

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/308972033>

INQUA PERIBALTIC WORKING GROUP MEETING 2016 CONFERENCE BOOK 28.08.2016–02.09.2016

Book · January 2016

CITATIONS

0

READS

89

1 author:



[Robert J. Sokołowski](#)

University of Gdansk

53 PUBLICATIONS 130 CITATIONS

SEE PROFILE

INQUA PERIBALTIC WORKING GROUP MEETING 2016 CONFERENCE BOOK 28.08.2016-02.09.2016



- meeting guide*
- meeting programme*
- oral session abstracts*
- poster session abstracts*



 INQUA
PERIBALTIC
2016

**QUATERNARY GEOLOGY OF NORTH-CENTRAL POLAND:
FROM THE BALTIC COAST TO THE LGM LIMIT**

INQUA PERIBALTIC WORKING GROUP
MEETING 2016 CONFERENCE BOOK
28.08.2016-02.09.2016

Władysławowo 2016

Faculty of Oceanography and Geography University of Gdańsk

This conference book is a result of Inqua Peribaltic Working Group Meeting, which held 28.08.2016-02.09.2016 in Poland. It was organized by University of Gdańsk, Nicolaus Copernicus University in Toruń and University of Łódź under the patronage of INQUA TEPRO Commission - Peribaltic Working Group, Committee for Quaternary Research of Polish Academy of Sciences and Association of Polish Geomorphologists. There is also a book „QUATERNARY GEOLOGY OF NORTH-CENTRAL POLAND: FROM THE BALTIC COAST TO THE LGM LIMIT” edited by R.J. Sokołowski and D. Moskaiewicz, which contain descriptions of field symposium locations.

Publication supported by Committee for Quaternary Research of Polish Academy of Sciences

Printed by *5xMedia*

Organizing Committee:

Robert J. Sokołowski - University of Gdańsk - chairman

Damian Moskaiewicz - University of Gdańsk - secretary

Piotr P. Woźniak - University of Gdańsk

Włodzimierz Narloch - Nicolaus Copernicus University in Toruń

Michał Jankowski - Nicolaus Copernicus University in Toruń

Wojciech Wysota - Nicolaus Copernicus University in Toruń

Piotr Czubla - University of Łódź

Organizers and patronage:



TABLE OF CONTENTS

TABLE OF CONTENTS.....	1
GUIDE.....	5
MEETING PROGRAMME.....	7
CONFERENCE PROGRAMME.....	9
ORAL SESSION ABSTRACTS.....	13
3D MICROFABRIC ANALYSIS OF PROGRESSIVE, POLYPHASE SUBGLACIAL DEFORMATION BENEATH THE LATE WEICHSELIAN BAL TIC ICE STREAM (SCANDINAVIAN ICE SHEET, EUROPE) Johannes Brumme, H. Hüneke, E. Phillips	14
CAN CLAST PLOUGHING PRODUCE MASSIVE SUBGLACIAL TILLS? Jan A. Piotrowski, Włodzimierz Narloch, Aleksander Adameczyk, Charlotte Rasmussen	15
PERIGLACIAL FEATURES AND PERMAFROST DISAPPEARANCE DURING MIS-2 IN NORTHERN POLAND AND GERMANY Mirosław Blazkiewicz, Andreas Börner	16
DIVERSITY OF THE FILLINGS OF THE GLACIGENIC KETTLE-HOLES IN THE AREA OF THE ŁÓDŹ PLATEAU (CENTRAL POLAND) Jacek Forysiak, Aleksandra Majecka, Leszek Marks, Anna Toloczko-Pasek, Piotr Majecki	17
LIDAR-BASED MAPPING OF GEOMORPHOLOGY, CONSTRUCTION SUITABILITY OF SOIL AND ENVIRONMENTAL IMPACT IN THE SODANKYLÄ REGION, NORTHERN FINLAND Peter Johansson, J. Räisänen, P. Sarala	18
SOILS ON BIPARTITE SEDIMENTS AS A PALEO GEOGRAPHIC ARCHIVE Alexander Makeev, Pavel Kust, Marina Lebedeva	19
MIS3 PALEOSOLS IN THE CENTER-NORTH OF EASTERN EUROPE AND WESTERN SIBERIA: REDUCTOMORPHIC PEDOGENESIS CONDITIONED BY PERMAFROST WITHIN THIS LATITUDINAL ZONE? Alexey Rusakov, Sergey Sedov, Vladimir Sheinkman	20
PALEOENVIRONMENTAL CYCLICITY BASED ON CARBONATE ANALYSIS DATA OF NON-GLACIAL SEDIMENTS FROM LITHUANIA Eugenija Rudnickaitė	21
TIMING OF ENVIRONMENTAL CHANGES DURING THE DECLINE OF THE VISTULIAN (18–11.5 KA CAL BP) USING FREQUENCY DISTRIBUTION OF RADIOCARBON DATES FOR THE ŁÓDŹ REGION, CENTRAL POLAND Danuta Dzieduszyńska	22
PALAEOECOLOGICAL INVESTIGATIONS AND ²³⁰ TH/U DATING OF THE EEMIAN INTERGLACIAL PEAT SEQUENCE NEUBRANDENBURG-HINTERSTE MÜHLE (NE- GERMANY) Andreas Börner, Anna Hrynowiecka, Renata Stachowicz-Rybka, Monika Niska, Magdalena Moskal- del Hoyo, Vladislav Kuznetsov, Fedor Maksimov, Aleksey Petrov	23

PALAEO GEOGRAPHICAL PROPERTIES CONDITIONING THE CONSTRUCTION AND UTILIZATION OF WELLS FROM THE ROMAN PERIOD IN THE KWIATKÓW SITE Joanna Petera-Zganiacz, Magdalena Piotrowska, Danuta Dzieduszyńska, Jacek Forysiak, Juliusz Twardy, Seweryn Rzepecki, Daniel Okupny	24
CYCLIC GLACIOFLUVIAL EROSIONAL MORPHOLOGY AND DELTAIC DEPOSITS IN SOUTHERN FINNISH LAPLAND Pertti Sarala, Jukka-Pekka Palmu, Joni Mäkinen, Jukka Räisänen	25
MIDDLE AND LATE HOLOCENE PALEOENVIRONMENTAL EVOLUTION OF THE CURONIAN LAGOON, LITHUANIA Giedrė Vaikutienė, Donatas Kaminskas, Eugenija Rudnickaitė, Albertas Bitinas, Alma Grigienė, Ilya V. Buynevich, Aldona Damušytė, Donatas Pupienis	26
PALAEOSEISMICITY OF THE EASTERN BALTIC REGION: IMPLICATIONS FOR THE SEISMOLOGICAL RISK ASSESSMENT Albertas Bitinas, Aldona Damušytė, Andrius Pačėsa	27
POSTER SESSION ABSTRACTS	29
PLEISTOCENE ARCHITECTURE AND STRATIGRAPHY IN THE CONTACT ZONE OF ICE STREAMS AND LOBES IN THE SOUTHEASTERN PART OF THE BALTIC REGION Valentinas Baltrūnas, Bronislavas Karmaza, Violeta Pukelytė, Danguolė Karmazienė	30
REGIONAL AND LOCAL ICE FLOW DIRECTIONS OF THE LAST SCANDINAVIAN ICE SHEET IN CENTRAL POLAND Małgorzata Roman, Piotr Czubla	31
MELT WATER DRAINAGE SYSTEM IN A COLD SVALBARD GLACIER Jan A. Piotrowski, Lena U. Hansen, Doug I. Benn	32
GLACIAL CURVILINEATIONS (GCLS) - AN INDICATION OF SUBGLACIAL CHANNELIZED MELT WATER FLOWS Jan A. Piotrowski, Aleksander Adamczyk, Wojciech Wysota	33
RECORD OF THE WEICHSELIAN CLIMATE CHANGES IN THE VISTULA TERRACES ON THE EXAMPLE OF THE SITES OF ROGÓW AND GOŁĄB Robert J. Sokółowski, Paweł Zieliński, Barbara Woronko, Michał Jankowski, Stanisław Fedorowicz, Karol Standzikowski	34
LOCAL STRATIGRAPHY OF THE QUATERNARY DEPOSITS FILLING OF THE WESTERN PART OF THE KLESZCZÓW GRABEN, CENTRAL POLAND Lucyna Wachecka-Kotkowska, Dariusz Krzyszkowski, Dariusz Wiczorek, Jerzy Raczyk, Katarzyna Adamczyk	35
A NEW SITE OF THE HOLSTEINIAN(?) LIMNIC DEPOSITS IN THE KSIĄŻNICA OUTCROP AT KRZCZONÓW, SUDETY FORELAND Lucyna Wachecka-Kotkowska, Dariusz Krzyszkowski, Zdzisław Jary, Małgorzata Malkiewicz, Jarmila Krzymińska, Dariusz Cizek, Monika Niska, Elżbieta Myśkow, Jerzy Raczyk, Wojciech Drzewicki, Dawid Hamryszczak, Jerzy Nawrocki, Klara Tomaszewska, Monika Rządziejewicz	36
PALYNOLOGICAL AND GEOCHEMICAL RECORD OF LATEGLACIAL CLIMATIC OSCILLATIONS: A CASE STUDY FROM LAKE RADUŃSKIE, NORTHERN POLAND Dawid Weisbrodt, Małgorzata Latałowa	37
DUNE PALAEODYNAMICS ALONG THE CURONIAN SPIT, SOUTHEASTERN BALTIC Albertas Bitinas, Nikita Dobrotin, Anatoly Molodkov, Ilya V. Buynevich, Aldona Damušytė, Virgilija Gregorauskienė, Jonas Mažeika, Donatas Pupienis	38

HOLOCENE HISTORY OF ENVIRONMENTAL DYNAMICS: MULTI PROXY APPROACH FROM THE ČEPKELIAI HIGHMOOR, SE LITHUANIA Laura Gedminienė, Miglė Stančikaitė, Ričardas Taraškevičius, Gražyna Gryguc, Rimantė Zinkutė, Jonas Mažeika	39
DEVELOPMENT OF THE SANDY BARRIER UNDER SEA-LEVEL RISE: THE FUTURE OF HEL PENINSULA Damian Moskalewicz	40
EFFECTS OF CLIMATE VARIABILITY ON SALTWATER INTRUSIONS IN COASTAL AQUIFERS IN SOUTHERN DENMARK Jan A. Piotrowski, Rena Meyer, Torben Sonnenborg, Peter Engesgaard, Anne-Sophie Høyer, Flemming Jørgensen, Klaus Hinsby, Birgitte Hansen, Jørn Bo Jensen	41
LIST OF PARTICIPANTS	42

GUIDE

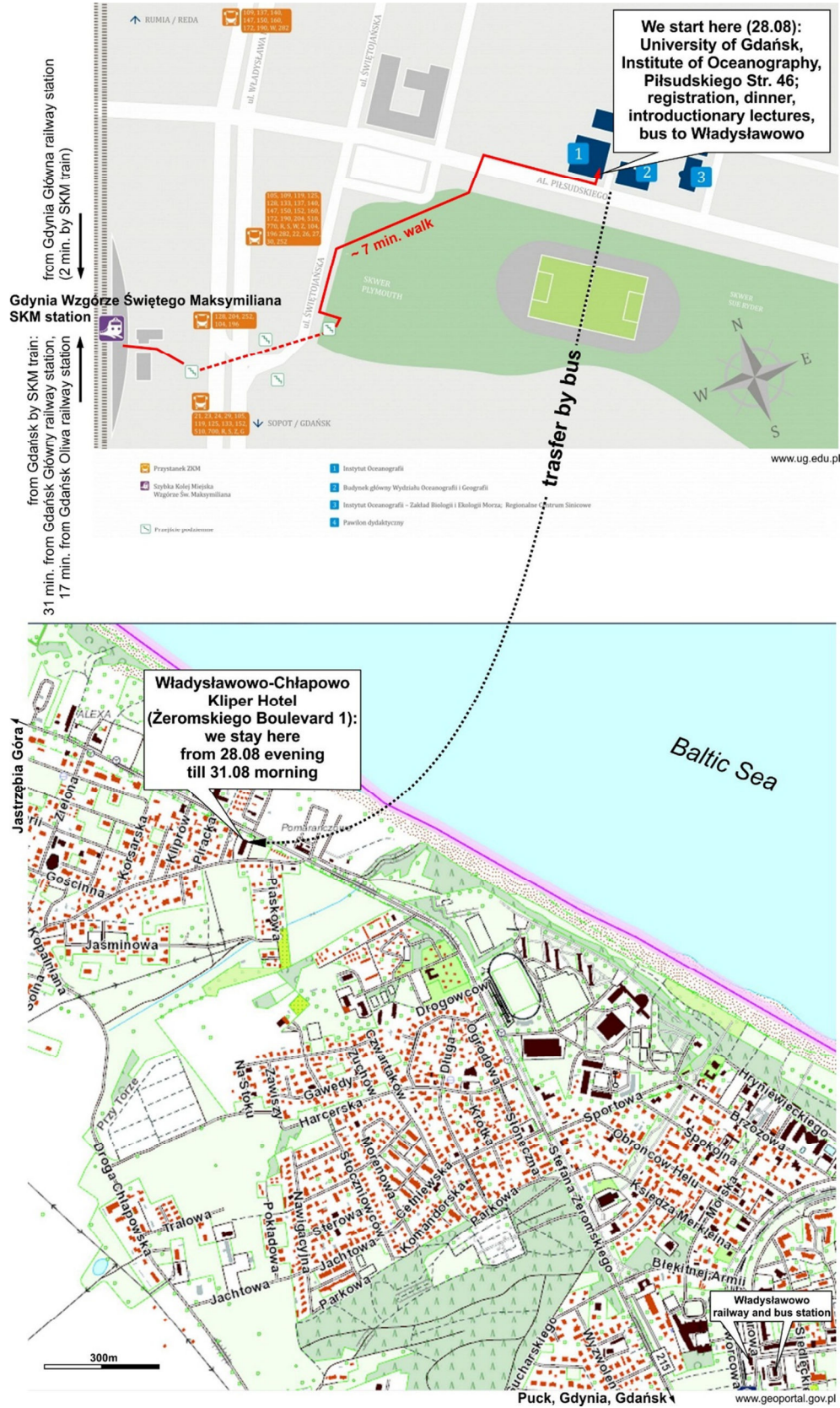


Fig. Location of the Institute of Oceanography in Gdynia and Conference Venue in Władysławowo.

