

ProGEO – The European Association for the
Conservation of the Geological Heritage

**MEETING OF THE ProGEO
WORKING GROUP No. 3
NORTH–WEST EUROPE**

VILNIUS–PALANGA, 6–10 MAY, 1999

Vilnius, 1999

**MATERIALS OF THE MEETING OF THE ProGEO
WORKING GROUP No. 3 NORTH–WEST EUROPE
Vilnius–Palanga, 6–10 May, 1999**

Organizing Committee: Jonas Satkunas, Carl Erik Johansson, Valentinas Baltrunas,
Vidas Mikulenas, Gunnel Ransed (secretary).

Organizations involved and supporting the meeting: Geological Survey of Lithuania,
Ministry of Environment of the Republic of Lithuania, Institute of Geology of
Lithuania, Geological Survey of Sweden.

Meeting place: Geological Survey of Lithuania, 35 S. Konarskio, Vilnius
Tel: +370 2 332482, Fax: +370 2 336156

Edited by J. Satkunas

Layout: G. Marcijoniene

Photos by V. Mikulenas

**Meeting is sponsored by EAGE–PACE Foundation.
Programme for Association and Cooperation in Earth Sciences.**

Published by Geological Survey of Lithuania

ProGEO – THE EUROPEAN ASSOCIATION FOR THE CONSERVATION OF THE GEOLOGICAL HERITAGE

ProGEO is the most prominent European association for the conservation of Europe's rich geological heritage. It is an open association for all kinds of conservation practitioners and geoscientists working with nature conservation in the wider sense, for instance planning, nature and natural resource managing, geological surveys, in museums, education and tourism. ProGEO seeks to mobilise the expertise, enthusiasm and goodwill of geoscientists and other specialists, and to influence national and international policy makers, by initiating joint project and demonstrating good practice in geoconservation.

ProGEO is working to promote the protection of Europe's typical and important landscapes and its many – faceted inheritance of geological phenomena – all of the greatest scientific and cultural importance. The most important subjective of ProGEO's activities is to select and delimit Geosites, i. e. outstanding representatives for the geologic regions, history, environments, processes and resulting landscapes in Europe.

European Association for Earth Science Conservation was born in 1988 during the first meeting in Netherlands.

ProGEO's Council members represent almost all the nations in Europe.

ProGEO's General Assembly has met every second year, its executive committee about twice a year. The Assembly elects the president of ProGEO for a two – year period. The Council elects the executive committee members.

ProGEO objectives

1. To promote the conservation of Europe's rich heritage of landscape, rock, cover fossil and mineral sires.
2. To inform a wider public of the importance of this patrimony, and its relevance to modern society.
3. To advise those for protecting our Earth heritage.
4. To organise and participate in research into all aspects of planning, science, management and interpretation that are relevant to geoconservation.
5. To involve all countries in Europe, exchanging ideas and information in an open forum, and taking full part in conservation in a global setting as Europe's geoconservation network, including the formulation of conventions and legislation.
6. To work towards an integrated European listing of outstanding geoscience sites, thus enabling full support to be given to the work of other international bodies, as well as to national initiatives towards site protection.
7. To achieve an integrated approach to nature conservation, promoting a holistic approach to the conservation of biological and physical/geological phenomena.

ProGEO NEWS and Homepage

Information of ProGEO, its activities and results is published in ProGEO NEWS edited by Lars Erikstad, NINA, Oslo, Norway. It is issued as a newsletter four times a year. ProGEO NEWS are also found in ProGEO's *homepage* <http://www.sgu.se/> ProGEO hosted by the Geological Survey of Sweden in Uppsala.

Reprinted from:

Johanson C. E., Wimbledon W. A. P. ProGEO – the European Association for the Conservation of the Geological Heritage // ProGEO'97: The Second General Assembly of the European Association for the Conservation of the Geological Heritage: Scientific Conference, Tallin–Lahemaa National Park, Estonia, June 2nd–4th, 1997: Proceedings. – Tallin, 1997. – P. 29–30.

Contents

PROGRAMME OF THE MEETING OF THE ProGEO WORKING GROUP No. 3 NORTH–WEST Europe	5
AGENDA FOR THE BUSINESS MEETING	6
ABSTRACTS OF THE KEY LECTURES	7
<i>Carl Erik Johansson</i> : GEODIVERSITY IN NATURE CONSERVATION.....	7
<i>Carl Erik Johansson</i> : TOWARDS THE GEOSITES LIST IN NORTHERN EUROPE.....	8
EXCURSION GUIDEBOOK	13
GEOTOPES OF THE VILNIUS CIT.....	14
ESKER ŠEŠKINE	
14	
PUCKORIAI OUTCROP.....	16
EXCURSION ROUTE: Vilnius – Vievis – Trakai National Park – Aukštadvaris Regional Park – Devil's Hole – Rokai – Panemuniu Regional Park – Palanga	17
VIEVIS BOULDER MUSEUM.....	17
THE DEVIL'S HOLE.....	17
THE ROKAI OUTCROP	19
EXCURSION ROUTE: Palanga–Kuršiu Nerija (Curonian Spit).....	20
NOMINATION OF CURONIAN SPIT NATIONAL PARK FOR INSCRIPTION ON THE WORLD HERITAGE LIST.....	20
SEASHORE CLIFF OLANDO KEPURE AT GIRULIAI.....	22
GEOLOGICAL STRUCTURE AND DEVELOPMENT OF THE KURŠIU NERIJA SPIT. POINT OF VIEW GARNIU KALNAS NEAR JUODKRANTE	23
BURIED SOILS: HISTORY OF HUMAN AND NATURE INTERACTION	26
DUNES OF THE KURŠIU NERIJA.....	28
PARNIDIS LAGOON MARL (CLAYEY GYTTJA) EXPOSURE	29
MEETING OF THE ProGEO WORKING GROUP No. 3 NORTH–WEST EUROPE. LIST OF PARTICIPANTS	31
FOR NOTES	35

PROGRAMME OF THE MEETING OF THE ProGEO WORKING GROUP No. 3 NORTH–WEST EUROPE

Vilnius–Palanga, 6–10 May, 1999

Programme

6 May, Thursday

Arrival, accomodation

14:00 Vilnius tour and welcome

7 May, Friday

9:00–12:00 Plenary meeting

Opening and Key lectures:

Carl Erik Johansson: "Geodiversity in Nature conservation".

Vidas Bezaras "Protection of the geological heritage in Lithuania".

William Wimbledon: "The Geosites (IUGS project, supported by UNESCO)".

Carl Erik Johansson: "Towards the geosites list in Northern Europe".

13:30-17:00

Round table – national presentations: United Kingdom, Sweden, Norway, Finland, Denmark, Karelia, Estonia, The Netherlands, Latvia

Guests of the WG No. 3: Poland, Belarus

Presentation of the Data Base "Geotopes of Lithuania"

18:00 Folk party

8 May, Saturday

8:00–11:00 ProGEO WG No. 3. Business meeting

11:00 Departure for excursion. Erratic boulder museum in Vievis. Landscapes of Weichselian margin, Trakai National Park, Aukštadvaris Regional Park, Velnio duobe (Devil's Hole), Rokai, Panemuniu Regional Park. Arrival to coastal area and accomodation in Palanga (late evening)

9 May, Sunday

8:00 Excursion to Curonian Spit

20:00 Winter Garden in Kretinga. Farewell party

10 May, Monday

Return to Vilnius, departure

AGENDA FOR THE BUSINESS MEETING

Membership of the group

Catalogue of the projects: Geoconservation in North–West Europe

Home subpage progress. L. Karis

Tasks of WG3 secretary Gunnel Ransed

Report on meeting in Estonia

Reports on various meetings

Next steps

Future meetings

Acknowledgement of supporting organisations

Other

Note:

Minutes of the meeting will be elaborated and presented into the home subpage of the ProGEO WG No. 3.

ABSTRACTS OF THE KEY LECTURES

Carl Erik Johansson:

GEODIVERSITY IN NATURE CONSERVATION

The project *Geodiversity in Nordic Nature conservation* aims at introducing the idea of geodiversity in the Nordic countries. It is a cooperation between Denmark, Iceland, Norway, Sweden and Finland under the Nordic Council of Ministers.

The concept "Geodiversity" means, broadly, the variation of the bedrock, the deposits, the terrain forms, and the geological processes that form landscapes. Geodiversity founds and manifests important parts of landscape diversity. It gives the frames and structures for ecosystems and biodiversity. In ecosystems (from Greek *Oichos* = "house") geology forms the floor whereas biology makes up the walls, the roof and the furnishing of the house. More precisely and operatively Geodiversity describes the diversity of geological phenomena and processes in a defined area. This may be a district, a region, a continent etc. Geodiversity is related to scale depending on the size and the detail degree when studying and describing geological phenomena. Different levels and scales can be distinguished for geodiversity as well as for biodiversity.

Geodiversity is an expression of different *geological environments*, such as volcanic, glacial, fluvial or littoral. It can be explained in geoscientific terms and themes; such as stratigraphy, morphology etc. *Biodiversity* depends essentially on *geodiversity* – on the geological environment with its variations. Geodiversity gives *landscapes* their profiles with *landscape elements* built up by geological building-stones.

