobytė R.

Satkūnas J., Mikšys R-B., Mikulėnas V., Minkevičius V.2008. Geodinaminiai procesai Vilniaus pilių teritorijoje: šlaitų deformacijos = Geodynamic Process in the territory of Vilnius Castles: Deformations of the Slopes // Lietuvos pilys. – 2008. – Nr. 4.

Satkūnas J. 2015. Vilniaus pilių kalvyno kilmė = Origin of the Hills of the Vilnius Castles. Chronicon Palatii Magnorum Ducum Lithuaniae. Vol. III (MMXII-MMXIII) = Lietuvos Didžiųjų Kunigaikščių rūmų kronika. III tomas (2012–2013). Nacionalinis muziejus Lietuvos Didžiosios Kunigaikštystės valdovų rūmai, Vilnius. pp. 282–291.

Vilnius mammoth – the last in the Baltic region

There are number of finds of remains of woolly mammoth (*Mammuthus primigenius Blum*.) in Lithuania and all of them are attributed to the pre-Last glaciation (time intervals: to 38–45 cal. kyr B.P. (Nemunas 2c cryomer) and to 31–34 cal kyr B.P. (Mickūnai 3 thermomer (Denekamp Interstadial)) (Satkūnas et al. 2023). The Vilnius mammoth is exceptional finding as this individual lived in Late Glacial i.e. 13 800 cal. yr B.P.

The rather full skeleton of the mammoth was found in 1957 in Smėlio street in Vilnius and is regarded as biggest palaentological finding the Baltic region.



Fragments of the skeleton of the Vilnius mammoth. Photos by J. Paškevičius, 5 August 1957.



References

Satkūnas J., Rudnickaitė E., Daugnora L., Satkūnienė I, Stančikaitė M., Mažeika J.· Pastatykime paminklą Vilniaus mamutui.Geologijos akiračiai. 2021 Nr. 1–2.

Satkūnas, J., Girininkas, A., Rimkus, T., Daugnora, L., Grigienė, A., Stančikaitė, M., Slah, G., Skuratovič, Ž., Uogintas, D., Žulkus, V., 2023. New 14C data of megafaunal remains from Lithuania – implications for the palaeoenvironmental interpretation of the Middle Weichselian. Geological Quarterly, 2023, 67: 3, doi: 10.7306/gq.1671. IF 1.576 / Q2 ECOLOGY.

Pučkoriai outcrop



The Pučkoriai is Lithuania's highest outcrop – 63,2 m (according to earlier measurements it was 65 m). Outcrop is 260 m long, its top altitude above sea level is 208.2 m. The exposure is located on the right slope of the Vilnia river (left tributary of Neris river) valley. The Pučkoriai outcrop was designated in 1974 as a geological monument and is located in Verkiai Regional park.

The outcrop was formed in Late Glacial and Holocene when the Vilnia river was deepening its valley and draining basin of the Mickūnai depression, however the present shape of the oucrop is rather young, as slope processes are very rapid.

The thickness of Quaternary at top of the Pučkoriai outcrop is approx 120 m. The outcrop displays inner structure of northernmost spur of the Medininkai (Ašmena Highland) that forms Vilnius relief. The Pučkoriai outcrop is outside of limit the Last Glaciation and its structure is not affected neigher accumulation nor erosion impact of the Weichselian ice sheet.