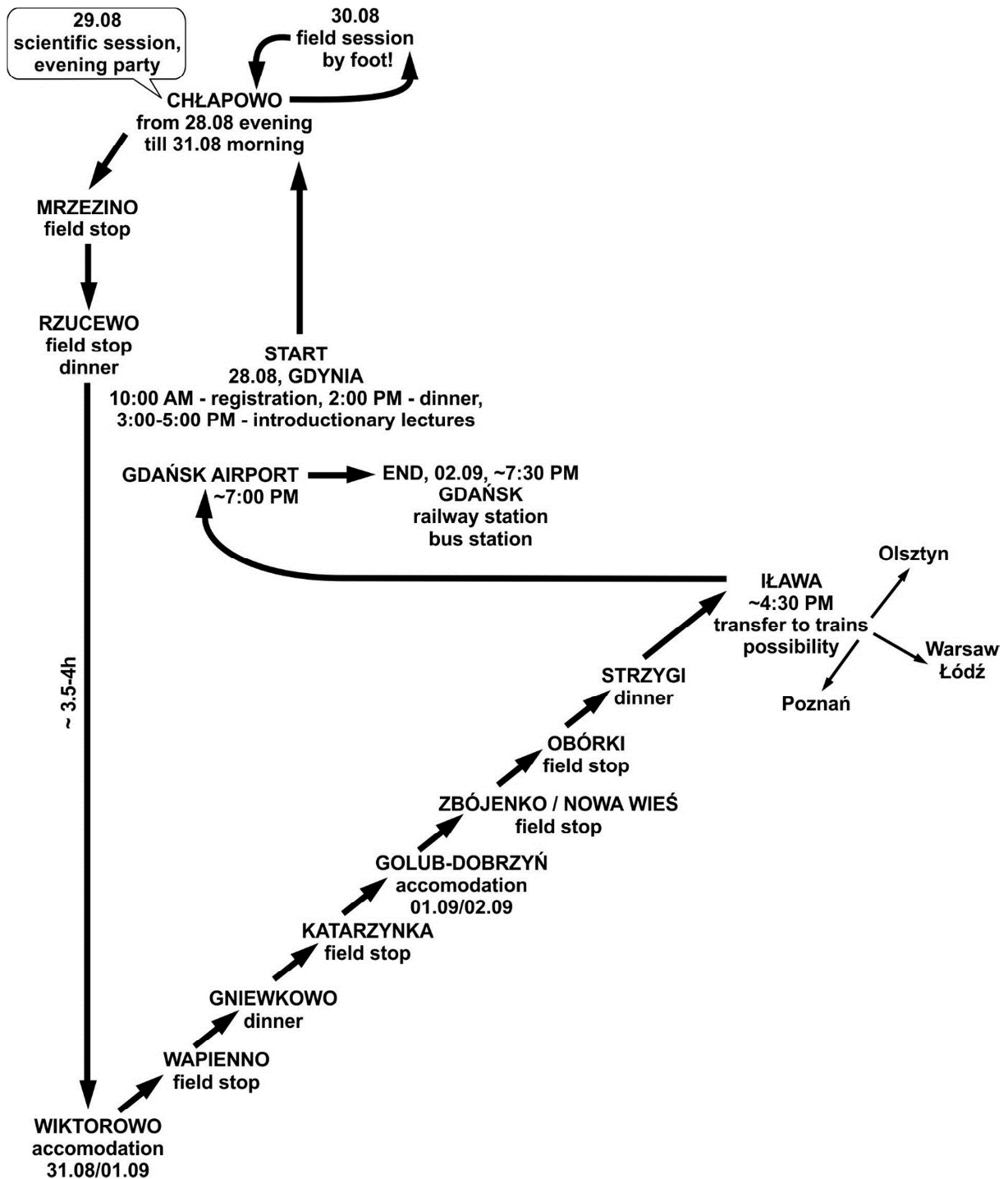









Fig. Schematic chart of the plan of field symposium.

MEETING PROGRAMME

28.08.2016 - Day I Sunday

	10 ⁰⁰ - 14 ⁰⁰	Registration of participants in Institute of Oceanography (al. Piłsudskiego 46, Gdynia)
	12 ³⁰	Optional transfer from Gdansk Airport or Gdynia main railway station to Institute of Oceanography
	14 ⁰⁰ - 15 ⁰⁰	Dinner
	15 ⁰⁰ - 17 ¹⁵	Introductory lectures
	17 ³⁰ - 20 ⁰⁰	Transfer of participants to Władysławowo, accommodation
	20 ⁰⁰ - 1 ⁰⁰	Ice-breaker party

29.08.2016 - Day II Monday

	7 ³⁰ - 8 ³⁰	Breakfast
	9 ⁰⁰ - 10 ⁴⁰	Session 1
	10 ⁴⁰ - 11 ¹⁰	Coffee break
	11 ¹⁰ - 12 ⁵⁰	Session 2
	12 ⁵⁰ - 13 ²⁰	Coffee break
	13 ²⁰ - 14 ⁴⁰	Session 3
	14 ⁴⁵ - 15 ⁴⁵	Dinner
	16 ⁰⁰ - 18 ⁰⁰	Poster session
	19 ⁰⁰ - 1 ⁰⁰	Evening party with local culture theme

30.08.2016 - Day III Tuesday

8:00-9:00 Breakfast

Chłapowo - fluvial sediments of Middle and Upper Pleistocene will be presented. Section reveals vertical transition of different fluvial sedimentation styles. Possible linkage between sediments formation and sea level changes will be discussed. (talk: D. Moskaiewicz, R. Sokołowski)

13:00-14:00 Dinner break

Hel Peninsula - development of sandy barrier under sea level rise with special reference to storm surge hazard and record of storm deposits on local coasts. Participants will observe the barrier on terrace placed 65 m above sea level. (talk: D. Moskaiewicz)

19:30-20:30 Supper

Accommodation- Władysławowo

31.08.2016 - Day IV Wednesday

8:00-9:00 Breakfast

Mrzezino - within Pleistocene sediments there have been separated 4 main units, formed under different depositional processes: fluvial, fluvioglacial and glacial. Sediments were partially deformed by glaciotectionic processes. (talk: R. Sokołowski)

13:00-14:00 Dinner break

Rzucewo - record of different flow types in glaciolimnic basin, generated by various mechanisms will be presented there. Resulting deposits of these flows and accompanied them soft-sediment deformation structures will be shown. (talk: P.P. Woźniak, M. Pisarska-Jamróży)

19:30-20:30 Supper

Accommodation- Wiktorowo

01.09.2016 - Day V Thursday

8:00-9:00 Breakfast

Wapienno - two successions will be presented: fluvial and glacial. Both units contain numerous periglacial structures. Results of petrographic investigation will be discussed and linked with movement direction and dynamics of ice lobes. (talk: R. Sokołowski, P.P. Czubła)

13:00-14:00 Dinner break

Katarzynka - inland dunes formation and transformation during the Late Glacial and the Holocene will be presented. Discussion will also cover a record of main climatogenic and anthropogenic episodes of the landscape evolution in Toruń Basin. (talk: M. Jankowski)

19:00-20:00 Supper

Accommodation- Castle in Golub

02.09.2016 - Day VI Friday

8:00-9:00 Breakfast

Zbójenko and Nowa Wieś - geomorphic and sedimentary record of catastrophic subglacial meltwaters drainage during the last glaciation in central part of the Dobrzyń Lakeland will be presented. Variability of ice-marginal depositional settings will be discussed. (talk: A. Adamczyk, J.A. Piotrowski, W. Wysota)

13:00-14:00 Dinner break

Obórki - two tills of the Saalian and Weichselian glaciations separated by fluvioglacial and fluvioperiglacial sandy deposits will be presented. Glacial processes and ice sheet dynamics under fluctuating subglacial water pressure conditions and processes acting under periglacial conditions will be discussed. (talk: W. Narloch)

16:00-18:00

End of conference. Transfer of participants to Gdańsk via Iława.

CONFERENCE PROGRAMME

SESSION OF INTRODUCTORY LECTURES 28.08.2016	15:00-17:15
OPENING CEREMONY	15:00-15:15
INQUA PERIBALTIC WORKING GROUP HISTORY Peter Johansson	15:15-15:45
UNDER THE PAST ICE SHEETS: PROCESSES, DEPOSITS AND LANDFORMS Jan A. Piotrowski	15:45-16:15
QUATERNARY GEOLOGY AND PALEOGEOGRAPHY OF KASHUBIAN REGION Robert J. Sokółowski	16:15-16:45
QUATERNARY GEOLOGY AND PALEOGEOGRAPHY OF KUJAWY REGION Wojciech Wysota	16:45-17:15
ORAL SESSION 1 29.08.2016	9:00-10:40
3D MICROFABRIC ANALYSIS OF PROGRESSIVE, POLYPHASE SUBGLACIAL DEFORMATION BENEATH THE LATE WEICHSELIAN BALTIC ICE STREAM (SCANDINAVIAN ICE SHEET, EUROPE) Johannes Brumme, H. Hüneke, E. Phillips	
CAN CLAST PLOUGHING PRODUCE MASSIVE SUBGLACIAL TILLS? Jan A. Piotrowski, Włodzimierz Narloch, Aleksander Adamczyk, Charlotte Rasmussen	
PERIGLACIAL FEATURES AND PERMAFROST DISAPPEARANCE DURING MIS-2 IN NORTHERN POLAND AND GERMANY Mirosław Błaszkiwicz, Andreas Börner	
DIVERSITY OF THE FILLINGS OF THE GLACIGENIC KETTLE-HOLES IN THE AREA OF THE ŁÓDŹ PLATEAU (CENTRAL POLAND) Jacek Forysiak, Aleksandra Majecka, Leszek Marks, Anna Toloczko-Pasek, Piotr Majecki	
LIDAR-BASED MAPPING OF GEOMORPHOLOGY, CONSTRUCTION SUITABILITY OF SOIL AND ENVIRONMENTAL IMPACT IN THE SODANKYLÄ REGION, NORTHERN FINLAND Peter Johansson, J. Räisänen, P. Sarala	

SOILS ON BIPARTITE SEDIMENTS AS A PALEO GEOGRAPHIC ARCHIVE

Alexander Makeev, Pavel Kust, Marina Lebedeva

MIS3 PALEOSOLS IN THE CENTER-NORTH OF EASTERN EUROPE AND WESTERN SIBERIA: REDUCTOMORPHIC PEDOGENESIS CONDITIONED BY PERMAFROST WITHIN THIS LATITUDINAL ZONE?

