



# Abstracts & Programme

**11<sup>th</sup> International Conference**

**"METHODS OF ABSOLUTE CHRONOLOGY"**

**15-18<sup>th</sup> May 2013  
Podlesice  
Poland**

Organised by:  
GADAM Centre of Excellence  
Department of Radioisotopes  
Institute of Physics Centre for Science and Education  
Silesian University of Technology  
Gliwice, Poland



Institute of Physics - CSE



Silesian University of Technology

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## **Local Organising Committee**

Adam Michczyński - chairman  
Natalia Piotrowska  
Barbara Sensuła  
Jarosław Sikorski

## **Conference venue**

Hotel "Ostaniec"  
Podlesice 82  
42-425 Kroczyce  
Poland

Edited by Natalia Piotrowska

GLIWICE/PODLESICE 2013



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# 11<sup>th</sup> International Conference "Methods of Absolute Chronology" Podlesice 15-18<sup>th</sup> May 2013

## Overview of the Conference Programme

Wednesday 15 <sup>th</sup> May	Thursday 16 <sup>th</sup> May	Friday 17 <sup>th</sup> May	Saturday 18 <sup>th</sup> May
	<b>9:00 – 10:40</b>  SESSION 2: Radiocarbon dating - <i>continued</i>	<b>9:00 – 11:05</b>  SESSION 4: Terrestrial archives of environmental changes	<b>9:00 – 11:05</b>  SESSION 6: Luminescence dating – <i>continued</i>
<b>10:30 – 14:30</b>  Registration & welcome coffee	<b>10:40 – 11:30</b>  Coffee break	<b>11:05 – 11:30</b>  Coffee break	<b>11:05 – 11:30</b>  Coffee break
	<b>11:30 – 13:35</b>  SESSION 3: Terrestrial archives of environmental changes – trees	<b>11:30 – 13:35</b>  SESSION 5: Luminescence dating	<b>11:30 – 12:00</b>  Discussion & conference closing
			<b>12:30 – 13:30</b>  Lunch
<b>14:30 – 15:30</b>  Lunch	<b>14:00 – 15:00</b>  Lunch	<b>13:35 – 14:30</b>  Lunch	
<b>15:30 – 16:00</b>  Conference opening	<b>15:30 – 17:30</b>  Poster session & coffee break	<b>14:30 – 19:30</b>  Conference excursion	
<b>16:00 – 18:05</b>  SESSION 1: Radiocarbon dating			
<b>18:30 – 20:30</b>  Ice break dinner & posters	<b>19:00 – 21:00</b>  Conference dinner	<b>20:00 – 21:00</b>  Dinner	

# Conference programme

**Wednesday 15<sup>th</sup> May 2013**

10:30 – 14:30 Registration & welcome coffee

14:30 – 15:30 Lunch

15:30 – 16:00 Conference opening

## **SESSION 1: Radiocarbon dating**

<b>Time</b>	<b>Authors</b>	<b>Title</b>
16:00	Hogne Jungner, V.A. Dergachev, I.V. Koudriavtsev, Yu.A. Nagovitsyn, M.G. Ogurtsov	On the influence of climatic factors on the ratio between the cosmogenic isotope $^{14}\text{C}$ and total carbon in the atmosphere in the past.
16:25	Konrad Tudyka, Andrzej Bluszcz, Beata Kozłowska, Jacek Pawlyta, Adam Michczyński	Rapid low level $^{14}\text{C}$ liquid scintillation measurements with a delayed coincidence monitoring of $^{222}\text{Rn}$ contamination
16:50	Natalia Piotrowska, Tadeusz Kuc, Sławomira Pawełczyk, Anna Pazdur, Andrzej Rakowski, Kazimierz Różański, Barbara Sensuła	Fossil fuel component of $\text{CO}_2$ in the atmosphere and biosphere on the basis carbon isotopes measurements, South Poland area
17:15	Adam Michczyński, Irka Hajdas	Complex statistical model of the Lake Soppensee chronology - some methodological problems concerning construction of age-depth models using OxCal
17:40	Wojciech T. J. Stankowski	The radiometric and dosemetric data of the Morasko meteorite impact age

18:30 – 20:30 Ice-break dinner & posters

## Thursday 16<sup>th</sup> May 2013

### SESSION 2: Radiocarbon dating – *continued*

Time	Authors	Title
9:00	Danuta Michczyńska, Leszek Starkel, Dorota Nalepka, Anna Pazdur	Hydrological changes after last ice retreat in Northern Poland in the light of radiocarbon dating
9:25	Adam Michczyński, Włodzimierz Margielewski, Piotr Kołaczek, Andrzej Obidowicz, Danuta Michczyńska	Comparison of paleogeographic records of the Holocene environmental changes in two landslide peat-bogs of the Beskid Sądecki Mts. – radiocarbon and palinological studies of Jesionowa and Wierchomla sites
9:50	Włodzimierz Margielewski, Jan Urban, Karel Žak, Valentina Zernitskaya	Dated speleothems of the speleothems from non-karst caves in the Polish Flysch Carpathians and their relation to climatic changes during the Late Glacial–Holocene
10:15	Jana Mellnerová Šuteková, Peter Barta	Chronometry versus relative chronology of Baden culture

10:40 – 11:30 Coffee break

### SESSION 3: Terrestrial archives of environmental changes - trees

Time	Authors	Title
11:30	Bogdan Wertz, Sławomir Wilczyński, Elżbieta Muter	Methods for detection the mid-term tree radial increment changes caused by selected environmental factors
11:55	Joanna Barniak, Marek Krąpiec, Leszek Juryś	Dendrochronological investigations of sub-fossil wood from the Rucianka raised bog (NE Poland)
12:20	Sławomira Pawełczyk, Anna Pazdur, Barbara Sensuła, Ryszard Kaczka	Carbon and oxygen isotopes in tree rings as climate and environmental changes archives for Tatras and Sudeten

12:45	Zdzisław Bednarz, Elżbieta Muter	Tree ring widths variability in Norway spruce ( <i>Picea abies</i> (L.) Karst.) from the Czarnohora Mountains (Ukrainian Eastern Carpathian Mts.)
13:10	Barbara Sensuła, Anna Pazdur	Stable carbon isotopes of glucose received from pine tree rings as indicators of anthropogenic effects in Niepołomice Forest (1950-2000 AD)

14:00 – 15:00 Lunch

15:30 – 17:30 **POSTER SESSION** + coffee break

19:00 – 21:00 Conference dinner

## Friday 17<sup>th</sup> May 2013

### SESSION 4: Terrestrial archives of environmental changes

Time	Authors	Title
9:00	François De Vleeschouwer, Heleen Vanneste, Pierre Falba, Nadine Mattielli, Aubry Vanderstraeten, Natalia Piotrowska, Gaël Le Roux	Peat bog records of atmospheric dust fluxes in Chilean Tierra del Fuego. Preliminary results and perspectives
9:25	Anna Babenko	Stable carbon ( $^{13}\text{C}/^{12}\text{C}$ ) and nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) analysis of Azmout and Ramon I zoogenic deposits (Negev desert, Israel)
9:50	Zhanna Antipushina	Isotope composition of bivalves' shell organic matrix from different biotopes (Adaki, Aleutian Islands) as reflection of their habitats
10:15	Evgeniya Kuzmicheva	Holocene climate and vegetation of the Bale Mountains (Ethiopia) based on pollen analysis and radiocarbon dating of zoogenic deposits
10:40	Beata Stepańczak, Krzysztof Szostek, Jacek Pawlyta	Stable oxygen isotopes for reconstruction of human mobility - the population of the Early Medieval Cracow, Poland

11:05 – 11:30 Coffee break

## **SESSION 5: Luminescence dating**

<b>Time</b>	<b>Authors</b>	<b>Title</b>
11:30	Daniela Constantin, Robert Begy, Stefan Vasiliniuc, Cristian Panaiotu, Cristian Necula, Vlad Codrea, Alida Timar-Gabor	High resolution OSL dating of the Costinești section Romania using fine and coarse quartz
11:55	Alida Timar-Gabor	On natural and laboratory generated dose response curves for quartz of different grain sizes from Romanian loess
12:20	Piotr Paweł Woźniak	Formation time-frames of the Late Weichselian tills in northern Poland
12:45	Van Nieuland Jasper, Vandenberghe Dimitri, Buylaert Jan-Pieter, Paulissen Etienne, Van den haute Peter	Optical dating of inland dunes in the campine area (NE Belgium): a case study
13:10	Leszek Starkel, Dominik Płoskonka, Grzegorz Adamiec	The OSL dating and maturity of soils help to reconstruct the neotectonic movements in the piedmont zone of Sikkimese-Bhutanese Himalaya

13:35 – 14:30 Lunch

14:30 – 19:30 **Conference excursion**

20:00 – 21:00 Dinner



## Saturday 18<sup>th</sup> May 2013

### SESSION 6: Luminescence dating – *continued*

Time	Authors	Title
9:00	Andrey Panin, Grzegorz Adamiec, Khikmatulla Arslanov, Vladimir Filippov, Natalya Zaretskaya, Elya Zazovskaya	Absolute chronology of the Upper Dnieper River development since LGM
9:25	Piotr Moska, Grzegorz Adamiec, Zdzisław Jary	Quartz coarse grains signal saturation effects in loess deposits from Biały Kościół, South-West Poland
9:50	Artur Zieliński, Ireneusz Olszak, Tomasz Kalicki	Origin and age of sediments at Rytwiany in Czarna river valley (Polish Uplands)
10:15	Robert J. Sokołowski, Paweł Zieliński, Stanisław Fedorowicz, Anatoly Molodkov	Chronostratigraphy of sedimentological environment changes during the transition between the Weichselian and Holocene in the central part of the European Sand Belt
10:40	Grzegorz Poręba, Zbigniew Śnieszko, Piotr Moska, Przemysław Mroczek	Application of the OSL dating method for stratigraphic study of Holocene slope sediments in the profile from Biedrzykowice (South Poland)

11:05 – 11:30 Coffee break

11:30 – 12:00 Discussion & conference closing

12:30 – 13:30 Lunch

# Poster presentations

## Radiocarbon dating

No	Authors	Title
1	Mitya Vasyukov, Bulat Khasanov, Olga Krylovich, Arkady Savinetsky	Reservoir effect in the Bering Sea: regional correction of radiocarbon dates of marine organisms
2	Mitsuru Okuno, Shinji Nagaoka, Isao Takashima, Jun Aizawa, Yoko Saito-Kokubu, Toshio Nakamura, Tetsuo Kobayashi	Radiocarbon dating of pyroclastic flows in the middle and western parts of Kuju Volcano, Kyushu, Japan
3	John Meadows, Māris Zunde	A lake-fortress, a floating chronology, and an atmospheric anomaly: the surprising results of a radiocarbon wiggle-match from Āraiši, Latvia
4	Adomas Vitas, Jonas Mazeika, Rimantas Petrosius, Rutile Pukiene	Radiocarbon and dendrochronological dating of sub-fossil oaks from Smurgainys riverine sediments
5	Natalia Piotrowska, Wojciech Tylmann, Małgorzata Kinder, Dirk Enters	Radiocarbon dating and age-depth model for laminated lake sediments from Lake Szurpily, NE Poland
6	Konrad Tudyka, Anna Pazdur, François De Vleeschouwer, Nathalie Fagel, Leszek Chróst, Nadine Mattielli	Radiocarbon time scale for elemental, lead isotopic and charcoal record in a peat core in the southern Poland
7	Peter Barta, Marta Kučerová, Mária Hajnalová	Chronometric dating of an early Slavic settlement in Spišský Štvrtok, Spiš Region, Slovakia
8	Peter Barta, Petra Kmeťová, Kristína Piatničková, Peter Demján, Eva Horváthová, Katarína Hladíková	Radiocarbon dates from contexts of Baden culture in Middle Danube region: State and perspectives of research
9	Adam Michczyński	To sum, or not to sum: that is the question
10	S. Chałupnik, M. Wysocka, J. Pawlyta, A. Michczyński, K. Tudyka, A. Pazdur	Improvement in the technique of C-14 measurement as a result of co-operation between two radiometric laboratories

11	Rana Baydoun, Omar El Samad, Maria Aoun, Bilal Nsouli, Ghassan Younes	Optimization and Set-up of Radiocarbon Laboratory at the Lebanese Atomic Energy Commission: First set of samples
11 A	Danuta Michalska	Chemical analysis of mortars components in a methodological aspect of radiocarbon dating

## Terrestrial archives of environmental changes – trees

No	Authors	Title
12	Elżbieta Szychowska-Krąpiec	Dendrochronological dating of wood from mediaeval gold mines in Lower Silesia
13	Barbara Sensuła, Anna Pazdur, Marie - France Marais	First application of mass spectrometry and gas chromatography in investigation of $\alpha$ -cellulose hydrolysates: the influence of climate changes and anthropogenic effects on glucose molecules in pine tree-rings
14	Sławomira Pawełczyk, Anna Pazdur, Barbara Sensuła, Ryszard Kaczka	Oxygen isotopes in tree rings as climate archives for Tatras
15	Andrzej Rakowski, Anna Pazdur, Toshio Nakamura	Tree rings in environmental monitoring
16	Marzena Kłusek	Tree-ring climate reconstructions in the area of northern Alps
17	Sławomir Wilczyński, Bogdan Wertz, Elżbieta Muter	The chronologies of the tree-ring widths, sensitivity and frequency as the methods of assessing the ecological requirements of Chinese <i>Metasequoia</i> ( <i>Metasequoia glyptostoboides</i> ) growing in the vicinity of Krakow Steelworks
18	Sławomir Wilczyński, Grzegorz Durło	Short-term increment reactions of Norway Spruce ( <i>Picea abies</i> (L.) Karst.) from the Western Beskid Mountains
19	Elżbieta Muter, Sławomir Wilczyński, Bogdan Wertz	Factors affecting the similarities and differences in tree growth reactions of pines and oaks growing in the same habitat conditions

20	Zdzisław Bednarz, Elżbieta Muter	Tree ring widths variability in Norway spruce ( <i>Picea abies</i> (L.) Karst.) from the Czarnohora Mountains (Ukrainian Eastern Carpathian Mts.)
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## Terrestrial archives of environmental changes

No	Authors	Title
21	Mohammed Allan, Nathalie Fagel, Gael Le Roux, Nadine Mattielli, Natalia Piotrowska, Jarek Sikorski	Dust historical record in ombrotrophic peat: The case study of a NW European bog
22	Marta Szal, Mirosława Kupryjanowicz, Mariusz Wyczółkowski	Local environmental changes in close vicinity of Poganowo settlement complex (Mrągowo Lake District, NE Poland) as a result of human activity
23	Natalia Nawrocka, Marek Krąpiec	Reconstruction of recent activity of the L. Sawicki's landslide in the vicinity of Szymbark (Low Beskid Mts., SE Poland)
24	Danuta Michczyńska, Jacek Forysiak, Dominik Pawłowski, Mateusz Płóciennik, Ryszard K. Borówka, Andrzej Witkowski, Milena Obremska, Michał Słowiński, Sławomir Żurek, Steve J. Brooks, Adam Michczyński	The environment changes and chronology of the Late Vistulian (Weichselian) sediments in the Rąbień mire
25	Jarosław Sikorski	Bagno Bruch, Bagno Mikołeska peatlands, age - depth model
26	Grzegorz Poręba, Paweł Prokop	Study of soil erosion under manual cultivation system in the monsoonal climate of the Meghalaya Plateau (India) based on radioisotope measurements
27	Ekaterina Gorlova	Marine or terrestrial diet of recent and ancient arctic fox from Chukotka, Russia?
28	Annika Berntsson, Jonas Bergman, Stephen J. Brooks, Lars Eriksson, Tomasz Goslar, Gunhild Rosqvist, Gaute Velle	Shifts in temperature and in seasonality of precipitation during the last 1000 yrs in west central Sweden – evidence from chironomids and lacustrine oxygen isotopes

29	Alicja Bonk, Wojciech Tylmann, Monika Motykowska-Liebner, Martin Grosjean	Validation of varve-based chronology for uppermost sediments using Cs-137: case study of Lake Żabińskie, northeastern Poland
30	Alicja Gabryś, Natalia Piotrowska, Wojciech Tylmann, Martin Grosjean	Stable isotopes in lake sediments from Lake Żabińskie, northeastern Poland, for temperature reconstruction during the last 120 years
31	Jacek Pawlyta, Mirosława Pawlyta, Waldemar Kwaśny, Beata Stepańczak	Some problems with the use of the nickelised carbon catalyst in the high-temperature Ag <sub>3</sub> PO <sub>4</sub> EA-CF-IRMS pyrolysis
32	Waczesław Andrejczuk, Jacek Pawlyta, Piotr Kotula	Isotopic investigations of Zolushka Cave – pilot study

## Luminescence & EPR dating

No	Authors	Title
33	N. Kijek, A. Cicha, A. Chruścińska, K. R. Przeglętko, P. Palczewski, K. Sulkowska-Tuszyńska	Luminescence dating of bricks from the gothic Saint James Church in Toruń
34	Dimitri Vandenberghe, Jasper Van Nieuland, Morgan De Dapper, Damien Flas, Ann-Eline Debeer, Elien De Pelsmaeker, K. Kolobova, K. Pavlenok, U. Islamov	Luminescence dating of the Palaeolithic site of Kulbulak (Uzbekistan) using IR50 and pIRIR290 signals from K-feldspar
35	Valentina Anecitei-Deacu, Kathryn Fitzsimmons, Daniel Vereş, Robert Begy, Alida Timar-Gabor	A comparison of luminescence dating methods applied on a sedimentary section in Southeast Romania interbedding an ash layer
36	Jarosław Kusiak, Przemysław Bobrowski, Maciej Jórdeczka	OSL and IRSL dating of deposits from the Sudanese archaeological sites - criteria for choosing a measurement procedure
37	Jarosław Kusiak, Maria Łanczont	Luminescence dating of the Dybawka Dolna profile on the San River middle terrace in the Carpathian marginal zone (Poland) – testing of different procedures
38	Dimitri Vandenberghe, Morgan De	Luminescence dating of Neolithic occupation near

	Dapper, Jasper Van Nieuland	an artesian spring in the Kharga Oasis, Egypt
39	Radosław Wróblewski, Stanisław Fedorowicz, Katarzyna Kamieńska	Holocene sediments of the Ustka Cliff (Northern Poland) in view of radiometric dating
40	Jasper Van Nieuland, Dimitri Vandenberghe, Jakob Wallinga, Peter Van den Haute	Applying Bayesian methods to OSL data for the coversand type localities in Grubbenvorst and Lutterzand (The Netherlands)
41	Alicja Chruścińska, Natalia Kijek	Estimation of OSL trap parameters by the optical "cleaning" – a critical study of the approach
42	Krzysztof Przeglętk	Equivalent bleaching as a tool for correction for partial bleaching in OSL dating method
43	Krzysztof Przeglętk, Piotr Palczewski, Paweł Molewski, Włodzimierz Juśkiewicz, Leon Andrzejewski	OSL dating of modern fluvial sediments in Lower Vistula (Poland): testing zeroing assumption
44	Konrad Tudyka, Andrzej Bluszcz	A study on photomultiplier afterpulses in luminescence reader
45	Andrzej Bluszcz, Grzegorz Adamiec, Aleksandra Heer	Statistical considerations in estimation of equivalent dose and its uncertainty in the OSL SAR protocol
46	Piotr Moska, Grzegorz Adamiec, Zdzisław Jary, Andrzej Bluszcz	Preliminary OSL dating results for loess deposits from Złota
47	Zuzanna Kabacińska, Ryszard Krzyminiewski, Danuta Michalska, Bernadeta Dobosz	Investigation of lime mortars and plasters from archaeological excavations in Hippos (Israel) using Electron Paramagnetic Resonance
48	Danuta Dzieduszyńska, Piotr Kittel, Joanna Petera-Zganiacz, Juliusz Twardy, Grzegorz Adamiec, Piotr Moska	Results of isotope age determination of the mineral and organic deposits (sequence) of the river Warta (Central Poland)
49	M. Ludwikowska-Kędzia, A. Bluszcz, G. Adamiec, A. Kubala-Kukuś	The age and origin of Quaternary sediments in Czaplów UJK-3 drilling profile (Holy Cross Mountains, Poland)

# **ORAL PRESENTATIONS**

# **SESSION 1 & 2**

## **Radiocarbon dating**



## **On the influence of climatic factors on the ratio between the cosmogenic isotope $^{14}\text{C}$ and total carbon in the atmosphere in the past**

Hogne Jungner<sup>1</sup>, V.A. Dergachev<sup>2</sup>, I.V. Koudriavtsev<sup>2</sup>, Yu.A. Nagovitsyn<sup>3</sup>, M.G. Ogurtsov<sup>2</sup>

<sup>1</sup>*University of Helsinki, Finland*

<sup>2</sup>*Ioffe Physical–Technical Institute, Russian Academy of Sciences. St-Petersburg, Russia*

<sup>3</sup>*Central (Pulkovo) Astronomical Observatory, Russian Academy of Sciences. St-Petersburg, Russia*

Contact: Hogne Jungner, email: hogne.jungner@helsinki.fi

The cosmogenic isotopes  $^{10}\text{Be}$  and  $^{14}\text{C}$  are generated in the Earth's atmosphere due to influence of galactic cosmic rays (GCR). The  $^{10}\text{Be}$  isotopes formed in the atmosphere fall down and are accumulated in polar ice cores. The  $^{14}\text{C}$  isotopes are involved in a number of processes of exchange between different natural reservoirs and are then captured by plants and deposited in annual tree rings. Solar activity influences on the rate of generation of these isotopes in the atmosphere as a result of modulation of the GCR intensity by the heliospheric magnetic field. Studies on time variations in concentrations of these isotopes in natural archives provide a possibility to investigate solar activity in the past. But climatic variations influence as well on these concentrations and thus distort the solar imprint.

The report shows results of model calculation of generation of the isotope  $^{14}\text{C}$  in the atmosphere and its relative abundance during the time interval 1500-1800, taking into account changing climatic influence. This interval includes Maunder minimum of solar activity and periods of significant change in atmospheric concentration of  $\text{CO}_2$  and global temperature. The result shows that taking into account the climatic changes is an important condition for the reconstruction of solar activity in the past using data based on cosmogenic isotopes.

## **Rapid low level C-14 liquid scintillation measurements with a delayed coincidence monitoring of Rn-222 contamination**

Konrad Tudyka<sup>1</sup>, Andrzej Bluszcz<sup>1</sup>, Beata Kozłowska<sup>2</sup>, Jacek Pawlyta<sup>1</sup>, Adam Michczyński<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Department of Nuclear Physics and its Application, Institute of Physics, University of Silesia, Uniwersytecka 4, 40-007 Katowice, Poland*

Contact: Konrad Tudyka, email: [konrad.tudyka@polsl.pl](mailto:konrad.tudyka@polsl.pl)

In this work we present routine C-14 measurements which are simultaneously performed with low level Rn-222 contamination monitoring in liquid scintillation benzene based cocktails. Measurements are performed with a laboratory-made multichannel analyzer which records a height of each pulse and a time interval between subsequent pulses. This feature is used to detect pairs from two subsequent decays of Rn-222 products which occur in less than 800  $\mu$ s and have pulse amplitudes with energies corresponding to more than 160 keV. Such pairs count rate is then used to correct a count rate in the fixed energy C-14 window. A set of test samples was measured four times after benzene synthesis on two independent systems. The results obtained show good agreement between measurements. The Rn-222 contribution decreases with time as expected. The contamination is systematic, however, its level varies with initial material. Peat samples tend to high amounts of Rn-222. The influence of Rn-222 needs be taken into account when rapid C-14 measurements are performed immediately after benzene synthesis.

## **Fossil fuel component of CO<sub>2</sub> in atmosphere and biosphere on basis carbon isotopes measurements, Southern Poland**

Natalia Piotrowska<sup>1</sup>, Tadeusz Kuc<sup>2</sup>, Sławomira Pawełczyk<sup>1</sup>, Anna Pazdur<sup>1</sup>, Andrzej Z. Rakowski<sup>1,3</sup>, Kazimierz Różański<sup>2</sup>, Barbara Sensuła<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Mickiewicza 30, 30-059 Krakow Poland*

<sup>3</sup>*Leibniz Laboratory for Radiometric Dating and Stable Isotope Research, Christian-Albrechts-University, Kiel, Germany*

Contact: Natalia Piotrowska, email: npiotrowska@polsl.pl

As is shown in the IPCC (Intergovernmental Panel on Climate Change) report, the observed climate changes are caused, among others, by human activity. Mainly emission of CO<sub>2</sub> to the atmosphere coming from the burning of fossil fuels, can have dire consequences for life on Earth and development of humankind. The report uses, among others, data obtained from isotopic measurements in the biosphere. Measurements of <sup>14</sup>C and <sup>13</sup>C concentration in modern atmospheric carbon dioxide and biosphere allow the determination of the decrease of the concentration of this isotope. Furthermore, the magnitude of emission to the atmosphere of carbon dioxide not containing the isotope <sup>14</sup>C can be estimated on this basis. Such emission stems from fossil fuel combustion – petroleum, natural gas and black coal. A sensitive bioindicator of the emission are annual tree rings. The measurements of <sup>14</sup>C concentration in tree ring material using AMS allow to see its seasonal changes. Trees, treated as an archive of changes in conjunction with information about the isotopic composition of carbon can be used for monitoring of environment as sensitive bioindicators on local, as well as on the global scale. Regular investigations of isotopic composition of carbon in trees have been carried out in the GADAM Centre for the urban areas of both Poland and worldwide. This method can be applied in the study of the emission of CO<sub>2</sub> to the atmosphere and its spatial and temporal distribution connected with the production of energy by power plants based on fossil fuel combustion for the area of southern Poland. Modelling of CO<sub>2</sub> emission using both <sup>14</sup>C and <sup>13</sup>C carbon isotopes measured in pine tree rings from Niepolomice Forest on the background of climatic changes will be presented. The national ecological policy in the era of global warming requires the manufacturers of energy to get involved in the development of methods suitable for monitoring the state of the environment. Hence, the interest in the area of monitoring the fossil fuel component in CO<sub>2</sub> in our region is raising. The measurements of <sup>14</sup>C (by AMS method) and <sup>13</sup>C isotopes are being carried out in atmospheric CO<sub>2</sub> and plants in the Gliwice city centre. A high decrease of both isotopes contents and their short-term seasonal changes during the year caused by human impact during the year are observed.