Diversity is one of the factors and criteria that determine the nature values of a site or landscape area. Diversity can be directly measured as well as size. Rarity, representativeness and scientific importance are derived from comparisons based on a wider knowledge. Remarkable conditions, such as scenery (beauty) are the most subjective criteria.

Minerals, bedrock and cover deposits are *natural resources* that cannot be regenerated after excavation. *Geotopes* are sites with defined geological and morphological phenomena and processes. They have basic importance for *biotopes*, landscape parts with a relatively uniform character and structure. Biotopes are living places for different plant and animal species *habitats*.

Geodiversity is related to geological nature types, land forms and regions. In the project these are developed and described from a framework for Geosites in Northern Europe drafted by Johansson et al (1998). The headlines of the framework are: principal features of the bedrock, the Quaternary cover, the land forms and geomorphological regions.

Nordic geological nature and landscape types with a great importance in an international perspective are, e.g.: Icelandic lava fields and geysirs, the sandur (outwash) fields of Svalbard, S Iceland and W Denmark, the Norwegian fjords and coastal flat, the bedrock archipelagos of E Sweden and SW Finland;

the moraine archipelagos of the Botnian Sea and Gulf, the "drowned" moraine landscape of Denmark, glaciers, ice-margin formations and eskers, raised cobble-fields, dune fields, and large mires in Sweden and Finland.

The above-mentioned nature and landscape types are all characteristic for their physical geographical regions. They may seem trivial in a local perspective – but many of them have a great international importance because they are very characteristic and well representative for their regions, landscape and nature types, geological development and morphological processes. The Nordic countries have a special responsibility to protect, for instance, landscape and nature types characteristic of Norden.

The report *Israndslinier i Norden* is a good example of Nordic responsibility to show, protect and manage and important parts of geodiversity in a European perspective. The sites presented are good examples of *Geosites*, 'geological or geomorphological sites, terrains or landscapes of outstanding value, making an indispensable contributions to the understanding of the geological history of a country, region or continent, and of broader or global patterns' (Wimbledon et al 1997).

The introduction of the geodiversity concept is directed to planners, nature managers and decision-makers in connection with land-use and nature management but also to schools and the public. Management includes planning, handling matters and environment impact analyses in connection with the use of natural resources and the influence on landscapes, geotopes and biotopes from land use of different kinds. A management strategy must comprise far more than selecting and delimiting sites and areas for special nature management measures. All management measures should be directed towards specific targets for landscape/nature protection with regard to geodiversity as well as biodiversity. Nature protection is an integrated part of a total strategy to safeguard the diversity of nature.

Management of geodiversity takes place in different levels and contexts: national (state), regional (counties) and local (municipalities), and in the private property. It is performed by community organs, companies and individuals. Overall consideration to the nature-values (including geological ones) is an important part of nature management.

REFERENCES

Andersen, S & S. S. Pedersen (eds.) 1998: *Israndslinier i Norden*. Tema NORD 1998: 584.

Geodiversitet i Norden. Den geologiska mångfaldens betydelse i nordisk naturvård. (Geodiversity in Nordic Nature conservation, in prep.) Tema NORD. Nordic Council of Ministers.

Johansson, C. E., S. Andersen, Z. Alexandrowicz, L. Erikstad, I. Federe, C. Fredén, G. Gonggrijp, A. Grube, L. Karis, R. Raudsep, J. Satkunas, V. Suominen, W. A. P. Wimbledon, 1998. Framework for Geosites in Northern Europe. ProGEO '97 Estonia: Proceedings. Geological Survey of Estonia.

Wimbledon, W. A. P., S. Andersen, C. J. Cleal, J. W. Cowie, L. Erikstad, G. P. Gonggrijp, C. E. Johansson, L. Karis, V. Suominen (in press). Geological World Heritage: GEOSITES – a comparative site inventory to enable prioritisation for conservation. Proceedings of the second ProGEO Symposium 1996. Memorie del Servizio Geologico d'Italia.

Carl Erik Johansson:

TOWARDS THE GEOSITES LIST IN NORTHERN EUROPE

ABSTRACT, – European Geosites can be seen as the top building-stones in a geological "value pyramid" representing the best of Europe's many-faceted geology. Prominent examples of 'top Geosites' are recalled from ProGEO'97. The responsibility of the Nordic countries to point out and protect Nordic geological nature types is discussed. Geosites on Nordic ice-margin lines are presented in the report *Israndslinier i Norden*. In *Verdensarv i Norden* a number of sites with outstanding geological features are proposed as World Heritage candidates. The state of the art to list Geosite candidates is shown in Sweden.

Geosites can be seen as building-stones of a pyramid where the top is the World Heritage. The pyramid is built up from the base with local sites overlain by regional sites, national geosites, Nordic, Baltic, British Geosites, N. European Geosites, European and Global Geosites. Geosites in national or higher levels are "geological or geomorphological sites, terrains or landscapes of outstanding value, making an indispensable contributions to the understanding of the geological history of a country, region or continent, and of broader or global patterns" (Wimbledon et al 1997). The nomination and appointment of Geosites as World Heritage candidates is a confirmation of their outstanding scientific and cultural value.

With a framework as a basis to find "the best" of the many-faceted geology of Northern Europe we showed some examples of topmost building-stones representing different geological environments at ProGEO'97 (Johansson et al 1998):

Baltic coast, Sweden: Stockholm Archipelago – Sub-Cambrian peneplain and fissurevalley archipelago.

Baltic Glint (scarp), Estonia: North-Estonian Glint – Ordovician stratigraphy; cliff coast, raised shores

W Norwegian coast: Sognefjord – a large fjord system.

North Sea coast, Denmark, Germany and the Netherlands – Vadehavet, Wattenmeer, Waddensee coast.

Iceland: Surtsey – strongly wave-abraded, recent volcanic island.

Weichsel glaciation maximum, stratotype of Saalian and Weichsel till, Lithuania:

Rokai outcrop.

South Finnish terminal moraine belt, Finland: Salpausselkä I – terminal moraine.

Coastal plain, Bothnian Sea, Finland: Wasa Archipelago – flat, low land upheaval coast.

Eastern Baltic Sand Coast, Lithuania: White dunes of Nida, Curonian Spit.

Continental peatlands at the fringe of the Scandinavian mountain range: Sjaunja – mire complex with aapa and palsa mires, Muddus – aapa mire complex.

Saaremaa, Estonia: Kaali Meteorite crater – astrobleme.

Joint Nordic contributions

The state of the art to point out and protect Geosites in co-operation between the Nordic countries is broadly as follows.

According to Nordic Nature Conservation – possibilities and problems (1995, ed. Johansson) the Nordic countries have a special responsibility to protect certain "Nordic" nature types, for example "fissure valley" landscapes ("Stockholm – Helsinki type"), archipelagos, land uplift coasts, mires, bare limestone land, ice-margin formations and esker systems, active volcano and hot spring areas, sandur areas, Mzvatn and the big springs in Iceland, not exploited rivers, dune landscapes, "drowned moraines" and Vadehavet (The Wadden Sea) that is best conserved in Denmark.

The report *Israndslinier i Norden* (1998, ed. Andersen & Pedersen) is a good example of a Nordic report presenting geosites of international importance. It gives an overview of the melting of the Weichselian ice cap from its maximum extension to its disappearance. It describes 87 sites selected to illustrate the ice margin and its deposits. The report recommends, for instance, that the selected sites should be protected and managed. The project should be followed by a selection of sites on a regional basis. It should be extended to neighbouring countries covered by the Weichselian ice cap and show related ice margin features. The extension of the project should be effected in co-operation with ProGEO. The results of this project should be published as a text book applicable to earth science education. The Nordic Council of Ministers should encourage similar projects with similar geological themes.

Verdensarv i Norden (1996, ed. Suul) is a Nordic Council of Ministers report with proposals of 21 new sites/areas for the UNESCO World Heritage list – WH candidates. These sites are of outstanding geological, historical or cultural value. The 16 ones of great geological importance are:

- Vadehavet, Denmark (Germany – The Netherlands) – The International Waddensee
- Jakobshavns Isfjord, Diskobugten, Greenland – fjord landscape
- Kolilandskapet, Finland – remarkable natural and cultural landscape (national landscape)
- Olvassuo myrmarker, Finland – mire landscape, mainly aapa mires
- Vasa skärgård, Finland – moraine lowland coast with strong land uplift
- Saimens skärgård, Finland – large lake archipelago
- Mzvatn, Iceland – volcanic area with Lake Mzvatn
- Surtsey, Iceland – young volcano island
- Thingvellir, Iceland – rift and lava flow landscape
- Snorralaus, Iceland – famous hot spring pool
- W. Norwegian fjord landscape of Geirangerfjord and Naeröyfjord
- N. Norwegian archipelago (strandflat) of Helgeland and Lofoten
- N. Norwegian fjord landscape of Rago and Tysfjord/Hellemo
- Stockholm Archipelago, Sweden – fissure valley archipelago
- S. Öland, Sweden – bare limestone plain, shore barriers
- Höga kusten, Sweden – raised coast with the highest raised sea shores in Europe.

The sites vary in size from limited spots (like 14 Snorralaug in Iceland) to large areas like to Stockholm Archipelago. No. 1, 7, 11, 15, 19, 20 and 21 are found as examples of topmost building-stones in our "Geosite pyramid" as World Heritage candidates in Northern Europe.