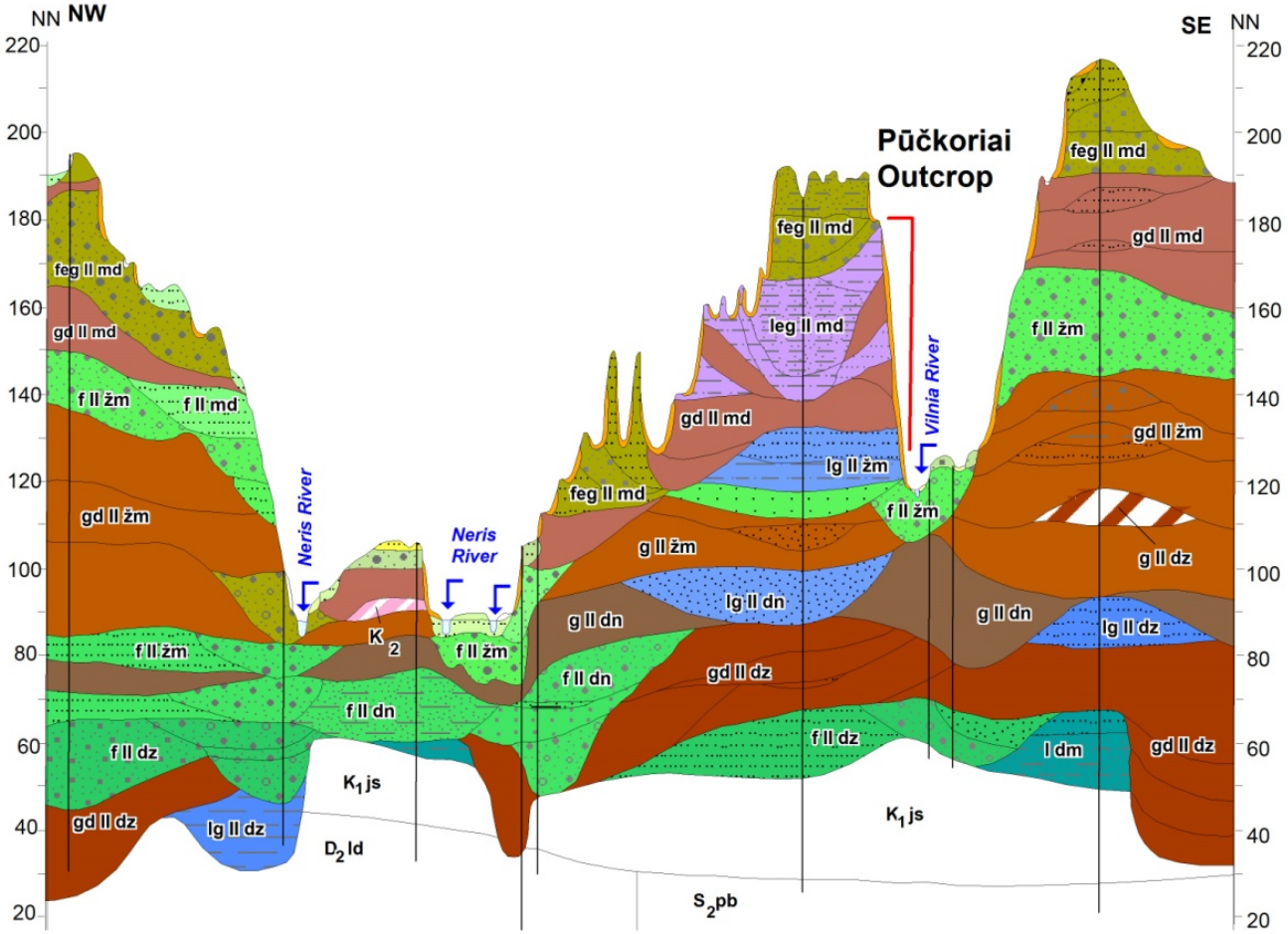
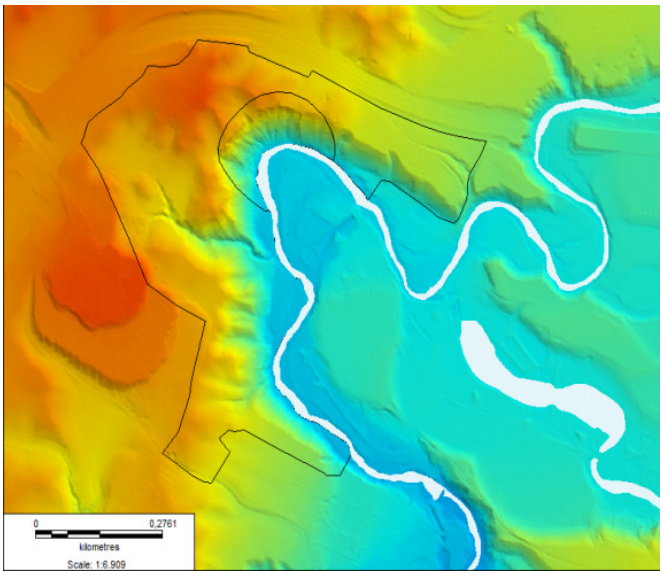


Fig. 1. *Quaternary structure of Vilnia river valley at Pučkoriai. Photo: Pučkoriai outcrop in 1981.*



LIDAR model of the Pučkoriai outcrop (Prepared by Vidas Mikulėnas).