## Complex statistical model of the Lake Soppensee chronology - some methodological problems concerning construction of age-depth models using OxCal

Adam Michczyński<sup>1</sup>, Irka Hajdas<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Ion Beam Physics, ETH Zürich, Schafmattstrasse 20, 8093 Zürich, Switzerland*

Contact: Adam Michczynski, email: adam.michczynski@polsl.pl

This study presents complex statistical model of the Lake Soppensee chronology, which joins two types of accessible chronological information together. The first type of information is represented by the varve chronology constructed for laminated part of Soppensee sediment (depth 540 – 360 cm) and fitted to the IntCal09 radiocarbon calibration curve. The second type of information is represented by radiocarbon dates obtained for non-laminated or partially laminated parts of the sediment. These dates have been used for construction of age-depth model. This complex statistical model makes a supplement of our previous work published in *Radiocarbon*, where chronologies constructed on a base of these two types of information separately were compared.

The complex statistical model of the Lake Soppensee chronology has been constructed using OxCal 4.1 program. The model consists of three parts included in *Sequence* function. The main part is the varve chronology, which is fitted to the IntCal09 using OxCal wiggle-matching function *D\_Sequence* on a base of 54 radiocarbon dates. Two remaining parts concern time periods before and after accumulation of laminated sediment. They are constructed using OxCal age-depth model function *P\_Sequence* with *k* parameter, which describes a magnitude of random variation from a constant sedimentation rate, equal to 3 (1/cm). These three parts are separated by OxCal *Boundary* commands. Additional *Boundary* command is included inside *P\_Sequence* function, which describes age-depth relationships for lower part of the sediment, and points a borderline between non-laminated and partially laminated part of the sediment. Presented model confirms our previous conclusions that depositional conditions of the lake Soppensee were rather stable during the early Holocene and allows to make precise dating of chronological events.

Important element of the present work is discussion of appropriate threshold value of the overall agreement index. Because in a model constructed using wiggle-matching function *D\_Sequence* is only one independent parameter, the threshold value of the overall agreement index depends on a number of dates included in the model. The complex model, which includes both *D\_Sequence* and *P\_Sequence* functions, needs special estimation of the threshold value. In this case the threshold value of the overall agreement index should be lower than 60% or overall agreement index of the model should be appropriately recalculated. In our analysis we recalculated the overall agreement index of our model to obtain a value, which may be compared with the “typical” threshold value (60%).

Deeper analysis of above-mentioned case leads to conclusion, that if we assign values of depth to dates, which are used to a construction of the *P\_Sequence* age-depth model, then a rigidity of the model increases. It means, that the dates are not completely independent and consequently the threshold value of the overall agreement index for *P\_Sequence* age-depth models should be also lower than 60%.

## **The radiometric and dosemetric data of the Morasko meteorite impact age**

Wojciech T. J. Stankowski<sup>1</sup>

<sup>1</sup>*Institute of Geology, Adam Mickiewicz University, Poznań, Poland*

Contact: Wojciech T. J. Stankowski, email: stawgeo@amu.edu.pl

The Morasko Meteorite Nature Reserve is one of dozen places on the globe where numerous lamps of metallic meteorites and the impact craters were documented. The age of impact was dating on multimethod way. Among mineralogical, morphogenetical, palynological data the radiocarbon and luminescence methods performed. The comparison of radiometric and dosemetric investigations results, seems to be the most important to establish the real impact age. The high surface temperature of a meteorite passing through the Earth atmosphere leads to changes in mineralogical properties and to superficial luminescence resetting. After the fall of the meteorite and contact hot lamps with surrounding materials, two crusts are generated: a) melt-weathering crust, covering the outside of the meteorite, b) sinter-weathering crust, consisting the sediments/rocks on which the meteorite has fallen. Both can be dating by luminescence technique. Age of craters created by falling meteorites, can be calculate by infilling materials – the radiometric elaborations are helpful. The multimethod – luminescence and radiometric datings on the sinter-weathering crusts and melt-weathering crusts of meteorites on the mineral, as well as organic material from the bottom of Morasko craters, indicate that the impact took place ~5000 years ago. The obtained data confirm earlier palynological and morphogenetical interpretations.

## **Hydrological changes after last ice retreat in Northern Poland in the light of radiocarbon dating**

Danuta Michczyńska<sup>1</sup>, Leszek Starkel<sup>2</sup>, Dorota Nalepka<sup>3</sup>, Anna Pazdur<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography and Spatial Organization Department of Geomorphology and Hydrology of Mountains and Uplands, PAS, Św. Jana 22 31-018 Krakow, Poland*

<sup>3</sup>*W. Szafer Institute of Botany PAS Lubicz 46 31-512 Kraków, Poland*

Contact: Danuta Michczyńska, email: Danuta.Michczynska@polsl.pl

A simplified model of hydrological changes during the Late Glacial and the Holocene is presented for the N. Poland regions that were ice covered during the Last Glacial. The reconstruction is based on a set of 197 <sup>14</sup>C dates from about 120 localities reflecting the sequence of alternating lake transgressions and regressions. First transgression is related to dead ice melting (sometime in 2-3 phases) and later ones are starting at more humid phases. But these are usually followed by regressions, which may be connected with formation of new drainage systems or with overgrowing of shallow lakes by peatbogs.

## **Comparison of paleogeographic records of the Holocene environmental changes in two landslide peat-bogs of the Beskid Sądecki Mts. – case study of Jesionowa and Wierchomla sites**

Adam Michczyński<sup>1</sup>, Włodzimierz Margielewski<sup>2</sup>, Piotr Kołaczek<sup>3</sup>, Andrzej Obidowicz<sup>4</sup>, Danuta Michczyńska<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Nature Conservation, Polish Academy of Sciences, A. Mickiewicza Ave. 33, 31-120 Kraków, Poland*

<sup>3</sup>*Department of Biogeography and Palaeoecology, Faculty of Geographical and Geological Science, Adam Mickiewicz University, Dziejelowa 27, 61-680 Poznań, Poland*

<sup>4</sup>*Institute of Botany, Polish Academy of Sciences, Lubicz 46, 30-069 Kraków, Poland*

Contact: Adam Michczynski, email: adam.michczynski@polsl.pl

Peat profiles collected from two landslide mires situated in the eastern part of the Beskid Sądecki Mts. (the Western Outer Carpathians) were investigated using the palynological analysis, analysis of the loss on ignition and the identification of organic deposits. Moreover for both sites age-depth models basing on radiocarbon dates were constructed. These models allow to establish absolute time scales for changes of the environment in the past. The first investigated site is located near Jesionowa village, while the second site near Wierchomla village. Both sites are situated in the Jaworzyna Krynicka Range, one about 7 km from the another, and lie on a similar altitude. These two profiles are the only available source of information about the vegetation development during the Holocene from the Beskid Sądecki Mts.

Even though both mires are situated close one to another, the results of age-depth models combined with the palynological and the LOI analysis show some distinct discrepancies in a vegetation history between Jesionowa and Wierchomla. It means, that influence of local factors on the vegetation development in mountainous areas and, in a consequence, on obtained palynological information may be more important than previously thought. Additionally the results presented here distinctly show, that a use of palynological episodes as the age-markers for age-depth models construction might be highly misleading.

## **Dated speleothems of the non-karst caves in the Polish Flysch Carpathians and their relation to climatic changes during the Late Glacial-Holocene**

Włodzimierz Margielewski<sup>1</sup>, Jan Urban<sup>1</sup>, Karel Žak<sup>2</sup>, Valentina Zernitskaya<sup>3</sup>

<sup>1</sup>*Institute of Nature Conservation, Polish Academy of Sciences, A. Mickiewicza Ave. 33, 31-120 Kraków, Poland*

<sup>2</sup>*Institute of Geology, Academy of Sciences Czech Republic, Prague, Czech Republic*

<sup>3</sup>*Institute for Natural Management, National Academy of Sciences of Belarus, Minsk, Belarus*

Contact: Włodzimierz Margielewski, email: [margielewski@iop.krakow.pl](mailto:margielewski@iop.krakow.pl)

The extensional cracks (crevice-type caves), genetically connected with initial stage of mass movements are very numerous in Polish Flysch Carpathians (Margielewski, Urban 2003). Therefore, dating of crevice-type caves formation is very important for the reconstruction of climatic changes during the Late Glacial and Holocene. The age of such caves formation can be detected by speleothems' datings: using the <sup>14</sup>C and U/Th methods for the carbonate forms (Margielewski et al. 2012). However, in non-karst caves of the Carpathians, carbonate speleothems are rare phenomena, they were found in some caves formed in sandstones with calcite cement. These speleothems represent typical carbonate forms: draperies, flowstones, stalactites, stalagmites (Urban et al. 2007).

Radiocarbon method is most accurate for speleothems' dating, however the reservoir effect must be taken into account. The value of this effect is difficult to estimate for carbonate speleothems of the Carpathian caves. Due to high contamination with detrital thorium and small content of original uranium, the U-series analysis is practically useless to estimate the real age of speleothems and value of reservoir effect for correction of <sup>14</sup>C ages (Margielewski et al., 2012). Following the previous data and experiences of Gently et al. (1999), Pazdur et al. (1999), Goslar et al. (2000), the ages were calculated using the dead carbon proportion yielding 15% (=1350 years), and calibrated.

The conventional radiocarbon dates were elaborated in radiocarbon laboratories in Gliwice and Skala (Poland), Minsk (Belarus), whereas the AMS datings were made in laboratories in Gliwice and Miami, Florida (USA). The corrected and calibrated dates varies from 16,4 kyrs cal BP to 0.56 kyrs cal BP. It suggests that the oldest speleothems started to form in the Late Pleistocene, during the time of permafrost retreat, as well as at the beginning of the Holocene (11.5-15 ka cal BP). The next stages of the speleothems formation fall to the Boreal (ca 10 ka cal BP), beginning of the Atlantic and Middle Atlantic (ca 9 ka and ca 7 ka cal BP), beginning of the Subboreal (ca 6 ka cal BP) and the Late Subboreal-Early Subatlantic (ca 3.0-3.5 ka cal BP). Some of the speleothems (which started from e.g. Atlantic or even Boreal, and have been growing continuously till now) has deconcentric rings, connected with gravitational movements of blocks forming cave walls, changing calcite precipitation (Margielewski et al. 2012). Radiocarbon datings of these changes in speleothems growth, confirm connection of secondary gravitational movements with growth of climate humidity in the Middle Atlantic, Late Subboreal/Early Subatlantic and the Middle Subatlantic. Part of the radiocarbon datings are confirmed by palynological analysis of speleothems. The datings of the speleothems' formation, as well as their deconcentric growth suggest, that the gravitational movements causing crevices opening or re-modelling were connected with humid climatic phases, during which the intensification of mass movements and fluvial activity were recorded in the Carpathians (Margielewski 2006; Starkel et al. 2013).

This study was conducted within a scientific project No. NN306 522 738 granted by Polish Ministry of Sciences.



## Chronometry versus relative chronology of Baden culture

Jana Mellnerová Šuteková<sup>1</sup>, Peter Barta<sup>1</sup>

<sup>1</sup>*Comenius University in Bratislava, Faculty of Philosophy, Department of Archaeology, Bratislava, Slovakia*

Contact: Jana Mellnerová Šuteková, email: sutekova@fphil.uniba.sk

Archaeological research of Baden culture as a phenomenon of Early Prehistory has recently entered the significant point of re-evaluation of vital facts of the culture existing in several regions. In time of Baden the population of 4th Millennium BC reached solid technological level and brought important innovation for further progress (wagon, plough, metallurgy etc.). In addition to interpretation of economic-technological level and life of prehistoric society, new answers of concrete space-time questions are needed. From traditional point of view Baden is presented as a consolidated culture with specific artifacts, funeral rites, types of settlements, symbolic elements etc. Its chronology has been formed by means of combination of ceramic typology and stratigraphy.

Important position in research of Baden absolute chronology still has the study of E. M. Wild et al. (Radiocarbon 2002). They presented summary of calibrated data in correlation with defined relative-chronological phases sensu Němejcová-Pavúková and investigated contemporaneous cultures as well. They placed Baden in the context of European cultural development in Late Neolithic, i.e. middle Aeneolithic according to Slovakian chronology, into 3700 – 2700 cal BC (95, 4% probability).

Recent research of Baden culture has raised an essential question of archaeological definition of this phenomenon (Furholt 2009) perceptible by means of a number of ceramic subsystems (Keramikstile). Consequently, this raises a question of detailed relation between chronometric data and Baden typological phases (4 phases with more subphases). In fact <sup>14</sup>C data form three groups that correspond with Boleraz (Baden I), Postboleraž and Classical Baden (Baden II-III/IV), and Postbadener (Baden IV and Late Aeneolithic groups). However, radiocarbon data are not easily tieable with shorter relative-chronological periods. This brings inhomogeneity since the <sup>14</sup>C data do not fit with detailed relative-chronological units of archaeologist.

The aim of this paper is first, to define the basis of the problem from both archaeological and chronometric views, and second, to present current questions of Baden cultural development and its interregional relations with an input of relevant chronometric data (Barta - Kmeťová - Piatničková et. al., in the present volume). The <sup>14</sup>C data of our research come from primary centre of Baden in Middle Danube and Tisza region. Our effort is to work with high standard of chronometric hygiene and to apply HBCO correction sensu Barta and Stolc 2007. Authors suggest alternative solutions based on series of Bayesian models (OxCal Programme) with consistently selected data in order to present a transparent methodology. Our results are to refresh current debate about Baden represented by new data from Hungary (Horváth et al. 2008, Siklósi 2009).

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0598-10.

# **SESSION 3**

## **Terrestrial archives of environmental changes - trees**

## **Methods for detection the mid-term tree radial increment changes caused by selected environmental factors**

Bogdan Wertz<sup>1</sup>, Sławomir Wilczyński<sup>2</sup>, Elżbieta Muter<sup>3</sup>

<sup>1</sup>*University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Mensuration, Al. 29 Listopada 46, 31-425 Krakow, Poland*

<sup>2</sup>*University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Protection, Entomology and Forest Climatology, Al. 29 Listopada 46, 31-425 Krakow, Poland*

<sup>3</sup>*Forest Biodiversity Institute, University of Agriculture, Krakow 31-425, Al. 29 Listopada 46, Poland*

Contact: Bogdan Wertz, email: b.wertz@ur.krakow.pl

The changes of tree radial growth over time are the result of the impact of various environmental factors. Among them an important role plays some factors, which reveals the most in the medium variation of tree increment activity. Commonly used dendrochronological methods usually focus on the widths of tree-ring series while the methods examining homogeneity of those reactions are relatively rarely used. Presented paper describes a possibility of using some indicators which in various ways describes homogeneity of incremental tree responses – such as coefficient of variation and the ratio of contribution. Analysis of their changes provide basis for identification of periods when environmental factors, such as air pollution or the insect outbreaks, influenced the trees, disturbing homogeneity of their incremental reactions.

## **Dendrochronological investigations of sub-fossil wood from the Rucianka raised bog (NE Poland)**

Joanna Barniak<sup>1</sup>, Marek Krąpiec<sup>1</sup>, Leszek Jurys<sup>2</sup>

<sup>1</sup>*Faculty of Geology, Geophysics and Environmental Protection, AGH-University of Science and Technology, A. Mickiewicza 30 Ave., 30-059 Krakow, Poland*

<sup>2</sup>*Polish Geological Institute – National Research Institute; Marine Geology Branch in Gdańsk-Oliwa; Kościarska 5; 80-328 Gdańsk, Poland*

Contact: Joanna Barniak, email: barniak@geol.agh.edu.pl

The dendrochronological research was carried out on well preserved sub-fossil pine wood, found in biogenic deposits of the Rucianka raised bog (NE Poland). 41 pieces of pine wood and one sample of oak wood were collected from a wood heap, stretching along the exploitation field. Correlation of individual tree-ring width sequences and visual comparing of dendrograms for each tree allowed to identify groups of samples of the same age. The chronology was constructed for each group of samples applying the standard dendrochronological method. Basing on radiocarbon analyses of six pine wood samples and the wiggle-matching method, three local floating chronologies were dated. The chronologies cover the period 990–460 cal. BC, which is very important from the palaeoclimatological interpretations point of view. The study allowed to identify distinct woodland generations separated by germination and dying-off phases (GDO). Woodland phases were determined to ca. 990–850 cal. BC, ca. 850–710 cal. BC, ca. 710–580 cal. BC and ca. 590–460 cal. BC. GDO phases identified are clearly related to the wetter climatic periods. Extinction of the trees appeared during the period of higher groundwater level which in turn caused favorable conditions for growth of young pines. Zones of narrow-ringed wood zones, which are response of trees to unfavourable habitat conditions, were observed in the pine discs collected. Growth depressions including even several dozen annual tree rings, indicated periodical deterioration of environmental conditions. Characteristic growth depressions, from 10 to 25 tree rings, were also noticed at the end of pines life. Some fires were recorded in the Rucianka bog as well. Fire scars were visible at four wooden discs. Based on the radiocarbon dating, the approximate time of the fires could be determined to ca. 710 BC and ca. 670 BC. Presented results have only a preliminary character, in view of the small number of sub-fossil wood pieces. Sampling of pine wood with the progress of peat harvesting, especially stumps in situ, should allow to analyze the bog development connected with climate variability and construct a dendrochronological standard covering hundreds of years.

## Carbon and oxygen isotopes in tree rings as climate and environmental changes archives for Tatras and Sudeten

Sławomira Pawelczyk<sup>1</sup>, Anna Pazdur<sup>1</sup>, Barbara Sensuła<sup>1</sup>, Ryszard Kaczka<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland*

Contact: Sławomira Pawelczyk, email: Sławomira.Pawelczyk@polsl.pl

One of the isotopic archives frequently used in recent years are tree rings. Isotopic fractionation of organic matter occurring in the tree depends on climatic and environmental conditions. Therefore  $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$  and  $\delta^{15}\text{N}$  in the  $\alpha$ -cellulose from wood can be used as a sensitive indicator of climate and environmental changes.

Investigations of stable isotopic C, O, and N compositions in  $\alpha$ -cellulose extracted from tree rings of spruce (*Picea Abies* L.) growing in Carpatian Mopuntains were undertaken for period 1850-2010. Sudeten, Tatras and Eastern Carpathians (Gorgans and Czarnohora) are main mountain ranges of the East Central Europe characterized by well-developed timberline ecotone. The summer temperature is dominant factor limited growth of trees in high mountain of temporal zone therefore tree rings and isotopes in tree rings can be considered as a good climate proxy, especially for temperature reconstruction.

As a part of research project results for Tatras and Sudeten area associated with the  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  measurement will be presented. Relationships between isotope values of tree rings and monthly climate data were modelled using bootstrapped correlation function in DendroClim2002 and confirm that  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  can be used as summer temperature record. Using a moving interval technique, the temporal stability of correlation between isotope chronology and climate was investigated, because the temporal stability of climate-proxy connections is an important issue in palaeoclimatic reconstruction. These studies showed no climate signal stability for years 1970-1990. This is probably related to industrial human activities.

## **Tree ring widths variability in Norway spruce (*Picea abies* (L.) Karst.) from the Czarnohora Mountains (Ukrainian Eastern Carpathian Mts)**

Zdzisław Bednarz<sup>1</sup>, Elżbieta Muter<sup>1</sup>

<sup>1</sup>*Forest Biodiversity Institute, University of Agriculture, Krakow 31-425, Al. 29 Listopada 46, Poland*

Contact: Elżbieta Muter, email: [rlkuchni@cyf-kr.edu.pl](mailto:rlkuchni@cyf-kr.edu.pl)

On the basis of 83 Norway spruces (*Picea abies* (L.) Karst.) from the Czarnohora Mountains a master chronology was prepared, spanning 310 years (1694-2003). For establishing Norway spruce dendrochronological standard we used cores from three localities (Dancerz, Homuł, Pożyżewska). The similarities between the local chronologies were very high. Analyses of the relationship between ring width indices of spruces and mean monthly air temperatures (1882-2002) in Lwów indicated a strict relationship between radial growth and June-July temperature ( $r = 0,5$ ,  $p = 0,001$ ; GL = 76%). The Norway spruce ring width data showed also significant relationship with June-July precipitations, but this relation was negative ( $r = -0,19$ ,  $p = 0,05$ ; GL = 42%). High mean temperatures in June-July enhance radial growth, while high sums of precipitation reduce ring widths.

**Stable carbon isotopes of glucose received from pine tree rings as indicators of anthropogenic effects in Niepolomice Forest (1950-2000 AD)**

Barbara Sensuła<sup>1</sup>, Anna Pazdur<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Barbara Sensuła, email: [barbara.sensula@polsl.pl](mailto:barbara.sensula@polsl.pl)

The mass spectrometric investigations of carbon isotopic composition of glucose received from  $\alpha$ -cellulose samples derived from Scots pine (*Pinus sylvestris* L.) growing in Niepolomice Forest was the main aim of this study. The annual rings covered the time span from 1950-2000 AD.  $\alpha$ -cellulose samples were extracted from increment cores of four representative trees and then acid hydrolysis were performed. The number of sunshine hours, thermal and pluvial conditions of the growing season and in the months preceding it had a significant effect on pine. Also non-climatic factors, most likely by industrial pollution signal has been recorder in isotopic composition of glucose. The relationship between climatic conditions, carbon dioxide emission and annual tree-rings carbon isotopic composition were analysed, using methods of correlation and response function, and multiple regression function.

# **SESSION 4**

## **Terrestrial archives of environmental changes**



## **Peat bog records of atmospheric dust fluxes in Chilean Tierra del Fuego. Preliminary results and perspectives**

François De Vleeschouwer<sup>1,2</sup>, Heleen Vanneste<sup>1</sup>, Pierre Falba<sup>1</sup>, Nadine Mattielli<sup>3</sup>, Aubry Vanderstraeten<sup>3</sup>, Natalia Piotrowska<sup>4</sup>, Gaël Le Roux<sup>1</sup>

<sup>1</sup>*Université de Toulouse, INP, UPS, EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement), ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France*

<sup>2</sup>*CNRS, EcoLab, 31326 Castanet Tolosan, France*

<sup>3</sup>*Laboratoire G-Time, Département des Sciences de la Terre et de l'Environnement, CP 160/02, Université Libre de Bruxelles, Belgium*

<sup>4</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: François De Vleeschouwer, email: francois.devleeschouwer@ensat.fr

Little attention has been given to pre-anthropogenic dust signals recorded in peat bogs, especially in the Southern Hemisphere. Yet they are important to 1/ better understand the different particle sources during the Holocene and 2/ to tackle the linkage between atmospheric dust loads and climate change and 3/ to better understand the impact of dust on Holocene palaeoclimate and palaeoenvironments in a critical area for ocean productivity. In the PARAD project, we will explore the use of a broad range of trace elements and radiogenic isotopes (Pb, Nd, Hf) as dust proxies. By coupling these findings with biological proxies (plant macrofossils, pollen) and detailed age-depth modelling, we expect to identify and interpret new links between atmospheric dust chemistry and climate change. In this contribution, we will present the preliminary elemental and isotopic signatures of a peat record in Chilean Tierra del Fuego, covering almost the entire Holocene. Results will also encompass density, ash content, grain size analyses, macrofossil determination and radiocarbon age modelling. Karukinka bog display several mineral peaks, which possible origin (soil particles, volcanism, cosmogenic dusts, marine aerosols) will be discussed here.

## **Stable carbon ( $^{13}\text{C}/^{12}\text{C}$ ) and nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) analysis of Azmaut and Ramon I zoogenic deposits (Negev desert, Israel)**

Anna Babenko<sup>1</sup>

<sup>1</sup>*Laboratory of historical ecology of A.N. Severtsov's Institute of Ecology and Evolution, Russian Academy of Science, Leninsky Prt., 33 119071 Moscow, Russia*

Contact: Anna Babenko, email: mnemosina\_a@mail.ru

Zoogenic deposits, which are accumulated in caves and niches, are an unique source of information of arid ecosystems history. Different species of animals use such shelters for thousands of years. Shepherds also exploit them as enclosures for livestock. Dung, bones and other organic materials form the deposit on the shelter bottom layer by layer thus offering opportunity for different paleoecological analysis.

In the central part of the Negev desert (Israel) we disclosed seven zoogenic deposits consisting of alternating dung, ash and mineral layers. The stable isotope ( $^{15}\text{N}/^{14}\text{N}$  and  $^{13}\text{C}/^{12}\text{C}$ ) analysis of two zoogenic deposits was done. The Azmaut deposit is of 108 cm in depth, one third of it is represented by ash layers. This deposit was accumulated during the last 6000 years, which was inferred from 10 radiocarbon data conducted. The Ramon I deposit is of 90 cm in depth, ash layers amount to 98 % of it. Only four radiocarbon data were obtained for this deposit, two in the upper and two in the lower part of it. It turned out to be that ash layers contain little organic material preserved. The Ramon I deposit was accumulated for the last 8000 years. The bottom layers of Ramon I deposit were formed 2000 years earlier than that of Azmaut. Merger of the results of stable isotope analysis of two deposits enable us to reconstruct the dynamics of precipitation of the region for the last 8000 years.

Decrease of  $\delta^{13}\text{C}$  value in plant remains is a sensitive indicator of paleoclimatic conditions in the region. The changes of  $\delta^{13}\text{C}$  value over the past eight thousand years almost fully coincide with increase of the total pollen concentration and the proportion of the Poaceae pollen in the profile of zoogenic deposits and with wetter conditions: 37th-23th BC, 19th-16th centuries BC, beginning of the 1st millennium BC – the first half of the 1st millennium AD, 13d-early 17<sup>th</sup> centuries AD.  $\delta^{15}\text{N}$  value is less sensitive indicator of climate dynamics and represents the most significant changes of precipitation in the region at the frontier of the IIIrd-IInd millennium BC.