The Norwegian fjord landscape of Rago and Tysfjord/Hellemo (No. 18) connects to the large existing Laponian World Heritage area in N Sweden. The antecedent joint Swedish–Norwegian WH area will represent a complete profile from the steep Atlantic fjord coast, over the Scandinavian Mountain Chain, down the valleys to the monadnock plain of Lappland with its large mire complexes. It comprises a large number of geosites. In the Laponian WH there are a number of national parks (the largest ones Sjaunja and Padjelanta) and some nature reserves.

The High Coast (21) is briefly described by Johansson et al (1998). It could be called "The Raised Coast". The highest raised shore-line here is 285 m above the present sea-level.

S. Öland (20) is a very gently sloping limestone cuesta with a Ordovician limestone surface near the western margin of the Baltoscandian plate. There are karst drainage patterns and springs. Traces from previous phases of the Baltic Sea are evident. To the west there are raised Baltic Ice Lake and Yoldia Sea reefs and ridges, to the east Ancylus Lake and Litorina Sea coast barriers crossing in the south. The Great Alvar of Öland is a very remarkable, world-unique open plain landscape with bare limestone ground and a mosaic of steppe and heath vegetation. Only minor areas in Sweden, Estonia and Bulgaria are comparable.

Stockholm Archipelago (20) is a Sub-Cambrian peneplain and fissure-valley archipelago representing the Fennoscandian Shield. It shows a very varied glacial sculpture depending on the Svecofennian bedrock structure and tectonic patterns.

The High Coast is proposed as a World Heritage area by the Swedish government.

The proposal to UNESCO is based on material from SEPA and the province administration of Västernorrlands län. A proposal for S. Öland is under preparation by SEPA and the province administration of Kalmar län. The province administrations and SEPA have a key role to point out Swedish WH candidates and show their scientific and cultural values.

The situation to make Geosite candidate lists is different in the Nordic countries. Compilations adjusted to the GEOSITES frame are delivered or will be made. The pre-requisites and state of the art in Sweden is in brief as follows.

Swedish Geosite contributions

Areas of national interest for nature conservation and open air recreation were stated according to the Natural resources Act by the Swedish Environmental Protection Agency 1987–1989. They are described by Häggbon (1992). The Geological Survey of Sweden (SGU) assessed Geological sites of National importance shown in National Atlas of Sweden: Geology (ed. Fredén, 1994). Geology accounts for about 70 types of geoscientific objects of national interest, apart from geoscientifically valuable types of landscape, such as the Stockholm Archipelago and the High Coast. They are divided into reference sites, bedrock morphology, peat lands, patterned ground and related frost phenomena, erosional forms in bedrock, erosional forms in Quaternary deposits, ancient and depositional littoral forms, erosional and depositional fluvial forms, depositional land forms mainly formed by inland ice, by meltwaters, generated by waves and currents and by winds.

In 1996 Fredén and Johansson compiled a draft list of IUGS Geosites and Geosite candidates in Sweden based on the above-mentioned material. This tentative list also comprises GILGES sites no. 117–132. The new candidates are 22 large bedrock areas, 5 mineral sites, and 72 sites/areas with Quaternary deposits and forms of different types. There are many sites representing more than one type. The Geosites candidate list will be revised according to the GEOSITES type division after regional comparisons and compilations based on more complete information.

At present there is a revision of areas of national interest under the new Environmental code. It is performed by SEPA in co-operation with the provincial administrations. As to sites/areas of national geoscientific interest the selection and delimiting is made together with SGU. Preliminarily there are 576 geoscientific objects. Swedish Geosite candidates will most probably be found among these. Some of them are World Heritage sites, three of them WH candidates, and a great many of them Nordic Geosite candidates.

REFERENCES

- Andersen, S. & S. S. Pedersen. (eds.) 1998: Israndslinier i Norden. Tema NORD 1998: 584.
- Fredén, C. (ed.) 1994: Geology. National Atlas of Sweden. Sveriges Nationalatlas.
- Fredén, C. and C. E. Johansson 1996: IUGS Geosites and Geosite candidates in Sweden. Draft list. Geological Survey of Sweden and ProGEO.
- Häggbom, J. (ed.) 1992: Områden av riksintresse för naturvård och friluftsliv (Areas of national interest for nature conservation and open air recreation). Naturvårdsverket (SEPA) Rapport 4037.
- Johansson, C. E. (ed.) 1995: Nordisk naturvård – möjligheter och problem (Nordic Nature Conservation – Possibilities and problems). Tema Nord 1995: 501.
- Johansson, C. E. & F. Zarlunga (in press): Protection of Geosites in Europe. State and trends. Proc. II Symposium ProGEO, Rome. Memorie del Servizio Geologico d'Italia.
- Johansson, C. E., Z. Alexandrowicz, L. Erikstad, I. Federe, C. Fredén, G. Gonggrijp, A. Grube, L. Karis, R. Raudsep, J. Satkunas, V. Suominen & W. A. P. Wimbledon 1998: Framework for Geosites in Northern Europe. ProGEO '97 in Estonia: Proceedings. Geological Survey of Estonia 1998.
- Suul, J. 1996 (ed.): Verdensarv i Norden. Forslag til nye områder på Verdensarvlisten – UNESCO's World Heritage List. Nordiska ministerrådet (Nordic Council of Ministers), NORD 1996: 30.
- Wimbledon, W. A. P., S. Andersen, C. J. Cleal, J. W. Cowie, L. Erikstad, G. P. Gonggrijp, C. E. Johansson, L. O. Karis and V. Suominen (in press): Geological World Heritage: GEOSITES – a global site inventory to enable prioritisation for conservation. Proc. II Symposium ProGEO, Rome. Memorie del Servizio Geologico d'Italia.

EXCURSION GUIDEBOOK

Excursion guides:

V. Baltrunas

A. Bitinas

A. Damušyte

B. Karmaza

A. Lincius

V. Mikulenas

J. Satkunas

GEOTOPES OF THE VILNIUS CITY

ESKER ŠEŠKINE

Site No. 2 on the map

A remarkable geological monument in Vilnius proclaimed in 1964 is the Šeškine esker, an unique element of glacial accumulation relief in Vilnius city. This geomorphologic body also is selected for insert into the list of representative geosites in Lithuania. This geomorphological form as an esker for the first time was described and popularised in press in 1936, and somewhat later the Šeškine esker was described in the Encyclopaedia of Great Britain "Britannica".

The esker is a flexuous ridge (has three distinct turns) of embankment shape, stretching from SW to NE. Its measurements are following: length – 1160 m, relative height – 3–18 m, width of crest – 3–12 m (average – 5 m), average width of base – 50 m, declivity of slopes – 7–30°. The Šeškine esker is formed of obliquely bedded gravel and sand; a lot of boulders >0.5 m in diameter are in the gravel. On the of ridge (crest) a thin (1.2–0.7 m) cover formed of brown loam or sandy loam occurs by spots.

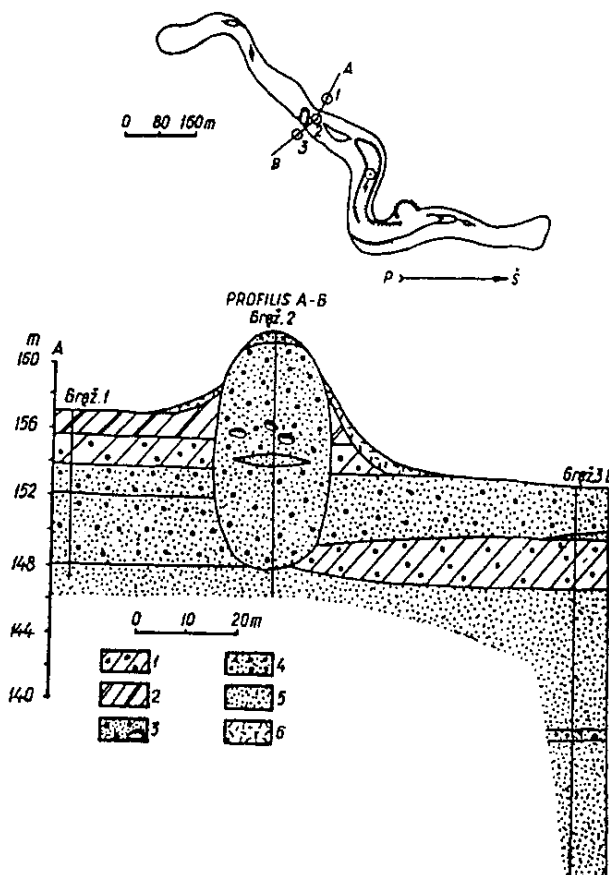


Fig. 1. The Šeškine esker and its mode of occurrence:

1 – glacial loam with abundant amount of gravel; 2 – clayey loam with scarce gravel; 3 – gravel with boulders; 4 – sand with gravel; 5 – fine, well-sorted sand; 6 – talus deposits (coatitig of slopes).