Alexey Rusakov, Sergey Sedov, Vladimir Sheinkman

PALEOENVIRONMENTAL CYCLICITY BASED ON CARBONATE ANALYSIS DATA OF NON-GLACIAL SEDIMENTS FROM LITHUANIA

Eugenija Rudnickaitė

TIMING OF ENVIRONMENTAL CHANGES DURING THE DECLINE OF THE VISTULIAN (18–11.5 KA CAL BP) USING FREQUENCY DISTRIBUTION OF RADIOCARBON DATES FOR THE ŁÓDŹ REGION, CENTRAL POLAND

Danuta DzieduszyńskaPALAEOECOLOGICAL INVESTIGATIONS AND ²³⁰TH/U DATING OF THE EEMIAN INTERGLACIAL PEAT SEQUENCE NEUBRANDENBURG-HINTERSTE MÜHLE (NE-GERMANY)**Andreas Börner, Anna Hrynowiecka, Renata Stachowicz-Rybka, Monika Niska, Magdalena Moskal-del Hoyo, Vladislav Kuznetsov, Fedor Maksimov, Aleksey Petrov**

PALAEOGEOGRAPHICAL PROPERTIES CONDITIONING THE CONSTRUCTION AND UTILIZATION OF WELLS FROM THE ROMAN PERIOD IN THE KWIATKÓW SITE

Joanna Petera-Zganiacz, Magdalena Piotrowska, Danuta Dzieduszyńska, Jacek Forysiak, Juliusz Twardy, Seweryn Rzepecki, Daniel Okupny

CYCLIC GLACIOFLUVIAL EROSIONAL MORPHOLOGY AND DELTAIC DEPOSITS IN SOUTHERN FINNISH LAPLAND

Pertti Sarala, Jukka-Pekka Palmu, Joni Mäkinen, Jukka Räisänen

MIDDLE AND LATE HOLOCENE PALEOENVIRONMENTAL EVOLUTION OF THE CURONIAN LAGOON, LITHUANIA

Giedrė Vaikutienė, Donatas Kaminskas, Eugenija Rudnickaitė, Albertas Bitinas, Alma Grigienė, Ilya V. Buynevich, Aldona Damušytė, Donatas Pupienis

PALAEOSEISMICITY OF THE EASTERN BALTIC REGION: IMPLICATIONS FOR THE SEISMOLOGICAL RISK ASSESSMENT

Albertas Bitinas, Aldona Damušytė, Andrius Pačėsa

PLEISTOCENE ARCHITECTURE AND STRATIGRAPHY IN THE CONTACT ZONE OF ICE STREAMS AND LOBES IN THE SOUTHEASTERN PART OF THE BALTIC REGION

Valentinas Baltrūnas, Bronislavas Karmaza, Violeta Pukelytė, Danguolė Karmazienė

REGIONAL AND LOCAL ICE FLOW DIRECTIONS OF THE LAST SCANDINAVIAN ICE SHEET IN CENTRAL POLAND

Małgorzata Roman, Piotr Czubla

SUITABILITY OF ERRATIC BOULDERS IN NW POLAND FOR COSMOGENIC DATING OF THE LAST SCANDINAVIAN ICE SHEET RECESSION

Karol Tylmann, Piotr P. Woźniak, Vincent Rinterknecht

MELTWATER DRAINAGE SYSTEM IN A COLD SVALBARD GLACIER

Jan A. Piotrowski, Lena U. Hansen, Doug I. Benn

GLACIAL CURVILINEATIONS (GCLS) - AN INDICATION OF SUBGLACIAL CHANNELIZED MELTWATER FLOWS

Jan A. Piotrowski, Aleksander Adamczyk, Wojciech Wysota

RECORD OF THE WEICHSELIAN CLIMATE CHANGES IN THE VISTULA TERRACES ON THE EXAMPLE OF THE SITES OF ROGÓW AND GOŁĄB

Robert J. Sokolowski, Paweł Zieliński, Barbara Woronko, Michał Jankowski, Stanisław Fedorowicz, Karol Standzikowski

LOCAL STRATIGRAPHY OF THE QUATERNARY DEPOSITS FILLING OF THE WESTERN PART OF THE KLESZCZÓW GRABEN, CENTRAL POLAND

Lucyna Wachecka-Kotkowska, Dariusz Krzyszkowski, Dariusz Wieczorek, Jerzy Raczyk, Katarzyna Adamczyk

A NEW SITE OF THE HOLSTEINIAN(?) LIMNIC DEPOSITS IN THE KSIĄŻNICA OUTCROP AT KRZCZONÓW, SUDETY FORELAND

Lucyna Wachecka-Kotkowska, Dariusz Krzyszkowski, Zdzisław Jary, Małgorzata Malkiewicz, Jarmila Krzysińska, Dariusz Ciszek, Monika Niska, Elżbieta Myśkow, Jerzy Raczyk, Wojciech Drzewicki, Dawid Hamryszczak, Jerzy Nawrocki, Klara Tomaszewska, Monika Rzodkiewicz

PALYNOLOGICAL AND GEOCHEMICAL RECORD OF LATEGLACIAL CLIMATIC OSCILLATIONS: A CASE STUDY FROM LAKE RADUŃSKIE, NORTHERN POLAND

Dawid Weisbrodt, Małgorzata Latalowa

DUNE PALAEODYNAMICS ALONG THE CURONIAN SPIT, SOUTHEASTERN BALTIC

Albertas Bitinas, Nikita Dobrotin, Anatoly Molodkov, Ilya V. Buynevich, Aldona Damušytė, Virgilija Gregorauskienė, Jonas Mažeika, Donatas Pupienis

HOLOCENE HISTORY OF ENVIRONMENTAL DYNAMICS: MULTI PROXY APPROACH FROM THE ČEPKELIAI HIGHMOOR, SE LITHUANIA

Laura Gedminienė, Miglė Stančikaitė, Ričardas Taraškevičius, Gražyna Gryguc, Rimantė Zinkutė, Jonas Mažeika

DEVELOPMENT OF THE SANDY BARRIER UNDER SEA-LEVEL RISE: THE FUTURE OF HEL PENINSULA

Damian Moskalewicz

EFFECTS OF CLIMATE VARIABILITY ON SALTWATER INTRUSIONS IN COASTAL AQUIFERS IN SOUTHERN DENMARK

Jan A. Piotrowski, Rena Meyer, Torben Sonnenborg, Peter Engesgaard, Anne-Sophie Høyer, Flemming Jørgensen, Klaus Hinsby, Birgitte Hansen, Jørn Bo Jensen

ORAL SESSION ABSTRACTS

3D MICROFABRIC ANALYSIS OF PROGRESSIVE, POLYPHASE SUBGLACIAL DEFORMATION BENEATH THE LATE WEICHSELIAN BALTIC ICE STREAM (SCANDINAVIAN ICE SHEET, EUROPE)

Johannes Brumme*¹, H. Hüneke, E. Phillips

¹Institute of Geography and Geology, University of Greifswald, Germany, e-mail: J_Brumme@gmx.de

We present the results of a detailed micro- and macrostructural study on the Late Pleistocene subglacial tills exposed in the sea cliffs at Jasmund on the Island of Rügen, northern Germany. These deposits form part of a major thrust and fold complex which developed as a result of glaciotectonism associated with the highly dynamic Baltic Ice Stream; the latter drained the Scandinavian Ice Sheet during the last glaciation in northern Europe. The island of Rügen is located on the southwestern Baltic Sea coast and was situated at the southern marginal zone of the Scandinavian Ice Sheet during the late Weichselian. Sediment-landform associations and flow-direction criteria derived from a variety of glacial deposits have been used to reconstruct successive glacial advances and retreats of this highly dynamic ice sheet across the Island of Rügen.

The microfibrils developed within the tills laid down by the Scandinavian Ice Sheet have been studied by means of a three-dimensional analysis based on the microstructural mapping methodology, enabling the identification and interpretation of the successive generations of fabrics in terms of a progressive, polyphase deformation history. The data sets derived from three perpendicularly oriented thin sections taken from 10 block samples, were used to construct detailed 3D models of the planar and linear microfibrils developed within the tills. The cross-cutting patterns of the microstructural domains which define these fabrics have been used to reconstruct a temporal succession of deformation events which occurred in response to ductile shearing imposed by the overriding ice. Three successive generations of microfibril have been identified: S1 (oldest) is a heterogeneously developed, up-ice-dipping, planar foliation (S fabric); whereas S2 is represented by a locally well-developed, down-ice-dipping linear fabric (L fabric); and S3 (youngest) is an anastomosing, variably developed subvertical fabric which probably formed as a result of the dewatering of the till during final stages of the shear event and the “locking” of the subglacial shear zone.

Shear-sense indicators, including asymmetrical S-C fabrics and C'-type shear bands, present within the tills are used to reconstruct the direction of ice flow responsible for subglacial deformation. This evidence, coupled with the orientation and relative age relationships displayed between the microfibrils have enabled the construction of a detailed 3D model of subglacial deformation beneath the Baltic Ice Stream. This progressive, ductile shearing event records a changing pattern of polyphase deformation which can be directly related to changes in the regional ice-flow direction across the Island of Rügen.

CAN CLAST PLOUGHING PRODUCE MASSIVE SUBGLACIAL TILLS?

Jan A. Piotrowski*¹, Włodzimierz Narloch, Aleksander Adamczyk, Charlotte Rasmussen

¹Department of Geoscience, Aarhus University, Denmark, e-mail: jan.piotrowski@geo.au.dk

Pleistocene ice sheets moved over soft beds by some combination of basal sliding and bed deformation. The latter process, besides contributing to the forward movement of ice, has been suggested to effectively mix the subglacial material by intergranular advection producing homogeneous basal tills as depositional end-products. Pervasive deformation in a soft, water-saturated, several-meters-thick basal sediment layer that yielded in response to glacier stress has been postulated as a widespread process under the Scandinavian, British-Irish and Laurentide ice sheets.

Here we investigate in detail the properties of a massive basal till of Weichselian glaciation at Sønderby, western Denmark in a single vertical profile spanning over 5 m of the till thickness and sampled in 26 closely spaced intervals. Grain-size distribution, fine-gravel composition, macroscopic and AMS till fabrics, micromorphological structures, and grain-shape characteristics all exhibit remarkably low variability indicating profound mixing of the material by a common and consistent process. We suggest that the mixing was primarily caused by clasts projecting from the ice sole that ploughed the bed before they were lodged and stabilized. Such clasts, typically with flattened and striated upper surfaces occur frequently in the Sønderby till. Calculations show that every part of the till during its formation must have experienced multiple ploughing events that cumulatively generated a well-mixed, homogenous basal till.

These results suggest that pervasive subglacial sediment deformation is not required to produce massive basal tills and be the predominant mechanism of ice-sheet movement and subglacial sediment transport. Instead, we favor a simpler process involving localized and non-pervasive yet efficient ploughing by clasts dragged along the ice/bed interface.

PERIGLACIAL FEATURES AND PERMAFROST DISAPPEARANCE DURING MIS-2 IN NORTHERN POLAND AND GERMANY

Mirosław Blaszkiewicz^{*1}, Andreas Börner

¹Institute of Geography and Spatial Organization, Polish Academy of Sciences, Poland, e-mail: miroslaw.blaszkiewicz@geopan.torun.pl

Periglacial areas are those which, although not actually glaciated, have been exposed to very cold conditions with intense frost action and the development of perennially frozen ground or permafrost. At the time of the maximum Late Weichselian glaciation, very harsh climatic conditions prevailed. It is possible to identify many landscape features of lowland in Northern Poland and Germany which represent relict features of periglacial activity. These features include ice wedge casts, polygons and other surface patterns, cryoturbation structures, pingo scars and thermokarst features. Permafrost can be defined as ground in which the temperature remains at or below 0°C for at least two years. Such ground is usually frozen and ice-rich but not always, because earth materials may be below 0°C in temperature but remain unfrozen. A discussion, however, is raised by the issue of the permafrost existence in the last glaciated area. Recent studies of the areas covered by the last glaciation indicate that the disappearance of permafrost under the ice sheet was not complete, and even that it was limited only to the subglacial water circulation zones. More recently, in the last-glaciated area the possibility of partial preservation of permafrost under the ice sheet originating from the transgression period has been considered. An important argument in this discussion is the important role of permafrost under the ice sheet in the formation of subglacial drainage and subglacial channels.

In the course of research in the Last Glaciation area some evidence pointing to encroachment of permafrost on the land released from the ice sheet were brought together. The most important include thermal contraction cracks, oriented kettle holes on outwash plains, permafrost-affected horizons in soil profiles, as well as the long-term preservation of buried dead ice blocks in depressions.

From the point of view of the appearance of lake deposits, three main lake generations were distinguished: 1. “early” pre-Allerød lakes, 2. lakes of the Bølling-Allerød period and 3. “late” generation of lakes, generated not until the Preboreal period. In the context of the time of the final permafrost decay, the lakes of the youngest, Preboreal generation are particularly important, since the lakes age differentiator was the varied length of preservation of lake basins by buried dead ice blocks, which in turn was dependent primarily on the conditions of surface drainage network. The buried ice was preserved until the Preboreal period justifies the thesis about the preservation of permafrost patches. Under the permafrost conditions, full preservation of dead ice blocks took place when the mineral cover reached the thickness corresponding to the depth of the active layer. In this way, buried dead ice blocks became an essential element of the permafrost. Under thermokarst, at the places where dead ice blocks existed, quickly spreading taliks formed, which greatly hastened the process of permafrost degradation.

In the northern Germany are some local evidences of periglacial features, like meso scaled ice wedges pseudomorphs and active layer based ball-and-pillow graviturbations, showing clearly the retreat of discontinuous permafrost during Younger Dryas period. The preservation of dead-ice masses in some local depressions until the Preboreal leads to the conclusion that the ultimate disappearance of permafrost in the study area occurred only at the beginning of the Holocene.

DIVERSITY OF THE FILLINGS OF THE GLACIGENIC KETTLE-HOLES IN THE AREA OF THE ŁÓDŹ PLATEAU (CENTRAL POLAND)

Jacek Forysiak*¹, Aleksandra Majecka, Leszek Marks, Anna Toloczko-Pasek, Piotr Majecki

¹Institute of Earth Sciences, University of Lodz, Poland; e-mail: jacekfor@interia.eu

The studied area is situated in Central Poland on the Łódź Plateau. The development of its land relief was an effect of the glacigenic processes of the Wartanian glaciation and transformations influenced by slope, fluvial and aeolian processes in the Vistulian. The most distinctive features of the geological surface structure, as well as the geomorphological image of the area are small kettle-holes without outflow. They were formed as a result of melting of ice blocks during the decline of the Wartanian Stadial of the Odranian Glaciation). Subsequently, they underwent multi-stage transformations, under the conditions of the Eemian, and the varying climate conditions of the Vistulian.

Despite the fact that the studied kettle-holes developed under similar climate and morphogenetic conditions, the sediments that fill them are varied. The research have shown the existence of distinct formations filled by fully mineral, mineral-organic, and fully organic matter. The thickness of the series of the fillings is also not uniform. The majority of the kettle-holes appear as barely visible in the contemporary surface, mostly as slight depressions or entirely flat surface. Even though they initially functioned as separate entities, the extensive surface transformations under the periglacial conditions of the Vistulian connected their basins to one another as well as to a system of denudation valleys. Only a few remained as basins without outflow to the present day.