## Isotope composition of bivalves' shell organic matrix from different biotopes (Adak and Aleutian islands) as reflection of their habitats

Zhanna Antipushina<sup>1</sup>

<sup>1</sup>*Laboratory of historical ecology of A.N. Severtsov's Institute of Ecology and Evolution, Russian Academy of Science, Leninsky Prt., 33 119071 Moscow, Russia*

Contact: Zhanna Antipushina, email: zh.antipushina@gmail.com

This report provides a preliminary result of isotope composition of bivalves' shell organic matrix from different biotopes. Subfossil and alive mussels *Mytilus trossulus* Gould, 1850 and clams *Clinocardium nittallii* (Conrad 1837) were used for stable carbon and nitrogen isotope analysis. Subfossil shells were sampled from the archaeological deposit (6500 (cal) years BP), situated near Clam lagoon, Adak Island. We analyzed shells from the upper (younger) and lower (older) layers separately. Mussels were sampled alive in different biotopes of Adak Island: Clam lagoon, Sweeper Cove, Finger Bay, and from the open sea coasts – from the opposite side of Clam lagoon, and from the opposite side of Shagak Bay.

Results of <sup>14</sup>N/<sup>15</sup>N analysis: Bivalve shells from different biotopes (except Clam lagoon) contain the same  $\delta^{15}\text{N}$  value ( $7.4 \pm 0.6\text{‰}$  in average). The  $\delta^{15}\text{N}$  value of shells sampled in Clam lagoon is higher: 9.95‰ (subfossil mussels), 10.2‰ (alive mussels), and 11.8‰ (subfossil clams). There is no difference between  $\delta^{15}\text{N}$  value in subfossil clams from the upper and lower layers of deposit.

Results of <sup>12</sup>C/<sup>13</sup>C analysis: Mussels sampled from Sweeper Cove (from biotope with high kelp biomass and low water turbulence) and from the both open sea sides (from biotope with high kelp biomass and high water turbulence) are <sup>13</sup>C-enriched. The  $\delta^{13}\text{C}$  value is highest in shells sampled from Sweeper Cove ( $-14.6 \pm 0.4\text{‰}$  in average) and a little bit lower in shells from the open sea sides ( $-5.1 \pm 0.3\text{‰}$  in average). Mussels sampled alive from Finger Bay and Clam lagoon (from biotopes without kelps) are <sup>13</sup>C-depleted ( $-16.1 \pm 0.1\text{‰}$ , and  $-16.0 \pm 0.4\text{‰}$ , respectively). The present results reinforce the Simenstad, Duggins and Quay's conceptual model of effect of kelp biomass and environmental exposure on  $\delta^{13}\text{C}$  of organic carbon fixed by kelps in coastal habitats. In macrophyte-based systems, in which *Laminaria* spp. is the dominant group of kelp, and kelp biomass is highest, [CO<sub>2</sub>]<sub>aq</sub> availability is reduced; this promotes <sup>13</sup>C-enrichment of kelp's tissues during carbon fixation. Detritus, also <sup>13</sup>C-enriched, involves by bivalves and other filtrators into trophic net. Where kelp structure is less dense and/or higher wave turbulence exists, the kelps (and shells of molluscs) are depleted in <sup>13</sup>C. All subfossil clams from the upper layer of the deposit have the equal  $\delta^{13}\text{C}$  value ( $-15.7 \pm 0.4\text{‰}$ ). In the lower layer we found clams contained the same  $\delta^{13}\text{C}$  value ( $-16.3 \pm 0.3\text{‰}$ ) and clams more <sup>13</sup>C-depleted ( $-17.9 \pm 0.2\text{‰}$ ). Subfossil mussels from the lower layer are the most <sup>13</sup>C-depleted ( $-19.3\text{‰}$ ).

These results allow to suggest that the older layer of deposit contains clams, sampled from different biotopes, and the younger layer contains clams, sampled from the same biotope.

I'm thankful to Arkady Savinetsky, Olga Krylovich, and Dixie West for material from Adak Island, and Alexei Tiunov for help with isotope analysis.

Study was supported by RFBR (№12-04-00655, 12-04-31010), and the programs "Biological Resources of Russia", "Problems of Origin of Life and Evolution of the Biosphere", "Wildlife".

## **Holocene climate and vegetation of the Bale Mountains (Ethiopia) based on pollen analysis and radiocarbon dating of zoogenic deposits**

Evgeniya Kuzmicheva<sup>1</sup>

<sup>1</sup>*Laboratory of historical ecology of A.N. Severtsov's Institute of Ecology and Evolution, Russian Academy of Science, Leninsky Prt., 33 119071 Moscow, Russia*

Contact: Evgeniya Kuzmicheva, email: kuzmicheva.evgeniya@gmail.com

The results of pollen analysis and radiocarbon dating are presented for two hyrax dung deposits from rock shelters found in the Afroalpine zone of the Bale Mountains (South-Central Ethiopia).

The Konteh sampling site is located at an altitude of 4117 m a.s.l. (6°51'N, 39°53'E) in the Afroalpine vegetation belt. The rock hyrax (*Procavia capensis*) dung deposit is about 20-cm thick. The Fincha Habera sampling site is located at an altitude of 3430 m a.s.l. (7°01'N, 39°44'E). The site lies at the boundary between the ericoid and Afroalpine vegetation belts. Niche contains sediments of, presumably, rock hyrax dung, and possibly other animals. Deposit thickness is 47 cm.

Radiocarbon dates were derived using conventional liquid scintillation techniques in the Laboratory of Historical Ecology (A.N. Severtsov Institute of Ecology and Evolution, RAS). For constructing age-depth model of zoogenic deposits we choose the Bchron 3.1 program. Samples from sediment profile were collected at 1–4 cm intervals and were processed for pollen analysis according to standard techniques.

Four radiocarbon dates were obtained for Konteh deposit. Sedimentation in the Konteh rock shelter began about 7000 (cal) years BP. Ten radiocarbon dates were obtained for Fincha Habera II deposit. The dating of the beginning of deposit accumulation is not known. Age of down layers exceeds 15,000 years. Sedimentation ended at about 1500 (cal) years BP.

A total of 14 pollen and spore types were distinguished in samples from the Konteh deposit. Pollen spectra from Konteh deposit are described by the high percentage of Asteraceae (43.7–63.2%). Poaceae, Urticaceae and Podocarpus are also numerous. The total pollen concentration (TPC) varies from 215,105 to 644,436 grains/cm<sup>3</sup>. Spore–pollen spectra from Fincha Habera II are taxonomically richer in comparison to that of the Konteh. We identified 22 taxa. Spectra from Fincha Habera II are characterised by the dominance of Poaceae pollen (42–81%). Asteroideae percentages range from 2 to 13%. TPC varies from 1,532,535 to 4,543,545 grains/cm<sup>3</sup>.

The pollen spectra of Konteh and Fincha Habera II are characterised by a pronounced dominance of only one taxon in each – Asteraceae and Poaceae, respectively. Apparently these features are connected with the origin of the deposits, which consist of rock hyrax dung, as well as with localization of niches. Pollen analysis and radiocarbon dating of two dung deposits detected key features of the vegetation and climate history of the Bale Mountains (South-Central Ethiopia) during the last 15,000 years. Pollen spectra of the initial stages of the deposit development correlate with unfavorable conditions in the LGM. The AHP (15,000–5000 (cal) years BP) is registered in this palaeoecological record as well as the YD event (about 12,500 (cal) years BP). Upward shift of Afromontane forest belt and an expansion of ericoid communities at high altitudes were characteristic of the Pleistocene/Holocene transition (about 10,000 (cal) years BP). The AHP which continues around 10,000 (cal) years BP after YD, was interrupted by a dry episode around 8200 (cal) years BP. Principal aridization trend during the last 5000 years was observed. Presumably the first traces of human activities in this area showed up about 2500 (cal) years BP.

## **Stable oxygen isotopes for reconstruction of human mobility - the population of the Early Medieval Cracow, Poland**

Beata Stepańczak<sup>1</sup>, Krzysztof Szostek<sup>1</sup>, Jacek Pawlyta<sup>2</sup>

<sup>1</sup>*Department of Anthropology, Institute of Zoology, Jagiellonian University, Gronostajowa 9, 30-387 Cracow Poland*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Beata Stepańczak, email: b.stepanczak@uj.edu.pl

Oxygen isotopes incorporated into living organisms, while tissues are formed and remodeled, are derived primarily from ingested fluids and reflect the isotopic value of consumed environmental water from the area inhabited by them. The oxygen isotope ratio of environmental water is determined by climatic and geographical factors such as global water cycles, evaporation/condensation processes as well as latitude and altitude. Hence, the oxygen isotope analysis allow us to investigate an individual's mobility patterns.

The main aim of this study was to apply the oxygen isotope ratios obtained from human skeletal tissues (bones and teeth) to identify 'foreigners' in the population from early medieval Cracow.

The skeletal material (bones and teeth) came from 35 adult individuals who were excavated from the early medieval cemetery situated at the east side of

the Market Square in Cracow. Pig's bones provided proxy data of the local oxygen isotope variation. It was also necessary to estimate diagenetic changes in crystallization of studied bones and teeth.

The stable oxygen isotope analysis in bones and teeth showed autochthonous origin of most individuals buried at examined cemetery. Although there are also 'non local' individuals. Among the population a higher proportion of migrant women compared to men was reported.

# **SESSION 5 & 6**

## **Luminescence dating**

## High resolution OSL dating of the Costinești section Romania using fine and coarse quartz

Daniela Constantin<sup>1,2</sup>, Robert Begy<sup>1,2</sup>, Stefan Vasiliniuc<sup>1</sup>, Cristian Panaiotu<sup>3</sup>, Cristian Necula<sup>3</sup>, Vlad Codrea<sup>4</sup>, Alida Timar-Gabor<sup>1,2</sup>

<sup>1</sup>*Faculty of Environmental Sciences, Babeş-Bolyai University, Fantanele 30, 400294 Cluj-Napoca, Romania*

<sup>2</sup>*Interdisciplinary Research Institute on Bio-Nano-Science of Babeş-Bolyai University, Treboniu Laurean 42, 400271 Cluj-Napoca, Romania*

<sup>3</sup>*Faculty of Physics, University of Bucharest, N. Balcescu 1, 010041 Bucharest, Romania*

<sup>4</sup>*Faculty of Biology and Geology, Babes-Bolyai University, Kogalniceanu 1, 400084 Cluj-Napoca, Romania*

Contact: Constantin Daniela, email: daniela.constantin@ubbcluj.ro

Previous studies on the application of optically stimulated luminescence dating on fine and coarse quartz extracted from Romanian loess sections at Mircea Vodă and Mostiștea yielded intriguing controversies. The present work reports a high-resolution SAR-OSL chronology for L1, S1 and L2 units of the loess-palaeosol profile from Costinești, a deposit that is containing at least five loess-palaeosol alternations and is located on the Black Sea Shore (Dobrogea, SE Romania). The analysis have been performed on fine (4-11  $\mu\text{m}$ ) and coarse (63-90  $\mu\text{m}$ ) quartz grains extracted from 25 samples collected at very high resolution (10-20 cm).

Luminescence investigations confirm the reliability of the SAR-OSL dating protocol previously applied on Romanian loess (preheat at 220 oC for 10 s, cutheat to 180 oC and ETOSL). The dose-response growth curve is best described by a sum of two saturating exponential functions and our results confirm the different saturation characteristics of fine and coarse grains of quartz reported in previous studies on the relevant loess section in SE Romania. Fine quartz OSL ages obtained significantly underestimate the coarse quartz age results as in the case of our previous studies on Mircea-Vodă and Mostiștea loess sections. The source of the discrepancy resides, as in the case of our previous studies, in the equivalent doses obtained, the values measured for coarse grains being higher in the case of all samples for coarse grains in comparison to the fine grains. By comparing the OSL chronology with a time model based on magnetic susceptibility measurements, the ages obtained on fine grains underestimate the expected magnetic ages in the case of samples collected from S1 and L2, while the coarse grain ages seem to overestimate the expected magnetic ages for samples collected from L1. Most intriguingly however, on coarse quartz, ages of  $94 \pm 11$  ka,  $116 \pm 11$  ka, respectively,  $120 \pm 10$  ka have been obtained for samples CST11-CST13, collected from the upper part of S1, ages that do not seem to underestimate the true burial age. As a premiere for loess deposits, the obtained coarse quartz chronology for the penultimate glacial cycle spans from ~120 ka to ~190 ka and do not underestimate the expected geological ages, as in previous cases reported in literature. Overall, from the luminescence results it can be concluded that the S1 palaeosol formed during the MIS 5, and the discrepancy observed on coarse and fine quartz OSL ages is a general feature of SE Romanian loess.

A.T.G., D.C., and R.B. acknowledge the financial support from a grant of the Romanian National Authority for Scientific Research CNCS-UEFISCDI, PN-II-RU-TE-2011-3-0062, nr.73/05.10.2011. C.P. and C.N. were supported by grant CNCS-ID31/2010.

## **On natural and laboratory generated dose response curves for quartz of different grain sizes from Romanian loess**

Alida Timar-Gabor<sup>1,2</sup>

<sup>1</sup>*Faculty of Environmental Sciences, Babeş-Bolyai University, Fantanele 30, 400294 Cluj-Napoca, Romania*

<sup>2</sup>*Interdisciplinary Research Institute on Bio-Nano-Science of Babeş-Bolyai University, Treboniu Laurean 42, 400271 Cluj-Napoca, Romania*

Contact: Timar-Gabor Alida, email: alida.timar@ubbcluj.ro

One of the most important but also most difficult to test assumptions of luminescence dating refers to the fact that the growth of the luminescence signal in nature can be reproduced under laboratory conditions by performing irradiations with a calibrated beta or gamma source. Fast component dominated quartz single aliquot regenerative dose optically stimulated luminescence (SAR-OSL) laboratory dose response curves that display continuing growth at high doses are increasingly reported in literature. This behaviour would, in theory, result in higher equivalent doses being obtained. In practice however, few ages that correspond to independent age control have been obtained beyond the Eemian by SAR-OSL dating using quartz. In this study we investigate fine (4-11µm) and coarse (63-90 µm) quartz extracted from Romanian loess. Our results indicate that the growth of the OSL signal in nature does not correspond to the laboratory generated laboratory dose response curve. The growth of the signal in nature follows a single saturating exponential model, with the signal of coarse grains starting to saturate at 100-200Gy, and for fine grains at 200-300Gy, respectively. Laboratory dose response curves continue to grow for high doses (>300 Gy) for both quartz fractions. The differences observed between the natural and the laboratory dose response for the two quartz fractions are believed to be a cause for the different chronologies previously reported using the two grain sizes of quartz on Romanian loess. Our finds question the reliability of obtaining high SAR-OSL equivalent doses for quartz samples displaying laboratory dose response curves for which a single saturating exponential model can properly describe the data.

A.T.G. acknowledge the financial support from a grant of the Romanian National Authority for Scientific Research CNCS-UEFISCDI, PN-II-RU-TE-2011-3-0062, nr.73/05.10.2011.



## Formation time-frames of the Late Weichselian tills in northern Poland

Piotr Paweł Woźniak<sup>1</sup>, Stanisław Fedorowicz<sup>1</sup>, Piotr Czubla<sup>2</sup>

<sup>1</sup>*University of Gdańsk, Department of Geomorphology and Quaternary Geology, Bażyńskiego 4, 80-952 Gdańsk, Poland*

<sup>2</sup>*University of Łódź, Laboratory of Geology, Narutowicza 88, 90-139 Łódź, Poland*

Contact: Piotr Paweł Woźniak, email: [geopw@ug.edu.pl](mailto:geopw@ug.edu.pl)

The authors discuss the outcomes of some selected works associated with a project which the main objective was to reconstruct geological processes accountable for the formation of the Late Weichselian till profiles in northern Poland. The research concerns the area which was engulfed by the Vistula palaeo-ice stream of the last ice sheet. There exist separate till beds in the southern part of the considered district, which represent successive phases of the Late Weichselian (Poznań (Frankfurt) Phase and Leszno (Brandenburg) Phase (see papers by the W. Wysota's team). The authors focussed on the northern quarter of the mentioned region, which remained under the Vistula palaeo-ice stream and which, despite changes to ice sheet extent during subsequent re-advances, stayed under the cover of ice. The whole Late Weichselian is there represented by a single till bed, though often being characterized by a complex vertical profile. In some key exposures macroscopic features of till are observed which may indicate signs of ice sheet reactivation and formation of one till bed during successive re-advances. The presumption of ice sheet reactivation is also supported by apparent changeability of till fabric and petrographic composition. Significant variation of the Late Weichselian tills petrographic composition visible in the discussed area contributes to a situation when application of just the lithostratigraphic criterion may not provide unambiguous determination of stratigraphic position of tills.

To define the formation time-frames of the examined tills the authors collected samples of the sub- and over-till sediments for dating. Current set of results corresponds to over 60 samples studied by means of luminescence techniques (TL and OSL). Moreover, a database has been created of published dating results (TL, ESR and radiocarbon) obtained for the mentioned region by other authors. Numerous available results of the TL dating studies performed simply for tills were not considered.

It is worth noting that the results of luminescence dating of the sub- and over-till sediments, performed as a part of the project, clearly reveal the formation time-frames of the examined tills. The major part of the data obtained for sub-till sediments indicates the age of about 22-30 ka, thus corresponding to a period before the Last Glacial Maximum in Poland. On the other hand, over-till sediments can also be found in some of the considered key exposures, which are related to deglaciation of the investigated region. And the corresponding luminescence dating results suggest that those sediments were formed at the close of the last glacial period.

The results of luminescence investigations by the authors are supported by other published findings, in that the ones obtained by luminescence, radiocarbon and ESR methods. Finally, it should be mentioned that dating results corresponding to some key exposures do not agree with the assumed stratigraphic model. The authors provide however probable interpretation of these discrepancies.

This project is financially supported by the Polish Ministry of Science and Higher Education research grant no N N306 766940.

## **Optical dating of inland dunes in the campine area (NE Belgium): a case study**

Jasper Van Nieuland<sup>1</sup>, Dimitri Vandenberghe<sup>1</sup>, Jan-Pieter Buylaert<sup>2,3</sup>, Etienne Paulissen<sup>4</sup>, Peter Van den Haute<sup>1</sup>

<sup>1</sup>*Laboratory of Mineralogy and Petrology, Department of Geology and Soil Sciences, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium*

<sup>2</sup>*Radiation Research Division, Risø National Laboratory for Sustainable Energy, Risø DTU, 4000 Roskilde, Denmark*

<sup>3</sup>*Radiation Research Division, Risø National Laboratory for Sustainable Energy, Risø DTU, 4000 Roskilde, Denmark*

<sup>4</sup>*KULeuven, Department Earth and Environmental Sciences, Division Geography, Celestijnenlaan 200E, B-3001 Leuven-Heverlee, Belgium*

Contact: Jasper Van Nieuland, email: jasper.vannieuland@ugent.be

The timing and duration of inland dune formation in NE-Belgium has been a matter of debate for decades and ages ranging from Late Glacial to historical have been advanced. This time-uncertainty is greatly due to the fact that chronostratigraphic correlation of the different dunes is difficult because, in contrast to the continuous coversand deposits, they occur as separate units. In such a situation absolute age information becomes crucial. In this study, we focus on the geochronology of the dune near Kasterlee (NE Belgium) using quartz-based OSL-dating. This dune formation is a NE-SW oriented sand ridge underlain by Tertiary sediments. The substrate is thought to be covered by aeolian coversands during the Upper Weichselian Pleniglacial, which have been resedimented after the Late Pleniglacial into drift sands. By directly determining the time of sediment deposition, this study aims at (i) verifying the proposed chronology of this ridge and (ii) determining the age and duration of sand accumulation phases. In addition, we characterize the textural changes in the sediments by grain size analysis.

Two profiles (~3 m high; n = 14) and the top of the ridge (n = 7) were sampled for OSL dating at closely spaced vertical intervals of ~ 40 cm. In one of the profiles a weak podzol could be observed while in the other it was absent. As Tertiary sediments were observed at the base of both profiles, we are confident to have sampled the whole Quaternary archive at this locality. We also collected samples for grain size analysis from one of the profiles (n=45). The optical ages were obtained by applying the SAR-protocol to sand-sized (125-180µm) quartz. The samples exhibited satisfactory luminescence characteristics and dose recovery tests ( $0.98 \pm 0.01$ ; n = 84) support the suitability of the applied procedure. Low-level gamma-ray spectrometry in the laboratory was used to determine the dose rate.

Our results show that the whole pre-Late Glacial Quaternary record is missing. As the ridge is clearly formed during at least 2 different aeolian phases, resulting in a Late Glacial (~12ka to ~13ka) unit, which is overlain by a very young drift sand (since the Medieval period) and only locally separated by a weak podzol. Interestingly, the precise time of deposition during both the Late Glacial and the Holocene differs between the two profiles. Our results however, refine the chronostratigraphical framework and point at a significant aeolian resedimentation, which is most probably induced by human occupation.

## **The OSL dating and maturity of soils help to reconstruct the neotectonic movements in the piedmont zone of Sikkimese-Bhutanese Himalaya**

Leszek Starkel<sup>1</sup>, Dominik Płoskonka<sup>1</sup>, Grzegorz Adamiec<sup>2</sup>

<sup>1</sup>*Institute of Geography and Spatial Organization, Department of Geomorphology and Hydrology of Mountains and Uplands PAS, Św. Jana 22, 31-018 Krakow, Poland*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Leszek Starkel, email: starkel@zg.pan.krakow.pl

For the whole Himalayan range are characteristic several overthrusts. The youngest of them the Siwalik belt built of Neogene-Pleistocene is still expanding. At the steep front of eastern Himalaya this zone is very narrow and even between Chel and Torsa rivers totally missing (Nakata 1972, Das and Chattopadhyay 1993, Guha et al. 2007). The front of mountains is retreating up to 10 km forming an semi-circular golf (Starkel et al. 2008). Just in this part of the piedmont we observe W-E elongated hills limited by fault-like scarps to 40-65 m height.

In the piedmont zone Nakata (1972) and Das and Chattopadhyay (1993a, 1993b) mapped several levels of fans putting them in stratigraphic order after their elevation and maturity of soil cover. At the beginning of the XXI century the researchers from the Geological Survey of India documented the presence of series of faults, both parallel to main Himalayan overthrust and rectangular ones. In similar time Polish-Indian team started to explore the formation of alluvial fans (Starkel et al. 2008).

In 2007 Guha et al. published a paper on tectonics and described elevated blocks built of gravels of Matiali formation partly overthrust and bordered by fault lines. They dated them by <sup>14</sup>C at between 22 and 34 ka BP. The young age of elevated blocks turned our attention to dating of terrace and fan levels using the OSL method and soil maturity based on detail characteristic of soil profile. We selected several localities sampling them in November 2009 and 2010.

Results of OSL datings and soil analyses at selected sites:

Chalsa site (CH2) is located at southern margin of elevated horst just above scarp about 65 m above river channel. The OSL date is 58.1±2.4 ka BP. At least 2 m deep uniform sandy soil of red and yellow color (10YR in Munsell soil color scale) indicate advanced maturity. The opposite NE margin of this flat level, at about 15 km distance, was dated by <sup>14</sup>C at 22-34 ka BP.

Daina site (DA2) is located at the most eastern part of the same level, but is elevated only 10-12 m above the floodplain of river Daina, the tributary of Jaldhaka. The OSL date is similar to the former one: 52.8±2.5 ka BP. The soil was developed on gravelly substrate and is also yellow-red (10YR), like in Chalsa.

Similar age have also sands and gravels from 5 m depth at 30 m high terrace of Chel river at Upper Phagu Tea Garden (UF1) north of marginal overthrust of Himalaya. The OSL date 57.4±4.4 ka BP indicate that probably the uplift rate was of similar order on both sides of faultline (compare with Guha et al. 2007).

Ranichera site (RC1) is located at fan-like surface along Chel river much lower than the previous ones (about 20 m above river channel). Sample from sands with gravelly horizons from 5 m depth was dated at 38.6±1.5 ka BP. The soil profile is shallower than previous ones. Colors of soil fluctuate between 10YR and 2.5Y and have lower chroma in deeper part of profile what indicate less advanced soil development (more yellow cambic horizon). This site probably represents younger phase. Also older map by Nakata (1972) and Guha et al. (2007) distinguish it as separate level.

Gabul Basra (GB1) site is the lowest and youngest among dated alluvial series. It is located at the margin of 10 -12 m high fan of Gabur Basra creek about 5 km from the outlet from Himalaya. This

fan is built of alternating layers of sands and gravels with some boulders. The chaotic sedimentation presents the deposition during flash floods probably with supply by debris flows. Soil profile is similar to RC1 but in the soil dominates yellow color (2,5Y). The sample from 5 m depth got the date  $13.8 \pm 1.4$  ka BP.

All described soils of the overflowed terraces represent Inceptisoils differing mainly stage of evolution. This soils are usually covered by tea plantations or forests. In the parallel valley of Pana creek has been analyzed the soil profile of the low floodplain having character of typical Entisol with visible fluvial lamination covered by grassland and frequently cultivated as ricefields.

General conclusions:

The OSL datings and previous  $^{14}\text{C}$  dates supported by characteristics of soil profiles help to distinguish several generations of late Quaternary terraces. The active neotectonic shows that the use of altitudinal method as leading one in the termination of chronological sequence in the evolution of fluvial systems is very problematic.

In the period between 50 and 60 ka BP it was intense fluvial activity, maybe connected with more humid phase. Later in the piedmont zone followed differentiated tectonic movements and uplift combined with overthrusting. Probably closer to the rising Himalayan front the aggradation continued longer and therefore the  $^{14}\text{C}$  dates from the northern part of Matiali formation are to 20 ka younger than OSL datings in the south. The much younger fan generation partly overlying older structures started to be formed in the Lateglacial (ca 15-14 ka BP). This coincide with the reactivation of monsoon activity in southern Asia (Overpeck et al. 1996, Kale et al. 2003). A distinct dissection of those fans and formation of new fills (still continuing) maybe both of climatic and neotectonic origin.