It is believed that the Šeškine esker appeared before 16–18 thous. years in margin of the last Pleistocene glacier (Weichselian) when a thick ice layer still occupied the whole lowering between Rieše upland and the present hills of Šeškine. The accumulation of glaciofluvial deposits forming the esker could take place in large fracture – tunnel of cracked ("dead") ice or in its mouth. When glacier thawed and these sediments sank down, the oblong flexuous ridge Šeškine esker – appeared on the Earth's surface. At present only the upper part of esker is seen, because the lower its part is hiding below its foot level.

For a some time the esker was devastated by excavation of gravel from it, and its natural picture could remain only in old aerophotos, but by common efforts of scientists and society it was preserved proclaiming it as a monument of nature. A street and a school are named Ozas after the Šeškine esker.

Šeškine esker is typical radial esker, formed in glacial conditions. This classical esker denoting maximum advance of the Weichselian glaciation is known since end of XIX century.

REFERENCES

Baltrunas V., Šliaupa A. 1980: *Neše velnias akmeni ... : Geologiniu reiškiniu liudininkai*. Vilnius: Mokslas. 88 p.

PUCKORIAI OUTCROP

Site No. 3 on the map

In the city of Vilnius near the road Vilnius–Naujoji Vilnia at Puckoriai locality the outcrop in Lithuania (approximately 63 m of height) of Quaternary (Pleistocene) rocks opens in the valley of Vilnia River, the left tributary of Neris River. This outcrop is located in the Pavilniai Regional Park and is proclaimed as a geological monument. Here an imposing escarpment and sight of the Vilnia River winding attract visitors during all seasons of year.

Puckoriai outcrop – it is a fragmental section where an interior structure of hill chain formed of push and press terminal moraines can be observed. Such the hills, evidently, were pushed by glacier of the Medininkai (Saalian) glaciation along its edge. This glacier left 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 are found. For example, B. Rydzewsky (1925) studied the Puckoriai outcrop and described the Jurassic block (J_{3ox}) formed 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 (K₂) which stuck in the upper part of outcrop.

Puckoriai outcrop – it is a permanently disintegrating steep tract of the right slope of Vilnia River valley. The lateral erosion of Vilnia River stimulates its instability. Lately the Vilnia River is unable to clean off abundant colluvium from the foot of outcrop, however erosional processes continue their activity in it. Particularly, owing to it, the upper, i.e., steepest, part of outcrop changes: disintegrating and becoming flat in many places it still advances further seizing for itself a part of pine forest growing above the outcrop – a part of Puckoriai Park.

The carvings of folk masters break the monotony of the environment of this outcrop. The Puckoriai outcrop also is known from the historical standpoint: near it in the left side of Vilnia River valley already in 17th century the large and well equipped arm workshop stood where different battle – arms were produced. For this purpose the Vilnia River her was dammed and its water by arranged canal, was subjected to rotate mechanisms of casting and to lift heavy things. The foundry existed up to 19th century and some its equipment and buildings were used by subunits of Swedish, Russian, Peter's the Great and French armies for repair cannons. After destruction of foundry, here the paper-mill was established. It worked until the World War I.

REFERENCES

Lincius A. 1990: Svarbiausiu Lietuvos geologijos paminklu mokslinis ivertinimas ir tvarkymo kryptys /Ataskaita už mokslini darba. – Vilnius. – P. 513–519.

EXCURSION ROUTE:
Vilnius – Vievis – Trakai National Park –
Aukštadvaris Regional Park – Devil's Hole – Rokai –
Panemuniu Regional Park – Palanga

VIEVIS BOULDER MUSEUM

Site No. 5 on the map

A large part of the Geological Museum of the Institute of Geology (T. Ševcenkos Str. 13, Vilnius) is in Vievis (37 km from Vilnius) near the highway and railway Vilnius – Kaunas. Here in the premises of the unique drillcore store of Lithuania collections of rocks, minerals and fossils are exhibited, the memorial exhibition of Prof. Acad. J. Dalinkevicius is established and the exhibition of erratic boulders (stones) is arranged in the open air on the area of 4 ha. Among planted bushes and trees, near foot – paths for pedestrians, in green lawns the erratic boulders, up to 5–6 m³ of volume, delivered from various localities of Lithuania, stand in groups. According to folk-legends, they have been carried and lost by devil.

THE DEVIL'S HOLE

Site No. 8 on the map

People speak about it in different way. Some people say that in the place of hole a church has been build, but it was cursed and disappeared without leaving a trace. Other ones tell about a new bell which fell from cart accidentally, when it was carried to the Užuguostis church, and rattled down into hole. Also it is told that a calf who drowned in a pit in a short run he emerged in the little Škilietai lake located nearby. So, the native inhabitants already a long time ago paid attention to the round pit, 200 m in diameter and 40 m deep (if a peat seam, 10 m thick, on its bottom is not included), in the Aukštadvaris Regional Park. However, the scientists became interested in this geological monument of nature of national significance not so long ago. They were tempted by mystery of Devil's Hole origin. At first, it has occurred to them that deep round depression was formed at foot of waterfall which fell down from edge of glacier. Later on the hypothesis of its thermokarst genesis appeared – it seems that the pit appeared in the place of ice block buried under thick cover of sand. When it thawed, sand cover fell down and a deep funnel – shaped pit appeared in the place of ice block buried under thick cover of sand. Latterly it was suspected, that the pit may be a meteoritic crater. The cosmic hypothesis of this monument of nature is attractive, however it is little substantiated by results of investigations until now.

The drilling of borings on the bottom and the analysis of pollen from peat indicated that the sand occurring under peat formed in the Late Glacial – i. e., during the Late Dryas. The accumulation

of peat started in Preboreal, and was most intensive in the first half of Holocene. The data testify that lime trees and elms predominated in the environs of hole, also there was a plenty of hares and alders. The determination of absolute age by radiocarbon method in the laboratory of the Institute of Geology showed that the lower part of peat was formed 9.7–9.8 thous. years ago. Hence, the hole itself is not younger.

The Devil's Hole is a one among the uncommon monuments of nature the popularity of which was also decided by their cultural "superstructure": enigmatic name, original legends and hypotheses arising curiosity. Unfortunately, such the monuments often are exhausted. It has happened to the well-known Devil's Hole too: the bog on its bottom is trampled down, its slopes destroyed. If it were not a care of park workers, schoolchildren assistance, the fate of Devil's Hole, probably, would be hopeless. Such the price of popularity is...

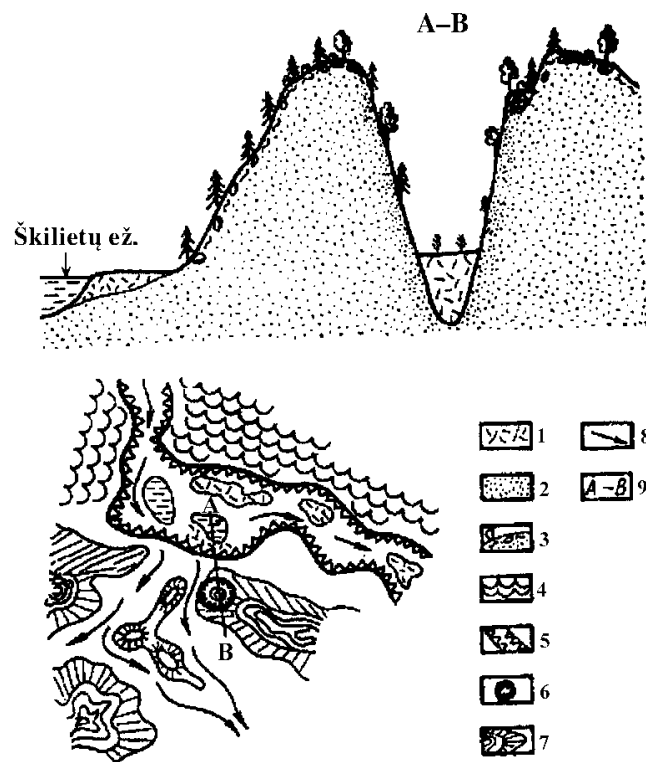


Fig. 1. The geomorphological situation and geological section of Devil's Hole environs:

1 – peat; 2 – sand; 3 – ablation moraine; 4 – hills piled in glacier edge; 5 – boundaries of depressed valley; 6 – Devil's Hole; 7 – separate hills (summits and slopes); 8 – direction of glacier meltwater flow; 9 – geological section A–B.

REFERENCES

Baltrunas V., Šliaupa A. 1980: *Neše velnias akmeni ... : Geologiniu reiškiniu liudininkai*. Vilnius: Mokslas. 88 p.

THE ROKAI OUTCROP

Site No. 9 on the map

The Rokai outcrop is situated on the right bank of the Jiesia River (left tributary of the Nemunas River) near Kaunas. The surrounding topography is flat till plain covered by varved clays. The section is 34 metres high and from top to bottom displays 8 beds of deposits of different age and these beds can be subdivided into 18 smaller units.

Middle Nemunas lake and river deposits in the Rokai section are covered by four Nemunas stage till units. The lower till belongs to the Gruda stadial, second- to the Žiogeliai phasial, third- to the maximum of the Baltija stadial and upper till was formed in the South Lithuanian phasial.

In the lowermost part of the outcrop, close to the present-day river level, a layer of grey silty/clayey till of the Medininkai (Saalian) glaciation occurs.