The Pučkoriai outcrop is section of glacial deformations of Saalian age composed of glacial loam with boulders, gravel, sand, silt, clay, etc. Owing to it, these rocks occur in great disorder, mosaicaly: in some places almost horizontally, elsewhere – obliquely, somewhere else – nearly vertically turned over or with distinct signs of glacial dislocations: folds, lumps, diapir folds (i.e. wedges), domes, blocks. Besides, in such a Quaternary rock mass the inserted blocks of Mesozoic rocks have been found. B. Rydzewsky (1925) studied the Pučkoriai outcrop and described the Jurassic block (J_3ox) of grey clay with considerable admixture of white mica and remains of belemnites, ammonites and other fauna. L. Micas (1946) mentioned about large block of white chalk of Cretaceous system (K_2) which stuck in the upper part of outcrop.



Fig. 2. *Left – Pučkoriai outcrop in beginning of 20th century (photo of author unknown, collection of Vida Petiukonienė). Right – outcrop in autumn 2012 (photo by Vidas Mikulėnas.*

In spite that outcrop is well accesible for investigations the documented section is available from report of investigations carried out in 1945 (Fig. 2) due to plans to contruct dam accros Vilnia valley and supply water through pipes for hydroelectric power plant in Antakalnis.

Pučkoriai outcrop is permanently changing slope of Vilnia river valley. The lateral erosion of Vilnia river stimulates its unstability, however lately the Vilnia river is unable to clean off abundant colluvium from the foot of outcrop and is overgrowing by vagetation.

References:

Halicki B., Jaroshevich-Halickaya A. 1945. Otchet po detalnoj kompleksnoj geologicheskoj sjomke rajona projektirujemoj H.E.S. Antakalnis. Vilnius. Manuscript. Lithuanian geological survey. Vilnius. – P.19 (In Russian).

Palaeolandscapes from Saalian to Weichselian, South Eastern Lithuania. Field trip guide of International Field Symposium Peribaltic 2013. Editors: Satkūnas J. and Guobytė R.

Rydzewski B. 1925. Kra jurajska w dyluwium Puszkarni pod Wilnem i głębokie wiercenia w Wilne. Rozn. Polsk. Towarz. Geol., Nr. 3. – P. 191–210

The boundary of maximum extend the Last (Weichselian) glaciation

The age of the till forming the relief of the Medininkai highland and the position of the outer margin of the Last Glaciation Maximum (LGM) in SE Lithuania has been subjects to intensive discussions until 1990-ies. In most geomorphological maps and schemes the Medininkai highland has been interpreted as formed during Late Saalian (Medininkai glaciation), however, some researchers considered this highland as a marginal formation of the maximum stage (Grūda, Brandenburg) of the Last (Weichselian) Glaciation (e.g. Vonsavičius 1982).

Number of criteria were applied for detection of the boundary of LGM: geomorphological, paleogeographical (presence of periglacial phenomena, hydrological pattern), geochemical and biostratigraphical. For example, comparison of the geochemical composition of the relief forming tills of the Baltic highland and the Medininkai highland shows, that the associations of trace elements are dependent on different degree of weathering (Bitinas & Satkunas 1995). The till of the Medininkai highland, formed during the Medininkai glaciation, is characterized by a strong association of "resistant" trace elements like Zr, Mn, Ti, Cu, Y, Yb. For the tills, forming the topography of the Baltic highland, the association of Ga, Cr, Co, V; Ni is characteristic. The geochemical data thus indicate that these highlands have been formed during different glaciations, and do support conclusions based on geomorphological, litho-and biostratigraphical data

Nevertheless, the biostratigraphical criteria is of highest significance, therefore occurrence and structure of Merkinė Interglacial deposits in the region of the boundary of LGM was studied in oder to date the relief forming till and, in general, the age of the Medininkai highland. If Eemian sediments are not covered by Weichselian tills, it means, that this height was located outside the maximum extent of the Weichselian glaciation and, therefore, must be attributed to formations of the Saalian glaciation.