## Absolute chronology of the Upper Dnieper River development since LGM

Andrey Panin<sup>1</sup>, Grzegorz Adamiec<sup>2</sup>, Khikmatulla Arslanov<sup>3</sup>, Vladimir Filippov<sup>1</sup>, Natalya Zaretskaya<sup>4</sup>, Elya Zazovskaya<sup>1</sup>

<sup>1</sup>*Faculty of Geography, Moscow State University, Russia*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>3</sup>*Faculty of Geography, Sankt-Petersburg State University, Russia*

<sup>4</sup>*Geological Institute, Russian Academy of Sciences*

Contact: Andrey Panin, email: a.v.panin@yandex.ru

The Dnieper River valley at its upper course was formed in the end of OIS-6 after the territory was left by the Moscovian (Late Saalian) ice sheet. In LGM, the ice sheet approached the latitudinal stretch of the Dnieper River valley downstream from the Smolensk city. Data on glacial influence over valley development and its further rebound are still controversial. Glacial boundary on quaternary maps of state geological surveys of different years is shown 50-100 km northward from the valley. On the other hand, Salov (1972) proposed that the river was dammed by the Valdaian (Weichselian) glacier, and Kvasov (1975, 1978) suggested that this ice-dammed lake overflowed into the Caspian basin and served one of the water sources for its maximal in Pleistocene Early Khvalynian transgression. One of actual questions in the Holocene history of the valley is connected with the 1995 discovery of buried cultural layer in the Dnieper River floodplain at the famous Gnezdovo Early Medieval settlement, which raised the problem of the Late Holocene palaeohydrological changes of Dnieper that promoted human settling on low topographic positions. Reconstruction of the Dnieper River valley development is the key element to decipher the history of the region in the end of the Quaternary. Geomorphic studies undertaken in the last years and about a hundred radiocarbon (GIN, IGAN, LU, LuS) and optical (GdTL) dates provide the basis for such reconstruction. All dates are in calibrated years.

1. LGM: lacustrine silts underlying low terrace and floodplain alluvium were found at elevation not more than 7 m above the river, which is insufficient to provide inter-basin overflowing. OSL and <sup>14</sup>C dating point at 22-24 ka BP as the most probable interval of their formation, which favors the hypothesis of river glacial damming during LGM.

2. Lateglacial is represented by river terraces T1b (12-15 m) and T1a (10-12 m), the latter being dated to 11.7±0.3 ka BP, i.e. to the Pleistocene/Holocene boundary. Terraces indicate incision of a high-discharge braided stream into the former lake bottom.

3. Early Holocene: large single-thread palaeochannel 400-500 m wide (7-8 times larger than the present-day channel) was dated between 7-9 ka BP. The palaeochannel belongs to a system of particular phenomenon of high erosion remnants in the Dnieper valley first described by (Kalicki, 1995). The remnants are found both downstream and upstream from Smolensk and in all cases they are separated by large palaeochannels, mostly of braided type. These palaeochannels were previously thought to have formed by glacial melt waters and their parameters were used to calculated melt water discharges (Sidorchuk et al., 2011). Time constraints imposed by results of absolute dating of palaeochannel alluvium excludes their glacio-fluvial origin and puts a question of climatic origin of the Dnieper River high discharges in the Early Holocene.

4. Middle Holocene is the most poorly represented epoch in the valley complex: we have only few <sup>14</sup>C dates on humus of buried floodplain soils. This evidences low fluvial activity.

5. Late Holocene is indicated both in floodplain morphology and in alluvial stratigraphy as epoch of high hydrologic variability. Extreme floods between 2.4-2.7 ka BP led to major transformation of river channel (meander straightening) and significant destruction of floodplain. Period between ca 2.0 ka BP and 0.8 ka BP was characterized by low floods, which provided conditions for the floodplain colonization by humans. According to dating of overbank silts and sands that bury the Early Medieval floodplain soil, floodplain inundation resumed about 0.8 ka BP, and peak floods were characteristic for a short period at the XIV/XVth centuries boundary.

## **Quartz coarse grains signal saturation effects in loess deposits from Biały Kościół, South-West Poland**

Piotr Moska<sup>1</sup>, Grzegorz Adamiec<sup>1</sup>, Zdzisław Jary<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography and Regional Development, University of Wrocław, Poland*

Contact: Piotr Moska, email: Piotr.Moska@polsl.pl

For loess to be useful in climatic reconstructions an numerical timescale is necessary. For this purpose optically stimulated luminescence (OSL) is particularly suitable. It is widely accepted that quartz OSL dating using the single-aliquot regenerative dose (SAR) procedure gives reliable ages, but these signals may suffer from saturation effects especially for higher equivalent dose obtained by using larger quartz grains. Several workers have reported this effect before.

These current work presents coarse grains quartz signal saturation effect in loess deposits from the deepest part of the Biały Kościół loess profile, one of the most complex loess/palaeosol complex in Poland. Previously the profile was dated using single aliquot optically stimulated luminescence (OSL) applied to coarse grained quartz fraction (90-125µm) using the central age model. This analysis yielded unexpectedly young ages for the deepest part of the profile (the oldest lithostratigraphic unit).

In the current study we attempt to investigate the differences between the previously obtained results for coarse grained quartz fraction (90-125µm) and new results obtained for medium grained quartz fraction (45-63µm). Ages obtained for those two fractions show no differences up to about 150 Gy.

In contrast to the younger samples, for the 5 oldest samples we observe that the results obtained for coarse grained quartz compare return underestimated ages in comparison to the medium grained quartz. Those differences reach 25% for the two deepest samples. Those results, obtained for lithostratigraphic units II and I which correspond to the MOIS 4 and 5, confirm the earlier established MOIS chronology and strengthen the chronological correlation of the loess profile at Biały Kociół with other loess profiles in Europe.

## **Origin and age of sediments at Rytwiany in Czarna river valley (Polish Uplands)**

Artur Zieliński<sup>1</sup>, Ireneusz Olszak<sup>1</sup>, Tomasz Kalicki<sup>1</sup>

<sup>1</sup> *Jan Kochanowski University in Kielce, Świętokrzyska str. 15, 25-406 Kielce, Poland*

Contact: Artur Zieliński, e-mail: artur.zielinski@ujk.kielce.pl

Czarna river, tributary of Vistula river, is the biggest river in Niecka Połaniecka region, part of the Mesozoic margin of Holy Cross Mountains with block structures. Spring of the river is located in the natural reservation Białe Ługi in Kielce Upland. Few kilometers upstream of study area Czarna river cut horst of Lower Cambrian shale near Kontuszowa.

Rytwiany profile is located few kilometers downstream of Staszów on the left site of the valley. Some geological members in pit could be distinguished. The Miocene grey clays of „krakowiec”, which are filling the valley occur in the lower part of profile. Process of forming reservoir sediments was in the time of the Pleistocene still running. At that time arises a mud member, lying on the Miocene clays. These sediments were studied with the dating TL method. Mud member was built of four complexes of different age. The oldest silts, which were found within the depths of 9.80–9.45 m, were dated between 111–110 ka. This silts are covered with colluvia in the depth of 8.90 m. Thickness of these sediments is only few decimeters. In the depth within 8.55–7.55 m occurs next complex of silts dated between 89.7–84.3 ka. Third complex of silts lying within depth of 6.10–3.50 m and it was dated between 46.6–41.3 ka. Fourth complex of the silts was dated between 33.8–32.4 ka and lies within the depths 2.70–1.25 m. Whole mud member was covered with fluvial sands, aged between 28–27 ka.

## **Chronostratigraphy of sedimentological environment changes during the transition between the Weichselian and Holocene in the central part of the European Sand Belt**

Robert J. Sokołowski<sup>1</sup>, Paweł Zieliński<sup>2</sup>, Stanisław Fedorowicz<sup>3</sup>, Anatoly Molodkov<sup>4</sup>

<sup>1</sup>*University of Gdańsk, Department of Marine Geology, University of Gdańsk, Piłsudskiego 46, 81-738 Gdynia*

<sup>2</sup>*Department of Physical Geography and Paleogeography, Maria Curie-Skłodowska University, Kraśnicka 2cd, 20-718 Lublin*

<sup>3</sup>*Department of Geomorphology and Quaternary Geology, University of Gdańsk, Bażyńskiego 4, 80-950 Gdańsk*

<sup>4</sup>*Institute of Geology, Tallinn Technical University, 7, Estonia Blvd., 10413 Tallinn, Estonia*

Contact: Robert Sokołowski, email: r.sokolowski@ug.gda.pl

The transition between the Weichselian and Holocene was characterised by rapid climate fluctuations, with a general tendency for the improvement of climate conditions. This resulted in the evolution of sedimentological environments both in the marginal zone of the Last Glaciation and the periglacial zone, particularly the loess and sand belt. The record of fluvial and aeolian sand deposition predominates in the sedimentary succession in the sand belt. A typical consequence of facies is the transition from sediments accumulated in a sandy braided river environment, to fluvio-aeolian sediments to an aeolian environment. Fossil soils have been recorded in some places within aeolian sediments and in the uppermost layer of fluvio-aeolian sediments. The scarcity of organic series underlying and/or overlapping with the fluvio-aeolian succession makes it difficult to determine the stratigraphic position of the particular facies. In consequence, radiocarbon dating and palynological analysis cannot be used here, and luminescence dating is used instead.

During studies of the central-eastern part of the aeolian sand belt, conducted under the Ministry of Science and Higher Education Grant N N 306 197639, fluvial-aeolian succession was identified at several sites, with certain differences in the development of the particular units. Nonetheless, the succession of units is analogous at each site. The goal of the study is to determine the chronostratigraphic position of the units under study, and to capture differences within the analysed area, i.e. Poland and Western Ukraine. The investigation was based on: a) lithofacies analysis of sediments at selected sites, b) description and determination of the lithostratigraphic position of periglacial structures, and c) absolute-age dating using TL and OSL methods.

The sedimentary succession under study typically consists of three complex–fluvial. This complex was recorded in–lithofacies complexes:

1) Lower most of the sites under study. It consists of sands of varying grain size, with a normal fraction grain size, and, to a smaller extent, silts. This complex is a record of the activity of a braided river developed in typical sub-environments: a deep channel represented by St→Sr lithofacies, mid-channel shallows (Sp and/or Sh) as well as proximal (Sh→Sr→SFv/SFf) and distal (SFh, Fh or Fm rhythmite) floodplain. According to OSL/TL dating, the age of this complex is 32.6±4.9–13.0±1.1 ka BP.

2) Central complex–fluvio-aeolian. This complex was recorded in most of the sites under study. It consists mainly of sands and/or sandy-silty rhythmite. The complex is a record of alternating fluvial and aeolian processes, most often within the floodplain. It is a sequence of sediments linked with deposition resulting from: a) sheet floods (Sh) and then aeolian accumulation on wet surface (SFv); b) aeolian deposition on dry surface as a result of ripple-mark migration (Src or sands with translational stratification) and then redeposition due to short-lasting, usually subcritical



flows (St, Sr). According to OSL/TL dating, the age range of these processes is  $27.5 \pm 3.8$ – $11.5 \pm 1.0$  ka BP.

3) Upper complex–Aeolian. The complex was recorded in all the sites studied, in the uppermost layer of the sedimentary succession under study. It consists of sands of varying grain size and, to a smaller extent, silty sands. They were deposited on the leeward slope of parabolic dunes (Si), the windward slope of stationary dunes (sands with translational stratification, Src, Sp, Sh) or slopes of elongated dunes (Sp, Src). According to OSL/TL dating, the age of these processes is  $12.7 \pm 1.3$ – $7.2 \pm 1.1$  ka BP.

Within the first and second complex, periglacial structures were documented in the form of syngenetic ice-wedge pseudomorphs, composite wedges, thermal contraction cracks, and cryoturbation on small and large scale.

The lithostratigraphic position of the studied sediments, periglacial structure layers and luminescence dating indicate that the succession under study developed from the Pleniglacial until the Meso-Holocene. The time frame associated with the fluvial complex confirms the activity of periglacial braided rivers in the Pleniglacial. The end of their activity occurred in the period between the climatic pessimum and the start of the Late Glacial, and was probably determined by local conditions. The broad time range obtained for the fluvio-aeolian complex confirms the impact of local conditions on the deposition of these sediments. In general, the accumulation of this unit began in the Late Pleniglacial and stopped at the beginning of the Late Glacial. The age of these sediments is younger towards the east. The deposition of the aeolian complex occurred in the Late Glacial and the start of the Holocene.

## **Application of the OSL dating method for stratigraphic study of Holocene slope sediments in the profile from Biedrzykowice (South Poland).**

Grzegorz Poręba<sup>1</sup>, Zbigniew Śnieszko<sup>2</sup>, Piotr Moska<sup>1</sup>, Przemysław Mroczek<sup>3</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Katowice School of Economics, Harcerzy Wrzeźnia 3 str., Katowice, Poland*

<sup>3</sup>*Department of Geoecology and Palaeogeography, Maria Curie-Skłodowska University, Kraśnicka 2cd, 20-718 Lublin, Poland*

Contact: Grzegorz Poręba, email: Grzegorz.Poreba@polsl.pl

This work presents the results of Optically Stimulated Luminescence (OSL) dating of Holocene slope sediments from Biedrzykowice (near Działoszyce, South Poland). Simultaneously with OSL dating the <sup>137</sup>Cs isotope measurement was done to find modern (last 50 years) sediments and activities of natural radionuclides in whole sediment profile were measured. In addition, to the OSL sampling, the samples for micromorphology study were taken. The study area is located on the archaeologically well documented loess area. The studied sediment profile from Biedrzykowice contains two layers of Holocene slope sediments. The older layer was dated by OSL to 5-4 ka BP whereas the younger layer was dated to 1,0-0,4 ka BP. Those two layers are separated by fossil soil. It was shown that Holocene colluvial sediments containing grains of quartz can be approximately dated using OSL.

# Poster presentations

# **Radiocarbon dating**

Poster no 1

**Reservoir effect in the Bering Sea: regional correction of radiocarbon dates of marine organisms**

Mitya Vasyukov<sup>1</sup>, Bulat Khasanov<sup>1</sup>, Olga Krylovich<sup>1</sup>, Arkady Savinetsky<sup>1</sup>

<sup>1</sup>*A. N. Severtsov's Institute of Ecology and Evolution RAS, Moscow, Russia*

Contact: Mitya Vasyukov, email: tipa2128506@gmail.com

The assessment of  $\Delta R$  for Bering Sea region was made on the base of radiocarbon dating of marine shells with known collection dates (McNeely et al., 2006). We chose only the dates with  $\delta^{13}\text{C}$  values reported (N=17). Mean value of  $\Delta R$  for sea shore from British Columbia up to the Bering Strait turned out to be  $380 \pm 20$  years. There were reported 30 pairs of datings of marine and terrestrial organisms from the same archaeological context for the Bering Sea (Dumond, Griffin, 2002; Khasanov, Savinetsky, 2002; Corbett et al., 2010; Okuno et al., 2012; Savinetsky et al., 2012). We checked the mean  $\Delta R$  value during calibration of paired dates of marine and terrestrial organisms with OxCal 4.1. Calibration of every pair of datings was performed in constraint that samples are related to the same event (for this case we used the “combine” function). OxCal 4.1 calculates statistical tests -  $\chi^2$  and index of agreement  $A_{comb}$  which show how well the original data fits in model building (Bronk Ramsey, 2009). In 20 cases out of 30 (67 %) the mean value of  $\Delta R$  satisfied to statistical tests. Hence the mean  $\Delta R$  we checked is well enough to use for calibration of archaeological samples from Bering Sea region. The large number of unsuccessful trials could originate from uncertainties associated with defining the same archaeological context or from inadequate materials chosen for dating.

Poster no 2

**Radiocarbon Dating of Pyroclastic Flows in the Middle and Western Parts of Kuju Volcano, Kyushu, Japan**

Mitsuru Okuno<sup>1</sup>, Shinji Nagaoka<sup>2</sup>, Isao Takashima<sup>3</sup>, Jun Aizawa<sup>1</sup>, Yoko Saito-Kokubu<sup>4</sup>, Toshio Nakamura<sup>5</sup>, Tetsuo Kobayashi<sup>6</sup>

<sup>1</sup>*Fukuoka University, Japan*

<sup>2</sup>*Formerly Nagasaki University, Japan*

<sup>3</sup>*Akita University, Japan*

<sup>4</sup>*Tono Geoscience Center, JAEA, Japan*

<sup>5</sup>*Center for Chronological Research, Nagoya University, Nagoya, Japan*

<sup>6</sup>*Kagoshima University, Japan*

Contact: Mitsuru Okuno, email: okuno@fukuoka-u.ac.jp

Kuju volcano, located between Aso and Yufu-Tsurumi volcanoes in middle Kyushu, Japan, consists of more than 20 eruptive centers (lava domes and cones). An eruptive episode including Handa pyroclastic flows (Pfl) is the biggest eruption (ca. 12 km<sup>3</sup>) during the last 100,000 years. Kamata and Kobayashi (1997) established the tephra-stratigraphy above the Aira-Tn ash (widespread tephra from Aira caldera at ca. 30 cal kBP), and demonstrated its eruptive history using radiocarbon ages for fallout tephtras. However, the stratigraphic position of the lava was still unclear mainly because it is difficult to preserve tephra layers in mountainous area. Thermoluminescence (TL) dating can directly provide the eruptive ages of domes. Okuno et al. (in preparation) obtained ca. 50 - 60 ka for Kutsukake-yama (Kk), Hossho-zan (Hs) and Ogigahana (Og) domes, ca. 30 TL ka for Hizenga-jo (Hz) dome using TL method, respectively. They are consistent with their topographic relation. We present here results of AMS radiocarbon dating to refine the history of the middle and western parts of Kuju volcano. Radiocarbon dating was measured by AMS (JAEA-AMS-TONO) under the Common-Use Facility Program of JAEA. Radiocarbon ages for pyroclastic flows on the southern sector of the volcano were 48,390±1140 BP and 41,060±380 BP for Shirani Pfl, 31,500±170 BP, 32,970±210 BP and 33,950±220 BP for Muro Pfl. These dates can be correlated with the TL ages for the lava domes. Therefore, both TL and radiocarbon dating methods can be useful tools in establishing the eruptive sequence of lava domes and pyroclastic flows. This study also demonstrates that these eruptive activities occurred after the Handa pfl (53,520±1140 BP) without a significant time interval.

Poster no 3

**A lake-fortress, a floating chronology, and an atmospheric anomaly: the surprising results of a radiocarbon wiggle-match from Āraiši, Latvia**

John Meadows<sup>1,2</sup>, Māris Zunde<sup>3</sup>

<sup>1</sup>*Zentrum für Baltische und Skandinavische Archäologie, Stiftung Schleswig-Holsteinische Landesmuseen, Schloss Gottorf, 24837 Schleswig, Germany*

<sup>2</sup>*Leibniz-Labor für Altersbestimmung und Isotopenforschung, Christian-Albrechts-Universität zu Kiel, Germany*

<sup>3</sup>*Institute of Latvian History, University of Riga, Latvia*

Contact: John Meadows, email: jmeadows@leibniz.uni-kiel.de

An Iron Age timber lake-fortress on a flooded island in Lake Āraiši, central Latvia, was excavated in 1965-69 and 1975-79 by teams led by the pioneering underwater archaeologist Jānis Apals, who recognised five settlement phases. Dendrochronological analysis produced a 95-year floating chronology for the best-preserved Norway spruce (*Picea abies* (L.) Karst.) timbers from the earliest phase.

A radiocarbon wiggle-match was undertaken to obtain an absolute date range for the final year of the floating chronology, and thus for the construction of the lake-fortress. Following simulation modelling of potential radiocarbon results, based on Apals' attribution of the site to the 9th-10th centuries AD, seven of the ten decadal or sub-decadal blocks in the floating chronology were dated. The samples were dated by AMS at the Leibniz Labor, Kiel. For quality-assurance reasons, each sample was dated twice, thus producing typical uncertainties for each sample's radiocarbon age of  $\pm 18$  or better.

Wiggle-matching the radiocarbon results dates the floating chronology a century or so earlier than expected. Two narrow date ranges, 40-50 years apart, are permitted by the radiocarbon data and the consensus international calibration curves, IntCal98 and IntCal09. Additional calibration data (McCormac *et al.* 2008) that will be incorporated in the 2013 international calibration curve suggest that the earlier matching position is probably correct. If so, the atmospheric radiocarbon anomaly dated to AD 775 in single-year tree-ring samples (Miyake *et al.* 2012) should be located within the final 6-year block of the Āraiši floating chronology. If the later matching position is correct, this anomaly should appear in the middle decades of the Āraiši sequence. Further samples will now be processed to test our current interpretation that the lake-fortress was built in c. AD 780.

F Miyake, K Nagaya, K Masuda and T Nakamura, 2012 A signature of cosmic-ray increase in AD 774-775 from tree rings in Japan, *Nature*, 486, 240-242

F G McCormac, A Bayliss, D M Brown, P J Reimer and M M Thompson, 2008 Extended radiocarbon calibration in the Anglo-Saxon period, AD 395-485 and AD 735-805, *Radiocarbon*, 50, 11-17

Poster no 4

**Radiocarbon and dendrochronological dating of sub-fossil oaks from Smurgainys riverine sediments**

Adomas Vitas<sup>1</sup>, Jonas Mazeika<sup>2</sup>, Rimantas Petrosius<sup>2</sup>, Rutile Pukienė<sup>1</sup>

<sup>1</sup>*Centre of Environmental Research, Faculty of Nature Sciences, Vytautas Magnus University, Z.E. Zilibero str. 2, LT-46324 Kaunas, Lithuania*

<sup>2</sup>*Radioisotope Research Laboratory, Nature Research Centre, Akademijos str. 2, LT-08412 Vilnius, Lithuania*

Contact: Jonas Mazeika, email: mazeika@geo.lt

Sub-fossil oaks excavated from the riverine deposits of river Neris (Vilija) in the vicinity of Smurgainys (Belarus) have been in the attention of scientists from 1960–1970s. The tree-ring widths of oak samples were measured and oak chronologies were constructed. According to the radiocarbon dating, the oldest oak grew approximately 5782–5612 BC and the youngest AD 1606–1778. Based on dendrochronological dating and radiocarbon dates, 97 samples were arranged into 17 groups; each of them containing from one to 25 samples. The longest compiled chronology No 16 spans for 548 years and was absolute dated against East Pomerania, Vilcuro1 and Baltic1 chronologies to AD 778–1325. The germination and dying-off phases were assessed from three the best replicated chronologies. The spectral (Fourier) analysis of developed chronologies has indicated that the length of cycles is variable for individual chronologies, on average ranging for 3–41 years. The aim of this study was to explore the tree-rings from subfossil oaks found in Smurgainys riverine deposits; to construct precise-dated chronologies to document forest history in Lithuania during the Holocene and to assess its potential as the dating proxy for Baltic oak timber.



Poster no 5

**Radiocarbon dating and age-depth model for laminated lake sediments from Lake Szurpily, NE Poland**

Natalia Piotrowska<sup>1</sup>, Wojciech Tylmann<sup>2</sup>, Małgorzata Kinder<sup>2</sup>, Dirk Enters<sup>3</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography, University of Gdansk, Poland*

<sup>3</sup>*University of Bremen, GEOPOLAR Institute of Geography, Bremen, Germany*

Contact: Natalia Piotrowska, email: npiotrowska@polsl.pl

In the framework of NORPOLAR (Northern Polish Lake Research), interdisciplinary research on laminated sediments from four northern Polish lakes is carried out. These paleolimnological studies will provide new high-resolution data of climatic and environmental changes in this part of Europe. The dating of sediment cores performed so far indicates, that three records retrieved cover the time span of entire Holocene up to the present time, and one of them from ca. 9500calBP.

One of the investigated lakes is Lake Szurpily, located in the NE edge of the Polish territory in the Suwalki Lakeland (54°13'40"N, 22°53'35"E). The landscape of this area was shaped by the retreating ice sheet, which formed, among others, numerous lakes, moraine and kame hills. Lake Szurpily covers 0.89km<sup>2</sup>, has a well-developed coastline, and the point of maximum depth (46.8m) was chosen as a coring location.

The recovered sediment core was subjected to palynological analysis, which allowed reconstruction of the land cover changes in the lake surroundings, as well as the human influence and development of aquatic plants. The diatom analysis resulted in the reconstruction of lake level, trophy and pH changes. The geochemical measurements have also been performed with use of X-ray Fluorescence, and the stable isotope analyses are being carried out.

Radiocarbon dating has been performed for macrofossils of the terrestrial origin collected from sediment material and identified botanically, e.g. fragments of leaves, pine epidermis and needles. In total 20 AMS measurements have been completed, mainly in frame of the running project «Modelling of calendar timescales for laminated lake sediments in Northern Poland as a basis for high-resolution palaeoenvironmental reconstructions» funded by Polish Ministry of Science and Higher Education (no. NN306291639).

The complete and comprehensive interpretation of the results requires a robust calendar timescale to be reconstructed for investigated sediment core. The final age-depth models will be based on various dating methods, taking into account the assumptions, limitations and uncertainties of each method. Varve counting is being performed for laminated sections of the core. The isotopic methods <sup>210</sup>Pb and <sup>137</sup>Cs will provide additional age control for uppermost parts. The presentation will focus on the radiocarbon dataset, which will be used in age-depth modelling. The one evident and some more possible outliers will be discussed taking into account the probable reasons for their occurrence. Finally, the age-depth model obtained with use of the varve chronology data to estimate the interval between the <sup>14</sup>C dated levels, where possible, will be presented. This model will be discussed and compared with the model constructed solely on radiocarbon dates with assumed stratigraphical order.

Poster no 6

**Radiocarbon time scale for elemental, lead isotopic and charcoal record in a peat core in the southern Poland**

Konrad Tudyka<sup>1</sup>, Anna Pazdur<sup>1</sup>, François De Vleeschouwer<sup>2,3</sup>, Nathalie Fagel<sup>4</sup>, Leszek Chróst<sup>5</sup>, Nadine Mattielli<sup>6</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Université de Toulouse, INP, UPS, EcoLab (Laboratoire Ecologie Fonctionnelle et Environnement), ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France*

<sup>3</sup>*CNRS, EcoLab, 31326 Castanet Tolosan, France*

<sup>4</sup>*UR Argiles, Géochimie et Environnement sédimentaires, Université de Liège, Liège, Belgium*

<sup>5</sup>*Laboratory for Ecological Research, Measurement and Expertise, Gliwice, Poland*

<sup>6</sup>*Laboratoire G-Time, Département des Sciences de la Terre et de l'Environnement, CP 160/02, Université Libre de Bruxelles, Belgium*

Contact: Konrad Tudyka, email: konrad.tudyka@polsl.pl

We present a mid-resolution elemental and isotopic record on a 13000-year old peat core from Żyglin (South Poland). Our principal objective is to decipher between human impact and natural variability causing changes in the geochemical and charcoal record of this minerogenic peat deposit. The multiproxy approach includes C-14 dating, elemental geochemistry (major elements and trace metals), lead isotopes and charcoal content. The Early Holocene (10700 BC-7550 BC) period presents increased fluxes of elements which indicates erosion during Younger Dryas and Preboreal. The Mid Holocene (7550-3000 BC) period shows the lowest fluxes which is assigned to climatic optimum and expansion of vegetation areas. Charcoal chunks started appear in the record around 3000 BC simultaneously to an increase in Pb, Ag, Zn and Cu concentrations. This period corresponds to copper and bronze age. During 800 BC-500 AD, there is a next significant increase in fluxes, this corresponds to iron age.