Palynological investigations of the Rokai section have revealed the presence of a tundra-like periglacial vegetation with many herbs (*Artemisia*, *Cyperaceae*, *Chenopodiaceae*, *Dryas*, etc.) and *Bryales*. Trees, predominantly *Pinitis* and *Betula*, are modestly represented. Palynological data from this section also reflect the spread of periglacial vegetation under severe climatic conditions.

Sand wedges and veins as well as cryoturbations are developed in Middle Nemunas soil horizons. The palynological results show that severe periglacial climatic conditions prevailed during deposition of the Rokai beds. The data confirm that no ice sheet reached Lithuania during the Early and Middle Nemunas stage.

The Rokai section is of particular importance, as it displays the Middle and Early Weichselian stratigraphy.

The Rokai outcrop is proposed as one of most representative geosites in Lithuania. This site belongs to the Jiesia geomorphological reserve.

REFERENCES

Gaigalas A. 1997: The Rokai outcrop: the Middle Nemunas (Weichselian) interstadial. The *Late Pleistocene in Eastern Europe: stratigraphy, palaeoenvironment and climate. Abstract Volume and excursion guide of the INQUA-SEQS Symposium*. (Ed. J. Satkunas). September 14–19, 1997, Lithuania. Vilnius. P. 82–84.

EXCURSION ROUTE: Palanga–Kuršiu Nerija (Curonian Spit)

NOMINATION OF CURONIAN SPIT NATIONAL PARK FOR INSCRIPTION ON THE WORLD HERITAGE LIST

JUSTIFICATION FOR INSCRIPTION ON THE WORLD HERITAGE LIST

Statement of significance

Curonian Spit is a narrow sandy dunes ridge separating the Baltic Sea and Curonian Lagoon. The Spit gained its present features due to the long-term interaction of natural and human driven processes. Nowadays, it hosts a very specific blend of natural and semi-natural habitats with valuable multicultural heritage, deserving the status of the UNESCO World Heritage Site.

Curonian Spit being a unique natural heritage area represents:

- natural geomorphological (physiographic) features of the great dune ridge: diversity of dune forms at different stages of formation; separate dune peaks, diversity of blown sand plain, capes and small bays, which are valuable from both aesthetic and scientific point of view;
- sandy beaches, the Baltic Sea coastal dune ridge, and great dune ridge provide for natural and seminatural habitats to threatened species of animals and plants; the old forests habitats are of outstanding universal value from the scientific and conservational points of view;
- precisely delineated by the Baltic Sea Curonian Lagoon area of outstanding universal value from the point of view of science, conservation and natural beauty;

and

Meets the following World Heritage list criteria:

- is an outstanding example of the Holocene epoch of Quaternary geological period, representing various stages of the Baltic Sea formation, where the development of geomorphic forms and features still continues;
- is an outstanding example representing significant on-going ecological and biological processes in evolution development of coastal and marine ecosystems, as well as the plant and animal communities;
- contains areas of exceptional natural beauty and aesthetic importance;
- provides valuable sandy habitats for in-situ conservation of biological diversity, containing threatened species of outstanding universal value from scientific and conservational point of view.

Curonian Spit landscape being created not only by natural processes but even by human activities represents the combined work of nature and that of man. It illustrates evolution of fisherman society and settlements over time, under the influence of the physical constraints and opportunities presented by their natural environment on one hand, and further development of natural areas caused by human influence – after cutting of large former forests in Curonian Spit – on the other hand. Curonian Spit is a good example enforcing humans to understand that they need to live in harmony with nature. It is an illustration of the interaction between mankind its natural environment. Protection of Curonian Spit cultural landscape can contribute to modern techniques of sustainable land-use and can maintain natural values in the landscape.

Curonian Spit cultural landscape can be ascribed to the second (ii) category of the cultural landscape described in the Operational Guidelines for the Implementation of the World Heritage Convention (paragraph 39). It is organically evolved landscape – the result from initial social imperative and has developed its present form by association with and in response to its natural environment. In Curonian Spit both sub-categories of the second category described in the Operational Guidelines can be found. It means that on one hand Curonian Spit is a continuing landscape, which retains an active social role in contemporary society associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time. On the other hand the relict (or fossil) landscape in which an evolutionary process came to an end in the past – the tribe Kuršiai, which have settled Curonian Spit for a long time, was disappeared, but their ethnographic heritage still exists, as well as the former landscape of fishermen villages can be found under the sand, sandy dunes – 13 villages were covered by sand, after cutting forests in Curonian Spit.

Cultural properties in Curonian Spit represent:

- sites (fishermen settlements): where works of man and nature are of outstanding universal value from the ethnocultural, historic and aesthetic value;
- monuments: architectural works, which are of outstanding universal value from the point of view of history, art and science;

and

Meets the following World Heritage List criteria:

- bear a unique testimony to a cultural traditions, some of which are living, and some of which have already vanished;
- is an outstanding example of a type building which illustrates significant stage in stage in human (fishermen) history;
- is an outstanding example of a traditional lay-out human settlements, as well as land-use which is representative to culture becoming vulnerable under the impact of irreversible change.

Legal status

Kuršiu Nerijos Nacionalinis parkas (Curonian Spit National Park) was established by the Lithuanian Supreme Council in 1991 on the basis of former Curonian Spit Landscape Reserve (established in 1960; in 30 April 1976 the Council of Ministers issued a Resolution on Further Regulations of Kuršiu Nerija and approved a statute of regulations, which made the regime of special conservation more strict).

SEASHORE CLIFF OLANDO KEPURE AT GIRULIAI

Site No. 14 on the map

The Quaternary deposits of the Lithuanian Maritime region occurs on the rocks of the Lower Cretaceous, Upper Jurassic, Lower Triassic and Upper Permian. Pre-Quaternary surface has dense network of palaeoincisions with their depths being within 30–40 m in average, sometimes reaching even 90–95 m. The average thickness of the Quaternary makes up 60–80 m, or 130–135 m in the palaeoincisions. Lithologically, the Quaternary cover is composed mainly of Pleistocene tills (sandy loam and loam). The intertill and interglacial, interglacial deposits (gravel, sand, silt, clay, gyttja, peat etc.) are less distributed, their thickness don't exceed 15–20 m, as rule. Higher thickness (to 40–50 m) are found only in the palaeoincisions. The deposits forming the relief in the northern part of the area consist mainly of till, whereas in the southern part of the area glaciofluvial, glaciolacustrine and alluvial deposits are prevailing. The most western part – at the Baltic Sea coast – there are deposits settled by the Baltic Ice Lake, Litorina and Post-Litorina (Limnea) Seas, as well as recent bog sediments and aeolic formations, that are most widely met in the Kuršių Nerija (the Curonian Spit).

The upper part of Quaternary deposits is well presented in the seashore cliff Olando Kepure, up to 16 m high. Holocene, Upper and Middle Pleistocene beds here crops out. Three till layers are distinguished belonging to Baltija and Gruda (Late Weichselian) and Medininkai (Warthe) regional stages. These horizons are separated by inter- or intratill glaciofluvial and glaciolacustrine gravel, sandy and silty sediments.

The Cliff Olando Kepure is one of the main key sections of Quaternary in the western Lithuania. The site Olando Kepure occurs within Pajurio Regional Park.

REFERENCES

- Bitinas A., Damušyte A. & Stancikaite M., 1996: Short geological and geomorphological review of the Lithuanian Maritime Region. *Geological history of the Baltic Sea: Abstract volume of a field symposium, September 8–12, 1996, Lithuania*. Geological Survey of Lithuania, Vilnius. P. 9–17.
- Bitinas A., 1997: Quaternary deposits on the outcrop Olando Kepure. *The Fifth Marine Geological Conference "The Baltic", October 6–11, 1997*. Institute of Geology, Vilnius. P. 109–110.

GEOLOGICAL STRUCTURE AND DEVELOPMENT OF THE KURŠIU NERIJA SPIT. POINT OF VIEW GARNIU KALNAS NEAR JUODKRANTE

Site No. 16 on the map

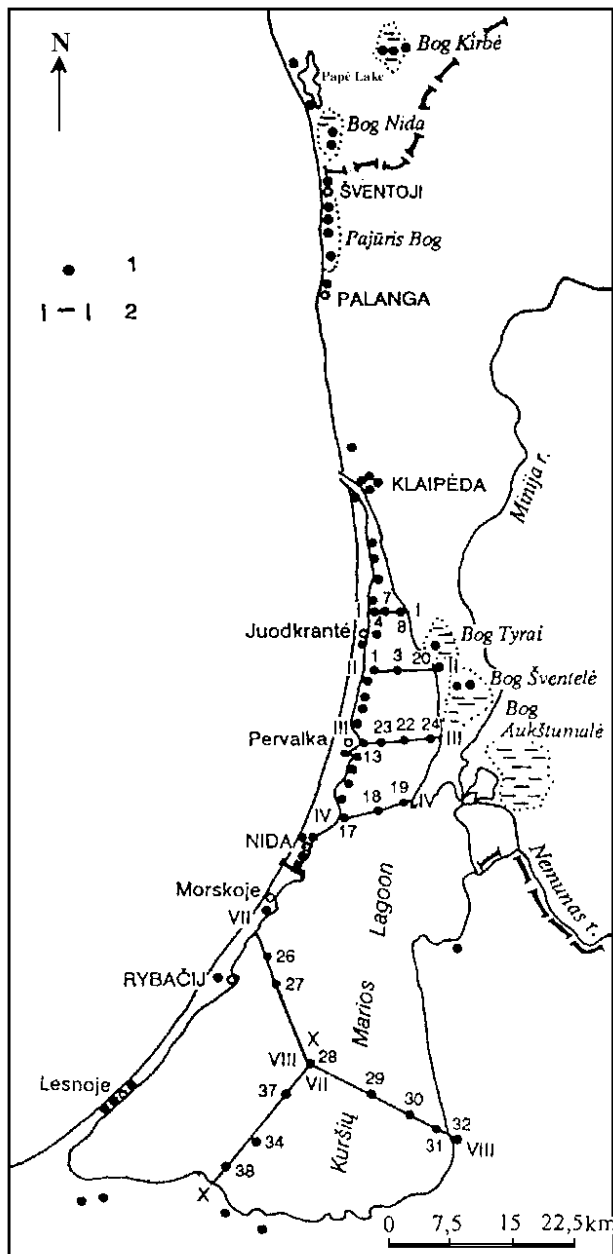


Fig. 1. Situation scheme of the Kuršiu Marios Lagoon and the Kuršiu Nerija Spit area: 1 - studied sites and 2 – geological cross-sections.