Up to 1991 Eemian (Merkinė) Interglacial deposits in the Medininkai highland were known from two localities: Kirtimai (suburb of Vilnius) and Medininkai village (Kondratienė 1978, Kondratienė & Klivečkienė 1983). The Eemian (Merkinė) Interglacial sediments have been identified and dated on the basis of pollen analysis.

Similar conditions of occurrence and composition (filling of palaeokettles and without any till on top) are characteristic for the sediments of the Murava Interglacial (Eemian) described from the Karachaishchina village (Vazniachuk et al. 1978) and at several other sites (Pavlovskaja & Satkūnas 1995) in adjacent areas of Belarus.

New data on Upper Pleistocene stratigraphy and age of the Medininkai highland have been obtained by geological mapping at a scale of 1:50 000, which has been performed for the environs of Vilnius in 1986–1991. Within the mapping project special attention has been paid to the problem of geological age of the Medininkai highland.

Nine of the most representative depressions (now occupied by peatlands) of the Medininkai highland have been selected for drilling, assuming that these depressions represent Eemian palaeolacustrine basins filled by sediments accumulated during the last Interglacial-Glacial cycle. Organic sediments of Eemian and Weichselian age have been found in all of these depressions (Fig. 2).

The composition of the Merkinė deposits of all these sites of the Medininkai highland is rather similar. Gyttja with wood remnants dominates. The kettles of the Merkinė palaeolakes are of different size. Their size of aquatories vary between 0.2 and 2 square kilometers and the altitudes of the Merkinė Interglacial lacustrine deposits vary from 142 m to 257 m a.s.l. This indicates that the sediments were deposited in separate lakes, scattered in the glacial relief of Saalian (Medininkai) age. The morphology of topography and distribution of the palaeolakes suggest presence of a network of small rivers during the Interglacial. The reconstructed network (Fig. 3) shows that the palaeolakes of the Medininkai highland were hydrographically connected with the Mickūnai palaeolake during the Merkinė Interglacial.