Poster no 7

**Chronometric dating of an early Slavic settlement in Spišský Štvrtok, Spiš Region, Slovakia**

Peter Barta<sup>1</sup>, Marta Kučerová<sup>2</sup>, Mária Hajnalová<sup>3</sup>

<sup>1</sup>*Comenius University in Bratislava, Faculty of Philosophy, Department of Archaeology, Bratislava, Slovakia*

<sup>2</sup>*Museum in Kežmarok, Kežmarok, Slovakia*

<sup>3</sup>*Constantine the Philosopher University in Nitra, Faculty of Arts, Department of Archaeology, Nitra, Slovakia*

Contact: Peter Barta, email: peterbarta@chello.sk

Poster presents the first attempt to systematically investigate absolute dating of an early Slavic archaeological context in Slovakia.

The recently excavated (2009-2011) small semi-circular settlement in Spišský Štvrtok (East Slovakia) consisted of four dwellings with sunken floors and ovens. According to the pottery the settlement belongs among the earliest Slavic evidence in Spiš region and is ascribable to Prague culture, phase Ib sensu G. Fusek.

We have sampled structural timbers, carbonized grain, and carbonized weed seed from two dwellings. The sampling strategy was aimed at collecting plant macro-remains with well describable mutual real-time relations. These relations were implied either by function of sampled parts of archaeological record in once-lived culture, or by character of sampled tissue (annual rings). All plant macro-remains have been taxonomically determined in order to exclude C4 plants.

As for chronometric dating we have used dendrochronology and radiocarbon method. However, the biggest fragment of carbonized timbers has yielded less than 40 annual rings and collected twenty charcoal fragments turned out to be mutually incomparable. Accordingly, we have employed radiocarbon dating and selected four samples to be used in a Bayesian model (OxCal). The constraints were defined by (1) construction and (2) period of use of the dwelling and were modelled by means of a bounded sequence of two decadal annual-ring samples and a following phase of carbonized cereal and weed. We have shown that the period of use is to be found during the 2<sup>nd</sup> half of 6<sup>th</sup> and early 7<sup>th</sup> century cal AD. Our result represents the first chronometric dating of a Slavic settlement context in Slovakia based on high-chronometric-hygiene samples.

This work was supported by the Museum in Kežmarok, Slovak Republic, and by the Slovak Research and Development Agency under the contract No. APVV-0598-10.

Poster no 8

**Radiocarbon dates from contexts of Baden culture in Middle Danube region: State and perspectives of research**

Peter Barta<sup>1</sup>, Petra Kmet'ová<sup>1</sup>, Kristína Piatničková<sup>1</sup>, Peter Demján<sup>1</sup>, Eva Horváthová<sup>2</sup>, Katarína Hladíková<sup>1</sup>

<sup>1</sup>*Comenius University in Bratislava, Faculty of Philosophy, Department of Archaeology, Bratislava, Slovakia*

<sup>2</sup>*Slovak Academy of Sciences, Archaeological Institute, Department for Research of East Slovakia, Košice, Slovakia*

Contact: Peter Barta, email: peterbarta@chello.sk

Aim of the poster is to present a review of published radiocarbon dates measured on samples from formation zone of Baden culture – the Middle Danube region and to suggest research strategy fitting the data. From Slovakia, Czech Republic, Austria, and Hungary total number exceeding 70 determinations is known. The majority of dates have been measured from sites in Hungary, followed by Austria, Czech Republic, and Slovakia. We use also several determinations from Lesser Poland. At last, we bring three fresh dates from collagen of terrestrial herbivores from East Slovakia. All presented <sup>14</sup>C dates are included in the database of <sup>14</sup>C determinations measured on archaeological samples from former Czechoslovakia and the neighbouring regions (Barta et al 2013).

As for their interpretative value for archaeological chronometry, the dates are of varying quality. Most of them have been measured on animal and human bone samples. The rest represent charcoal including long-lived species, e.g. *Quercus*. Sampled have been predominantly the settlements. From cemeteries, the best investigated site represent Budakalász in Hungary (14 dates). As for relative-chronological distribution, most dates represent contexts from early, followed by evolved stages of the culture. Rarely have been sampled contexts from what used to be termed late phase of Baden.

The focus of our work is on analysis of <sup>14</sup>C-sampled archaeological contexts and on chronometric hygiene of analysed samples. We propose to use <sup>14</sup>C dates from different sample materials to tackle different chronological questions. For questions of varying chronological resolution specific samples are to be selected. In order to overcome the impact of low-gradient and/ or wiggly portions of calibration curve we suggest testing chronological constraints (in Bayesian models) that are rooted mostly in typological analysis of the pottery. The stratigraphic constraints are rare as a consequence of archaeological records of Baden culture. This methodology, which has not been proposed before, presents a start of qualitatively new chronometric research of Baden.

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0598-10.

References:

Barta P, Demján P, Kmet'ová P, Piatničková K 2013. Database of radiocarbon dates measured on archaeological samples from Slovakia, Czechia, and adjacent regions. Archaeological Chronometry in Slovakia, Slovak Research and Development Agency Project No. APVV-0598-10, 2011-2014, Dept. of Archaeology, Faculty of Philosophy, Comenius University in Bratislava, URL: <http://archeologia.fphil.uniba.sk/index.php?page=archeochno>

Poster no 9

**To Sum, or not to Sum: that is the question**

Adam Michczyński<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Adam Michczynski, email: adam.michczynski@polsl.pl

The problem how to estimate a time interval of an archeological or geological phase using a group of radiocarbon dates assigned to this phase is typical problem, which must be often solved when a chronology of an investigated site is constructed. In nineties there was widely used the method, which creates a summed probability density distribution of a phase by summing individual distributions of the calibrated dates of samples, which represent this phase. The interquartile range (Aitchison *et al.* 1991) or the highest probability confidence intervals of this summed distribution are usually interpreted as the time limits of the phase. This method is also implemented to OxCal program by the Sum command of the Chronological Query Language. However this method was then criticized as based on unclear statistical basis. Instead of this a calculation of the start and end of the phase using the OxCal Boundary command was proposed. This poster presents comparison of the results obtained by the both methods for a case study of the Wolin settlement, located at the Polish Western Pomerania. It shows quite good agreement of these results.

References:

Aitchison T, Ottaway B, Al-Ruzaiza AS. 1991. Summarizing a group of <sup>14</sup>C dates on the historical time scale: with a worked example from the Late Neolithic of Bavaria. *Antiquity* 65(246):108-16

Poster no 10

**Improvement in the technique of C-14 measurement as a result of cooperation between two radiometric laboratories**

Jacek Pawlyta<sup>1</sup>, Mirosława Pawlyta<sup>2</sup>, Waldemar Kwaśny<sup>2</sup>, Beata Stepańczak<sup>3</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering Materials and Biomaterials, Gliwice, Poland*

<sup>3</sup>*Jagiellonian University, Institute of Zoology, Department of Anthropology, Kraków, Poland*

Contact: Jacek Pawlyta, email: jacek.pawlyta@polsl.pl

Isotopic analysis of oxygen of bone phosphate is nowadays more and more popular tool in both palaeoenvironmental/palaeoclimatic and migration studies. The method requires quite complicated sample processing and perfect tuning of the analytical system.

Isotopic ratio mass spectrometer running in the continuous flow mode coupled to the elemental analyser is the most popular tool of the oxygen isotopic investigations of organic matter as well as bone phosphates. There are some works published describing the method which suggest use of the nickelised carbon as the catalyst. Here we present description and analysis of problems we found during the use of NiC catalyst.

**Poster no 11**

**Optimization and Set-up of Radiocarbon Laboratory at the Lebanese Atomic Energy Commission: First set of samples**

Rana Baydoun<sup>1</sup>, Omar El Samad<sup>1</sup>, Maria Aoun<sup>1</sup>, Bilal Nsouli<sup>1</sup>, Ghassan Younes<sup>2</sup>

<sup>1</sup>*National Council for Scientific Research, Lebanese Atomic Energy Commission, Lebanon*

<sup>2</sup>*Beirut Arab University, Faculty of Science, Chemistry Department, Lebanon*

Contact: Rana Baydoun, email: rbaydoun@cnrs.edu.lb

A new radiocarbon laboratory was established recently at the Lebanese Atomic Energy Commission. The laboratory consists of benzene synthesis line and a low level background Tricarb 3180 TR/SL with Bismuth Germante (BGO) guard detector. The effectiveness of synthesis line was tested firstly by preparing benzene from a wood sample after carbide and acetylene receiving. The liquid scintillation counter was normalized by passing sample rack containing background, radiocarbon standard sample and tritium standard sample. For standardization and efficiency correction a set of Oxalic Acid II standard samples with different quenching degrees were prepared and measured, while for background correction a set of vials containing dead benzene and scintillator were counted. The measurement was carried out at different energy ranges; the Figure of Merit (E2/B) for each region was then determined. To assure reliability and accuracy of results, benzene was synthesized from two reference materials travertine and wood available through the International Atomic Energy Agency (IAEA-C2 and IAEA-C5). Also two left over intercomparison samples from the Fifth International Radiocarbon Intercomparison (VIRI) were analyzed, Humic acid (T) and murex shell (R). Measurement was carried out and the data obtained were found to be acceptable based on z-score evaluation and relative bias. Then, a preliminary study was done in order to assess the anthropogenic impact and degree of environmental pollution in terms of radiocarbon isotope ratio ( $\Delta^{14}\text{C}$ ) deduced from the Percent Modern Carbon or PMC. Four green grass samples were analyzed; two were collected from clean zones and two other from the area of industries based on fossil fuel combustion.  $\Delta^{14}\text{C}$  in clean zones was found to be 50‰ and 52‰ which correspond to the global modern atmospheric value, while in polluted zone it was 7‰ and 15‰. These data will be the base for future advanced ecological studies concerning the technological influence using radiocarbon values.

**Poster no 11 A**

**Chemical analysis of mortars components in a methodological aspect of radiocarbon dating**

Danuta Michalska<sup>1</sup>

<sup>1</sup>*Institute of Geology, ul. Maków Polnych 16, 61-606 Poznań, Poland*

Contact: Danuta Michalska, email: danamich@amu.edu.pl

Mortars may contain the carbonates from different origin. Binder carbonates absorb the present <sup>14</sup>C concentration of atmospheric CO<sub>2</sub> during the hardening process. Carbonate aggregates contain the carbon partially or completely devoid of <sup>14</sup>C isotope and represent the geological age of raw material. It causes overestimation of dating results of mortars. The geological studies on the investigated area and petrographic analysis of mortars and raw material help to identify the provenance of the applied carbonates. When carbonates aggregates are originated from one geological source with known age, the reservoir age correction for those mortars can be applied (Michalska *et al.*, 2013). In case of different sources of limestone for mortars production, the application of appropriate age correction is difficult. Then the fractional separation gives better results (Nawrocka *et al.*, 2009).

The potential influence of carbonates from different origin on mortars dating can be observed in petrographic and chemical analysis, e.g. by following the course and rate of leaching reaction. The analyses as XRF, XRD or DTA and DTG give additional information about mortars components and the production process.

The presented results of chemical analysis of chosen group of mortars show the impact of geologically different carbonates on radiocarbon dating of mortars.

Michalska D., Pazdur A., Czernik J., Szczepaniak M., Żurakowska M., 2013 - Cretaceous aggregate and reservoir effect in dating of binding materials. *Geochronometria*, 40,1: 33-41.

Nawrocka D., Czernik J., Goslar T., 2009: <sup>14</sup>C dating of carbonate mortars from Polish and Israeli sites. *Radiocarbon*, 51, 2: 857-866.



# **Terrestrial archives of environmental changes – trees**

Poster no 12

**Dendrochronological dating of wood from mediaeval gold mines in Lower Silesia**

Elżbieta Szychowska-Krąpiec<sup>1</sup>

<sup>1</sup>AGH University of Science and Technology, Kraków, Poland

Contact: Szychowska-Krąpiec Elżbieta, email: [szycha@geol.agh.edu.pl](mailto:szycha@geol.agh.edu.pl)

Historic mines Zlate Hory, Głucholazy, Złoty Stok, and Marcinków started their mining activity as early as in the Middle Ages. The Złoty Stok gold mine belongs to the oldest and most important gold mines in the Lower Silesia, the mining works apparently started there in the tenth century. In two neighbouring towns in the Opawskie Mountains, Głucholazy and Zlate Hory, gold mining has a long tradition, closely connected with discovering deposits of this precious metal near Zlate Hory at the beginning of the thirteenth century, which contributed to the development of both towns. First notes on the mine in Marcinków date back to around 1465. Beside Złoty Stok and Kletno, it was one of the biggest and most important mining centres in the Kłodzko Valley, in which except gold silver, among others, was exploited as well.

Dendrochronological analysis was made for wood from casings in the mines discussed. Wood for analyses was taken in the form of slices cut with a handsaw or a chain saw, and in the form of cores, with the Pressler increment borer. The oldest casing elements, dating back to the fourteenth c. (1332 AD, 1397 AD), were determined in the mine Zlate Hory. The growth sequences analysed consisted of 17-81 rings, in most cases more than 30 rings. However, absolute dating of only four samples representing spruce wood turned out to be successful. These timbers were dated against the Czech spruce standard (Kyncl & Kyncl).

Fifteenth-century wood (1419 AD, 1501 AD) was preserved in the mines Głucholazy and Zlate Hory (1404 AD, 1486 AD). The mine in Marcinków proved to contain wood of pine and larch trees cut down in the seventeenth century (after 1614 AD), and also younger, nineteenth-century wood. The pinewood was dated against the pine standards for South Germany (Heussner) and South Poland (Lower Silesia – Szychowska-Krąpiec), whereas the larch wood was dated basing on heteroconnection with the fir standard for South Poland (Szychowska-Krąpiec). In the Złoty Stok mine the pine and fir wood proved to represent quite a broad time interval; from the seventeenth till twentieth century. On the basis of the investigations carried out, the species of wood were determined, as well as absolute age determinations were produced. Amongst the timbers examined, exclusively wood of coniferous tree species was determined: *Pinus sylvestris*, *Abies alba*, *Picea abies* and *Larix decidua*. Broader studies would certainly contribute to the mining history and the chronology of mining works in the region of Lower Silesia, as it took place in the case of the studies performed in Austria, in the famous salt mine in Hallstatt.

Poster no 13

**First application of mass spectrometry and gas chromatography in investigation of  $\alpha$ -cellulose hydrolysates: the influence of climate changes and anthropogenic effects on glucose molecules in pine tree-rings.**

Barbara Sensuła<sup>1</sup>, Anna Pazdur<sup>1</sup>, Marie-France Marais<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*CERMAV-CNRS, Grenoble, France*

Contact: Barbara Sensuła, email: [barbara.sensula@polsl.pl](mailto:barbara.sensula@polsl.pl)

We present the first results of the quantitative and qualitative gas chromatographic and isotope ratio mass spectrometric analysis of monosaccharides derived from acid hydrolysis of  $\beta$ -cellulose extracted from annual pine tree-rings. The conifers investigated in this study grew in the Niepolomice Forest in Poland, and the annual rings covered the time span from 1940 to 2000 AD. The challenge is to establish, with respect to climate changes and environmental conditions, the significance of the interannual variations in the observed monosaccharide concentration.

Poster no 14

**Oxygen isotopes in tree rings as climate archives for Tatras**

Sławomira Pawełczyk<sup>1</sup>, Anna Pazdur<sup>1</sup>, Barbara Sensuła<sup>1</sup>, Ryszard Kaczka<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Faculty of Earth Sciences, University of Silesia, Sosnowiec, Poland*

Contact: Sławomira Pawełczyk, email: Sławomira.Pawełczyk@polsl.pl

Mass spectrometric methods allow for precise measurement of stable isotope ratios ( $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$  and  $\delta^{15}\text{N}$ ). One of the isotopic archives frequently used in recent years are tree rings. Isotopic fractionation of organic matter occurring in the tree depends on climatic and environmental conditions.

Investigations of stable isotopic O compositions in  $\alpha$ -cellulose from tree rings of spruce (*Picea* *Abies* L.) growing in Tatras were undertaken for period 1900-2010 in the frame of more complex project. The summer temperature is dominant factor limited growth of trees in high mountain of temporal zone therefore tree rings and isotopes in tree rings can be considered as a good climate proxy, especially for temperature reconstruction.

As a part of research project results for Tatras area associated with the  $\delta^{18}\text{O}$  measurement will be presented. Isotope chronologies are not fully random and they exhibit significant deterministic components. Relationships between isotope values of tree rings and monthly climate data were modelled using bootstrapped correlation function in DendroClim2002. The  $\delta^{18}\text{O}$  values of cellulose are clearly influenced by the climatic condition in August. For this month the strongest association between the  $\delta^{18}\text{O}$  values and temperature ( $r=0.41$ ) as well as precipitation can be observed ( $r=-0.30$ ). If combination of month were taken into consideration, the average March-August temperature and precipitation yielded the best correlation between climate and isotope data ( $r=0.35$ , and  $r=-0.44$  for temperature and precipitation respectively). Using a moving interval technique, the temporal stability of correlation between isotope chronology and climate was investigated, because the temporal stability of climate-proxy connections is an important issue in palaeoclimatic reconstruction. These studies showed no climate signal stability for years 1970-1990. For this period, the climate signal is probably disturbed by human impact on the on the environment.

Poster no 15

**Tree rings in environmental monitoring**

Andrzej Rakowski<sup>1,2</sup>, Anna Pazdur<sup>1</sup>, Toshio Nakamura<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Leibniz Laboratory for Radiometric Dating and Stable Isotope Research, Christian-Albrechts-University, Kiel, Germany*

<sup>3</sup>*Center for Chronological Research, Nagoya University, Nagoya, Japan*

Contact: Andrzej Rakowski, email: arakowski@leibniz.uni-kiel.de

Measurements of radiocarbon concentration conducted in material of plant origin are very important to reconstruct changes of radiocarbon concentration in the past (calibration curve). It also can be use for environmental monitoring of CO<sub>2</sub> emission from combustion of different fossil fuel. An important advantage of this method is relatively easy access to research material, and the ability to reproduce the concentration of radiocarbon in the past (annual growth of trees). The obtain value represents the average radiocarbon concentration in the growing season. Temporal resolution for monitoring the concentration of radiocarbon for this method depends mainly on the length of the vegetation period and plant species used for research. This can be use as a complementary method wherever the atmospheric CO<sub>2</sub> data are not available.

Poster no 16

**Tree-ring climate reconstructions in the area of northern Alps**

Marzena Klusek<sup>1</sup>

<sup>1</sup>BOKU University of Natural Resources and Applied Life Sciences Vienna, University Research Center Tulln, Konrad Lorenz Strasse 24, 3430 Tulln an der Donau, Austria

Contact: Marzena Klusek, email: marzena.klusek@boku.ac.at

The presented research is aimed at the reconstruction of climatic conditions in the area of northern Alps. The study is performed by the application of dendrochronological method, on the basis of 3.5-thousand-year chronology. This chronology contains wood from subfossil and living spruce (*Picea abies* (L.) Karst.) and larch (*Larix decidua* Mill.). The samples included in chronology come from a small area situated around the lake Schwarzer See. This lake is located in the Dachstein Mountains, within the northern Limestone Alps in Austria. Previously the measurements of annual growth-ring width and density were performed. This study represents the next stage of the research carried out on the basis of stable carbon isotopes in rings.

The methodology of the conducted research utilises the strong dependence which exists between the weather conditions in a given year and the content of carbon isotopes in the newly formed growth ring. In sub-Alpine area the temperature is the main factor that restricts the tree growth. It influences the length of vegetation period and its value does not reach the optimum suitable for the plants biological processes. Therefore the correlation of carbon isotopic ratio with the temperature values is planned. For this comparison only contemporary woods is used. However, obtained results can be translated into the earlier period, for which there exist no meteorological records. In this way the reconstruction of temperature will be possible.

The wood is composed of lignin, hemicellulose and cellulose and the amount of these compounds varies between individual trees and between different rings within one tree. These cell wall components have a specific isotopic ratio, because the processes that lead to their production are characterised by a different degree of isotopic fractionation. As the result cellulose is much more enriched in <sup>13</sup>C in comparison to lignin. Therefore, in order to avoid the potential bias resulting from the changes in lignin and cellulose proportion in growth rings, the research is carried out with the application of cellulose only. The cellulose extraction is a crucial process especially in the case of subfossil woods, as in these samples the mutual quantitative ratio of cell walls components is disturbed. The amount of lignin and cellulose in subfossil wood changes in time and depends on the sample history and conditions of preservation.

The study began from the selection of wood fragments in such a way that the mean sample prepared for every year contains the material obtained from four trees. The individual growth rings were separated within these samples. In the current stage of research the separation has been completed. At the moment the procedure of alpha cellulose extraction is conducted in accordance with the modified Green method and with the application of ultrasonic baths technique.

Poster no 17

**The chronologies of the tree-ring widths, sensitivity and frequency as the methods of assessing the ecological requirements of Chinese *Metasequoia* (*Metasequoia glyptostoboides*) growing in the vicinity of Krakow Steelworks**

Sławomir Wilczyński<sup>1</sup>, Bogdan Wertz<sup>2</sup>, Elżbieta Muter<sup>3</sup>

<sup>1</sup>University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Protection, Entomology and Forest Climatology, Al. 29 Listopada 46, 31-425 Krakow, Poland

<sup>2</sup>University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Mensuration, Al. 29 Listopada 46, 31-425 Krakow, Poland

<sup>3</sup>Forest Biodiversity Institute, University of Agriculture, Krakow 31-425, Al. 29 Listopada 46, Poland

Contact: Sławomir Wilczyński, email: slawomirwilczynski1963@wp.pl

Chinese *Metasequoia* is a species which is considered to exhibit a high resistance to harmful environmental factors. For this reason it has been introduced to cities, but it is also grown in plantations because of its rapid volume growth. The climate in the vicinity of Krakow differs from that in its natural habitat in China as the annual temperatures and precipitation in Poland are significantly lower. The research was focused on 45-year-old trees, planted on fertile alluvial soils with an average level of ground water, in the vicinity of the steelworks which has been operational since 1954. The average width of tree rings between 1974 and 2011 was 6 mm and the greatest ring width exceeded 11 mm. During the period of the highest level of air pollution in the 1970s and 80s, the radial increment showed an increasing trend. However, one cannot state how large the increment would have been if the trees had not been subjected to the pressure of pollution. At the end of the 1980s, when the emissions were reduced, a decreasing trend in radial growth was recorded. Throughout the entire period of their life the trees have shown high short-term homogeneity of growth response. Their sensitivity chronology is characterised by a high representativeness and a strong high frequency signal. This may indicate that the studied trees have shown a large sensitivity to climatic factors. The analysis of the dependency of radial increment on climate was possible because of the correct dating of all tree rings. The results of the correlation analysis and response function of the site sensitivity chronology indicated that the growth of *Metasequoia* benefitted from a dry October, as well as a wet and humid December of the previous year followed by a cool and wet spring. During the 38-year period of the study there were seven positive signature years ( $P=100\%$ ) and 8 negative signature years ( $P=0\%$ ). The analysis of the climatic conditions in the signature years confirms to a great degree and supplements the results of the correlation analysis and response function.

Poster no 18

**Short-term increment reactions of Norway Spruce (*Picea abies* (L.) Karst.) from the Western Beskid Mountains**

Sławomir Wilczyński<sup>1</sup>, Grzegorz Durło<sup>1</sup>

<sup>1</sup>*University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Protection, Entomology and Forest Climatology, Al. 29 Listopada 46, 31-425 Krakow*

Contact: Sławomir Wilczyński, email: slawomirwilczynski1963@wp.pl

The aim of this study was dendroclimatological characteristics of short-term incremental response of Norway Spruce (*Picea abies* (L.) Karst.) growing at different altitudes. The sub-populations of spruce from the Western Beskid Mts. were studied. Tree-ring widths are taken as a measures of the condition of trees and incremental capacity, which are their response to the climate conditions. With the change of elevation sensitivity of trees in different climatic elements also changes. They change not only their values but also their role as a factor limited growth of trees. Trees adapt to these changes and records their preferences for the various meteorological elements in the process of tree-ring formation. Therefore, on the basis of properly transformed tree-ring sequences the tree elevation can be identified.



Poster no 19

**Factors affecting the similarities and differences in tree growth reactions of pines and oaks growing in the same habitat conditions**

Elżbieta Muter<sup>1</sup>, Sławomir Wilczyński<sup>2</sup>, Bogdan Hertz<sup>3</sup>

<sup>1</sup>*Forest Biodiversity Institute, University of Agriculture, Krakow 31-425, Al. 29 Listopada 46, Poland*

<sup>2</sup>*University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Protection, Entomology and Forest Climatology, Al. 29 Listopada 46, 31-425 Krakow, Poland*

<sup>3</sup>*University of Agriculture in Krakow, Faculty of Forestry, Department of Forest Mensuration, Al. 29 Listopada 46, 31-425 Krakow, Poland*

Contact: Elżbieta Muter, email: [rlkuchni@cyf-kr.edu.pl](mailto:rlkuchni@cyf-kr.edu.pl)

**Abstract:**

Increment cores were taken at three locations in the Niepołomice Forest from pines and oaks growing together in the same habitat conditions. On the basis of tree-ring widths from each stand, chronologies of both species were developed and then dendroclimatological analyses were carried out. Principal component analysis was used to determine the similarity of pine and oak growth patterns. The values of first principal component (PC1) had the strongest positive relationship with temperatures of February and March. The second component (PC2) divided pine and oak chronologies into two groups according to the species. Values of PC2 were significantly, positively correlated with temperatures and sunshine of May and negatively correlated with precipitation of April. In case of the third component (PC3) we found significant and positive correlation coefficients with temperatures and sunshine in May of previous year and with temperatures in April of the year of ring formation.