The causes of the diversity of the filling of the studied kettle-holes and the transformations of their basins are: location in different morphological situations in/on the initial postglacial surface, the lithology of the surface formations that surround a given kettle-hole, as well as the lithology of the sediments in the bottom of a kettle-hole. After the melting of glacial ice, during the decline stage of the glaciation mineral sediments – sandy silt and silty loam - were accumulated. If the supply of mineral sediments was limited and the kettle-holes were filled with water, mineral-organic sediments were accumulated. The warming of the Eemian Interglacial and the development of a dense plant cover limited the slope processes that had previously delivered sediments into the kettle-holes. The kettle-holes that had been filled with water or had soaked bottoms underwent peat accumulation or transformed into lakes with increasing thickness of organic deposits. It is possible that this stage lasted until the Early Vistulian.

The maximum intensity of denudation processes in the Plenivistulian in many cases led to a complete filling with mineral sediments but also to chain-linking of previously isolated kettle-holes into complex structures or to the formation of denudation valleys that connected them. Only a limited number of kettle-holes endured through this stage in the form of isolated basins and became filled with organic-mineral sediments.

LIDAR-BASED MAPPING OF GEOMORPHOLOGY, CONSTRUCTION SUITABILITY OF SOIL AND ENVIRONMENTAL IMPACT IN THE SODANKYLÄ REGION, NORTHERN FINLAND

Peter Johansson*¹, J. Räisänen, P. Sarala

¹Geological Survey of Finland, Finland, e-mail: peter.johansson@gtk.fi

High-resolution digital elevation maps generated by airborne LiDAR (Light Detection And Ranging) has improved the mapping process by clarifying interpretation of densely forested areas and allowing the identification of detailed land surface features not originally distinguished in the aerial photos and in the field. It is an optical remote sensing technology based on laser pulses transmitted by an active sensor, or a laser scanner and on accurate location information. LiDAR data is typically used to produce elevation models, as the technique is particularly well suited for providing the elevation data of the ground beneath the vegetation canopy. The Geological Survey of Finland (GTK) carried out geomorphological mapping in 2013-2014 in the Sodankylä region of northern Finland. The mapping area covered about 370 km², with the LiDAR data having a pixel size of 2 m x 2 m and vertical resolution 0.3 m. The mapping process was supported by the Quaternary stratigraphical and geochronological works.

The geomorphology of the area consists of large till-covered hills, ground moraine plains, glaciofluvial sand and gravel deposits composed of esker systems and related delta and outwash formations of the Weichselian cold stages, followed by pro-glacial glaciolacustric and post-glacial lacustric and fluvial deposits and Holocene mires. The study proved that the benefit of LiDAR data compared with traditional interpretation methods was in more detailed identification of surface deposits particularly in densely forested areas. This is an advantage, for example, in the case of till-covered stratified sand and gravel deposits, and in shallow till areas where the LiDAR interpretation provides more precise edging of the morphologies. It evolved into an important tool for detecting glaciohydrographical landforms of different kinds and development of ice lake stages. As an example, it was also possible to distinguish several till-covered delta and sandur deposits which based on OSL dating date back to the Early Weichselian stadial (74-89 ka).

By combining and interpreting soil and bedrock data thematic maps were also produced. The most important land use properties, which are practical to present in map form, are the construction suitability of soil and the environmental impact. The construction suitability of soil map is based on the compaction and excavation of soils, the gradient of the ground and the depth of frost limit and groundwater level. They have an effect on construction the foundation of buildings or roads. The soils are classified as three classes: good, moderate and weak capability. A crystalline bedrock outcrop is the fourth group.

There are thousands of tank trucks in the highways, which carry chemical compounds to the industrial estates. In the case of traffic accident, the compounds can spread and penetrate into the ground. A map of environmental impact describes the fluctuations in the infiltration capacity of soil and bedrock. It controls the extent of the damages and the magnitude of the groundwater pollution. The map is useful in the environmental impact assessment studies, in the control of risks and in the land use planning. The soils were divided into four group: permanent, quite permanent, nearly permeable and permeable. Additionally rock areas were divided after the density of fractures.

SOILS ON BIPARTITE SEDIMENTS AS A PALEOGEOGRAPHIC ARCHIVE

Alexander Makeev*^{1,2}, Pavel Kust, Marina Lebedeva

¹Institute of Geography, RAS, Moscow, Russia,

²Faculty of Soil science, M.V. Lomonosov Moscow State University, Russia,

e-mail: makeevao@gmail.com

Base tills of Moscow (Late Saalian, Warthe, and MIS6) glaciation form important component of landscapes in northern Europe, including the centre of the Russian Plain. They are often covered only with a thin veneer of sands, sandy and silty loams, so that surface soils are formed on bipartite sediments. The study of such soils as pedosedimentary sequences allows identifying a set of lithological, pedogenic and cryogenic features that had been formed during various stages within several climatic cycles.

The lower units of bipartite sediments are reddish-brown diamictons. The bright reddish-brown colour and high birefringence of plasma is typical for base tills of Moscow age and are inherited from sediments mobilized by the glacier. Uniform composition of tills indicates effective mixing and homogenization of material along the ice flow path. Glacial till architecture includes sand lenses and heterogenic fragments due to the filling of small subglacial cavities. Glaciotectonic deformation structures include shearing features, folding, thrusting and rotational structures, tension fractures, till wedges and other evidences of emplacement of matrix within the mobile sediment.

During and immediately after deposition diamictons were overlain by veneer of fluvio-glacial sands with an aeolian admixture with the minimal thickness of 45 cm. Aeolian input results either in a separate silty layer, patches of silty material or in the admixture of silty particles. Such pattern indicates that aeolian input accompanied deposition of melt-water sediments and final depositional stages occurred in arid environments. Prismatic structural units that could be traced throughout the whole strata of glacial till had been formed by shrinking during sediment stabilization. Impact of a long pedogenesis, presumably occurring during the last interglacial (MIS5) is well seen in the lower unit of bipartite sediments. It is resulted in the formation of pedogenic structural architecture (cracks, superimposed on earlier prismatic units, subangular blocky peds and porosity) and well-developed multi-layered clay cutans. These lead to the formation of a sequence of Bt horizons. Platy structure due freeze-thaw cycles may be observed within the upper meter of diamicton. Irregular network of frost fissures indicate severe freezing. Frost features include stone lines on the border of cover layer and diamicton, signs of cryoturbation (lenses and pockets) and sand grain circles. Cryogenic features are responsible for intermixing of cover layer and till deposits, resulting in the complicated morphology of EBt horizons. Streaks of Bt horizon are presented in the frost wedge fillings, while clay cutans are absent here, indicating that cryogenic stage succeeded pedogenesis, presumably during Valday (Wurmian) glacial time.

Holocene pedogenesis being mostly of eluvial - illuvial character, probably strengthens initial lithological discontinuity of bipartite parent material. Soil horizonation is clearly seen within the upper unit (a sequence of A and E or Bw horizons). Clear record of final stages of sedimentation and ancient pedogenesis within profiles of day-surface soils in glacial tills may help to derive reliable palaeoclimatic interpretation from the last interglacial - glacial cycle till present. Correlation of these records with other archives in glacial and periglacial areas opens attractive research perspectives.

MIS3 PALEOSOLS IN THE CENTER-NORTH OF EASTERN EUROPE AND WESTERN SIBERIA: REDUCTOMORPHIC PEDOGENESIS CONDITIONED BY PERMAFROST WITHIN THIS LATITUDINAL ZONE?

Alexey Rusakov*¹, Sergey Sedov, Vladimir Sheinkman

¹ Institute of Earth Sciences, Saint-Petersburg State University, Russia,

e-mail: a.rusakov@spbu.ru

Paleosols formed during Marine Isotope Stage 3 (corresponding to Middle Pleniglacial of the last glacial period) comprise one of important terrestrial proxies of environmental changes. The MIS3 paleosol units comprise a prominent element of the loess-paleosol sequences throughout the Eurasian Loess Belt. To the north of the loess regions, the findings of MIS3 paleosols were few: it was supposed that geomorphic processes related to the extensive ice cover of the Last Glacial Maximum destroyed the earlier soil mantle. Recently, much smaller extent of continental ice in the east of Northern Europe and ice-free West Siberian Plain during MIS2 has been hypothesized, supposing preservation of MIS3 and earlier paleopedological records.

We discovered in the centre-north of European Russia (Upper Volga basin, Yaroslavl and Vologda Oblast of Russia, 57°–59° N) and Western Siberia (Middle Ob basin, Khanty-Mansi Autonomous Okrug of Russia, 61°–62° N), MIS3 paleosols within the Late Pleistocene alluvial and lacustrine sequences and correlated the studied profiles on the basis of macro- and micromorphological characteristics and radiocarbon datings of the paleosol organic materials. Radiocarbon dates of the paleosol organic matter vary between 27–51 ka cal BP (Upper Volga basin) and 27–35 ka cal BP (Middle Ob basin). Paleosols are represented by hydromorphic profiles with Histic horizons and gleyic colour pattern. Conspicuously, they are developed in the well-drained geomorphic positions, where modern soils are non-gleyic.

We suppose that the presence of permafrost was responsible for water logging and generation of reductomorphic soil environment. We further hypothesize a northern zone of MIS3 soil mantle, comprised of Histic and Reductaquic Cryosols different from synchronous Cambisols and Chernozems formed within loess sequences to the south.

This study was supported by RFBR (14-04-00894a).

PALEOENVIRONMENTAL CYCLICITY BASED ON CARBONATE ANALYSIS DATA OF NON-GLACIAL SEDIMENTS FROM LITHUANIA

Eugenija Rudnickaitė*¹

¹Faculty of Natural Sciences, Vilnius University, Lithuania, e-mail: eugenija.rudnickaite@gf.vu.lt

Total content of carbonates and their mineralogical composition of non-glacial sediments taken from interglacial deposits of different age were determined. The samples were taken from stratotypic outcrops and wells sections of Pleistocene interglacial, Late Glacial and Holocene of Lithuania.

This study is based on the presumption that in the interglacial lakes as well as in the recent ones sedimentation at some extent is controlled by climate. Content of carbonates in non-glacial deposits increase during climate warming and flourishing of organic world. The data of carbonates and spore-pollen from interglacial deposits of different age were compared. Sufficiently good and confident correlation coefficients between carbonates and palynological data were established. It enabled to reconstruct the conditions of paleoclimate from the fossils lacking strata. The direct relationship between carbonates and vegetation development caused by climate during Pleistocene interglacial, Late Glacial and Holocene was established.

The variation of carbonates and their composition is in good agreement with palynological and diatoms studies data and reflect the variation of paleogeographical conditions. It was noticed that curves of carbonate content visually almost precisely coincide with the curves of climate change constrained from glaciers of Greenland and Antarctica (Delta-O-18 record from the NGRIP core). The mineralogical composition of carbonates and their quantities variation in non-glacial deposits reflect climate conditions during sedimentation. The latter fact enables us to reconstruct general climate features, judge about position of sedimentary basin during sedimentation. The cyclicity of peaks of carbonates sedimentation reflects global climate change cycles and is in agreement with global climate change curves of Greenland and Antarctica. This gives us a possibility to reconstruct and forecast forthcoming changes of natural environment (climate and ecological).

Obtained results show uneven distribution of carbonates in the studied sections. The variation curves of carbonates content are coincident to those of vegetation and represent climate and paleoenvironment variation cyclicity.

TIMING OF ENVIRONMENTAL CHANGES DURING THE DECLINE OF THE VISTULIAN (18–11.5 KA CAL BP) USING FREQUENCY DISTRIBUTION OF RADIOCARBON DATES FOR THE ŁÓDŹ REGION, CENTRAL POLAND

Danuta Dzieduszyńska*¹

¹Institute of Earth Sciences, University of Łódź, Poland,
e-mail: danuta.dzieduszynska@geo.uni.lodz.pl

The objective of the study is to determine the timing of shifts in the environmental conditions in the Vistulian decline, from ca. 18 ka cal BP onwards, by tracing the course of the probability distribution function (PDF) of the selected radiocarbon dates. The analysis is based on a set of 175 ¹⁴C individual dates of geological samples from 55 localities of the Łódź region, situated in the old-morainic part of Central Poland. The radiocarbon dates were calibrated using the OxCal v. 4.2 programme, Calib programme and the calibration curve IntCal 13. The obtained individual distributions were summed up and the probability density function (PDF) in calendar timescale was constructed.

The conclusions formulated follow the assumption that the shape of the PDF results from a combination of preferential sampling, determined primarily by environmental conditions favouring organic production, and calibration curve properties; therefore the maxima reflect warmings and the minima illustrate deteriorating climatic conditions. By comparing the function with the results obtained during comprehensive palaeogeographical investigations of the area of the discussed time interval, the author aim to highlight the regional characteristics of the course of events in relations to chronostratigraphic data from well-elaborated localities and to global signal from independent chronologies (e.g. ice-core Greenland record).