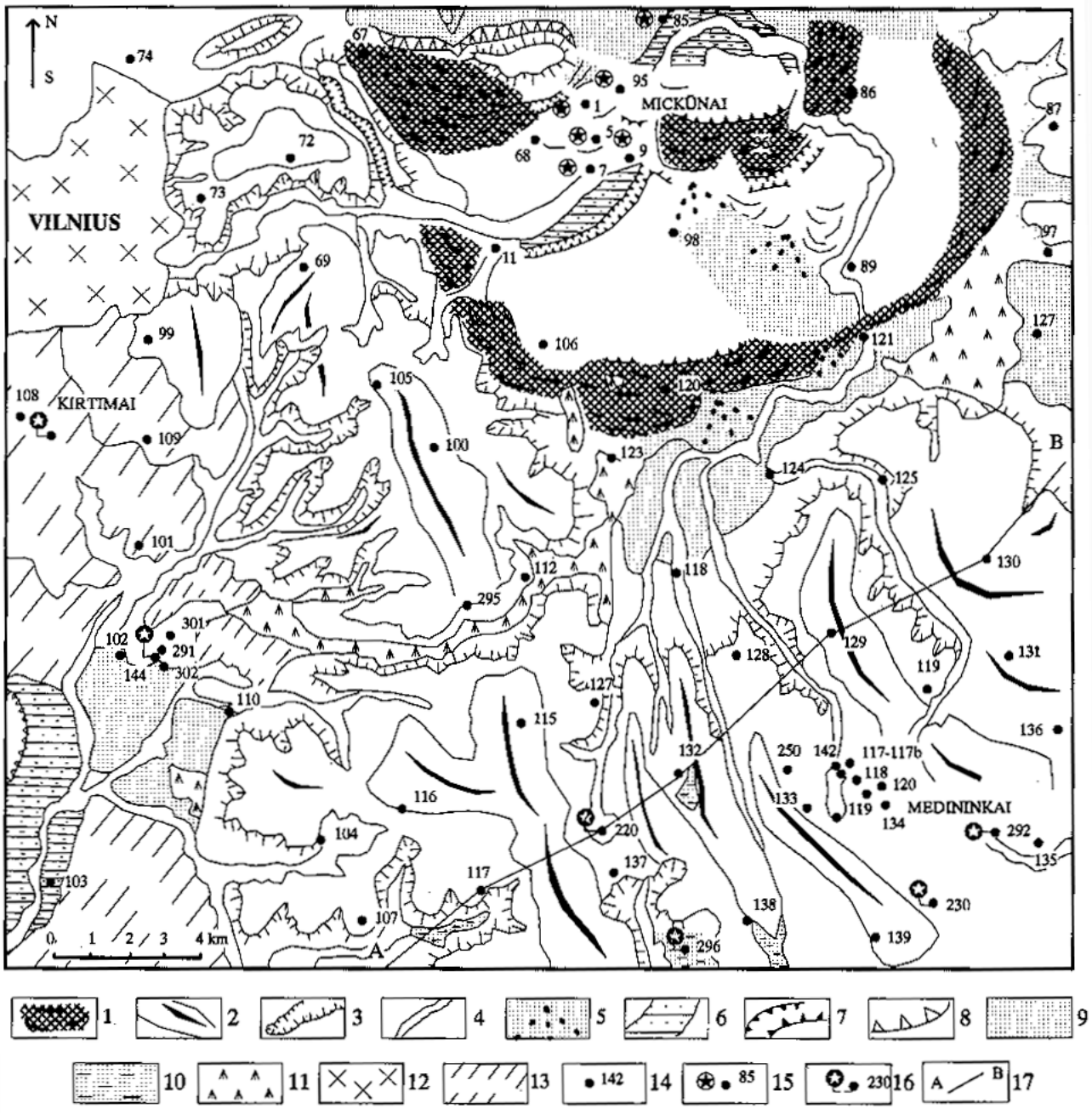


Fig. 2. *Geomorphological map of the Medininkai highland and the Vilnia-Neris (Mickūnai) glacial depresion (by Rimantė Guobytė).*

Location of Merkinė (Eemian) Interglacial deposits.

1 – end moraine ridges of the oscillations of the Grūda advance of the Late Weichselian (Nemunas);
2 – massifs and ridges of the Medininkai (Warthe) relief;
3 –ravine;
4 – flood plain valleys;
5 – sandur deltas; 6 – glaciofluval terraces;
7 – erosional slopes;
8 – ice contact slopes;
9 – glaciolacustrine plains;
10 – marshy lacustrine plains;
11 – mire plains;
12 – technogenous relief of urban area;
13 – morainic plateau of the old (Medininkai) relief; 14 –location of borehole;
15 – borehole with Merkinė (Eemian) deposits covered by Late Nemunas (Weichselian) till;
16 – borehole with the Merkinė deposits without coverage of Nemunas (Weichselian) till;
17 – cross-section.