Poster no 20

**Tree ring widths variability in Norway spruce (*Picea abies* (L.) Karst.) from the Czarnohora Mountains (Ukrainian Eastern Carpathian Mts.)**

Zdzisław Bednarz<sup>1</sup>, Elżbieta Muter<sup>1</sup>

<sup>1</sup>Forest Biodiversity Institute, University of Agriculture, Kraków 31-425, Al. 29 Listopada 46, Poland

Contact: Elżbieta Muter, email: [rlkuchni@cyf-kr.edu.pl](mailto:rlkuchni@cyf-kr.edu.pl)

On the basis of 83 Norway spruces (*Picea abies* (L.) Karst.) from the Czarnohora Mountains a master chronology was prepared, spanning 310 years (1694-2003). For establishing Norway spruce dendrochronological standard we used cores from three localities (Dancerz, Homuł, Pożyżewska). The similarities between the local chronologies were very high. Analyses of the relationship between ring width indices of spruces and mean monthly air temperatures (1882-2002) in Lwów indicated a strict relationship between radial growth and June-July temperature ( $r = 0,5$ ,  $p = 0,001$ ; GL = 76%). The Norway spruce ring width data showed also significant relationship with June-July precipitations, but this relation was negative ( $r = -0,19$ ,  $p = 0,05$ ; GL = 42%). High mean temperatures in June-July enhance radial growth, while high sums of precipitation reduce ring widths.

# **Terrestrial archives of environmental changes**

Poster no 21

**Dust historical record in ombrotrophic peat: The case study of a NW European bog**

Mohammed Allan<sup>1</sup>, Nathalie Fagel<sup>1</sup>, Gael Le Roux<sup>2</sup>, Nadine Mattielli<sup>3</sup>, Natalia Piotrowska<sup>4</sup>, Jarek Sikorski<sup>4</sup>

<sup>1</sup>University of Liege, Sart Tilman, B18, AGEs Geology, Liege, Belgium

<sup>2</sup>EcoLab, ENSAT, Avenue de l'Agrobiopole, 31326 Castanet Tolosan, France

<sup>3</sup>G-Time, Dept. Earth and Environmental Sciences, Université Libre Bruxelles ULB, Belgium

<sup>4</sup>Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland

Contact: Mohammed Allan, email: mallan@doct.ulg.ac.be

Ombrotrophic peatlands are unique environmental archives of natural and anthropogenic atmospheric dust deposition because their surface layers are exclusively fed by atmospheric inputs. Lead (Pb) isotopes have been often used to evidence any anthropogenic influence in peat, but they only record trace metal pollution. Another radiogenic isotope, the Neodymium (Nd), could be also use to discriminate the sources of dust in peat bogs. Dust fluxes were investigated over the last 2500 years in the Misten peat bog in Eastern Belgium. Our aims were to use Nd isotope signature to decipher between local and distal dust supplies, the Pb isotopes to trace the antropogenic influences. To address these aims we analyzed REE and lithogenic element analyses, as well as the Nd and Pb isotopes, using HR-ICP-MS and MC-ICP-MS, respectively in peat layers dated by <sup>210</sup>Pb and <sup>14</sup>C. Changes in REE concentration variations in peat samples are correlated with Ti, Al, and Zr that are lithogenic conservative elements, suggesting that REE are immobile in the studied peat bogs and can be used as tracers of dust deposition. Dust fluxes show pronounced increase at BC300, AD600, 1000AD, 1200AD and from 1700AD, recording either influence of human activities (regional erosion due to forest clearing and soil cultivation activities) or local and regional climate changes. Lead enrichments reveal strong human impact over the last 300 years. Lead isotope signatures are consistent with local and regional contamination by coal combustion and smelting activities. Neodymium isotopes allow to identify three periods characterised by dominant-distal sources (at 320AD, 1000 AD and 1700AD). Those periods are consistent with local wetter intervals as indicated by lower humification degree. Local erosion prevails durier drier (higher humification) intervals (-100AD, 600AD). On a global scale more distal supplies are driven during colder periods, in particular Oort and Maunder minima, confirming the hypothesis that cold climate conditions favor distal supplies. Combining geochemical elementary content and isotope data in ombrotrophic peat allows to decipher between dust flux changes related to human and climate forcing.

Poster no 22

**Local environmental changes in close vicinity of Poganowo settlement complex (Mrągowo Lake District, NE Poland) as a result of human activity**

Marta Szal<sup>1</sup>, Mirosława Kupryjanowicz<sup>1</sup>, Mariusz Wyczółkowski<sup>2</sup>

<sup>1</sup>University of Białystok, Institute of Biology, ul. M. Skłodowskiej-Curie 14, 15-097 Białystok, Poland <sup>2</sup>Wojciech Kętrzyński Museum, pl. Zamkowy 1, 11-400 Kętrzyn, Poland

Contact: Marta Szal, email: martaszal@op.pl

Palaeoecological researches (pollen analysis, <sup>210</sup>Pb and <sup>14</sup>C dating) of deposits from a small peat bog, localized in the vicinity of Poganowo settlement complex, have been conducted in order to examine human impact on vegetation of this region within the last 2000 years. On the basis of the discovered fragments of pottery, it can be stated that the settlement complex dates back to the Iron Age and the Early Middle Ages. The remains discovered during archaeological excavations, identified as ritual ones, used for cult ceremonies connected with horse sacrifices, consisting of anthropomorphic stone statues, are extremely interesting. It seems important to find out the relationship between the examined Poganowo complex and its vicinity (about 5-6 km) functioning in the same period, in micro-region nearby Lake Sałęt (Nowakiewicz 2006).

Both pollen analysis and radiocarbon dating indicate that bottom layers of the analyzed sediments were accumulated in the Late Glacial (Allerød and Younger Dryas) and at the beginning of the Holocene (the Preboreal). In the examined profile there can be found a hiatus covering the Boreal, Atlantic and Subboreal. The next sedimentation started in the Subatlantic.

In a pollen diagram from the upper Subatlantic part of the profile, 6 local pollen assemblage zones were distinguished. This allowed us to distinguish six phases of vegetation changes in direct vicinity of Poganowo settlement complex. In phase 1 there dominated thick forests, divided into a few types (multi-species deciduous forests with dominating linden, riverine forests, alder forests, pine forests, mixed forests). The area of open communities was very small. The first settlement of those areas took place right after that phase. Radiocarbon dating, showing that it started 2140-1996 years BP., probably slightly rejuvenates it, as the archaeological data indicate that it should have ended at the beginning of III century B.C. Phases 2, 4 and 6 were connected with intensification of anthropogenic vegetation changes in the vicinity of Poganowo complex. Phase 2 fell on the first period of settlement, which was archaeologically dated back to III phase of the West Baltic Barrow Culture (III-I century B.C.). Deforestation of almost all types of forests, registered in the pollen record, was probably connected with logging for the purposes of settlement construction and/or to improve visibility in its foreground. In the deforested areas, there developed open assemblages and willow bushes. The deforestation did not last long, and it was probably only one-time event. Desisting from it caused that in the process of natural succession, secondary birch forests suddenly spread in the deforested areas. Phase 4 of vegetation changes in Poganowo region was connected with the second phase of settlement, falling on the Early Middle Ages (the end of 10th – the beginning of 12th century). At that time, there were destroyed mixed forests with linden and elm, which occupied the most fertile grounds. Spruce forests, secondary birch forests and alder forests were also exploited, but to a lesser extent. Some of the deforested areas were devoted to cultivation of cereal. There also developed meadows and/or pasturelands and ruderal assemblages. In phase 6 of forests development around Poganowo, there took place a considerable reconstruction of forest stands, expressed by sudden increase of spruce numbers, which – besides pine – became a dominant kind of tree in that area. That change was probably a result of forest economy in Prussia – starting from 17th-18th century, spruce was systematically planted in hornbeam and oak assemblages. Lead dating of the beginning of spreading spruce in the region of Poganowo indicates that this kind of forest

economy started only around 1860. Development of planted spruce was considerably limited by acreage of such elements of those forests as hornbeam, linden, elm and hazel. There took place thinning of forest stands and spreading of open assemblages, usually, connected with a human activity (cultivation of cereal and rape or other plants of Brassicaceae family, ruderal assemblages, meadows and/or pasturelands). Their development was related to creation of a few villages and estates, orientated towards forest economy service, in close vicinity of Poganowo settlement complex. In phases 3 and 5 there took place natural regeneration of local forest stands, related to reduced intensity of human impact on environment in the periods between settlement phases in Poganowo complex. Phase 3 was characterized by progressive secondary succession of forest in the areas that were deforested in phase 2. There developed pine forests with aspen and hazel bushes. There took place reconstruction of alder forests, riverine forests and multi-species deciduous forests. In phase 5, in the most fertile habitats, linden - destroyed in phase 4 – was replaced by hornbeam, which is able to regenerate from root offshoots better than other trees. Some of post-agricultural areas were occupied by birch forests and pine forests. We acknowledge financial support, provided by the Ministry of Science and Higher Education/ the Centre of National Science in Poland (DEC-2011/01/B/HS3/04167).

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Poster no 23

**Reconstruction of recent activity of the L. Sawicki's landslide in the vicinity of Szymbark (Low Beskid Mts., SE Poland)**

Natalia Nawrocka<sup>1</sup>, Marek Krąpiec<sup>1</sup>

<sup>1</sup>*Faculty of Geology, Geophysics and Environmental Protection, AGH-University of Science and Technology, A. Mickiewicza 30 Ave., 30-059 Kraków, Poland*

Contact: Natalia Nawrocka, email: nawrocka@geol.agh.edu.pl

Trees, being inclined due to ground motion, during the process of regaining vertical position produce deconcentric ring patterns. Dendrochronology can be used for accurate dating of tree rings that could have been affected by geomorphic processes. The presented study was performed on a complex, active landslide in the Low Beskid Mts (SE Poland), so-called Sawicki's landslide. Two different methods were used and compared: distribution patterns of deconcentric annual growths analysis and the eccentricity index evaluation. The samples were collected using the Pressler increment borer from 90 trees of various species. Exact location of the individuals analyzed was determined with the GPS and mapped. The majority of samples was taken from trees growing on the landslide body. The trunks of those trees had been deformed and rotated by self-adjustment to vertical position. Based on the measured sequences of annual growths from trees growing in the stable conditions, local chronologies were constructed. Every tree was sampled with two cores, acquired from both the slope-facing and opposite side of the trunk, and directed towards its maximal bending. The dendrochronological curves, representing upper and lower sides of trunks, were presented in pairs for individual trees. Years with the greatest number of trees showing the diagnostic signals considered as indicative for ground motion, such as sharp divergence of dendrograms combined with the reaction wood or abrupt changes in eccentricity index values were identified. Both methods enabled dating of particular episodes of landslide activity with year-to-year accuracy and determined the ground movements in various parts of the landslide area within the time limited by the age of the trees.

Dendrochronological analysis pointed to several phases when at large numbers of trees reaction had occurred. These results were compared with climate records. It was noted that the most intensive ground movements were mostly related to the years thermally cool and humid, especially periods of high total rainfall. Direct impact of the landslide activity was reflected in trees almost immediately in the same year (for example: 1973, 1997, 1998), or with a delay of one or two years (for example 1971, 1981, 1986, 2011). For instance, the year 1981, which was characterized by strong response of trees, may be associated with extreme total rainfall recorded in 1980. Spatial and temporal development of displacements, which took place in various parts of the landslide, was also investigated. It turned out that the middle part of the landslide was the most active one. Before the 1950s movement was recorded mostly by trees located in the upper and middle part of the landslide body. After the year 1951 the movement was recorded almost over the entire form. Since 2000 a decrease of activity in the upper parts proceeds.

Poster no 24

**The environment changes and chronology of the Late Vistulian (Weichselian) sediments in the Rąbień mire**

Danuta Michczyńska<sup>1</sup>, Jacek Forysiak<sup>2</sup>, Dominik Pawłowski<sup>3</sup>, Mateusz Płóciennik<sup>4</sup>, Ryszard K. Borówka<sup>5</sup>, Andrzej Witkowski<sup>5</sup>, Milena Obremska<sup>6</sup>, Michał Słowiński<sup>7</sup>, Sławomir Żurek<sup>8</sup>, Steve J. Brooks<sup>9</sup>, Adam Michczyński<sup>1</sup>

<sup>1</sup>Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland

<sup>2</sup>Department of Geomorphology and Palaeogeography, University of Lodz, Narutowicza 8, 90-139 Łódź, Poland

<sup>3</sup>Adam Mickiewicz University Institute of Geology Maków Polnych 16 61-606 Poznań, Poland

<sup>4</sup>Department of Invertebrate Zoology and Hydrobiology, University of Lodz, Banacha 12/16, 90-237 Łódź, Poland

<sup>5</sup>Geology and Palaeogeography Unit, Faculty of Geosciences, University of Szczecin, Mickiewicza 18, Szczecin 70-383, Poland

<sup>6</sup>Institute of Geological Sciences, Polish Academy of Sciences, Research Centre in Warsaw, Twarda 51/55, 00-818 Warsaw, Poland

<sup>7</sup>Department of Environmental Resources and Geohazards, Institute of Geography and Spatial Organization, Polish Academy of Sciences, Kopernika 19, 87-100 Toruń, Poland

<sup>8</sup>Szareckiego 6/48, 01-493 Warszawa, Poland

<sup>9</sup>Department of Life Sciences, Natural History Museum, Cromwell Road SW7 5BD, London, Great Britain

Contact: Danuta Michczyńska, email: Danuta.Michczynska@polsl.pl

Rąbień mire is located in central Poland, in the morainic Łask Upland, about 11 km to the west of Łódź. The mire is situated in an oval depression surrounded by dunes. The deposits contain mainly biogenic sediments, consisting of gyttja and peat. Lake sediments form the base of the profile (6.2-1.8 m) are covered with peat. From the deepest part of the mire, a 6.2 m core was taken (R-II). Rąbień mire was previously the subject of palaeobotanical and geological studies (Balwierz 2005, 2011; Kloss 2005; Kloss and Żurek 2005). These studies indicate that gyttja deposition started during the Oldest Dryas and continued to present day.

In the present palaeoecological study, palynomorphs, plant macrofossils, *Cladocera*, diatoms, chironomids and sediment geochemistry proxy were analyzed. Radiometric dating was also undertaken. The stratigraphic framework (age-depth model) for the Rąbień profile was constructed on the basis of ten radiocarbon dates of organic material using the P-Sequence function of the OxCal calibration programme. This indicates the base of the profile is 14920-14500 cal yr BP (68.2% conf. interval). The lithological and geochemical data indicate that sudden changes in deposition rate took place at 1.8, 4.1 and 4.4 m.

The present palaeoecological and chronological study focuses on the lower section of the R-II sequence, which is a fairly complete sedimentary record from approximately 15 to 12 ka cal BP. This period is characterized by a series of climatic changes. The sequence contains evidence for short-lived climate oscillations during the late Vistulian in the biotic records (*Cladocera* as well as plant community). Generally, the biotic and radiocarbon data are consistent and indicate the main climatic phases recognized in other Polish and European records.

Palaeoecological studies based on lacustrine sediments from Europe predating the Late Glacial are scarce, therefore, every study that provides data for the late Vistulian are desirable.

Presented studies were obtained in the framework of an interdisciplinary research projects from the Polish Ministry of Science and Higher Education, NN306 276735 and Polish National Science Centre, N N306 034040.



Poster no 25

**Bagno Bruch, Bagno Mikołeska peatlands, age - depth model**

Jarosław Sikorski<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Jarosław Sikorski, email: jaroslaw.sikorski@polsl.pl

The aim of described measurements will be establishing an accumulation peat model, for industrial anthropogenic changes, peat bog.

The main aim of the study is developing and improvement of method of using  $^{210}\text{Pb}$  to study peat erosion and accumulation on modern peat land areas.

Important aim is also to use of the technique of the gamma spectrometry measurement in application to measurements of  $^{210}\text{Pb}$  isotope concentration especially in peat samples as well as to learn other dating or measurement techniques possible to use to study modern geomorphological processes.

Details of activities: General overview of measure procedures used in the alpha and gamma spectrometry with special regards on the procedure of measure and calculating  $^{210}\text{Pb}$  in environmental samples. Calculating of sample age use lead dating method for Bagno Mikołeska and Bagno Bruch (southern Poland) peatland.

Poster no 26

**Study of soil erosion under manual cultivation system in the monsoonal climate of the Meghalaya Plateau (India) based on radioisotope measurements**

Grzegorz Poręba<sup>1</sup>, Paweł Prokop<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography and Spatial Organization Department of Geomorphology and Hydrology of Mountains and Uplands PAS Św. Jana 22 31-018 Krakow, Poland*

Contact: Grzegorz Poręba, email: Grzegorz.Poreba@polsl.pl

The Meghalaya Plateau located in North-East India one of the rainiest environments on Earth, where about 65% of the population's livelihood is dependent on agriculture. The hilly terrain with narrow valleys in between limits the net availability of land for cultivation. However over the last few decades, widespread agricultural expansion onto marginal land in response to population growth is observed.

Consequently soil erosion accelerated by shifting cultivation - the predominant form of agriculture is the main cause of present day soil degradation. Therefore, it is necessary to quantify soil loss and to identify adequate land management to prevent progressive erosion.

To assess soil erosion and sediment accumulation on the study area two fallout radioisotopes were used: <sup>137</sup>Cs and <sup>210</sup>Pb. Those methods allow to assess mid-term soil erosion (50-150 years). The activity in soil samples were measured by gamma-ray spectrometry using HPGe detector. For both isotopes the mass balance models were applied to calculate soil erosion. The obtained results of soil erosion are in wide range from 0.5 t/ha/yr in case of degraded grasslands up to 100 t/ha/yr in case of cultivated fields. Soil erosion and deposition patterns are predominantly influenced by land use. Within the same land use category, soil erosion rates are strongly related to slope steepness.

## Poster no 27

### **Marine or terrestrial diet of recent and ancient arctic fox from Chukotka, Russia?**

Ekaterina Gorlova

<sup>1</sup>A.N. Severtsov's Institute of Ecology and Evolution, Russian Academy of Science, Leninsky Prt., 33 119071 Moscow, Russia

Contact: Ekaterina Gorlova, email: gorlova.k@gmail.com

It is known that the Arctic fox (*Vulpes lagopus lagopus*) is an opportunistic predator. The species also exploits both terrestrial and marine environments. Typically the arctic fox is found in two main habitat types: 1). animals living inland feed mainly rodents and 2). animals living near sea-cost feed both terrestrial and marine prey (sea birds, fish, invertebrates and carcasses of marine mammals). Stable carbon ( $^{13}\text{C}/^{12}\text{C}$ ) and nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ) isotope ratios in 100 bone samples from near-shore ancient fox were measured in order to quantify the importance of marine diet and to document temporal variation in their diet.. Bones were studied from cultural layers of ancient sea-mammal hunters' settlement on the western coast of the Bering Strait (Chukotka Peninsula, Russia). Radiocarbon dates suggest that the settlement existed about 2300-200 yrs BP. In addition to ancient, modern samples were measured too. We used 8 samples/individuals of modern arctic fox from coastal habitat of Chukotka, 39 samples representing 7 terrestrial species and 10 samples/individuals of polar bear (*Ursus maritimus*) representing marine predator.  $\delta^{13}\text{C}$  ranged from  $-23.3\pm 1.3\text{‰}$  for terrestrial species to  $-13.2\pm 0.9\text{‰}$  for polar bear.  $\delta^{15}\text{N}$  was least enriched for rodents ( $3.9\pm 2.8\text{‰}$ ) for the marine highest-order consumers ( $21.9\pm 0.6\text{‰}$ ). We used these data to value importance of marine or terrestrial food items for near shore arctic fox. All modern individuals had isotope signature indicating typical terrestrial predators ( $\delta^{13}\text{C}$ :  $-21.7\pm 1.4\text{‰}$ ,  $\delta^{15}\text{N}$ :  $7.5\pm 1.4\text{‰}$ ). Data for ancient fox presented that for 92% of animals terrestrial prey played a key role in feeding, for 7% of animals diet was mixed and 1 individual showed isotope signature near polar bear value ( $\delta^{13}\text{C}$ :  $-13.0\text{‰}$ ,  $\delta^{15}\text{N}$ :  $18.9\text{‰}$ ). Probably this fox had unusual life strategy more time leaded on the littoral or following a polar bear and eating the remains of his meal. The appearance of foxes with mixed diet hasn't correlated with climatic or other changes. But there is slight decrease in  $\delta^{15}\text{N}$  values (from  $8.5\pm 1.7\text{‰}$  at the base to  $6.9\pm 1.3\text{‰}$  at the top) over 2000-1000 BP. Later, over Little Ice Age (700-200 BP)  $\delta^{15}\text{N}$  values became more positive again ( $7.9\pm 2.1\text{‰}$ ). Climatic reconstructions for our region reveal that the beginning of the first millennium AD was colder than its end. Our data suggest that enrichment of  $^{15}\text{N}/^{14}\text{N}$  ratio may be associated with climatic cooling or sea-ice cover. Variations in the  $\delta^{13}\text{C}$  profile disagree with the  $\delta^{15}\text{N}$  profile. Probably variation in isotopic signature associated not with important marine or terrestrial prey, and with something another.

The present study was supported by the grant of RFBR (12-04-00655) and the programs "The Living Nature: the Present-Day Condition and the Problem" and "Biological Resources of Russia: Dynamics under Conditions of Global Climate and Anthropogenic Impacts".

Poster no 28

**Shifts in temperature and in seasonality of precipitation during the last 1000 yrs in west central Sweden – evidence from chironomids and lacustrine oxygen isotopes**

Annika Berntsson<sup>1</sup>, Jonas Bergman<sup>2</sup>, Stephen J. Brooks<sup>3</sup>, Lars Eriksson<sup>4</sup>, Tomasz Goslar<sup>5</sup>, Gunhild Rosqvist<sup>6</sup>, Gaute Velle<sup>7</sup>

<sup>1</sup>*Department of Physical Geography and Quaternary Geology, Stockholm University, Sweden*

<sup>2</sup>*Contract Archaeology Service, Swedish National Heritage Board, Stockholm, Sweden*

<sup>3</sup>*Natural History Museum, London, UK*

<sup>4</sup>*Department of Aquatic Sciences and Assessment, SLU (Swedish University of Agricultural Sciences), Uppsala, Sweden*

<sup>5</sup>*Poznan Radiocarbon Laboratory, Poznan, Poland*

<sup>6</sup>*Department of Physical Geography and Quaternary Geology, Stockholm University, Sweden*

<sup>7</sup>*Uni Environment, Uni Research, Bergen, Norway*

Contact: Annika Berntsson, email: annika.berntsson@natgeo.su.se

Here we present summer temperature and precipitation reconstructions based on lake sediments from west central Sweden. Lake Spåime, is situated at 887 m a.s.l. (63°06'40"N; 12°19'11"E) in Jämtland, west central Sweden, c. 90 m above the present treeline. Recent mean July air temperature at the site is 10.8 °C in contrast to the AD 1961-1990 mean July temperature of 9.1 °C. We apply chironomid analysis, quantitative and  $\delta^{18}\text{O}$  analysis of diatom silica with the aim to reconstruct temperature and precipitation. Preliminary results suggest that chironomids can be used to reconstruct July temperatures at the decadal time scale but fail to reconstruct the warming after the 1990's. Results from analysis of TOC, C/N and XRF are used to track changes in the lake and its catchment. The age-depth model is based on  $^{210}\text{Pb}$  and  $^{137}\text{Cs}$  dating, 17  $^{14}\text{C}$  dates (terrestrial macrofossils) and identification of the AD 1875 Askja tephra horizon. Lake Spåime is a shallow, hydrologically open, through-flow lake. The lake water  $\delta^{18}\text{O}$ , which has been preserved in opal silica of diatom frustules, reflects the  $\delta^{18}\text{O}$  of local precipitation. Previous work has shown that stratigraphic changes in  $\delta^{18}\text{O}$  from diatom silica from Lake Spåime reflect changes in the seasonality of precipitation.

Poster no 29

**Validation of varve-based chronology for uppermost sediments using Cs-137: case study of Lake Żabińskie, northeastern Poland**

Alicja Bonk<sup>1</sup>, Wojciech Tylmann<sup>1</sup>, Monika Motykowska-Liebner<sup>1</sup>, Martin Grosjean<sup>2</sup>

<sup>1</sup>*Institute of Geography, University of Gdansk, Poland*

<sup>2</sup>*Oeschger Centre for Climate Change Research, University of Bern, Switzerland*

Contact: Alicja Bonk, email: geoab@univ.gda.pl

Lake Żabińskie is a study site of the CLIMPOL project, a joint Polish-Swiss initiative aiming at quantitative reconstruction of climate change in northern Poland during the last millennium. The lake is located in the Masurian Lakeland (54°07'54."N; 21°59'01.1"E) and presents features typical for kettle-hole lakes, i.e. small surface area (41.6 ha) and considerable depth (44.4 m). The catchment is dominated by glacial and fluvioglacial sediments deposited during the Vistulian glaciation. A set of gravity and piston cores was collected from the deepest part of the lake during field works carried out in 2011 and 2012. Undisturbed sediment cores were collected from a coring platform using 90 mm diameter UWITEC gravity and piston corers.

The sediment record shows laminated structure which was recognized as biogenic (calcite) varves. Varve identification was based on microscopic analysis of thin sections. Three independent counting enabled estimation of the number of varves and counting uncertainty for the last 120 years. However, complex structure of varves including multiple calcite laminae within one-year-deposition caused problems with defining varve boundaries in some sections. To verify the varve counting we used Cs-137 as an independent and unambiguous chronostratigraphic marker. Samples for Cs-137 measurements were taken in 3-years resolution according to estimated varve boundaries. The activity of Cs-137 was determined by gamma-ray spectrometry using HPGe well-type detector (Canberra). The obtained Cs-137 profile shows clearly two maxima: the first peak at the depth ca. 32 cm can be interpreted as deposition of radionuclides in the Northern Hemisphere after nuclear weapon tests in 1963 and the second peak at the depth ca. 13 cm is related to fallout after Chernobyl reactor accident in 1986. These two validation points were used to verify the varve time scale and support substantially our varve counting strategy.