Evaluation of the collated dates together with geological, geomorphological and ecological evidence supplied by published sources give insight into timing and pace of changes during the transitional time of rebuilding of periglacial realm into moderate conditions. Timing of individual climate-stratigraphic units was established, including cool intervals for which the limited organic production often hampers radiocarbon dating. The following ages are proposed (in ka cal BP): pre-Oldest Dryas warming up to 17.2, Oldest Dryas 17.2 – 14.2, Bölling 14.2 – 13.5, Older Dryas 13.5 – 13.25, Alleröd (early) 13.25 – 13.05, inter-Alleröd oscillation 13.05 – 12.85, Alleröd (late) 12.85 – 12.6, Younger Dryas from 12.6. The steep sections of the function (wiggles) highlight fluctuations of the calibration curve, thus indicates periods during which the substantial environmental changes occurred. Important seems the confirmation of warming in the region at ca. 18 ka cal BP, associated with retreat of the ice sheet and substantial environmental events. A contribution to the knowledge of the palaeogeography of the region is the recognition in the record of the cold inter-Alleröd period. So far there is no findings of this cooling neither from other sedimentary environments nor from pollen record in the study area.

The ages for the start and end of the units fit well with centennial oscillations recognized in an overregional scale, thus support the idea on global driving mechanism of the Late Glacial environmental events in the study area. Good agreement of the frequency distribution and conclusions drawn from other regional data causes that the analysis can be a supplementary tool in regional chronostratigraphical studies, especially in old glacial areas where high resolution record of laminated material is unavailable.

PALAEOECOLOGICAL INVESTIGATIONS AND ²³⁰TH/U DATING OF THE EEMIAN INTERGLACIAL PEAT SEQUENCE NEUBRANDENBURG-HINTERSTE MÜHLE (NE-GERMANY)

Andreas Börner*¹, Anna Hrynowiecka, Renata Stachowicz-Rybka, Monika Niska, Magdalena Moskal-del Hoyo, Vladislav Kuznetsov, Fedor Maksimov, Aleksey Petrov

¹Nature protection and Geology of Mecklenburg-Western Pomerania - State Geological Survey, Germany, e-mail: andreas.boerner@lung.mv-regierung.de

The Eemian interglacial sequence was explored in the gravel pit “Neubrandenburg-Hinterste Mühle” (HM) near Neubrandenburg (NE-Germany). The HM-profile is situated in a former (buried) kettle hole depression between underlying till (Wartanian) covered by Weichselian till unit. According to the palynological classification of Strahl the HM-section represents the first complete Eemian sequence in Mecklenburg-Western Pomerania. The main aim of our investigation was a high resolution record with supplemented proxies and new dating results of the entire sequence.

The limnic sedimentation began during the Late Saalian period in a landscape characterized by herbaceous vegetation and heliophytes. Later, cool, clear and calcium carbonate-rich lake water dominated, inhabited by Characeae that indicates a presence of stonewort meadows, most typical to waters up to 10 m in depth. The beginning of Eemian interglacial succession is characterized by a dominance of light birch forest followed by pine forest. The beginning of mesocratic ecological phase of the Eemian is characterized by the development of thermophilic communities initially dominated by oak forest with appearance of warm climate indicators. The ensuing climate optimum was characterized by the encroachment of hazel-oak forest and after by mixed deciduous forest. Limnic sedimentation ceased in the basin during this phase and the end of dominating limnic conditions is marked by a decrease in the frequency of aquatic vegetation and an increase in the amount of brown mosses. In the interglacial optimum mixed forests reigned. This phase bears a record of oligotrophication in transition bog and raised bog and the aquatic plants vanished. The depression gradually became shallower and was overgrown by a forest cover. During the telocratic phase of the Eemian communities with pine, birch and fir spread. The ending interglacial is characterized by a disappearance of the riparian forest and a sporadic appearance of plant rushes.

At the beginning of Early Weichselian a deterioration of climatic conditions formed a highly spread heaths on acid soils and trees withdrew. The HM-sequence shows the development of a small kettle hole lake and its transformation to a overgrowing peat bog including terrestrialization processes during Eemian interglacial. The U/Th data obtained for five samples from the upper part of the HM-profile had been analysed by TSD technique yielded age of $116 \pm 13/10$ ka and provide a good estimate for a deposition during MIS-5e in good agreement with the biostratigraphical classification.

PALAEOGEOGRAPHICAL PROPERTIES CONDITIONING THE CONSTRUCTION AND UTILIZATION OF WELLS FROM THE ROMAN PERIOD IN THE KWIATKÓW SITE

Joanna Petera-Zganiacz^{*1}, Magdalena Piotrowska, Danuta Dzieduszyńska, Jacek Forysiak, Juliusz Twardy, Seweryn Rzepecki, Daniel Okupny

¹Institute of Earth Science, University of Łódź, Poland, e-mail: joanna.petera@geo.uni.lodz.pl

Kwiatków site is located in the north-south oriented section of the Warta river valley, where the valley expands to 10 km in width and where joins with the W-E oriented Warsaw-Berlin ice marginal valley. During the Vistulian the area remained under periglacial conditions. The present-day relief is generally dominated by flat and monotonous area. The major relief element in the Kwiatków site is the extensive low terrace of the Late Vistulian age and the narrow valley bottoms of the Holocene age. The low terrace is cut by numerous streams – a remain of a multichannel system of the Warta river developed here at the end of the Younger Dryas and reactivated in the Holocene. Individual river channels of this system were separated with stable, sandy islands. The interchannel area, where the Kwiatków site is located, is covered with aeolian sands.

The vertical profile of sediments of the low terrace, consists of about 50 cm thick organic rich deposits and about 2-3 m thick sandy or sandy-silty series, locally covered by aeolian sand. A characteristic feature of the organic series is the presence of well-preserved tree remains, such as collapsed trunks, in situ stumps and branches. In the interchannel area with the Kwiatków site, a vast settlement complex were constituted. Majority of the discovered archaeological sources is associated with the settlement of the Przeworsk culture population dated to the pre-Roman and Roman periods. Among the registered features there were ovens, hearths, storage facilities, in-ground post constructions and unspecified pits. However, the most interesting features are represented by a large complex of wells. These features are part of the complex, distinguishing the presented site against other settlements related to this period. The basic criterion for classification of the well type was the shape of the casing. The well boardings can be classified into: 1 – wells with a round casing, made from a hollowed tree trunk, 2 – wells with a casing resembling a quadrangular "box". The main material utilized for construction of the wells was oak. The presence of the well-preserved construction timber allows to analyse the morphology of the features and the stage of its technological advancement, but above all, provides material to dendrochronological studies. Dates obtained so far indicate that the wells were constructed in the early Roman period – mostly in the II AD. A special attention should be given to the spatial and functional relationships of the location of the wells in Kwiatków. Some of them were in the immediate vicinity of shallow pithouses of the pole structures which probably functioned as workshops. Perhaps these were the places of specialized production requiring a permanent supply of water. It should be highlighted that in prehistory the area was characterized by an abundance of flowing waters and stability of groundwater table. Structures of wells in Kwiatów were based or dug in organic rich, very fine-grained deposits. Sedimentological features of that series together with its sorption properties led to the formation of the poorly permeable layer at the bottom and in consequence the groundwater horizon developed in the overlying sandy or sandy-silty sediments. Chemical composition of water of the first water-bearing horizon points to its low quality. Analyses showed its acidification, turbidity and odors, so probably water was used to economic rather than consumer purposes.

CYCLIC GLACIOFLUVIAL EROSIONAL MORPHOLOGY AND DELTAIC DEPOSITS IN SOUTHERN FINNISH LAPLAND

Pertti Sarala*¹, Jukka-Pekka Palmu, Joni Mäkinen, Jukka Räisänen¹

¹Geological Survey of Finland, Finland, e-mail: pertti.sarala@gtk.fi

An erosional, subglacial meltwater channel network was recognized in the Rovaniemi-Tervola region, southern Finnish Lapland while examining the high-resolution digital elevation maps generated by airborne LiDAR (Light Detection And Ranging). The channel pattern is composed of subglacial erosional valleys including deltaic sand and gravel deposits with cyclic, 10-15 km interval occurrence. The erosional parts of the channels are seen as shallow valleys having typically a thin and disintegrated sediment cover with numerous bedrock outcrops, washed boulders and boulder fields surrounded by the shallow peatland areas. The valleys are typically 100-500 m in width and several tens of kilometres in length. In places, coarse sands and gravelly or even bouldery sediments are observed on the edge of the valleys. Occasionally, on both side of the valleys, transversal to it, narrow, short and small ridges composed of diamicton can be identified. They resemble De Geer moraines but with a very close spacing. Delta deposits are fan-type where the sands are spread on both sides of the main channel. The delta deposition occurred in subaquatic conditions as the glacier ended in the pro-glacial lake of which depth was about 120-150 m. Deltas are usually 1-3 km² but their original dimensions are difficult to calculate due to postglacial reshaping during the shore phases of the Ancylus Lake. The cyclic pattern of the erosional channels and deltas is repeated two to four times in the western, i.e. core parts. Towards the east, the meltwater streaming was weakened enhancing the sand deposition as eskers in the subglacial tunnels.

The study area locates in the root part of the Kuusamo ice lobe (i.e. in western part of the lobe) that existed during the end of Late Weichselian cold stage. The ice lobe was active, dominantly surging type having flow direction W-E, and was formed after the Younger Dryas cold phase. The surging type glacial movement is indicated by the large Kuusamo drumlin field in the east while the core part of the glacier remained cold-based. As the retreat of the glacier margin continued, the ribbed moraine fields were formed in the transitional zone of thawed-frozen bed conditions. At the same time, the subglacial meltwater system was developed and was indicated at the early stage by the esker formations and later, close to core part by the erosional channel system described earlier. It is remarkable that during the late phase, i.e. at the same time with the erosional meltwater channel development, glacier movement was turned towards NW-SE although the basal conditions still remained dominantly cold-based. That was probably caused the fragmentation of the glacier and formation of strong crevasse network into ice providing the channels of the supra and englacial meltwaters flow to the glacier bottom. In the subglacial conditions subglacial water reservoirs, i.e. lakes were formed. Finally, due to the reoriented glacier movement and the close vicinity of the subaquatic marginal zone, cyclic burst out of the subglacial lakes occurred, generating erosional tunnel valleys and the deposition of stratified gravels and sands as the delta deposits in the subaquatic glacier margin.

MIDDLE AND LATE HOLOCENE PALEOENVIRONMENTAL EVOLUTION OF THE CURONIAN LAGOON, LITHUANIA

Giedrė Vaikutienė*¹, Donatas Kaminskas, Eugenija Rudnickaitė, Albertas Bitinas, Alma Grigienė, Ilya V. Buynevich, Aldona Damušytė, Donatas Pupienis

¹Faculty of Natural Sciences, Vilnius University, Lithuania, e-mail: giedre.vaikutiene@gf.vu.lt

The reconstruction of the evolution of the northern Curonian Lagoon, Lithuania, during the Holocene is based on a relatively wide suite of studies: diatom and carbonate analyses, measurements of magnetic susceptibility, as well as geochemical data. Dating results from the Nida-VI borehole show that the age of lacustrine and lagoonal sand spans from Boreal to Sub-Atlantic.

Diatom analyses at the bottom (2640-1720 cm) of the sediment section reveal changes in the groups of brackish-fresh and fresh-brackish species and show relatively rapidly changing environmental conditions that could have existed through the first Litorina Sea transgressions when water level fluctuates and gradually rises. According to the dominance of *Epithemia* sp. at the top of this interval, the oxygen requirement had to be fairly high (>75% saturation). Large number of diatoms in the samples upwards (1720-1320 cm) indicate a permanent water basin environment. The lagoon was quite “open“, shallow with clean bottom, almost freshwater with very small brackish water inflow. Sediments in this interval were deposited during the maximum Litorina transgression in the Middle Holocene.

The depth interval 1320-720 cm is represented by the layer of “lagoon marl“. At the base of this interval, freshwater-brackish benthic and epiphytic species comprise up to 95%. However, brackish benthic diatoms are also present. Diatom content suggests sediment accumulation in relatively shallow lagoon. Minor amounts of brackish diatoms suggest that intrusions of marine water rarely reached the study area, dominated freshwater runoff. Diatoms were only detected in the basal samples of the overlying interval (720-230 cm). Most numerous are freshwater-brackish planktonic species, similar to recent assemblage of the Curonian Lagoon. The topmost sediments in the section are nearly devoid of diatoms. Likely due to high accumulation rates of sand, the environmental conditions became unfavourable for these algae.

Climate changes and local environmental conditions have been distinguished based on carbonate content, with lower values associated to colder periods. The increase in carbonate fraction during the Late Atlantic is related mostly to warmer Holocene climate phases. The Al and Ti oxide data were used for general climate type reconstruction: arid conditions are reflected by Al/Ti oxide ratios of >20, humid climates yield <20 and values close to 20 were linked to transitional phases.

Based on this new dataset, the Boreal climate was arid and the Early Atlantic largely transitional, whereas the Late Atlantic was humid. The absence of negative Ce anomalies, as well as Th/U ratios, suggest that rather oxic regime prevailed during sedimentation. The latter findings are consistent with diatom analysis. The origin of several cycles of variation in Zr and Al content is still unclear, but substantial amounts of these elements may indicate increased weathering typically associated with humid conditions. Indeed, high amounts of these elements are characteristic for the Late Atlantic period. Down-core variations in bulk volume magnetic susceptibility closely mirror the textural and compositional trends, with peaks likely reflecting pulses of terrigenous flux during dry periods.