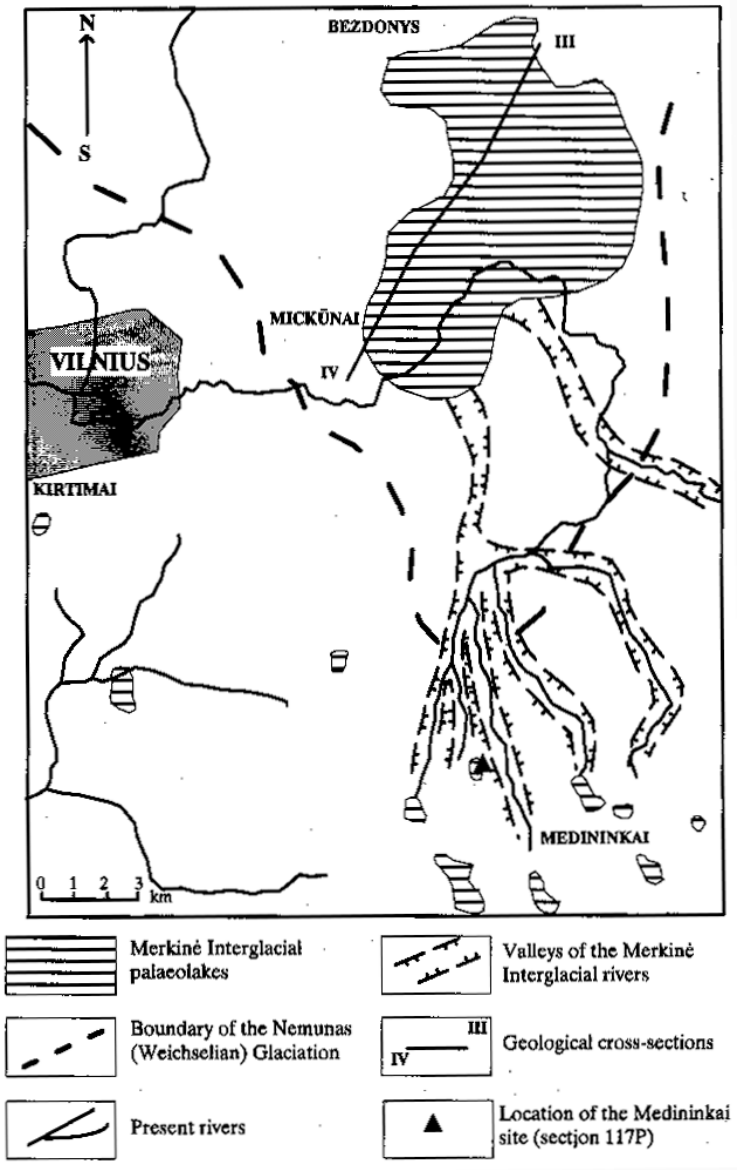


Fig. 3. *Merkinė (Eemian) Interglacial sites in the environs of Vilnius.*

References:

Kondratienė O. 1978. The position of Merkinė (Eemian) sediments south of the Baltic upland. Geological Institute. Vilnius. P. 37–38.

Kondratienė O. & Klivečkienė A. 1983. New sections of the Eemian Interglacial in eastern part of Lithuania. Palinologija v geologičeskich issledovanijach Pribaltiki i Baltijskogo moria. Riga. P. 51–53. (In Russian).

Pavlovskaja I. & Satkūnas J. 1995. Upper Pleistocene lacustrine deposits in the North Western Belarus and the Eastern Lithuania. Doklady AN Belarusi. Minsk. T. 39, No. 1. P. 95–99. (In Russian).

Palaeolandscapes from Saalian to Weichselian, South Eastern Lithuania. Field trip guide of International Field Symposium Peribaltic 2013. Editors: Satkūnas J. and Guobytė R.

Satkūnas J. & Bitinas A. 1995. The lithological composition of Saalian tills in Lithuania as a criterion for lithostratigraphical subdivision. Acta Geographica Lodzienska No 16. P. 173–180.

Vazniachuk L. et.al. 1978. Upper Pleistocene and Holocene at Ashmiana ridges. Dasliedovanij antropogenu Bielarusi. Minsk. P. 110–129. (In Russian).

Vonsavičius V. 1982. Relationship between present and burried topography of Lithuania. Preglacial relief of North West of Russian Plain. Leningrad. P. 30–33. (In Russian).

Medininkai Castle

Medininkai nowadys is small village located just 2 km to the border of Belarus. However, ruins of olden castle indicates that the locality has outstanding and mysterious history. Some historic sources sume that in XIII–XIV centuries there was a wooden castle, which was in late XIV-early XV century rebuilt into stone and brick castle. The castle first time is mentioned in chronicles of crussaders in 1387.