The spit of Kuršiu Nerija (Curonian Spit) is a narrow, 0.4–4 km wide land strip separating the lagoon of Kuršiu Marios (Curonian Lagoon) from the Baltic Sea. The length of the spit makes up 97 km with 51 km belonging to Lithuania. The area of Kuršiu Marios (Curonian Lagoon) is 1584 km² with 413 km² belonging to Lithuania. The largest depth is 5.8 m in the southern part of lagoon (in Klaipėda strait's deepening – 15 m), the average depth – 3.8 m. The geology and geomorphology of the spit, the lagoon and the adjacent region had been studied by numerous researchers: J. Schumann (1859) and G. Berendt (1869), H. Wichdorff (1919), O. Prätze (1931), V. Gudelis (1959, 1961, 1976) and others.

Detailed investigations of the Kuršiu Nerija Spit and Kuršiu Marios Lagoon origin and development during Late Glacial and Holocene by pollen and diatom methods started only in the second half of 20th century (Brockmann, 1954; Kabailienė, 1959, 1967, 1990). These investigations are being continued further (Bitinas, Damušyte, Stancikaite, 1996; Kabailienė, 1996 1997). Now we have plenty of sections with data on pollen and diatom stratigraphy. These data enable to single out (Fig. 1) cross-sections.

The major part of the Kuršiu Nerija surface is occupied by a sand plain called here "palve" with a long range of high dunes stretching along the eastern margin of the spit. This range consists of dunes of two generations: ancient ones covered by ancient soils, and new very high migrating dunes above the first ones. Along the western margin of the spit there is a protective dune ridge, 6–12 m high and mainly human-made, a beach which is continuing its formation now.

The Kuršiu Marios Lagoon occupies the shallow hollow – about 99.5% of its bottom has the angle of incidence 1° (Cervinskas, 1959). In the southern part of the lagoon is the shallow depression (the depth 4–5.8 m). In the northern part – prevails the depth about 1.5–2 m and only the submarine chute stretches up to 3–4 m of depth along the shoreline of the Kuršiu Nerija Spit.

During the Late Glacial the area of the Kuršiu Marios Lagoon and Kuršiu Nerija Spit was covered by ice-dammed water bodies. During Yoldia time, there was a land dissected by rivers which eroded valleys (one of them is stretching from the present Nemunas Delta towards Nida and Morskoje on the Kuršiu Nerija Spit).

During transgression of the Ancylus Lake, the major part of the present spit was under the water. The water level was a few meters lower than the present. Approximately 8000–7800 BP the Litorina Sea transgression set in and formed several bays submerging mainly the northern part of the present spit (northwards from Morskoje) and the lagoon of Kuršiu Marios. The water level was a few meters lower than the present. Soon (during Early Atlantic) a drop of short duration occurred, bringing down a Litorina Sea level 9–10 m below the present one. In the shallow bays and around them rich vegetation appeared. This favoured the accumulation of peaty deposits. During Late Atlantic the maximum of Litorina transgression took place. The water level was some few meters higher than present one. Not only the territory of present lagoon but also part of the present coastal area were submerged. After the regression of the Litorina Sea maximum transgression c. 5700 BP the spit of Kuršiu Nerija started to be formed: the southern part of the spit up to settl. Morskoje emerged from the water. At that time a big island between settl. Juodkrante and Nida and a few smaller isles in the belt of the present spit emerged. The Nemunas waters had evidently a free flow in the area of the settl. Nida. Later due to aeolic processes and Litorina Sea level oscillations, the intervals between the islands were filled with sand brought from Nemunas and other rivers and the final structure of the present spit was formed.

So the southern part of the Kuršiu Nerija Spit lying southward from Morskoje is composed of a till loam constructing the hill ridge rising above the present sea level in some places, it is covered with a thin layer of the deposits of the Baltic Sea stages and aeolic sand. The geological structure of that part of Kuršiu Nerija Spit that lies northwards from Morskoje is quite different. Here occur thick layer of the deposits of the Baltic Sea stages above the till loam. These deposits are covered by aeolic sand. In the northern part of the Kuršiu Nerija Spit and the present area of the Kuršiu Marios Lagoon above the till loam of the Last glaciation there are deposits of such basins: the Baltic Ice Lake, Ancylus Lake, Litorina and Post Litorina Sea.

REFERENCES

- Bitinas, A., Damušyte, A. & Stancikaite, M., 1996: Short geological and geomorphological review of the Lithuanian Maritime region. *Geological history of the Baltic Sea: Abstract volume of a field symposium, September 8–12, Lithuania*. Vilnius. P. 9–17.
- Brockmann, Ch., 1954: Die diatomeen in den Ablagerungen der Ostpreußischen Haffe, Meniana, *Veröffentlich. Geologischen Institut der Univers. Kiel*. 3. Herausgeben K. Gripp, E. W. Guenther, Kiel. P. 95.
- Cervinskas, E., 1959: The main features of hydrological regime of the Kuršiu Marios. *Kuršju Mares*. Vilnius. P. 47–68, (in Russian).
- Gudelis, V., 1959: Geologiceskie i fiziko-geograficeskie uslovija zaliva Kuršju Mares i territorii okajmljajuščij zaliv. [Geological and physical geographical conditions of the Lagoon Kuršiu Marios and surrounding territory]. *Kuršju Mares*. Vilnius. P. 7–45, (in Russian).
- Gudelis, V., 1961: Nekotorye voprosy razvitija Baltijskogo morja i neotektoniki golocena [On the development of the Baltic Sea and its neotectonics]. *Voprosy Golocena*. Vilnius. P. 69–76, (in Russian).
- Gudelis, V., 1976: Istorija razvitija Baltijskogo morja [The history of the Baltic Sea]. *Geologija Baltijskogo morja*. Vilnius. P. 95–116, (in Russian).
- Kabailiene, M., 1996: Geological structure of the Kuršiu Nerija Spit and Kuršiu Marios Lagoon, development during Late Glacial and Holocene. *Geological history of the Baltic Sea: Abstract volume of a field symposium, September 8–12, Geological Survey of Lithuania*. Vilnius. P. 33.
- Kabailiene, M., 1997: Kuršiu Nerija Spit and Kuršiu Marios Lagoon: geological structure, origin and development during Late Glacial and Holocene, *Fifth Marine Geological Conference "The Baltic"*. Geologijos institutas, Vilnius. P. 134–142.
- Kabailiene, M., 1998: Geological structure and development of the Kuršiu Nerija (Curonian Spit) and the Kuršiu Marios Lagoon during Late Glacial and Holocene. *Environmental perspectives of sensitive south-eastern Baltic coastal areas through time: Nordic–Baltic NorFA Network: Excursion guidebook of the NorFA interdisciplinary research course in the Baltic Countries, 9–20 May, 1998. Lithuanian part, 16–20 May, 1998*. Vilnius. P. 14–20.
- Pratje, O., 1931: Die Sediments des Kurishen Haffes. *Geologie u Palaeont.* P. 10.
- Wichdorff, von Hess H., 1919. Die Geologic der Kurischen Nehrung und des Samlands, in Abhandl. *Preuss. Geol. Landesanst.* N.F.H. P. 77.

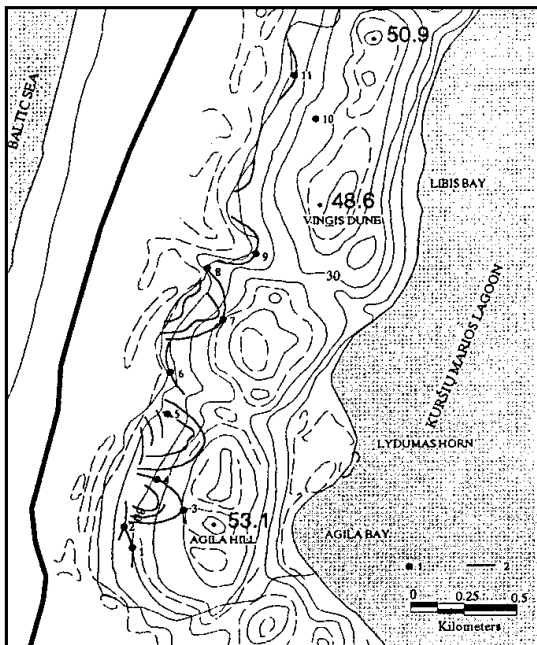
BURIED SOILS: HISTORY OF HUMAN AND NATURE INTERACTION

Site No. 17 on the map

The Kuršiu Nerija Spit separating the Kuršiu Marios Lagoon from the Baltic Sea is an unique place by its development and human history. Moving sand forms dominated in the relief since the earliest periods of the spit existence. Interaction between the nature and man has played a dominant role in the development of the flora and fauna, as well as the Kuršiu Nerija Spit itself.