PALAEOSEISMISITY OF THE EASTERN BALTIC REGION: IMPLICATIONS FOR THE SEISMOLOGICAL RISK ASSESSMENT

Albertas Bitinas*¹, Aldona Damušytė, Andrius Pačėsa

¹Open Access Centre for Marine Research, Klaipėda University, Lithuania, e-mail: albertas.bitinas@apc.ku.lt

Traditionally the entire Eastern Baltic Region has been considered as a low seismic activity area. Probably, it is possible to identify two main reasons that seismic activity has not been adequately assessed: 1) a priori prevailing opinion that the Region is of a very small seismic activity due to its geological structure (that is a stable part on the Eastern European Craton), and 2) lack of experience and skills to identify reliably traces of the past earthquakes.

As a result, in a number of previous publications the palaeoseismic deformations were attributed to the particular structures triggered by other geological processes: permafrost (cryoturbations), slope processes, glaciotectionism (glacioidislocations), activity of living organisms (bioturbations), soil-forming processes, etc. The prevailing opinion about low seismic activity of the Region has changed significantly after 4.7 magnitude earthquake in the Osmussaar Island in Estonia in 1976 and especially after two consecutive 5.0 and 5.2 magnitude earthquakes in the Kaliningrad Oblast of the Russian Federation in 2004. The mentioned events have led to a new assessment of the Eastern Baltic Region seismicity: it was started to look for the evidences of the potentially former earthquakes in the written historical sources; a network of seismic monitoring stations was established in Lithuania; the assessment of seismicity of the whole Region was carried out using modern scientific methods, etc. As a result, a lot of new information about seismic activity of the Region during the last millennium has been collected. Nevertheless, the question about palaeoseismic activity of the Region during the recent geological past (Late Glacial - Holocene) still remains as an open issue. Some preliminary information about possible strong earthquakes after the decay of the Last Glacial were published only a few years ago.

Currently an assumption that the palaeoseismic events were active in the Eastern Baltic Region is based on the latest results of geological survey and critical analysis of some previous scientific publications. Only recently the first scientific paper analysing post-glacial seismic events in the territory of Latvia was published. The soil liquefaction structures (palaeoseismic deformations), of both Late Glacial-Holocene and Interglacial ages, were identified in a number of localities along the entire Region. The collected new data and re-interpretation of previous researches from seismological point of view enable us to make more precise and reliable seismological risk assessment of the existing or newly constructed potentially hazardous industrial facilities in the entire Eastern Baltic Region.

POSTER SESSION ABSTRACTS

PLEISTOCENE ARCHITECTURE AND STRATIGRAPHY IN THE CONTACT ZONE OF ICE STREAMS AND LOBES IN THE SOUTHEASTERN PART OF THE BALTIC REGION

Valentinas Baltrūnas*¹, Bronislavas Karmaza, Violeta Pukelytė, Danguolė Karmazienė

¹Institute of Geology and Geography, Nature Research Centre, Lithuania, e-mail: pukelyte@geo.lt

An abundant material of geomorphological research of glacial relief indicates that the deglaciation took place as ice streams, lobes and tongues. The routes of glacier advancing are less investigated, but it may be presumed that analogous ice streams (sub-streams) like during glacial recession took place.

The southeastern part of the Baltic region during the Last Glaciation was covered by Baltic ice stream. In the continental part it split into sub-streams (large lobes) which are differently entitled in the scientific publications. One of the earliest statements is that, according to the investigation data of indicator-boulders and the orientation of their long axes, the West Lithuania and Kaliningrad region were covered by the Middle sub-stream of the Baltic ice stream, while the Gulf of Riga and Middle Lithuania – by the Eastern sub-stream. The eastern parts of Estonia, Latvia and Lithuania were covered by the Western sub-stream of Karelian-Finnish ice stream. Similarly researches of the neighbouring countries generalised that the region was covered by the Oder and Riga lobes of the Baltic stream, or the Chudskoye lobe of the Finnish stream, or the palaeo-ice streams of Mazury, Lithuania and the stream to the east of them. Therefore the aim of the research was to discuss the glacial multilayered architecture of Pleistocene strata in the Southeast Baltic region as a phenomenon in the contact zone of ice streams and lobes.

The hypsometric analysis of the palaeosurfaces of the pre-Quaternary deposits in South Lithuania, the top palaeosurfaces of the widely spread Dainava and Medininkai tills and the present surface (Baltija till) and determination of the correlation between the palaeosurfaces and the present surface, revealed several peculiarities. Though the correlation of the present surface with the palaeosurfaces is positive, but going deeper, i.e. for each older palaeosurface, it decreases: $r = 0.591 \rightarrow r = 0.442 \rightarrow r = 0.323$. The correlation coefficients between the adjacent surfaces going deeper increase: $r = 0.591 \rightarrow r = 0.619 \rightarrow r = 0.751$. The information presented evidences the phenomenon of geomorphological heredity.

The aforementioned material indicates that the uneven dynamic activity of ice streams and lobes was a natural and objective phenomenon. Basing on this concept, it is possible to explain the multilayered architecture of the glacial deposits in South Lithuania and to give the stratigraphic interpretation for the Pleistocene strata. Complex investigations of the deposits in South Lithuania enabled to determine up to 11 glacial deposit layers (tills). The fact should be accepted that during different stages of the same glaciation, one ice stream or lobe could creep into the depression formed by the other (adjacent) ice stream, thus leaving tills with different composition. This methodological principle helps for correlation of the glacial strata in West and East Lithuania having several layers with the multilayered strata in South Lithuania.

REGIONAL AND LOCAL ICE FLOW DIRECTIONS OF THE LAST SCANDINAVIAN ICE SHEET IN CENTRAL POLAND

Małgorzata Roman*¹, Piotr Czubla

¹Institute of Earth Sciences, University of Łódź, Poland,
e-mail: malgorzata.roman@geo.uni.lodz.pl

To provide a reconstruction of the ice flow directions of the Last Scandinavian Ice Sheet (LSIS) in central Poland, the southernmost part of the SIS, we have compiled and synthesized our and published geomorphological data for glacial lineations (streamlined bedforms), end moraines, glacial troughs, eskers, marginal meltwater channels and also the geological evidence such as till fabric, vergence of glaciotectionic structures, direction of small-scale subglacial deformations formed beneath the flowing ice, orientation of pavement stone longitudinal axes, stone lee ends and the surface striae. Reconstruction of regional ice movement directions based on indicator erratics analysis was also carried out, using the Theoretical Boulder Centres (TBC) technique with later modifications. We also used optically-stimulated luminescence (OSL) datings from sands, collected directly from under and above the LSIS till at numerous sites to determine the till age. This has been summarized as a map of the LSIS in central Poland with the ice sheet maximum extent between 23 and 18 ka BP, directions of the ice flow and age of advance, in respect to the Brandenburg (Leszno) and Frankfurt (Poznań) Phases.

Quantity relation of erratics originating from different Fennoscandia regions indicate that during the Brandenburg Phase the ice sheet travelled roughly from N to S while during the younger Frankfurt Phase the glaciation center moved eastwards, which, is shown by TBC position along with a higher share of East Fennoscandia rocks in indicator erratics. However, because of the number of sites which may be statistically insignificant, our regional inference should be treated as preliminary and a more detailed analyses would require a much higher number of sites to investigate.

Local ice movement directions and the flow pattern of the LSIS in central Poland have been derived from direct geological and geomorphological evidence. Their spatial distribution reveals the distinct divergence of ice flow vectors towards the maximum extent of the ice sheet. The ice-lobe margin shape along with radial, fan-like, structure of ice masses inflows within the individual lobes may be indicative for the palaeo-ice stream terminal zone. The ice inflow system in central Poland with its age indicates the maximum LSIS extent to be metachronic. The western part of the said area experienced two advances during the Brandenburg and Frankfurt Phases, while in the earlier one ice masses came from NW, presumably along the eastern limb of the Odra (B2) palaeo-ice stream and then from N, along the Vistula (B3) stream. The LSIS only once occupied the eastern sector of the area, during the Frankfurt Phase, building the so-called Płock lobe.

Identification of the ice flow pattern has been essential for a broader palaeogeographical study, encompassing modelling of the Last Scandinavian Ice Sheet advance into the territory of Poland.

MELTWATER DRAINAGE SYSTEM IN A COLD SVALBARD GLACIER

Jan A. Piotrowski*¹, Lena U. Hansen, Doug I. Benn

¹Department of Geoscience, Aarhus University, Denmark, e-mail: jan.piotrowski@geo.au.dk

A combination of speleological exploration and high-resolution radar survey was applied to investigate the englacial and subglacial drainage system of Longyearbreen, a cold glacier in Svalbard. Direct observations were compiled with remotely-sensed data in a 3D visualization of the drainage system using Petrel software package. In addition, a radar survey covering the entire glacier provided information on changes in the glacier thermal regime over time.

Previous studies claimed that in cold glaciers there is no englacial and subglacial drainage because cold ice acts as a barrier to water flow (cf. the classical Shreve's model of the glacial meltwater system). However, the meltwater conduits present in Longyearbreen show that englacial and subglacial drainage channels indeed can develop in an un-crevassed cold glacier and we suggest that they formed through the cut-and-closure process upon which supraglacial channels progressively cut into the ice while being closed by ice creep at the top. Investigating whether meltwater can reach the bed through a cold surface layer is relevant to the understanding of glacier dynamics and stability, and cold valley glaciers in Svalbard such as Longyearbreen are potentially important contributors to the near-future sea level rise.

GLACIAL CURVILINEATIONS (GCLS) - AN INDICATION OF SUBGLACIAL CHANNELIZED MELTWATER FLOWS

Jan A. Piotrowski*¹, Aleksander Adamczyk, Wojciech Wysota

¹Department of Geoscience, Aarhus University, Denmark, e-mail: jan.piotrowski@geo.au.dk

The impact of subglacial meltwater flows on shaping glacial landscapes has been attracting research for decades. In 2010 Jerome Lesemann and colleagues documented glacial curvilineations (GCLs) as a new type of landforms attributed to erosion by rapid, possibly cataclysmic, channelized subglacial meltwater flows. Based on detailed terrain analysis using high-resolution LiDAR imagery we present further occurrences of several tens of GCL sites under the southern, soft-bedded fringe of the last Scandinavian Ice Sheet (SIS) in Denmark, Germany and Poland.

The newly identified GCLs occur in glacial overdeepenings and tunnel valleys in fields with different morphological characteristics and various areal extents ranging from a few to several hundred square kilometres. Some fields are further subdivided into smaller units – GCL swarms, typically not exceeding 2 km². The swarms have a maximum length of several kilometres and width between 0.5 and 3 km. GCLs are composed of various glacial deposits whereby the surficial material is typically sand and gravel, and to a lesser degree till. The troughs between the GCLs are often occupied by bogs and lakes. The individual ridges are up to several meters high, few kilometres long and of up to several hundred meters wide. Their numbers within individual fields or swarms range from few to several dozens.

We interpret the GCLs as erosional remnants of older landscapes dissected by high-energy subglacial meltwater flows. These findings suggest that palaeoglaciological significance of meltwater drainage under the southern portion of SIS may have been hitherto underestimated.

RECORD OF THE WEICHSELIAN CLIMATE CHANGES IN THE VISTULA TERRACES ON THE EXAMPLE OF THE SITES OF ROGÓW AND GOŁĄB

Robert J. Sokolowski*¹, Paweł Zieliński, Barbara Woronko, Michał Jankowski, Stanisław Fedorowicz, Karol Standzikowski

¹Institute of Oceanography, University of Gdańsk, e-mail: r.sokolowski@ug.edu.pl

River valleys are an excellent indicator of climate change. Any climate fluctuations are recorded as cycles of erosion and accumulation, and are visible both in the relief of valley bottoms and in the sediments that build them. Large river valleys of the Central European Lowlands, such as the middle section of the Vistula valley, have been the subject of numerous studies aimed at showing the response of fluvial systems to the Weichselian climate change. Recognition of fluvial-aeolian deposits and conditions of their sedimentation in the profiles of these valleys have given the opportunity for more detailed paleoclimatic reconstructions.

The aim of this study was to determine the impact of the Weichselian climate change on the formation of deposits that build higher terraces in the Vistula valley between Kamień and Dęblin (Middle Vistula). The study was based on the following analyses: geomorphological, lithofacial, grain size and morphoscopic, characteristics of cryogenic structures and fossil soil levels, as well as luminescence and ¹⁴C dating at the research sites of Rogów and Gołab.

The examined sites are located in the Vistula valley, on two different levels of the Weichselian meadow terraces. In both sites a similar sedimentary succession was recognised, composed of three complexes – fluvial, fluvial-aeolian and aeolian. There are some differences in the development of the individual complexes as well as in the age of the fluvial complex.

The fluvial complex is represented by a sandy braided river, developed in the form of deep riverbeds (lithofacies St, SGt) and mid-riverbed shallows – prograding transverse sandbars (lithofacies Sp). In the site of Rogów this complex is also developed in the form of floodplain deposits – rhythmite of sands (Sh, Src, Sm) and dust (Fh, FSh). Documented cryogenic structures indicate the encroachment of permafrost onto the valley sections abandoned by the flowing water. Dating of deposits of this complex indicates that at the site of Rogów they were accumulated in the early Weichselian, while in the site of Gołab - in the late pleni-Weichselian.