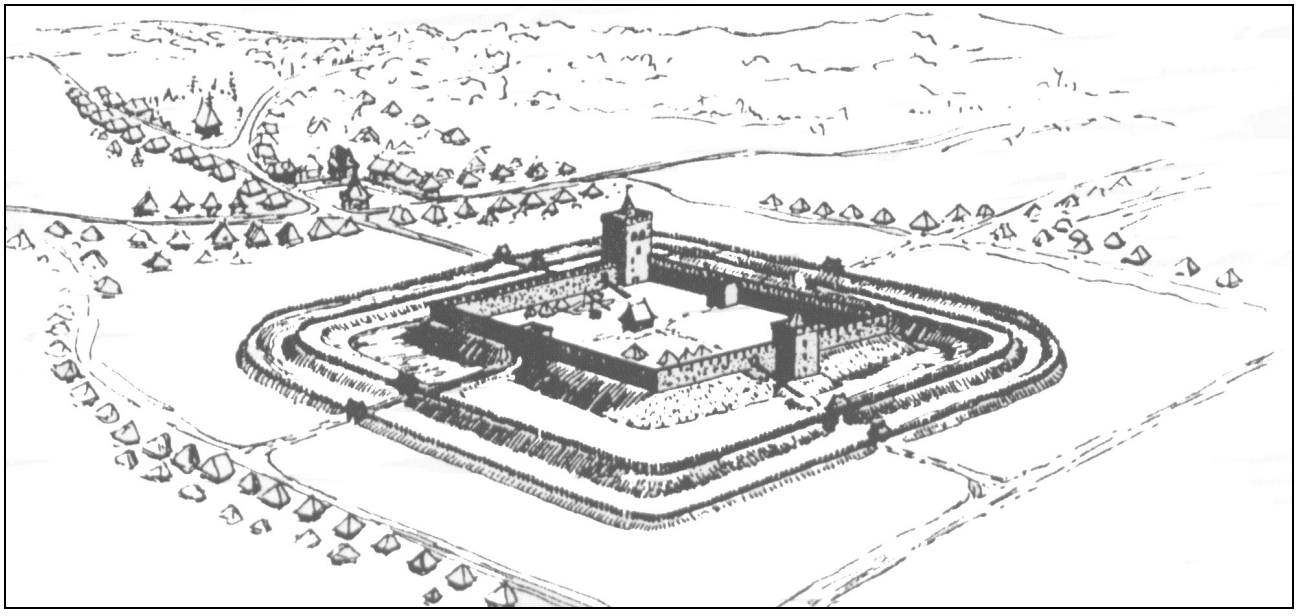


The castle was taken by crussaders in 1402. This campaing was aimed to take Vilnius however it failed. In 1415, Vytautas the Great Duke of Lithuania in the Medininkai wrote a letter to Magister of the Crussaiders that has been send from this castle. That a very scarse hitorical facts of the history of the Medininkai Castle.

In XV century the castle lost is defensive significance.

Castle is quadriangle "fence type" establishment taht occupies 2 hectares. It had four towers (now remained only one) up to 30 m high. Walls were up to 14–15 m high. Perimeter of the walls is 568 m. This is one of biggest „fence type“ castles in the Baltic states.

The walls of the castle are built of stones collected in vicinites and some of the have features of periglacial polishing, that is proper for cold and harsh climate conditions.



Medininkai Castle reconstruction (author S. Lasavickas).

References:

Žukauskas D. Trakų istorijos muziejus, Kęstučio g. 4, Trakai.

Semeskaitė I. Lietuvos pilys ir dvarai. – Vilnius: Algimantas, 2005. – 288 p.: sp. Iliustr., žemėl.

Juozapynė hill and Medininkai heights

The Medininkai Heights in southeastern Lithuania is a northwestern extension of the Ašmena (Oshmianskaja) Upland located in northwestern Belarus (see enclosed geomorphological map). The Medininkai Heights, reaching 200–290 m above present sea level, is the highest part of Lithuania. The highest point of Lithuania is situated here. That honor until 2007 had Juozapynė Hill (Lithuanians call it Juozapynė *Mount*). Its altitude is 292.83 m. In 1978 was observed the possibly higher hill 500 m to the south from Juozapynė Hill. In 2004 has been carried out repeated measurements which confirmed the southern hill, the current Aukštojas Hill, is 1 m higher than Juozapynė. Thus, the highest point in Lithuania is 293.8 m a. s. l. In 2007 was also found the Žibartonys Hill which situated 8,8 km to the west from Juozapynė Hill to be the second highest peak of Lithuania: 293.57 m a.s.l.

The Medininkai Heights is mainly built up by marginal ice-pushed moraines, formed by an active glacier (Fig. 1). The morainic landforms have a clearly elongated shape, with an orientation from northwest to southeast. It is a characteristic feature that the tills, glaciolacustrine and glaciofluvial sediments are strongly glaciotectonically disturbed, reflecting an active glacial push towards southeast. The glaciotectonic deformations have been observed in numerous outcrops and gravel pits. No lakes exist today on the Medininkai Heights and this is a characteristic feature.