An unique monument of the Kuršiu Nerija development has been found in sand dune ridge, extending between Rasyte and Nida. Few buried soil horizons corroborated the theory concerning the development of the relief of Kuršiu Nerija, palaeoecological conditions during the second part of the Holocene period, human influence in to environment.

Now the major part of the dune ridge is overgrown by grass and forest and only few places with open sand afford us an opportunity for investigations of the buried soil horizons. The horizons are found northwards from Pervalka between Agila Hill and Vingis Dune on the windward (western) slopes of the dune ridge (Fig. 1). Dune ridge in Kuršiu Nerija is composed of two eolic sand complexes. The lower part of the dunes have been formed as parabolic ones, the so-called "ancient buried parabolic dunes" and the upper part has been formed during 18–19th century (Gudelis and Savukyniene, 1995). Soil horizons overlay the surface of the ancient buried parabolic dunes. The buried soils stretches along the western slope of the dunes in the north-south or west-east direction. The slopes of the dunes have been influenced by wind and part of the sand has been eroded.



The configuration of the soil layers reflects the shape of the ancient dunes. Even stumps and trunks of the huge trees have been found in some places. High amount of the charcoal in soils shows the big fires in Kuršiu Nerija Spit. The shape of the old dunes, formed by the wind was very changeable and the belts of the soil horizons confirmed that.

The ancient soil layer is composed of the forest litter of various thickness, podzol horizon, which is composed of grey fine sand, then follows illuvial horizon which is of reddish or brownish colour due to high content of iron and manganese. (Gudelis and Savukyniene, 1995).

Fig. 1. A sketch map of the distribution of exposed soils in the Kuršiu Nerija Spit at Pervalka (according V. Gudelis & N. Savukyniene, 1995) 1 – exposed soils, 2 – fossil dunes.

The pollen analyses and the results of the radiocarbon dating of the soil horizons and pieces of the wood confirmed the stratigraphical relationship of the soil layers with the type of the flora flourished at the time of the soil formation.

The earliest traces of humans have been detected at Juodkrante and Nida and it was attributed to the Middle Neolithic (Rimantiene, 1989). Entire Kuršiu Nerija Spit was populated only during Late Neolithic – the period of Corded Ware Culture (Rimantiene, 1995). Since the beginning of the Subboreal period the plant cover in Kuršiu Nerija has been destroyed few times. After the collapsing of the vegetation cover the sand started to move and layers of the sand between soil horizons have been formed. High amount of the charcoal in the sediments confirmed the presumption about the big fires as the main cause of the vegetation diminishing. The origin of the ancient catastrophic fires, is under discussion. Few presumptions exist: fires caused by lightning dry summers or initiated by man. Since the 15th century forest were devastated by man. Wood – cutting in 16–17th centuries caused catastrophic consequences, 14 villages have been covered by wind-driven sand. In order to stop the movement of dunes, afforestation was initiated in 19th century. G. D. Kuvertas head of the post office in Nida has initiated the afforestation that was finished in 1902.

REFERENCES

Gudelis, V. & Savukyniene, N., 1995: Buried forest soils in the dunes of the Kuršiu Nerija. *Natural environment, man and cultural history on the coastal area of Lithuania: Excursion guidebook of the NorFa course in the Baltic Countries*. Vilnius. P. 34–37.

Rimantiene, R., 1989: *Nida. The settlement of ancient Balts*. Vilnius. 158 p., (in Lithuanian).

Rimantiene, R., 1995: Archaeological sites in the Kuršiu Nerija *Natural environment, man and cultural history on the coastal area of Lithuania: Excursion guidebook of the NorFa course in the Baltic Countries*. Vilnius. P. 39–40.

Stancikaite M., 1998: Aeolian sedimentation and history of human and nature interaction. *Environmental perspectives of sensitive south-eastern Baltic coastal areas through time: Nordic–Baltic NorFA Network: Excursion guidebook of the NorFA interdisciplinary research course in the Baltic Countries, 9–20 May, 1998. Lithuanian part, 16–20 May, 1998*. Vilnius. P. 21–23.

DUNES OF THE KURŠIU NERIJA

Site No. 18 on the map

The Spit of Kuršiu Nerija is an inimitable part of Lithuania's landscape without which it would be impossible to imagine the Coast of Lithuania. Along the entire area of the Spit, there are dune ridges stretching. The aeolic dunes are typical of the entire Lithuanian coast, but only in the Kuršiu Nerija the dunes are obviously dominating type of relief. From the very beginning aeolic processes play a very important role in its development. They formed the largest and the highest dune formations in North Europe. Wind driven dunes attained the parabolic shape. Such dunes at Juodkrante and Nida remained from the end of the Litorina Sea time. Now they are overgrown by forest, and their shape is not easily observed. The rest part of the Spit has young linear dunes which buried the old parabolic ones. Average height of the dunes is 40 m. The highest dune of Sklandytoju /glider flyers/ sometimes reaches 68 m in height. The hill of old inn at Preila is 63 m high, above the sea level. Very interesting and distinctive part of dunes is between Juodkrante and Pervalka, where dunes practically are not changed by human activities; there are several soil horizons and tree remains buried under the sand. Dunes in this part of the Spit practically do not move, whereas the area at Nida with the Parnidis dune is an excellent good example of moving dunes. The eastern shoreline of the Spit is very uneven; there are numerous sand peninsulas called by Lithuanians "ragas" /horn/. Most impressive is Grobšto Ragas with a picturesque Vienišoji /solitary/ Dune. The remains of ancient forests seen in the places, where sand retreated from large forest areas buried by sand before are also very impressive.

For long centuries, the dunes in the Kuršiu Nerija Spit were freely driven by wind. Only in 19th century the afforestation and stabilisation of dunes started. Thus, finally, the sand transport from the Baltic Sea side interrupted, hence, dunes are starting to become smaller.

REFERENCES

Lincius, A. & Narbutas, V., 1969: *Traces of geological past in Lithuania's landscape*. Vilnius. P. 86–102, (in Lithuanian).

Stancikaite M. 1998: Aeolian sedimentation and history of human and nature interaction. *Environmental perspectives of sensitive south-eastern Baltic coastal areas through time: Nordic–Baltic NorFA Network: Excursion guidebook of the NorFA interdisciplinary research course in the Baltic Countries, 9–20 May, 1998. Lithuanian part, 16–20 May, 1998*. Vilnius. P. 21–23.

Stancikaite M., Bitinas A. 1998: Dunes in the Kuršiu Nerija. *Environmental perspectives of sensitive south-eastern Baltic coastal areas through time: Nordic0150Baltic NorFA Network: Excursion guidebook of the NorFA interdisciplinary research course in the Baltic Countries, 9–20 May, 1998. Lithuanian part, 16–20 May, 1998*. Vilnius. P. 24–26.

Telksnyte, M., 1979: *Kuršiu Nerija*. Vilnius. P. 1–26, (in Lithuanian).

PARNIDIS LAGOON MARL (CLAYEY GYTTJA) EXPOSURE

Site No. 19 on the map

Southwards from Nida at the bottom of high dune ridge descending into the Kuršiu Marios Lagoon at the coves of Parnidis and Grobštas, are exposures of clayey gyttja (Fig. 1). From XIX century German researchers used to call this rock "Haffmergel". After the analogy Lithuanian specialists named it "mariū mergelis" – a lagoon marl. According to average data of analysis of composition this rock is like clayey gyttja: prevail organic matter in form of fine detritus (about 50%), pelitic (clayey) particles make up 30% (sometimes up to 60%) and carbonates – 15–20% or less.

The length, width and height of the exposures is changing with a time. Last measurements of these exposures were made by A. Lincius in autumn of 1990 (Lincius 1993). On the southern shore of Parnidis Cove, there was an exposure 150 m long, 29 m wide and 3.42 m high, with two belts of dark grey rock divided by a pit 9 m wide, filled with water and connected with the Kuršiu Marios Lagoon. At the Grobštas Cove, near to the southern border of Lithuania, in an area about 700 m long and 60 m wide. A. Lincius described even three lagoon marl belts situated in parallel to the bottom of the dune and separated one from another by water spans. The highest belt (up to 3.5 m) was found to be the nearest to the dune bottom.

The book "Kuršiu Nerija" by V. Viliamas published in 1932 mentioned marl exposures in the other places of the Kuršiu Nerija Spit, but now they could not be found.