The fluvial-aeolian complex is separated from the fluvial complex by an erosion level, and in the Rogów site also by a level of deflationary pavement. This level possibly corresponds to the Benuingen Gravel Bed. Fluvial-aeolian sediments constitute a record of alternate fluvial accumulation in the form of sheet floods (Sh → Sr) or concentrated flow (cut-and-fill structures), and aeolian in the form of adhesive (FSw) or migrant ripplemarks on dry surfaces (sands of translational stratification). Thermal contraction structures and small scale involutions indicate discontinuous/insular permafrost or seasonal deep freeze. This complex was deposited in the oldest Dryas.

The muck-gley soil developed in the ceiling of the above sediments indicates warming during the Bølling interstadial and succession of tundra communities. The aeolian complex was accumulated in the form of aeolian covers (Rogów site) and/or moving dunes (Gołab site) in the older and younger Dryas

LOCAL STRATIGRAPHY OF THE QUATERNARY DEPOSITS FILLING OF THE WESTERN PART OF THE KLESZCZÓW GRABEN, CENTRAL POLAND

Lucyna Wachecka-Kotkowska*¹, Dariusz Krzyszkowski, Dariusz Wieczorek, Jerzy Raczyk, Katarzyna Adamczyk

¹Institute of Earth Sciences, University of Łódź, Poland,
e-mail: lucyna.wachecka@geo.uni.lodz.pl

Quaternary lithostratigraphy for central Poland was based mainly on the results of studies of sediments filling the Kleszczów tectonic graben in its middle part, in the Bełchatów opencast mine (since 1977). For the local division of Quaternary sediments and also for the lithostratigraphic division, localities names with the word FORMATION were used. Continuation of research in the adjacent Szczerców field, in the western part of the graben (since 2009) helped to make correlations and additions to lithostratigraphy.

In both Bełchatów and Szczerców outcrops, the Quaternary is located within two structural units: lower - disturbed (Bełchatów) and upper - undisturbed. The boundary is located between them extends in the roof of Ławki Formation and under the Chojny Formation (Pilica/Lublinian Interstadial). Seven levels of till were distinguished, T1-7, corresponding to respective glaciations. Cold periods are represented by the Folwark (T1), Kuców (T2), Rokity (T3), Ławki (T4) and Rogowiec (T5-7) Formations. Warm periods sediments are developed mainly as fluvial deposits of the Czyżów, Chojny and Aleksandrów Formations. Besides, the oldest deposit from Early-Pleistocene is Łękińsko Formation, and the youngest Holocene, are Widawka and Szerokie Formations. The least recognized sediments are the oldest (Elsterian): Folwark (Nidanian) and Kuców (Sanian) Formations. Tills and sands of the Folwark Formations lied on Neogene clay, silt and sand. Above them, there were diagnosed distorted sandy-gravelly, clay and till deposits of the Kuców Formation. Both sedimentary complexes form south Polish Glaciations (South Polish Complex) were cut by faults. South of Chabielice fault (part of the Kleszczów graben), various-grain sands from Czyżów Formation occur (Holsteinian). On them, in the roof of the lower (disturbed) structural unit, Ławki Formation sediments (Odranian, Saalian) are widely spread. There are glacial tills (T4), fluvio-glacial sands under or on them or dammed deposits (?). Sediments from the Rokity and Stawek Formations (Middle Polish Complex) were not found.

Rogowiec Formation (Wartanian, Late Saalian) is represented by the glacial till (T7) and fluvio-glacial sands and gravels. The T5 and T6 tills are reduced. On the pavement, above the T7 till or fluvio-glacial sands, there are Aleksandrów Formation sediments (Lower Weichselian/Eemian) in the axis of the Krasówka river valley. On Aleksandrów, Rogowiec, Ławki and probably Czyżów (?) Formations are Piaski Formation sediments (North Polish Complex, Weichselian), accumulated in periglacial conditions. This is the thickest series of sand within the Quaternary. Radiocarbon dating indicates Middle Pleniglacial (47 kBP) as the beginning of filling of the Krasówka river valley and Late Pleniglacial (24 kBP) finishing the fluvio-periglacial sands and silty-sands. This sediments are partly covered by the Widawka Formation mineral-organic material (Holocene). The research of the Pleistocene sediments in the Szczerców outcrop allowed to systematize and explain the lithostratigraphic profile of central Poland Quaternary. Moreover, multiproxy investigation made more detailed the transitional period between the Eemian Interglacial and Weichselian. The new till lithotypes, T2A and T2B from the South Polish Complex, were distinguished.

A NEW SITE OF THE HOLSTEINIAN(?) LIMNIC DEPOSITS IN THE KSIĄŻNICA OUTCROP AT KRZCZONÓW, SUDETY FORELAND

Lucyna Wachecka-Kotkowska*¹, Dariusz Krzyszkowski, Zdzisław Jary, Małgorzata Malkiewicz, Jarmila Krzysińska, Dariusz Cizek, Monika Niska, Elżbieta Myśkow, Jerzy Raczyk, Wojciech Drzewicki, Dawid Hamryszczak, Jerzy Nawrocki, Klara Tomaszewska, Monika Rzodkiewicz

¹Institute of Earth Sciences, University of Łódź, Poland,
e-mail: lucyna.wachecka@geo.uni.lodz.pl

The „Książnica” gravel pit is located 200 m south of the Krzczonów-Książnica road within the Krzczonów Hills, reach 25 m height (275 m a.s.l.). The area discussed, located SW of the Kielczyńskie Hills range, belongs to the Świdnicka Plain, part of the Sudety Foreland.

Along with a progressive exploitation of Middle Pleistocene deposits, in November 2014 organic sediments were revealed in the north-western wall - peats, muds and sands filling the palaeocavity. Organic material lied directly on various grain-size sands and layered diagonally. In the 534 cm deep research profile in the central part of a palaeolake 267 samples at an interval of 2 cm were collected. The samples were submitted for specialist research: palaeobotanical (Diatom, palynology, plant macroremains and fossil wood), palaeozoological (Cladocera, Mollusca and Ostracoda), geochemical (content of chemical elements and isotopes) and palaeomagnetic.

The pollen composition of samples with predominant trees and shrubs on herbaceous plant indicates an interglacial or interstadial age. The pollen spectra of top profile (peat) are characterized mainly by the presence of pine, birch, spruce, larch and a significant share of herbaceous plants (average about 30%) as well as a lack of thermophilus trees. The pollen spectra of limnic deposits are characterized by the presence of deciduous and thermophilus trees and shrubs. This section indicates the interglacial age. Analysis of several samples of fossil wood showed widespread presence of *Pinus* remains and numerous fragments of rhytidome (bark). Development of the peat layer (1,36-0,68 m) began from paludification of the forest with *Betula*. Analysis of Cladocera showed the presence of chitin armor components in three samples from the depth of 1.0-0.82 m. Identified species are *Chydorus sphaericus*, *Alona rectangula* and efiopia of *Alona rectangula*. Within the whole profile (0.4-4.56 m below the surface), no remains of molluscs and ostracods were found.

The loss of ignition (LOI), as well as share of Na, K, Mg, Ca, Fe, Mn, Al, Ti, P, Si was determined. The silicone shows considerable variation depending on the profile. The results of isotopic carbon analysis in organic matter exhibit large variations in the isotopic composition of $\delta^{13}\text{C}$, from -22 to -29,5‰. Large variations in isotopic composition may explicitly indicate unstable environmental conditions, mainly temperature fluctuations. There was an accumulation of organic matter (probably in situ) with the episodic increase in supply of mineral material. The profile is magnetized in the normal direction.

At this stage it is difficult to clearly determine the age of filling laying on the Mazovian interglacial river sediments. Further, detailed research will allow to show, during which interglacial sedimentation in the reservoir occurred. On the other hand, absolute values for the identified taxa justify the Mazovian Interglacial (Holsteinian), but only its younger part which is characterized by fir with hornbeam. This is a clear warming climate with pronounced swings in the direction of cool towards lower temperatures.

Another advantage of the place is its interesting location in the Sudety Foreland, south of the Ślęza Massive and geomorphological location, near the Bystrzyca river valley.

PALYNOLOGICAL AND GEOCHEMICAL RECORD OF LATEGLACIAL CLIMATIC OSCILLATIONS: A CASE STUDY FROM LAKE RADUŃSKIE, NORTHERN POLAND

Dawid Weisbrodt*¹, Malgorzata Latalowa

¹Institute of Geography, University of Gdańsk, Poland, e-mail: d.weisbrodt@ug.edu.pl

Pollen, non-pollen palynomorphs (NPPs), geochemistry and macrofossil data from sediments of Lake Raduńskie (Kashubian Lake District, N. Poland) illustrate changes in terrestrial and aquatic ecosystems during the Vistulian Lateglacial. Our data reveal several distinct phases of climate changes which corroborate well with the widely-defined cooling and warming episodes (e.g. NGRIP ice core) in the period between ca. >14,000 – 11,700 years cal. BP.

The bottommost part of the sediments developed in the Bölling period. In this period, in the terrestrial vegetation tree birches were already present; they probably formed an open park-tundra or at least patches of *Betula* sect. *albae* groves together with willows and *B. humilis*. In the profile from Lake Raduńskie the Older Dryas period is clearly distinct by strong increase of mineral matter, AP decline and especially sharp increase of *Artemisia*; *Betula nana*, *Helianthemum*, *Selaginella selaginoides* and *Dryas octopetala* were locally present. In the lake ecosystem there was strong decline in green algae.

The well-developed, clearly tripartite Alleröd section is characteristic for our profile. Among the main elements of the terrestrial vegetation were tree birches, willows, juniper and *B. nana*; *Pinus sylvestris* was locally present. The Gerzensee Oscillation is distinct by a sharp increase in mineral matter, decline of CaCO_3 , a drop in tree-birches pollen, increase of *B. nana*, *Artemisia* and higher frequencies of several taxa typical of the so-called “Dryas floras”. The lake productivity decreased as shown by a decline by green-algae.

Strong environmental changes are reflected in the section representing the Younger Dryas period. The NAP attain over 50% in the pollen diagram and mineral matter absolutely dominates in the sediment. Among the most distinct features is *Artemisia* pollen reaching 20% of the pollen sum. Also other taxa typical of the Lateglacial cold periods occur in high frequencies.

The very distinct reaction of the terrestrial vegetation and the Raduńskie Lake ecosystem to the climate changes have been probably stimulated by a specific geomorphologic features of the studied area.

DUNE PALAEODYNAMICS ALONG THE CURONIAN SPIT, SOUTHEASTERN BALTIC

Albertas Bitinas*¹, Nikita Dobrotin, Anatoly Molodkov, Ilya V. Buynevich, Aldona Damušytė, Virgilija Gregorauskienė, Jonas Mažeika, Donatas Pupienis

¹Open Access Centre for Marine Research, Klaipėda University, Lithuania, e-mail: albertas.bitinas@apc.ku.lt

Dune massifs are the most important landforms and most prominent objects of geological and geomorphological interest along the Curonian Spit – a mega-barrier along the southeastern Baltic that separates the Curonian Lagoon from the Baltic Sea. To date, an assessment of various parameters of migrating dunes along the spit was based on comparative analysis of old cartographic materials or aero- and cosmic-images, as well as geodetic measurements. These investigations allowed assessment of dune palaeodynamics for a relatively short historical period (ca. 1700s-present).

The most recent detailed investigations of the Dead (Grey) Dunes massif along the Lithuanian part of the spit by ground-penetrating radar (GPR) and magnetic susceptibility surveys, supported by radiocarbon (¹⁴C) chronological framework of paleosols and infrared optically stimulated luminescence (IR-OSL) ages of sand horizons, have advanced our understanding of aeolian landscape evolution. The evaluation of the dune palaeodynamics parameters was generally based on the IR-OSL dating results of the sand layers located between the palaeosols of known age. The influence of soil-forming processes on the IR-OSL dose parameters related to possible migration of radioactive isotopes of U, Th, and K via aeolian sand layers was tested.

A few hypotheses of dune re-activation and migration caused by abrupt regional climate shifts, catastrophic forest fires, anthropogenic influence, and more local forcings were developed and tested. The integrated approach of dune investigations enabled to estimate the rates of sand accumulation and key phases of aeolian paleodynamics during both stormy and calm periods, as well as to extend the record of dune evolution to mid-Holocene. According to the data of palaeoenvironmental and palaeodynamic reconstructions carried out in the Dead Dunes massif, the early (mid-Holocene) phase of dune activity was of a local character and likely did not exceed several centuries.

HOLOCENE HISTORY OF ENVIRONMENTAL DYNAMICS: MULTI PROXY APPROACH FROM THE ČEPKELIAI HIGHMOOR, SE LITHUANIA

Laura Gedminienė¹, Miglė Stančikaitė, Ričardas Taraškevičius, Gražyna Gryguc, Rimantė Zinkutė, Jonas Mažeika

¹Nature Research Centre, Lithuania, e-mail: lauragedminiene@yahoo.com

Despite the long-term investigations, previous information describing the responses of the Holocene biotic and abiotic palaeoenvironment to the globally recorded climatic fluctuations is rather poor in detail, existing chronology is minor in many cases as well as complexity of the methods applied. Studies contributing to the solution of the issues of stratigraphy, palaeogeography and evolution of the components of the palaeoecosystem were mainly concentrated on the Lateglacial interval in Lithuania. In order to fill existing gap, the sediment sequence from Čepkeliai Highmoor, SE Lithuania, was studied applying the multiproxy approach involving geochemical, palynological and plant macrofossil survey, measurements of ¹⁴C, loss-on-ignition (LOI) and magnetic susceptibility ($M\chi$). Alongside human initiated fluctuations were recorded.