The cover of Quaternary deposits (Fig. 1) in the Medininkai Heights is in average 200–250 meters thick. It is composed by pre-Pleistocene (Preglacial) lacustrine sediments (Daumantai formation), Early Pleistocene (Kalviai Glacial and Vindžiūnai Interglacial), Middle Pleistocene tills, glaciolacustrine and glaciofluvial sediments. The presence of sediments of Late Pleistocene age (Eemian with periglacial Weichselian cover) is very regular also.

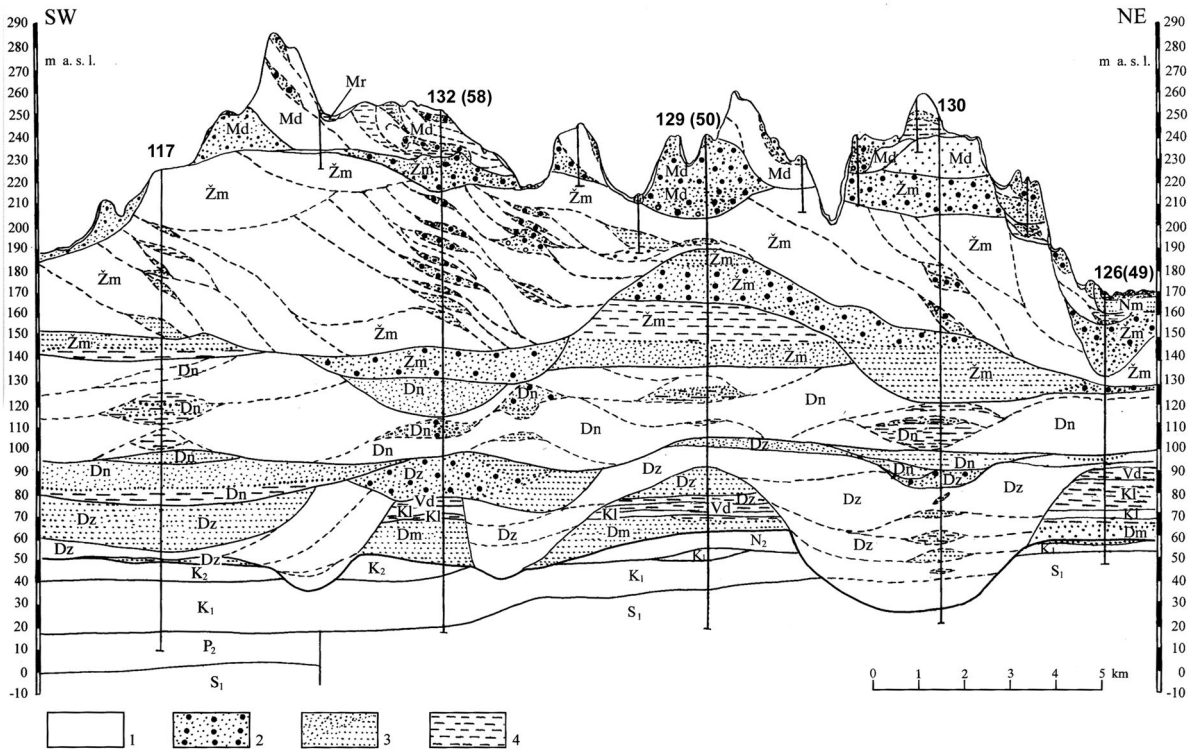


Fig. 1. *Cross-section of Quaternary cover of the Medininkai Hights (for location of the cross-section see Fig. 2). Stratigraphic indexes: S1 – Lower Silurian; D3 – Upper Devonian; P2 – Upper Permian: K1 – Lower Creataceous, K2 – Upper Cretaceous, N2 – Upper Neogene, Dm – Daumanta, Kl – Kalviai, Vd – Vindžiūnai, Dz – Dzūkija, Dn – Dainava, Žm – Žemaitija, Md – Medininkai, Mr – Merkinė, Nm – Nemunas. Lithology: 1 – till; 2 – gravel; 3 – sand; 4 – silt and clay.*

Reference

Palaeolandscapes from Saalian to Weichselian, South Eastern Lithuania. Field trip guide of International Field Symposium Peribaltic 2013. Editors: Satkūnas J. and Guobytė R.

For notes