Poster no 30

**Stable isotopes in lake sediments from Lake Żabińskie, northeastern Poland, for temperature reconstruction during the last 120 years**

Alicja Gabryś<sup>1</sup>, Natalia Piotrowska<sup>1</sup>, Wojciech Tylmann<sup>2</sup>, Martin Grosjean<sup>3</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography, University of Gdansk, Poland*

<sup>3</sup>*Oeschger Centre for Climate Change Research, University of Bern, Switzerland*

Contact: Alicja Gabryś, email: [alicja.gabrys@polsl.pl](mailto:alicja.gabrys@polsl.pl)

The period of the last 1000 years provides information about the changes that have occurred in European modern climate. This information is the key for understanding the natural variability of European climate and can be used to create a model of climate changes in the future.

North-eastern Poland is the one of the best locations for create a model of climate changes, because reflects the variability of winter temperature for the European land areas. CLIMPOL project is aimed at quantitative reconstruction quantitative temperature series for northern Poland for the past 1000 years. The key site for project studies is Lake Żabińskie, located in the Masurian Lakeland. The sediments of this lake are annually laminated providing a basis for high-resolution reconstructions.

One of the project tasks is quantitative summer temperature reconstruction at annual and subdecadal resolution and validation with early instrumental and documentary data. For this purpose the set of samples comprising the last 120 years have been subsampled with yearly resolution, and the results will be used as training set for calibration-in-time.

The results of stable carbon and oxygen isotope composition of carbonate from uppermost 120 years will be presented

Project CLIMPOL is supported by a grant from Switzerland through the Swiss Contribution to the enlarged European Union (Project No. PSPB-086/2010).

Poster no 31

**Some problems with the use of the nickelised carbon catalyst in the high-temperature  $\text{Ag}_3\text{PO}_4$  EA-CF-IRMS pyrolysis**

Jacek Pawlyta<sup>1</sup>, Mirosława Pawlyta<sup>2</sup>, Waldemar Kwaśny<sup>2</sup>, Beata Stepańczak<sup>3</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Silesian University of Technology, Faculty of Mechanical Engineering, Institute of Engineering Materials and Biomaterials, Gliwice, Poland*

<sup>3</sup>*Jagiellonian University, Institute of Zoology, Department of Anthropology, Kraków, Poland*

Contact: Jacek Pawlyta, email: jacek.pawlyta@polsl.pl

Isotopic analysis of oxygen of bone phosphate is nowadays more and more popular tool in both palaeoenvironmental/palaeoclimatic and migration studies. The method requires quite complicated sample processing and perfect tuning of the analytical system.

Isotopic ratio mass spectrometer running in the continuous flow mode coupled to the elemental analyser is the most popular tool of the oxygen isotopic investigations of organic matter as well as bone phosphates. There are some works published describing the method which suggest use of the nickelised carbon as the catalyst. Here we present description and analysis of problems we found during the use of NiC catalyst.

Poster no 32

**Isotopic investigations of Zolushka Cave – pilot study**

Wiaczesław Andrejczuk<sup>1</sup>, Jacek Pawlyta<sup>2</sup>, Piotr Kotula<sup>1</sup>

<sup>1</sup>*University of Silesia, Faculty of Earth Sciences, Sosnowiec, Poland*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Jacek Pawlyta, email: jacek.pawlyta@polsl.pl

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Isotopic ratio mass spectrometer running in the continuous flow mode coupled to the elemental analyser is the most popular tool of the oxygen isotopic investigations of organic matter as well as bone phosphates. There are some works published describing the method which suggest use of the nickelised carbon as the catalyst. Here we present description and analysis of problems we found during the use of NiC catalyst.



# **Luminescence & EPR dating**

Poster no 33

**Luminescence dating of bricks from the gothic Saint James Church in Toruń**

N. Kijek<sup>1</sup>, A. Cicha<sup>2</sup>, A. Chruścińska<sup>1</sup>, K. R. Przegiętka<sup>1</sup>, P. Palczewski<sup>1</sup>, K. Sulkowska-Tuszyńska<sup>2</sup>

<sup>1</sup>*Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5, 87-100 Toruń*

<sup>2</sup>*Institute of Archaeology, Faculty of History, Nicolaus Copernicus University, Szosa Bydgoska 44/48, 87-100 Toruń*

Contact: Natalia Kijek, email: natalia@fizyka.umk.pl

Bricks were one of the first objects of luminescence dating over fifty years ago. Investigations of this material have also an important contribution into the development of retrospective dosimetry especially during examining the consequences of the Chernobyl accident. Brick dating, however, comparatively to pottery or geological sediment dating is rather rarely reported in literature. Saint James Church in Toruń is one the most precious gothic monuments in Poland, so applying the luminescence method to establish the history of this object may make luminescence dating more popular among Polish architecture researchers. Regular excavations have been carried out for several years in order to investigate the remains of the church that had existed before the present seven hundred-year-old temple was build. Altogether 13 samples were collected in 5 excavations located by the southeastern side, northwestern side of the present presbytery and vestry. Here we present results obtained for 6 samples collected from the excavations on the northwestern side of presbytery.

Quartz grains having  $m$  were extracted from bricks by the standard  $\mu$ the diameter between 100 and 200 procedure including heavy liquid separation and etching. In order to estimate the equivalent dose ( $D_e$ ) two methods have been applied - the additive dose method using thermoluminescence (TL) signal and the single aliquot regeneration dose protocol (SAR) that is a series of optically stimulated luminescence (OSL) measurements. Whereas the SAR method allows to estimate the equivalent dose for the single aliquot of quartz grains, the additive dose method requires measurements for a set of several aliquots as well as taking into account the nonlinear dependence of TL signal on small doses by incorporating an adequate correction in the  $D_e$  calculation. All OSL measurements were carried out using the RISØ TL/OSL System TL-DA-20 equipped with conventional Hoya U-340 filter and EMI 9235QB photomultiplier. Blue LED stimulation module (450-550 nm, 80 mW/cm<sup>2</sup>) was applied as an optical stimulation source. The TL investigations were conducted using the RISØ TL/OSL System TL-DA-12 equipped with BG-39 Schott filter and EMI 9235QA photomultiplier.

Age calculations require, besides the  $D_e$  value, estimation of the annual dose ( $D_a$ ). This value is partially determined by the external gamma dose absorbed by quartz from the surrounding at the place of origin of the brick and partially by the internal dose coming from the brick alone. All samples come from walls that are now about 1 m below the surface of the ground, so, next to the bricks, several samples of the soil adjacent to the walls were collected in order to estimate the external gamma dose. The brick samples were transported in hermetic containers and their moisture was measured immediately after collecting them. Canberra Gamma-ray Spectrometer with the germanium detector was used for measuring the activity of radionuclides contained in the bricks and soil samples. Using these data the annual doses were calculated.

Poster no 34

**Luminescence dating of the Palaeolithic site of Kulbulak (Uzbekistan) using IR50 and pIRIR290 signals from K-feldspar**

Dimitri Vandenberghe<sup>1,2</sup>, Jasper Van Nieuland<sup>1</sup>, Morgan De Dapper<sup>2</sup>, Damien Flas<sup>3</sup>, Ann-Eline Debeer<sup>1</sup>, Elien De Pelsmaeker<sup>1</sup>, K. Kolobova<sup>4</sup>, K. Pavlenok<sup>4</sup>, U. Islamov<sup>5</sup>

<sup>1</sup>Laboratory of Mineralogy and Petrology, Department of Geology and Soil Sciences, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium

<sup>2</sup>Regional Geomorphology and Geoarchaeology, Department of Geography, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium

<sup>3</sup>F.R.S.-FNRS, Department of Prehistory, Liège University, Place du 20-Août 7, 4000 Liège, Belgium.

<sup>4</sup>Institute of Archaeology and Ethnography, Russian Academy of Sciences (Siberian Branch), Lavrentieva prosp. 17, 630090 Novosibirsk, Russia

<sup>5</sup>Institute of Archaeology, Uzbek Academy of Sciences, Tashkent, Uzbekistan

Contact: Dimitri Vandenberghe, email: dimitri.vandenberghe@ugent.be

Kulbulak has been considered as a key site for the Palaeolithic archaeology in Central Asia. The stratigraphic column covers a thickness of ~ 14 m, and contains several archaeological horizons. A major limitation to interpreting the record, however, has been the lack of a chronological framework. In this paper, we report on our investigations using infrared stimulated luminescence (IRSL) signals from K-feldspar to obtain absolute age information for the sequence.

Two IRSL signals are investigated; the first is stimulated with infrared at 50°C (IR50), while the second is stimulated at an elevated temperature of 290°C following a bleach with IR at 50°C (pIRIR290). We first document the characteristics of these luminescence signals in terms of behavior in the SAR protocol (recycling ratio, recuperation and dose recovery). It is shown that fading-corrected IR50-ages are independent of preheat temperature, but that the fading rate decreases with preheat temperature. This observation is taken to advantage in measurements of the pIRIR290 signal (which are preceded by a preheat of 320°C), and a prior-IR stimulation plateau-test is used to optimize the first stimulation temperature. The pIRIR290-signal is significantly more stable (g2days:  $1.0 \pm 0.2$  %/decade;  $n = 56$ ) than the IR50-signal (g2days:  $3.3 \pm 0.2$  %/decade;  $n = 70$ ), and may not require correction for anomalous fading.

We then compare fading-corrected IR50-ages with uncorrected pIRIR290-ages. The fading-corrected IR50-ages that have been obtained so far (uppermost 6 m of the sequence) range from  $39 \pm 2$  ka to  $82 \pm 6$  ka and are broadly consistent with the stratigraphic position of the samples. The pIRIR290-ages are systematically higher, and indicate an age range from  $45 \pm 5$  ka to  $100 \pm 4$  ka. We use the combined IR50/pIRIR290 dataset to assess which samples are likely to have been well-bleached and yield the most reliable age results.

We conclude that pIRIR290-dating has the advantage of circumventing, at least to some extent, the limitations of a model that is required to correct the IR50-ages for anomalous fading. The pIRIR290-signal bleaches significantly slower than the IR50-signal, however. The sequence of Kulbulak consists of a complex alternation of layers that were deposited under various regimes, ranging from gentle aeolian to turbid alluvial; from this perspective, it remains useful to compare the pIRIR290-ages with ages that are derived from a signal that exhibits a higher fading rate, but is reset more rapidly by exposure to daylight.

Poster no 35

**A comparison of luminescence dating methods applied on a sedimentary section in Southeast Romania interbedding an ash layer**

Valentina Anechitei-Deacu<sup>1,2</sup>, Kathryn Fitzsimmons<sup>3</sup>, Daniel Vereş<sup>1,2,4</sup>, Robert Begy<sup>1,2</sup>, Alida Timar-Gabor<sup>1,2</sup>

<sup>1</sup>*Faculty of Environmental Sciences, Babeş-Bolyai University, Fantanele 30, 400294 Cluj-Napoca, Romania*

<sup>2</sup>*Interdisciplinary Research Institute on Bio-Nano-Science of Babeş-Bolyai University, Treboniu Laurean 42, 400271 Cluj-Napoca, Romania*

<sup>3</sup>*Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Deutscher Platz 6, D-04103 Leipzig, Germany.*

<sup>4</sup>*Institute of Speology, Romanian Academy, Clinicilor 5, 400006 Cluj-Napoca, Romania.*

Contact: Valentina Anechitei-Deacu, email: tina\_anechitei@yahoo.com

A number of volcanic ash layers embedded in Pliocene loess and fluvial deposits in south-western Romania have been assigned to the Campanian Ignimbrite/Y5 tephra layer by previous investigations involving glass chemical composition and OSL dating of adjacent material. The Campanian Ignimbrite /Y5 tephra (dated by  $^{40}\text{Ar}/^{39}\text{Ar}$  to 39-40 ka) could play a very important role as a marker horizon at sub-continental scale, provided that more potential tephra locations are identified in the Lower Danube region. In the present study we present luminescence chronological investigations on four samples of loess embedding an ash layer located at Rasova site, on the eastern bank of Danube River, southeastern Romania. First investigations involved SAR-OSL dating on fine (4-11  $\mu\text{m}$ ) and coarse (63-90  $\mu\text{m}$ , 90-125  $\mu\text{m}$ ) grains of quartz with a two-fold aim. On the one hand it was intended to chronologically constrain the deposition of the ash layer to the Campanian Ignimbrite Y5 eruption, while on the other hand, the study design aimed at gaining more insights on the cause of the severe age discrepancy between the fine and the coarse quartz grain fractions previously reported on the representative loess-palaeosol sections in southern Romania. In our previous studies on Mircea Vodă, Mostiștea and Costinești sections, the fine grain chronology yielded ages much younger than the coarse grains. The age discrepancy resided in the different equivalent doses, the fine equivalent doses being in all cases much lower than the coarse quartz equivalent doses. Preliminary age results broadly assign the ash layer to the Campanian Ignimbrite /Y5 tephra. For one sample collected below the ash layer SAR OSL ages of  $44.4 \pm 4.5$  ka (4-11  $\mu\text{m}$  quartz) and  $46.2 \pm 3.7$  ka (63-90  $\mu\text{m}$  quartz) have been obtained, while for a sample collected from above the ash layer, ages of  $36.3 \pm 3.5$  ka (4-11  $\mu\text{m}$  quartz) and  $42.3 \pm 3.1$  ka (63-90  $\mu\text{m}$  quartz) have been derived. These results indicate that the previously mentioned age discrepancy is not present, at least to the same extent, at this particular location. This observation highlights the need for more extensive investigations into the luminescence properties of quartz as well as into the origin of quartz contributions from different primary sources. Final results of ongoing work will be presented at the conference.

V.A.D, A.T.G., D.V. and R.B. acknowledge the financial support from a grant of the Romanian National Authority for Scientific Research CNCS-UEFISCDI, PN-II-RU-TE-2011-3-0062, nr. 73/05.10.2011.

Poster no 36

**OSL and IRSL dating of deposits from the Sudanese archaeological sites - criteria for choosing a measurement procedure**

Jarosław Kusiak<sup>1</sup>, Przemysław Bobrowski<sup>2</sup>, Maciej Jórdeczka<sup>2</sup>

<sup>1</sup>*Department of Geoecology and Palaeogeography, Maria Curie-Skłodowska University, Al. Kraśnicka 2cd, 20-718 Lublin Poland*

<sup>2</sup>*Group for Research on Prehistory and Early Civilization of Africa Institute of Archaeology and Ethnology Polish Academy of Science ul. Rubież 46 Poznań Poland*

Contact: Jarosław Kusiak, email: kusiak@umcs.pl

In the years 2010-2012 the Group for Research on Prehistory and Early Civilization of Africa carried out the studies of petroglyphs and associated settlement in Bir Nurayet, Red Sea Mountains, north-eastern Sudan, and began also work in the Khour Shambat 1 - the newly discovered Neolithic site in Omdurman (Khartoum). Radiocarbon and luminescence (TL, OSL, IRSL) methods were used in order to determine the chronology of events. The petroglyphs were covered by a thick layer of alluvial deposits with distinct stratification. The determination of luminescence age of these deposits was of great importance for establishing when the petroglyphs were created. We assume that these deposits started to accumulate in the period of sudden climate changes about 3000-1000 years BC, which are recorded, among others, in historical sources. The end of deposition is indicated by the age of a destroyed grave with skeleton, discovered on the surface of deposits, which was radiocarbon dated at  $415 \pm 30$  lat BP. The site in Khartoum contains the relics of settlement and burial ground, which was dated by archaeological methods at about 5-7(8.5) ka. In order to confirm the site chronology the luminescence OSL and IRSL dating was carried out on the layer of cemented sand, in which graves were sunk, and on the Neolithic cultural layer. The samples of human bones from two graves were dated by radiocarbon method. The first results of TL dating for the Bir Nurayet site were obtained using the Mikrolab RA'94 reader. The samples taken from a depth of 40 cm, 80 cm, and 120 cm were dated at  $2099 \pm 197$ ,  $2117 \pm 201$ , and  $3763 \pm 357$  years, respectively. The results of luminescence OSL and IRSL dating were obtained using the Risø DA-20 reader (SAR protocol). The ages of the postIR OSL 125 procedure were  $554 \pm 38$ ,  $1042 \pm 93$ , and  $4196 \pm 222$  years before 2013. The IR 50 measurements according to the postIR IRSL 225 procedure yielded the following results:  $435 \pm 37$ ,  $455 \pm 27$ , and  $2627 \pm 205$  years before 2013, without the correction for anomalous fading. We expected analogous results for the samples from the other part of the Bir Nurayet site (called Wadi Diib). The postIR OSL 125 procedure yielded the following results:  $1236 \pm 154$ ,  $215 \pm 16$ , and  $422 \pm 30$  years before 2013. The samples collected in the Khour Shambat site were dated using the postIR IRSL 290 and postIR OSL 125 procedures. The results obtained using the first procedure for the cultural layer were  $6000 \pm 528$  and  $8400 \pm 621$  years, and for the underlying sandy deposits -  $9945 \pm 962$  years before 2013. The postIR OSL 125 procedure gave results:  $5240 \pm 330$  for the cultural layer and  $4900 \pm 363$  years before 2013 for the underlying sandy deposits. The results of radiocarbon dating indicate that the postIR OSL 125 luminescence procedure gives more reliable results for very young deposits, and the postIR IRSL 290 – for several thousand years old deposits.

Poster no 37

**Luminescence dating of the Dybawka Dolna profile on the San River middle terrace in the Carpathian marginal zone (Poland) – testing of different procedures**

Jarosław Kusiak<sup>1</sup>, Maria Łanczont<sup>1</sup>

<sup>1</sup>*Department of Geoecology and Palaeogeography, Maria Curie-Skłodowska University, Al. Kraśnicka 2cd, 20-718 Lublin Poland*

Contact: Jarosław Kusiak, email: kusiak@umcs.pl

Aeolian covers of silt deposits (loess) occupy large areas in the marginal zone of the Polish Carpathians. They reach the greatest thickness in river valleys on the Pleistocene terraces due to the proximity of alimentation areas and favourable morphological conditions. Profiles of these deposits are continuous and stratigraphically diversified. They permit us to date the period when terrace surface was stabilized and became fossil surface. Therefore, these loess covers are an important source of detailed palaeogeographical information. Among the terraces of the San River the middle one (20-35 m) is especially noteworthy. It occupies the largest area so it is a key horizon for alluvial surfaces in the valley. It occurs in fragments on both sides of the valley, and forms a wide step with high scarp. Loess deposits covering this terrace represent at least the whole last glacial cycle. The distribution of loess and loess-like deposits in the environs of Przemyśl - mostly in the valleys of the San River and its larger tributaries - is an important argument for the thesis that periglacial floodplains were the main source area of loess material. Dust was blown away from this area and transported to river terraces and nearby hills. The comparison of heavy minerals composition in loess and weathered flysch rocks occurring in close vicinity confirms that low and short-distance transport of aeolian dust was of major importance. The applicability of different approaches in the luminescence dating of Vistulian (Weichselian) loess is investigated based on the results obtained in four laboratories. Based on the results of the parallel measurements (postIR IRSL290 SAR, OSL SAR, IRSL SAR, TL MAR and TL TB) carried out for the Dybawka Dolna - Biała Skala profile in the San River valley near Przemyśl, we can state that luminescence ages are influenced by the applied measurement techniques. As the OSL readers are very commonly used, many researchers are of the opinion that only the OSL method gives reliable results whereas TL ages are overestimated. Indeed, in case of the examined profile the youngest dates were obtained using the OSL SAR method, and the TL MAR ages are distinctly older. However, both the OSL and TL MAR dates are considerably underestimated and incompatible with the stratigraphic interpretation of the profile. The most reliable and similar results were obtained using the TL TB, IRSL SAR, and postIR IRSL290 SAR procedures, which is in contradiction with the common opinion that the TL method is useless. In the discussion on the results of luminescence dating we should always provide precise information about the applied procedure because some optical and thermoluminescence procedures can yield underestimated results. Based on the similar IRSL and TL TB dates obtained for the Dybawka profile, we can also formulate other important conclusion: it is possible to obtain well corresponding and reliable IRSL and TL ages even for the deposits transported over a short distance, which is of great importance for chronostratigraphic investigations conducted in the Carpathian marginal zone.

Poster no 38

**Luminescence dating of Neolithic occupation near an artesian spring in the Kharga Oasis, Egypt**

Dimitri Vandenberghe<sup>1,2</sup>, Morgan De Dapper<sup>2</sup>, Jasper Van Nieuland<sup>1</sup>

<sup>1</sup>*Laboratory of Mineralogy and Petrology, Department of Geology and Soil Sciences, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium*

<sup>2</sup>*Regional Geomorphology and Geoarchaeology, Department of Geography, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium*

Contact: Dimitri Vandenberghe, email: dimitri.vandenberghe@ugent.be

Over the past decade, a large number of Neolithic sites have been identified in the southern part of the Kharga Oasis (Egypt). These sites are usually associated with fossilized artesian springs. The stratigraphic sequences consist of interfingering sediment layers that originate with anthropogenic and natural processes (spring activity, aeolian activity etc.). Material suitable for radiocarbon dating is scarce; even if the method can be applied, it provides no direct chronology for the environmental and climatic dynamics that are archived in the sedimentary record, and hence for the driving factors behind human occupation and migration.

In this study, quartz-based SAR-OSL dating is applied to a stratigraphic sequence at a site that is associated with a fossilized artesian spring in the Dush Oasis (southern end of the Kharga region). We first document the quartz OSL characteristics and behavior in the SAR protocol. The quartz OSL signals are bright and dominated by a fast component. The samples behave well in the SAR protocol as indicated by recycling ratios close to unity, recuperation below 0.1% of the corrected natural OSL signal, and a measured to given dose ratio of  $1.03 \pm 0.01$  ( $n = 30$ ). The optical dates are consistent with the stratigraphic position of the samples, and bracket the investigated sequence between  $4.6 \pm 0.4$  ka and  $92 \pm 10$  ka. The results are then interpreted in terms aridification, spring activity and human occupation. We conclude that optical dating is a powerful and widely applicable tool for understanding spatial and temporal occupation patterns in the Kharga Oasis, and their relation to environmental forcing.

Poster no 39

**Holocene sediments of the Ustka Cliff (Northern Poland) in view of radiometric dating**

Radosław Wróblewski<sup>1</sup>, Stanisław Fedorowicz<sup>1</sup>, Katarzyna Kamieńska<sup>1</sup>

<sup>1</sup>*Department of Geomorphology and Quaternary Geology, University of Gdańsk, Bażyńskiego 4, 80-950 Gdańsk*

Contact: Radosław Wróblewski, email: dokrw@univ.gda.pl

The cliff in Ustka (Northern Poland) is an active one. The area is one of the most eroded sea shores of the Polish coast. The ease of access to the Ustka Cliff, good testing conditions as well as clearly visible sediments sequences in the cliff in the period from November 2009 to May 2010, allowed to conduct the field search. The Ustka Cliff mainly consists of Holocene sandy deposits, but its basis is built of glacial till and clay. The field search allowed to recognize the structure and sedimentary conditions of Holocene deposits exposed in the cliff. The comparison of dating results obtained for fossil soils and peat as well as aeolian deposits, using <sup>14</sup>C and TL methods, respectively, with available literature records are presented. The evaluation of results obtained allowed to define three main dune-forming phases for the first time for this part of the Polish coast. During the research studies new data on the processes and environmental conditions was gained and the development of structure of the area during the last 10 thousand years was reconstructed. The analysis of available data from other sections of the southern Baltic coast shows that results obtained are age similar to those determined for the Łeba Spit.



Poster no 40

**Applying bayesian methods to OSL data for the coversand type localities in Grubbenvorst and Lutterzand (The Netherlands)**

Jasper Van Nieuland<sup>1</sup>, Dimitri Vandenberghe<sup>1,2</sup>, Jakob Wallinga<sup>3</sup>, Peter Van den Haute<sup>1</sup>

<sup>1</sup>*Laboratory of Mineralogy and Petrology, Department of Geology and Soil Sciences, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium*

<sup>2</sup>*Regional Geomorphology and Geoarchaeology, Department of Geography, Ghent University, Krijgslaan 281 (S8), B-9000 Gent, Belgium*

<sup>3</sup>*Wageningen University, Netherlands centre for Luminescence dating, Soil Geography and Landscape Group, Droevendaalsesteeg 3 (GAIA building), 6700 AA Wageningen, The Netherlands*

Contact: Jasper Van Nieuland, email: [jasper.vannieuland@ugent.be](mailto:jasper.vannieuland@ugent.be)

The classical stratigraphic subdivision of the Late Weichselian fluvio-aeolian and aeolian sediments in the NW Europe lowlands comprises the following succession: Older Coversand I, Beuningen Gravel Bed, Older Coversand II, Younger Coversand I, Usselo Soil and Younger Coversand II. In the Netherlands, the succession is fully developed in the type localities in Grubbenvorst (in the south), and Lutterzand (in the east). Over the past few years, we have established a chronostratigraphical framework for both localities through quartz-based SAR-OSL dating of a large number of samples ( $n = 79$ ); these samples were taken in a well-defined stratigraphic relation, at closely-spaced intervals.

In this study, we revisit the two OSL datasets using Bayesian methods. Our aims are to (i) enhance the chronological resolution by utilizing the stratigraphical relationship between the samples, (ii) obtain precise estimates for the duration of the various aeolian phases (deposition and erosion) by exploiting the fact that systematic uncertainties are shared between the samples, and (iii) use the improved temporal framework at each locality for spatial correlation and testing the synchronicity of phases.

Poster no 41

**Estimation of OSL trap parameters by the optical “cleaning” – a critical study of the approach**

Alicja Chruścińska<sup>1</sup>, Natalia Kijek<sup>1</sup>

<sup>1</sup>*Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University*

Contact: Alicja Chruścińska, email: [alicja@fizyka.umk.pl](mailto:alicja@fizyka.umk.pl)

In the practice of optically stimulated luminescence (OSL) dating of geological sediments, distinguishing fast and slow components of the OSL signal is of great importance. Extracting the fast component, which can be easily bleached by sun during the sediment grain transport before the deposition, can allow to obtain data for sediments that were exposed to sunshine not long enough for the total zeroing of OSL signal. On the other hand, using the slower OSL components for date estimation may help to extend the time limit of dating when the slow component increases slower with excitation dose than the fast one. On the present stage of the development of OSL measurement techniques, however, it is hard to separate the individual OSL components experimentally. The way of optical stimulation in both CW-OSL and LM-OSL measurement techniques causes the simultaneous decay of all OSL components. The fact that this decay is not equally efficient for the fast and slower components may suggest the way of component separation consisting in gradual optical “cleaning” of more and more slower components by repetition of several OSL measurements after one excitation. The premise accepted here is that when one bleaches the major part of faster component the next slower component can be observed more clearly. In this study a detailed analysis of such approach by computer simulations of OSL process is presented. With the aim of the explicitness of results a simple OSL model including two electron traps and one luminescence centre has been assumed. The set of differential equations for such model was solved for the process of trap filling, relaxation after excitation, the first optical stimulation (“cleaning”), relaxation after optical stimulation and the second optical stimulation. The simulations were carried out for different trap parameters (optical cross-section, concentration and retrapping parameter) and for different experimental conditions (“cleaning” time and stimulation light intensity). Special attention was paid to the possibility of proper reconstruction of the optical cross-section for the trap responsible for the slower component by the analysis of the shape of OSL curve measured during the second stimulation. It turns out that after the “cleaning” of the fast component the effects of trap coupling strongly influence the OSL process during the second stimulation. The analysis of OSL curve obtained at this stage can lead to optical cross-section values significantly deviating from the real values postulated in the model.