In case of Čepkeliai a robust age-model was established from 16 ¹⁴C measurements, that indicated sedimentation beginning at about 13 000 cal yr BP. Results of LOI shows four stages in the sedimentation. The newly obtained pollen data reveals several intervals related with the long-term climatic fluctuations and short-term changes as 8,2 ka event. Plant macrofossil data based the reconstruction of the vegetation and hydroclimatic variations in an underutilized geographic region over period with limited environmental information i.e. last two thousand years. New data shows that most settlement periods indicated by pollen and archaeological data can be geochemically identified in the sediment sequence using tracer elements such as K, Rb, Zr and the K/Zr ratio. Site-specific geochemical analyses documented variations in silicate inputs (Zr/Ti, Si/Ti, K/Ti and K/Rb), productivity (TOC, Ca/Ti and Sr/Ti), as well as redox conditions in the sediment (δ^{13} C, Mn/Ti and Fe/Ti), which were linked to the regional climatic framework. The geochemical record archived in the sediments was found to be the integrated result of physical erosion, landscape and soil development, vegetation changes, basin hydrology and moisture variations and it might fill an important information gap in scientist understanding of the geochemical response of lake sediments to past climate change. Larger non organic accumulation (LOI and $M\chi$ data shows) is fixed in dryer – colder periods. These possible driving mechanisms, explaining variation of low and high $M\chi$ values in terms of dry and more humid climate conditions, also were explained by previous researchers.

When Ūla River captured the upper reaches of the Katra River, in the second half of 19th century hydrological conditions significantly changed. High groundwater level initiated the intensive evotranspiration confirmed by subsequent changes of chemical trace-elements recorded in the uppermost part of sediment core accompanied by higher $M\chi$ rates. Also a higher productivity and redox conditions in the first 50 cm of sediment core occurred as Ca/Ti and Fe/Ti rate is decreased in the diagrams. It is predicted that rise of the water table initiated formation of raised bog environment. These preliminary assumptions are subjected to more detailed correlation between chemical and lithological composition, micro and macrobotanical results and $M\chi$ data.

DEVELOPMENT OF THE SANDY BARRIER UNDER SEA-LEVEL RISE: THE FUTURE OF HEL PENINSULA

Damian Moskalewicz*¹

¹Institute of Geography, University of Gdańsk, Poland, e-mail: geodm@ug.edu.pl

The Hel Peninsula is a unique landform in the Baltic coast. 36 km long, its width ranges from less than 200 m to over 3 km. It was formed during Littorina transgression after Scandinavian Ice Sheet recession and gradual sea-level rise. In the first phase of development, the sandy barrier was only partially above the sea surface. With time, washovers with small dune ridges on their surface were formed. Given the considerably positive sediment balance at that time, the barrier's shape finally became stable, however it continued to migrate slightly landward.

The most stable parts of the fans began to be covered by vegetation, and peat plains developed on the surface of the fans. A sand-dune ridge and forms characteristic of the beach and foreshore developed on the seaward side of the barrier. A very important role was played by longshore drift because without it, the formation of such a wide form as is the case in the eastern part of the Hel Peninsula would be impossible. A significant role was played by the sediment transport and deposition processes occurring on the distal side of the barrier and forming a not fully developed and submerged Seagulls Shoal Barrier, also called Rewa Mew.

In modern times, a systematic rise in the sea level can be observed in the South-Eastern Baltic. At the same time, a discussion takes place on global climate change in increased frequency of extreme events, including storm surges. Therefore, it should be expected that in the future, the global trend of increased storm flood hazard will also be confirmed in the Southern Baltic.

On the northern side of the Hel Peninsula, marine abrasion will become a dominant coastal process. Due to strong anthropopressure within Polish coasts, manifested in the construction of concrete bands on the cliffs and spits, the amount of sediment may turn out to be insufficient for the natural compensation of sediment loss within the Hel Peninsula. In the long term, this can mean a considerable sediment deficit and a lasting disruption of the peninsula's continuity in its narrower sections.

If such an event occurs, the coast would seek stabilisation through the formation and progressive migration of a new sandy barrier towards the land. In that case, the inner part of Puck Bay might change into a lagoon separated from the sea. Hydrodynamic processes would probably use one of the underwater slopes, which evidence past storm washovers into the bay, as well as the Seagulls Shoal Barrier that would become a fully developed barrier. This would lead to the formation of an environment similar to the spits and lakes occurring in the central part of the Southern Baltic coast.

At the same time, the eastern part of the Hel Peninsula would be separated from the land and would become an independent island. A future connection with the land as well as the transformations of the western part of the island would depend on the sediment balance and new water circulation in the proximity of this form. Due to the continuing rise of the sea level, the connection with the land would probably be lost irreversibly.

EFFECTS OF CLIMATE VARIABILITY ON SALTWATER INTRUSIONS IN COASTAL AQUIFERS IN SOUTHERN DENMARK

Jan A. Piotrowski*¹, Rena Meyer, Torben Sonnenborg, Peter Engesgaard, Anne-Sophie Høyer, Flemming Jørgensen, Klaus Hinsby, Birgitte Hansen, Jørn Bo Jensen

¹Department of Geoscience, Aarhus University, Denmark, e-mail: jan.piotrowski@geo.au.dk

Pleistocene ice sheets moved over soft beds by some combination of basal sliding and bed deformation. The latter process, besides contributing to the forward movement of ice, has been suggested to effectively mix the subglacial material by intergranular advection producing homogeneous basal tills as depositional end-products. Pervasive deformation in a soft, water-saturated, several-meters-thick basal sediment layer that yielded in response to glacier stress has been postulated as a widespread process under the Scandinavian, British-Irish and Laurentide ice sheets.

Here we investigate in detail the properties of a massive basal till of Weichselian glaciation at Sønderby, western Denmark in a single vertical profile spanning over 5 m of the till thickness and sampled in 26 closely spaced intervals. Grain-size distribution, fine-gravel composition, macroscopic and AMS till fabrics, micromorphological structures, and grain-shape characteristics all exhibit remarkably low variability indicating profound mixing of the material by a common and consistent process. We suggest that the mixing was primarily caused by clasts projecting from the ice sole that ploughed the bed before they were lodged and stabilized. Such clasts, typically with flattened and striated upper surfaces occur frequently in the Sønderby till. Calculations show that every part of the till during its formation must have experienced multiple ploughing events that cumulatively generated a well-mixed, homogenous basal till.

These results suggest that pervasive subglacial sediment deformation is not required to produce massive basal tills and be the predominant mechanism of ice-sheet movement and subglacial sediment transport. Instead, we favor a simpler process involving localized and non-pervasive yet efficient ploughing by clasts dragged along the ice/bed interface.

LIST OF PARTICIPANTS

Valentin Andreichev

e-mail: andreichev@geo.komisc.ru
Institute of Geology
Russian Academy of Sciences
Pervomaiskaya street. 54
167982 Syktyvkar
Russian Federation

Lyudmila Andreicheva

e-mail: andreicheva@geo.komisc.ru
Institute of Geology
Russian Academy of Sciences
Pervomaiskaya street. 54
167982 Syktyvkar
Russian Federation

Albertas Bitinass

e-mail: albertas.bitinas@apc.ku.lt
Open Access Centre for Marine Research
Klaipeda University
Herkaus Manto str. 84
LT-922 Klaipeda
Lithuania

Mirosław Błaszkiwicz

e-mail: mirek@geopan.torun.pl
Institute of Geography and Spatial
Organization
Polish Academy of Sciences
Twarda 51/55
00-818 Warsaw
Poland

Andreas Börner

e-mail: andreas.boerner@lung.mv-
regierung.de
State authority of Environment.
Nature protection and geology
Mecklenburg
-Western Pomerania
Goldberger Str.12
18273 Güstrow
Germany

Achim Brauer

e-mail: brau@gfz-potsdam.de
GFZ German Research Centre
for Geosciences

Telegrafenberg 14473 Potsdam
Germany

Johannes Brumme

e-mail: j_brumme@gmx.de
Institute of Geography and Geology
Ernst-Moritz-Arndt-Universität
Friedrich-Ludwig-Jahn-Straße 17a
17487 Greifswald
Germany

Marina Buravskaya

e-mail: buravskaya@geo.komisc.ru
Institute of geology
Russian Academy of Sciences
Pervomaiskaya street. 54
167982 Syktyvkar
Russian Federation

Piotr Czubla

e-mail: piotr.czubla@geo.uni.lodz.pl
Institute of Earth Sciences
University of Łódź
ul. Narutowicza 88
90-139 Łódź
Poland

Danuta Dzieduszyńska

e-mail:
danuta.dzieduszynska@geo.uni.lodz.pl
Institute of Earth Sciences
University of Łódź
ul. Narutowicza 88
90-139 Łódź
Poland

Jacek Forysiak

e-mail: jacekfor@interia.eu
Institute of Earth Sciences
University of Łódź
ul. Narutowicza 88
90-139 Łódź
Poland

Laura Gedminienė

e-mail: lauragedminiene@yahoo.com
Nature Research centre
LT-084 Vilnius
Lithuania

Alma Grigiene

e-mail: alma.grigiene@lgt.lt
Lithuanian Geological Survey
S.Konarskio str. 35
LT-031 Vilnius
Lithuania

Michał Jankowski

e-mail: mijank@umk.pl
Nicolaus Copernicus University in Toruń
Lwowska 1
87-100 Toruń
Poland

Peter Johansson

e-mail: peter.johansson@gtk.fi
Geological Survey of Finland
Box 7796101 Rovaniemi
Finland

Asta Jusiene

e-mail: asta.jusiene@lgt.lt
Lithuanian Geological Survey
S.Konarskio str. 35
LT-031 Vilnius
Lithuania

Alexandra Krotova-Putintseva

e-mail: avacha2001@rambler.ru
Russian Geological Research Institute

Sredny pr. 74
199106 Saint-Petersburg
Russian Federation

Vladislav Kuznetsov

e-mail: v.kuznetsov@spbu.ru
Saint-Petersburg State University
Universitetskaya nab. 7/9
199034 St. Petersburg
Russian Federation

Alexander Makeev

e-mail: makeevao@gmail.ru
Institute of Geography RAS
Staromonetny lane 29
109017 Moscow
Russian Federation

Damian Moskalewicz

e-mail: geodm@ug.edu.pl
Institute of Geography
University of Gdansk
Bażyńskiego 4
80-952 Gdańsk
Poland

Włodzimierz Narloch

e-mail: w.narloch@umk.pl
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń
Poland

Joanna Petera-Zganiacz

e-mail: joanna.petera@geo.uni.lodz.pl

Institute of Earth Sciences
University of Łódź
ul. Narutowicza 88
90-139 Łódź
Poland

Magdalena Piotrowska

e-mail: piotrowskamagda@op.pl
Adam Mickiewicz University in Poznań
Umultowska 89D
61-614 Poznań
Polska

Jan A. Piotrowski

e-mail: jan.piotrowski@geo.au.dk
Department of Geoscience
Aarhus University
Hoegh-Guldbergs Gade 2
DK-800 Aarhus
Denmark

Violeta Pukelytė

e-mail: pukelyte@geo.lt
Nature Research Centre
Akademijos Str. 2
LT-084 Vilnius
Lithuania

Vincent Rinterknecht

e-mail: vincent.rinterknecht@lgp.cnrs.fr
CNRS 1 place Aristide Briand
92195 Meudon
France

Eugenija Rudnickaitė
e-mail: eugenija.rudnickaite@gf.vu.lt
Faculty of Natural Sciences
Vilnius University
M.K.Čiurlionio 21/27
LT0310 Vilnius
Lithuania

Alexey Rusakov
e-mail: spp-06@mail.ru
Institute of Earth Sciences
Saint-Petersburg State University
University embankment 7/9
199034 Saint-Petersburg
Russian Federation

Pertti Sarala
e-mail: pertti.sarala@gtk.fi
Geological Survey of Finland
P.O. Box 77
96101 Rovaniemi
Finland

Robert Jan Sokolowski
e-mail: r.sokolowski@ug.edu.pl
Institute of Oceanography
University of Gdańsk
al. Marszałka Piłsudskiego 46
81-378 Gdynia
Poland

Karol Tylmann
e-mail: k.tylmann@ug.edu.pl
Institute of Oceanography
University of Gdańsk
al. Marszałka Piłsudskiego 46
81-378 Gdynia
Polska

Giedre Vaikutiene
e-mail: giedre.vaikutiene@gf.vu.lt
Faculty of Natural Sciences
Vilnius University
Ciurlionio 21/27
LT-031 Vilnius
Lithuania

Lucyna Wachecka-Kotkowska
e-mail: lucyna.wachecka@geo.uni.lodz.pl
Institute of Earth Sciences
University of Łódź
ul. Narutowicza 88
90-139 Łódź
Poland

Dawid Weisbrodt
e-mail: d.weisbrodt@ug.edu.pl
Institute of Geography
University of Gdansk
Bażyńskiego 4
80-952 Gdańsk
Poland

Piotr Paweł Woźniak
e-mail: geopw@ug.edu.pl
Institute of Geography
University of Gdansk
Bażyńskiego 4
80-952 Gdańsk
Poland

Wojciech Wysota
e-mail: wysota@umk.pl
Nicolaus Copernicus University in Toruń
ul. Lwowska 1
87-100 Toruń
Poland