In 1985, S. Kazakevicius and A. Klimašauskas from Vilnius Gediminas Technical University during field investigation discovered the new lagoon marl (clayey gyttja) exposure on the eastern shore of the spit between Juodkrante and Pervalka settlements, to the north of Naglis Horn. The outcrops are exposed 2 m above the water level and more than 0.5 m below the water of the Kuršiu Marios Lagoon.

Pollen and diatom analysis data of lagoon marl (clayey gyttja) from exposures in Nida showed that these rocks exposed at the bottom of dune belong to the Atlantic and Subboreal chronozones and are deposited in the bay of the Litorina Sea.

The exposures of clayey gyttja (lagoon marl) seem to be caused by a colossal mass of the dune ridge. The ridge of aeolic sand is slowly moving eastwards and pressing the coast of the Kuršiu Marios Lagoon.

This caused the deformation of the clayey gyttja beds occurring under the sand and their exposure at the surface. The moving of the dunes ridge eastwards and displacement of shore line confirm the data of measurements of S. Kazakevicius on the displacement of the eastern shore line of the Kuršiu Nerija Spit on area of Naglis Horn from 1910 to 1979 year.

The part of the clayey gyttja (lagoon marl) in exposures is eroded by the lagoon waves, but significant part remains for many years, until the dune bottom approaches to it and later buries it. Then the new belt of gyttja (marl) is being pressed out in the other place of the eastern coast of the Kuršiu Nerija Spit.

REFERENCES

- Kabailiene, M., 1959: The development of the coastal zone of Lithuania and Southern Latvia during the Late Glacial and Holocene according to the data of diatom analysis. *Moksliniai pranešimai: Geologija, geografija, Vol. 10, No. 2*. Vilnius. P. 175–213, (in Lithuanian).
- Kabailiene, M., 1967: The development of the Kuršiu Nerija Spit and the Kuršiu Marios Bay. *Voprosi geologii i paleogeografii cetverticnovo perioda. Vol. 5*. Vilnius. P. 181–207, (in Russian).
- Kabailiene, M., 1995: Lagoon marl exposures at Nida. *Natural environment, man and cultural history on the coastal area of Lithuania: Excursion guidebook of the NorFa course in the Baltic Countries*. Vilnius. P. 40–43.
- Kabailiene, M., 1998: Lagoon marl (Clayey Gytija) exposure at the Kuršiu Nerija (Curonian Spit). *Environmental perspectives of sensitive south-eastern Baltic coastal areas through time: Nordic–Baltic NorFA Network: Excursion guidebook of the NorFA interdisciplinary research course in the Baltic Countries, 9–20 May, 1998. Lithuanian part, 16–20 May, 1998*. Vilnius. P. 26–30.
- Lincius, A., 1993: A secret of the lagoon marl. *Geologijos akiraciai, No. 1 (9)*, Vilnius. P. 29–33, (in Lithuanian).

MEETING OF THE ProGEO WORKING GROUP No. 3
NORTH–WEST EUROPE
Vilnius–Palanga, 6–10 May, 1999

LIST OF PARTICIPANTS

1. United Kingdom

William Wimbledon - Executive Secretary of ProGEO

Postgraduate Research Institute for Sedimentology, University of Reading, Whiteknight Reading RG6 6AB, UK

Tel: +44 1222 772400

Fax: +44 1635 44133

E-mail: <aberdon@pop3.demon.co.uk>

2. Sweden

Carl Erik Johansson - ProGEO Past President (Swedish Environmental Protection Agency, S-106 48 Stockholm) Växthusvägen 51,

S - 17834 Ekerö

Tel: +46 856033379

E-mail: <earlej@swipnet.se>

Lars Karis

Geological Survey of Sweden, S-75128 Uppsala, Sweden.

Tel: +46 181 79376

Fax: + 46 185 01020

E-mail: <lkaris@sgu.se>

Gunnel Ransed

Geological Survey of Sweden, SE-75128 Uppsala, Sweden.

Tel: +46 18 1792 88

Fax: +46 18 17 92 10

E-mail: <gunnel.ransed@sgu.se>

Kristina Fredriksson

Swedish Environmental Protection Agency, Dept. for International Relations SE-106 48 Stockholm, Sweden

Tel: +46 86981633

Fax: + 46 86981504

E-mail: <kristina.fredriksson@environ.se>

Gösta Persson

Geological Survey of Sweden, Box 670, SE-751 28 Uppsala, Sweden

Tel: +46 18179130

Fax: +46 18179210

E-mail: <gosta.persson@sgu.se>

3. Norway

Lars Erikstad

NINA, Box 736 Sentrum, N-0105 Oslo, Norway

E-mail: <lars.erikstad@ninaosl.ninainiku.no>

4. Finland

Veli Suominen

Geological Survey of Finland, P.O.Box 96,02151 ESPOO, Finland.

Tel: + 358 20 550 2290

Fax: + 358 20 55012

E-mail: <veli.suominen@gsf.fi>

Markku Peltoniemi

Helsinki University of Technology, Lab. of Engineering Geology and Geophysics

Vuorimiehentie 2 A, P.O. Box 6200, FIN-02015 HUT, Finland

Tel: +358 9 451 2730

Fax: +358 9 451 2731

E-mail: <Markku.Peltoniemi@hut.fi>

5. Denmark

Steen Andersen

Natural Forest and Nature agency, Haraldsgade 53, 2100 Copenhagen, Denmark

Tel: + 45 39 47 22 58

Fax: + 45 39 27 98 99

E-mail: <SAN@SNS.DK>

6. Russia (Karelia)

Vladimir Makarikhin

Institute of Geology, 11 Puskinskaya str. 185610 Petrozavodsk, Russia.

Tel: + 0078 142 772753

Fax: 0078 142 770602

F-mail: <heiskanen@post.karelia.ru>

7. Estonia

Rein Raudsep

Ministry of the Environment, Toompuie stee 24 Tallinn, Estonia.

Tel: + 372 6262885

Fax: + 327 6262801

E-mail: <raudsep@ekm.choir.ee>

8. The Netherlands

Gerard P. Gongrijp

Odinksveld NL-7491 HD Delden

Tel/Fax: + 31 74 376 1234

9. Latvia

Vitalijs Zelcs

Riga University, Raina Blva. 19, Riga LV-1586, Latvija

Tel: + 371 7332566

Fax: + 371 7332704

E-mail: <vzelcs@lanet.lv>

10. Belarus

Vinokurov Valery

Institute of Geological Sciences, Geological Museum, Zhodinskaja St., 7, 220141 Minsk

Tel: + 0172 635400

Fax: + 0172-636398
E-mail: <vinok@ns.igs.ac.by>

LIST OF PARTICIPANTS

11. Poland

Andrzej Ber

Polish Geological Institute, Rakowiecka 4, 00-975 Warszawa, Poland
Tel: + 48-22 495351
Fax: + 48-22 495342

12. Lithuania

Valentinas Baltrunas

Institute of Geology, T. Ševcenkos 13, Vilnius, Lithuania
Tel: + 370 2 235819
Fax: + 370 2 236710
E-mail: <valbal@geologin.lt>

Julius Belickas

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 332267
E-mail: <Julius.Belickas@lgt.lt>

Vidmantas Bezaras

Department of Forests and Protected Areas,
Ministry of Environment of the Republic of Lithuania, A. Juozapaviciaus 9, Vilnius
Tel: + 370 2 726306
Fax: + 370 2 722029

Albertas Bitinas

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 335323
E-mail: <Albertas.Bitinas@lgt.lt>

Aldona Damušyte

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 239044
E-mail: <Aldona.Damusyte@lgt.lt>

Vyda Elena Gasiuniene

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 335537
Fax: + 370 2 336156
E-mail: <Vyda.Gasiuniene@lgt.lt>

Bronius Karmaza

Institute of Geology, T. Ševcenkos 13, Vilnius, Lithuania
Tel: + 370 2 236201
E-mail: <bkarmaza@geologin.lt>

Augustinas Lincius

Institute of Geology, T. Ševcenkos 13, Vilnius, Lithuania
Tel: + 370 2 236305
E-mail: <lincius@geologin.lt>

Giedre Marcijoniene

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 239045
E-mail: <Giedre.Marcijoniene@lgt.lt>

LIST OF PARTICIPANTS

Vytautas Marcinkevicius

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 239048
E-mail: <Vytautas.Marcinkevicius@lgt.lt>

Vidas Mikulenas

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 332286
E-mail: <Vidas.Mikulenas@lgt.lt>

Juozas Mockevicius

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 332889
Fax: + 370 2 336156
E-mail: <Juozas.Mockevicius@lgt.lt>

Vytautas Narbutas

Institute of Geology, T. Ševcenkos 13, Vilnius, Lithuania
Tel: + 370 2 236305
E-mail: <narbutas@geologin.lt>

Jonas Satkunas – Leader of the ProGEO WG No. 3

Geological Survey of Lithuania, S. Konarskio 35, Vilnius, Lithuania
Tel: + 370 2 332482
Fax: + 370 2 336156
E-mail: <Jonas.Satkunas@lgt.lt>

Jonas Šimenas

Parliament of the Republic of Lithuania

Eduardas Vaitkevicius

Department of Forests and Protected Areas,
Ministry of Environment of the Republic of Lithuania, A. Juozapaviciaus 9, Vilnius
Tel: + 370 2 723432
Fax: + 370 2 722029

FOR NOTES