Poster no 42

**Equivalent bleaching as a tool for correction for partial bleaching in OSL dating method**

Krzysztof Przeciętka<sup>1</sup>

<sup>1</sup>*Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5, Torun, 87-100, Poland*

Contact: Krzysztof Przeciętka, email: [przeciu@fizyka.umk.pl](mailto:przeciu@fizyka.umk.pl)

The new idea of Equivalent Bleaching (EB) is presented. EB is defined as controlled optical bleaching experiment performed in laboratory and imprinting an effect on OSL results which is equivalent to that observed for natural sample. Basing on this approach a new method for detecting partial bleaching in samples of geological deposits subjected to OSL dating is proposed. Numeral coefficient  $Q$  is introduced in order to characterize bleaching quality in quantitative way. The series of bleaching experiments is performed with help of luminescence reader equipped in Blue Light emitting LEDs and beta radiation source. For measuring  $Q$  coefficient standard Single Aliquot Regeneration OSL technique is applied. The results obtained for laboratory bleaching series are analyzed and compared to the data received for natural sample. Once the  $EB$  is found the bleaching quality coefficient for natural sample  $Q_{nat}$  can be estimated. Its value indicates degree of partial bleaching and implies appropriate correction for equivalent dose  $ED$ .

The presented method is offered for using for geological deposits which  $ED$  values estimated by standard SAR OSL method are supposed to be affected by insufficient bleaching during transport and sedimentation. In such a case OSL age overestimation should be eliminated. However the method is expected to produce right outcome exclusively under assumption that the only factor influencing  $ED$  distribution is high and uneven OSL residual level in the sample.

Poster no 43

**OSL Dating of Modern Fluvial Sediments in Lower Vistula (Poland): Testing Zeroing Assumption**

Krzysztof Przeglęta<sup>1</sup>, Piotr Palczewski<sup>1</sup>, Paweł Molewski<sup>2</sup>, Włodzimierz Juśkiewicz<sup>2</sup>, Leon Andrzejewski<sup>2</sup>

<sup>1</sup>*Institute of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus University, Grudziadzka 5, Torun, 87-100, Poland*

<sup>2</sup>*Institute of Geography, Faculty of Earth Sciences, Nicolaus Copernicus University, Lwowska 1, Torun, 87-100, Poland*

Contact: Krzysztof Przeglęta, email: [przeciu@fizyka.umk.pl](mailto:przeciu@fizyka.umk.pl)

The samples of recent fluvial deposits were collected from Vistula river at two sites in Toruń and Ciechocinek. Ripple-laminated sands newly exposed by the river or covered by shallow water were selected for testing completeness of natural bleaching in fluvial environment. The coarse quartz grains were separated. The Single Aliquot Regeneration OSL technique was applied for measuring Equivalent Doses from multigrain aliquots. Residual OSL signal was found to be very low proving the credibility of OSL zeroing assumption. The dose rates were estimated by gamma spectrometry confirming homogeneity of the radiation field.

Poster no 44

**A study on photomultiplier afterpulses in luminescence reader**

Konrad Tudyka<sup>1</sup>, Andrzej Bluszcz<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Konrad Tudyka, email: konrad.tudyka@polsl.pl

In this work we are investigating photomultiplier (PMT) afterpulses caused by ionizing radiation (muons, betas and gammas). Afterpulses were observed in the ET 9235QA photomultiplier tube built into the Daybreak 1150 TL/OSL reader. The amplitude and time interval between subsequent pulses were recorded with laboratory made multichannel analyzer.

Measurements were performed with the use of different radioactive sources (Am-241, Co-60, Cs-137, Sr-90/Yr-90) and for various temperatures of PMT. In addition we present a long term correlations with the atmospheric pressure as well as measurements of partially irradiated PMT with collimated 241Am source. Distributions of time intervals between pulses show that afterpulses are in coincidence with pulses caused by ionizing radiation. The amplitude of observed afterpulses corresponds to a single photoelectron and they are detected up to approximately 200  $\mu$ s after the initial pulse. This kind of events leads to the dispersion larger than it would be expected just from pure Poisson distribution.

Poster no 45

**Statistical considerations in estimation of equivalent dose and its uncertainty in the OSL SAR protocol**

Andrzej Bluszcz<sup>1</sup>, Grzegorz Adamiec<sup>1</sup>, Aleksandra Heer<sup>2</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography, University of Bern, Hallerstrasse 12, 3012 Bern, Switzerland*

Contact: Grzegorz Adamiec, email: grzegorz.adamiec@polsl.pl

We present a modified assessment of equivalent dose error in optically stimulated luminescence (OSL) dating. Currently, OSL measurements rely on the determination of the number of counts recorded by a photomultiplier tube. Our new assessment is based on the fact that the number of photomultiplier counts follows a negative binomial distribution rather than the usually assumed Poisson distribution. The negative binomial distribution has the property of having a variance exceeding that of the Poisson distribution by a variance excess factor which must be determined in advance of the error estimation of equivalent dose ( $D_e$ ) values. The variance excess factor depends on the particular measurement system. Further, a recorded OSL count consists of the sum of counts generated by photons and a dark counts which also follow a negative binomial distribution, however with a different variance excess factor.

In the current work we used negative binomial distribution with the experimentally determined variance excess factors to realistically generate pseudo random number of counts of OSL saturating exponential dose growth curves. We then tested two types of weights in the used weighted least squares fitting of the growth curve that is used to estimate the  $D_e$  by extrapolation of the natural OSL signal. Several simulations were performed for artificial data sets simulating quartz grains of varying brightness and different  $D_e$  values in relation to  $D_0$  (saturation dose of the growth curves).

We conclude that for samples of very low brightness least square fitting does not yield reliable  $D_e$  estimates. For samples of sufficient brightness we show which weights should be used to obtain unbiased  $D_e$  estimates and correct error estimates.

Acknowledgements: A.B. and G.A. would like to acknowledge the grant PBS1/A9/4/2012 by the Polish National Centre for Research and Development.

Poster no 46

**Preliminary OSL dating results for loess deposits from Złota**

Piotr Moska<sup>1</sup>, Grzegorz Adamiec<sup>1</sup>, Zdzisław Jary<sup>2</sup>, Andrzej Bluszcz<sup>1</sup>

<sup>1</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>2</sup>*Institute of Geography and Regional Development, University of Wrocław, Poland*

Contact: Piotr Moska, email: Piotr.Moska@polsl.pl

Loess formations in Poland display a close relationship with cooling and warming trends of the Northern Hemisphere during the Pleistocene. Loess sequences sensitively record regional palaeoclimatic and palaeoecological changes. In general, loess is typical of cold and dry, periglacial climate and environment. The intercalated palaeosols are indicators of warmer and more humid climate, representing interstadials or interglacials. The silty and sandy aeolian material originates mainly from weathered rock surfaces affected by frost shattering or from glaciouval/fuvial deposits of river flood plains. In Poland, loess and loess-like formations occur in the southern part of the country, mostly in the south polish uplands, i.e. in the Lublin, Sandomierz, and Cracow Uplands. In addition, such deposits are found in the forelands and foothills of the Carpathians and Sudetes. At present, luminescence dating provides the greatest number of chronostratigraphic data concerning loess deposits. In this work we report preliminary luminescence ages of loess from the last glacial cycle in SE Poland (up to about 100 ka), obtained in the Gliwice Luminescence Laboratory. 21 samples were collected from the investigated loess profile in Złota (21°39'E, 50°39'N). Combined infrared (post-IR IRSL for the deepest part of the profile) and blue light stimulated luminescence dating were applied to the polimineral fine grains (4-11µm) and medium grained quartz fraction (45-63µm).

Poster no 47

**Investigation of lime mortars and plasters from archaeological excavations in Hippos (Israel) using Electron Paramagnetic Resonance**

Zuzanna Kabacińska<sup>1</sup>, Ryszard Krzysiniowski<sup>1</sup>, Danuta Michalska<sup>2</sup>, Bernadeta Dobosz<sup>1</sup>

<sup>1</sup>*Medical Physics Division, Faculty of Physics, Adam Mickiewicz University Umultowska 85, 61-614 Poznań, Poland*

<sup>2</sup>*Institute of Geology, Department of Dynamic and Regional Geology, Adam Mickiewicz University, Maków Polnych 16, 61-606 Poznań, Poland*

Contact: Zuzanna Kabacińska, email: zuziakab@amu.edu.pl

This study presents the preliminary results of investigation of the types and dynamics of paramagnetic centres in lime mortars and plasters from archaeological excavation in Hippos (Israel), using Electron Spin Resonance (ESR) spectroscopy, in order to characterize the building material and to evaluate the possibility of dating them. Lime mortar is valuable but problematic material for luminescence and radiocarbon dating. It has not been dated before using ESR; therefore, careful studies are required to identify the useful paramagnetic centres. The ancient settlement Hippos (Sussita) situated on the east shore of the Sea of Galilee functioned from the 3<sup>rd</sup> cent. BC until it was destroyed by the earthquake in 749 AD. Samples were taken mainly from NW church and surrounding area. The petrographical analyses showed carbonate and locally gypsum character of binder and different kind of aggregate. Chosen samples in different fractions were dated by AMS and GPC technique. All samples were  $\gamma$ -irradiated in 60C bomb with the doses of 1, 10, 20, 50, 80 and 100 kGy. The measurements were performed at room temperature using EPR spectrometer working at 9 GHz frequency. In all spectra signals from  $\text{Fe}^{3+}$  and  $\text{Mn}^{2+}$  ions have been observed. Some of the ESR signals may be interpreted as connected with  $\text{CO}_2^-$ ,  $\text{CO}_3^-$ ,  $\text{CO}_3^{3-}$ ,  $\text{SO}_2^-$  and  $\text{SO}_3^-$  paramagnetic centres. Amplitudes of the gamma-induced signals were measured after subtraction of non-irradiated samples spectra. Exponential growth of the curve and saturation for doses above 20 kGy were observed; therefore, irradiation with smaller doses is required. Differences in presence of some paramagnetic centres and the level of dose saturation between the investigated samples are connected with different age of samples, their localization and preparation technology.



Poster no 48

**Results of isotope age determination of the mineral and organic deposits (sequence) of the river Warta (Central Poland)**

Danuta Dzieduszyńska<sup>1</sup>, Piotr Kittel<sup>1</sup>, Joanna Petera-Zganiacz<sup>1</sup>, Juliusz Twardy<sup>1</sup>, Grzegorz Adamiec<sup>2</sup>, Piotr Moska<sup>2</sup>

<sup>1</sup>*University of Lodz, Faculty of Geographical Sciences, Department of Geomorphology and Palaeogeography, Narutowicza st. 88, 90-139 Lodz, Poland*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

Contact: Danuta Dzieduszyńska, email: dadziedu@geo.uni.lodz.pl

The studied deposits come from the middle section of the river Warta (Koźmin Las site). The relief of the valley is dominated there by a low terrace which is cut by numerous channels developed in three generations and evidences a multichannel style of the river Warta before regulation. The studied sequence of deposits consists of three units: lower sandy unit, middle organic unit and upper sandy and sandy-silty unit. The mineral units are of fluvial origin while the middle organic unit consists of peat and organic silt with an assemblage of tree remnants including stumps in situ which prove the existence of a forest at the site.

The aim of the investigations was to establish the time relation between the formation of the organic series dated by <sup>14</sup>C method (both: conventional and AMS) and the accompanying mineral deposits dated by OSL method.

In the light of radiocarbon data, the organic part of the profile covers the period not shorter than between  $10\,850 \pm 60$  <sup>14</sup>C yr BP (12 897 – 12 599 cal. BP – 2σ range) and  $9780 \pm 110$  <sup>14</sup>C yr BP (11 603 – 10 765 BP cal - 2 σ range). The beginning of accumulation of organic deposits took place until ca. 12 900 – 12 600 yr BP. The stratigraphy of the organic unit was based on radiocarbon dating of the samples of the tree trunks as well. The data of the trees cover the period since  $10\,940 \pm 50$  <sup>14</sup>C yr BP (13 048 – 12 638 cal. BP - 2 σ range) until  $10\,310 \pm 90$  <sup>14</sup>C yr BP (12 518 – 11 765 cal. BP - 2 σ range). Thus the unit dates at the Younger Dryas period.

The OSL analysis of the lower fluvial unit gave the result 13,08(73)ka BP and suggest its time formation directly before the organic deposition. The results yielded for the upper fluvial unit, overlying the organic material, range from 12,73(62)ka BP to 14,28(74)ka BP. These ages are consistent within error limits with the <sup>14</sup>C dating reinforcing the <sup>14</sup>C chronology.

Poster no 49

**The age and origin of Quaternary sediments in Czaplów UJK-3 drilling profile (Holy Cross Mountains, Poland)**

M. Ludwikowska-Kędzia<sup>1</sup>, A. Bluszcz<sup>2</sup>, G. Adamiec<sup>2</sup>, A. Kubala-Kukuś<sup>3</sup>

<sup>1</sup>*Institute of Geography, Jan Kochanowski University, ul. Świętokrzyska 15, 25-435 Kielce, Poland*

<sup>2</sup>*Department of Radioisotopes, Institute of Physics, Silesian University of Technology, Krzywoustego 2, 44-100 Gliwice, Poland*

<sup>3</sup>*Institute of Physics, Jan Kochanowski University, ul. Świętokrzyska 15, 25-435 Kielce, Poland*

Contact: Małgorzata Ludwikowska-Kędzia, email: mlud@ujk.kielce.pl

Czaplów UJK-3 borehole was made within the Plenivistulian (Pleniglacial) Valley level of the Kielce-Lagów Valley, in the vicinity of Czaplów. The level of the Paleozoic bedrock was reached at the depth of 38.5 m.

The obtained geological profile of the sediments was found to be of significance, as the lithostratigraphy of the central part of Holy Cross (Świętokrzyskie) Mountains has been only scarcely identified. The sediments from the drilling profile were analyzed with respect to their structural and textural features (grain size, heavy minerals content, frosting and rounding of quartz grains) and the geochemical ones (marking the elemental composition using the WDXRF method). The age of the sediments was identified by means of the OSL method.

The obtained dating results permitted the distinguishing of three differently aged series of sediments, with different lithology, origin and geochemistry.

I.PN-Q - Paleogen-Neogen, Quaternary (?); the series of rock debris and dolomite sand, i.e. the weatherings of the Paleozoic bedrock. The layer of the dolomite sand, whose formation is not unambiguous, is particularly interesting. The series contains the highest concentration of Fe, Mg, Al, Mn and Ca in the analyzed sediments profile.

II.OG - Odranian Glaciation; the series of sands, gravels and silt with a complex origin, most probably fluvioglacial, and at a certain formation stage, fluvioperiglacial. The series is characterized with a high degree of sandy sediments aeolization and a low concentration of elements. Resistant and highly resistant minerals about 90% of its mineral composition.

III.UP - Upper Pleniglacial; this series has a dual character. The lower part contains silts (IIIUP-a), the sediments formed during a basin sedimentation, with a large group of micas in the lower part. The content of carbonates falls within the range: from 5% to 10%. The series is characterized by a medium concentration of the minerals: Fe, Ca, Al, Mg i Mn. The upper part of the series (III.UP-b) contains fluvial sands, dominated by transparent minerals, app. 75% of the heavy minerals composition is occupied by minerals resistant. The sediment is transformed by aeolian processes to a large extend and is characterized by a low concentration of elements.

The determined age series of the Quaternary deposits in Czaplów drilling profile does not differ from generally assumed paleogeographic concepts of the Holy Cross Mountains Quaternary. The results of detailed sedimentological and geochemical analyses of the sediments considerably broadened the hitherto prevailing interpretation of their origin. They indicate the necessity to verify the established facts concerning the Pleistocene paleogeography of the Holy Cross Mountains.

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## List of participants

	<b>Name</b>	<b>email</b>	<b>Country</b>
1	Grzegorz Adamiec	grzegorz.adamiec@polsl.pl	Poland
2	Mohammed Allan	mallan@doct.ulg.ac.be	Belgium
3	Wiaczesław Andrejczuk	geo@qnoz.us.edu.pl	Poland
4	Valentina Anechitei-Deacu	tina_anechitei@yahoo.com	Romania
5	Zhanna Antipushina	zh.antipushina@gmail.com	Russia
6	Anna Babenko	mnemosina_a@mail.ru	Russia
7	Joanna Barniak	barniak@geol.agh.edu.pl	Poland
8	Peter Barta	peterbarta@chello.sk	Slovakia
9	Rana Baydoun	rbaydoun@cnrs.edu.lb	Lebanon
10	Robert-Csaba Begy	robert.begy@ubbcluj.ro	Romania
11	Annika Berntsson	annika.berntsson@natgeo.su.se	Sweden
12	Andrzej Bluszcz	Andrzej.Bluszcz@polsl.pl	Poland
13	Alicja Bonk	geoab@univ.gda.pl	Poland
14	Alicja Chruścińska	alicja@fizyka.umk.pl	Poland
15	Daniela Constantin	daniela.constantin@ubbcluj.ro	Romania
16	Justyna Czernik	justyna.czernik@gmail.com	Poland
17	François De Vleeschouwer	francois.devleeschouwer@ensat.fr	France
18	Vandenberghe Dimitri	dimitri.vandenberghe@ugent.be	Belgium
19	Danuta Dzieduszyńska	dadziedu@geo.uni.lodz.pl	Poland
20	Chongyi E	echongyi@163.com	China
21	Alicja Gabrys	alicja.gabrys@polsl.pl	Poland
22	Ekaterina Gorlova	gorlova.k@gmail.com	Russia
23	Hogne Jungner	hogne.jungner@helsinki.fi	Finland
24	Zuzanna Kabacińska	zuziakab@amu.edu.pl	Poland
25	Natalia Kijek	natalia@fizyka.umk.pl	Poland
26	Marzena Klusek	marzena.klusek@boku.ac.at	Poland
27	Piotr Kotula	pkotula@us.edu.pl	Poland
28	Marek Krąpiec	mkrapiec@agh.edu.pl	Poland
29	Jarosław Kusiak	kusiak@umcs.pl	Poland
30	Evgeniya Kuzmicheva	kuzmicheva.evgeniya@gmail.com	Russia
31	Xiangjun Liu	xjliu@isl.ac.cn	China
32	Małgorzata Ludwikowska-Kędzia	mlud@ujk.kielce.pl	Poland
33	Włodzimierz Margielewski	margielewski@iop.krakow.pl	Poland
34	Jonas Mazeika	mazeika@geo.lt	Lithuania
35	John Meadows	jmeadows@leibniz.uni-kiel.de	Germany
36	Jana Mellnerova Šuteková	sutekova@fphil.uniba.sk	Slovakia
37	Danuta Michalska	danamich@amu.edu.pl	Poland
38	Danuta Michczyńska	Danuta.Michczynska@polsl.pl	Poland
39	Adam Michczyński	adam.michczynski@polsl.pl	Poland

## Conference participants

---

40	Piotr Moska	Piotr.Moska@polsl.pl	Poland
41	Elżbieta Muter	rlkuchni@cyf-kr.edu.pl	Poland
42	Dorota Nalepka	D.Nalepka@botany.pl	Poland
43	Natalia Nawrocka	nawrocka@geol.agh.edu.pl	Poland
44	Mitsuru Okuno	okuno@fukuoka-u.ac.jp	Japan
45	Piotr Owczarek	piotr.owczarek@uni.wroc.pl	Poland
46	Piotr Palczewski	piotrp@fizyka.umk.pl	Poland
47	Andrey Panin	a.v.panin@yandex.ru	Russia
48	Sławomira Pawełczyk	Slawomira.Pawelczyk@polsl.pl	Poland
49	Jacek Pawłyta	jacek.pawlyta@polsl.pl	Poland
50	Anna Pazdur	anna.pazdur@polsl.pl	Poland
51	Natalia Piotrowska	npiotrowska@polsl.pl	Poland
52	Grzegorz Poręba	Grzegorz.Poreba@polsl.pl	Polska
53	Ramya Bala Prabhakaran	pramyabala@gmail.com	India
54	Krzysztof Przegięta	przeciu@fizyka.umk.pl	Poland
55	Andrzej Rakowski	arakowski@leibniz.uni-kiel.de	Germany
56	Mahmoud Sakhaee	sakhaee@um.ac.ir	Iran
57	Jorge Sanjurjo Sánchez	jsanjurjo@udc.es	Spain
58	Barbara Sensuła	barbara.sensula@polsl.pl	Poland
59	Jarosław Sikorski	jaroslaw.sikorski@polsl.pl	Poland
60	Robert Sokołowski	r.sokolowski@ug.gda.pl	Poland
61	Marko Sraka	marko.sraka@ff.uni-lj.si	Slovenia
62	Wojciech Stankowski	stawgeo@amu.edu.pl	Poland
63	Leszek Starkel	starkel@zg.pan.krakow.pl	Poland
64	Beata Stepańczak	b.stepanczak@uj.edu.pl	Poland
65	Yongjuan Sun	yjsun@isl.ac.cn	China
66	Marta Szal	martaszal@op.pl	Poland
67	Elżbieta Szychowska-Krąpiec	szycha@geol.agh.edu.pl	Poland
68	Alida Timar-Gabor	alida.timar@ubbcluj.ro	Romania
69	Konrad Tudyka	konrad.tudyka@polsl.pl	Poland
70	Jasper Van Nieuland	jasper.vannieu.land@ugent.be	Belgium
71	Mitya Vasyukov	tipa2128506@gmail.com	Russia
72	Bogdan Wertz	b.wertz@ur.krakow.pl	Poland
73	Sławomir Wilczyński	slawomirwilczynski1963@wp.pl	Poland
74	Piotr Paweł Woźniak	geopw@ug.edu.pl	Poland
75	Radosław Wróblewski	dokrw@univ.gda.pl	Poland

---



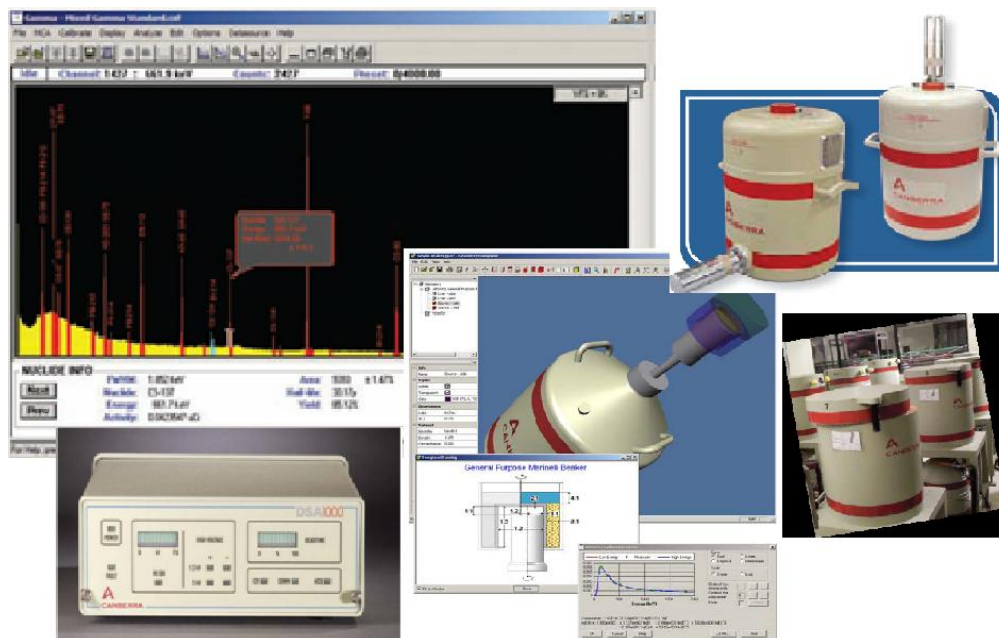
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**CANDELA Sp. z o.o.** has been a dynamically developing company established in 1988 and currently employs over 50 people. We are an authorized sales representative of companies which have gained the trust of many customers around the world. In a CANDELA Sp. z o.o. products portfolio you will find analytical apparatus and a wide range of accessories, which manufacturers have used the latest technology.

With the continuous development and improvement guaranteed by leading manufacturers such as **Agilent Technologies, CEM Corporation, Teledyne Tekmar, Thermo Scientific, ORTEC and Foss NIRSystems**, we offer you a friendly-to-use, high-tech equipment, which in combination with the use of Green Technology provides you improved performance, lower power consumption and used space, which causes a much lower maintenance and operating costs.

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For 50 years, **ORTEC** has been an industry leader in the design and manufacture of precision detectors, signal processing electronics, software, and systems for industry, academia, and government requirements. The **ORTEC** product line of over 1600 products includes equipment and instruments for nuclear power plant and government nuclear facility operations, special nuclear material safeguards, and fundamental research.

**ORTEC** brand products are used in a wide variety of nuclear measurements from research to applied systems. Our company specializes in the design and fabrication of turn-key spectroscopy systems for applications such as Failed Fuel Monitors, Radiochemistry Laboratories, Air and Liquid Effluent Monitors, Whole Body (personnel) Counters, Waste Characterization (in situ) Systems, Non-destructive Waste and Material Assay, and Nuclear Material Safeguards and Accountability Systems.

**ORTEC** was originally founded in 1960 by a group of scientists from the Oak Ridge National Laboratory to provide a commercial source for research grade silicon surface barrier charged particle detectors. **ORTEC** has grown to provide state of the art solutions in virtually all areas of nuclear measurements

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