Uniwersytet Wrocławski

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International Union for Quaternary Research

Kukla LOESSFEST'14 - 7th Loess Seminar

International Conference On Loess Research
In memoriam George Kukla

Wrocław, Poland

UMCS
UNIWERSYTET MARII CURIE-SKŁODOWSKIEJ

Plenary session on the
6th Loess Seminar in May 2011
„Closing the gap - North Carpathian loess traverse in the Eurasian loess belt"

Participants of the 6th Loess Seminar in May 2011 (Biały Kościół site)

Loess gully in Kawęczyn

Loess exposure at Złota near Sandomierz

Loess exposure in Branice on the Głubczyce Upland

Wedges with primary mineral infiling in Złota loess section

Loess exposure in Zaprężyn on the Trzebnica Hills

Loess exposure in Korshiv (Ukraine)

Loess relief near Szczebrzeszyn

George J. Kukla (1930 - 2014)

Loess section at Tyszowce

Institute of Geography and Regional Development, University of Wroclaw

Faculty of Earth Sciences and Spatial Management, Maria Curie-Sklodowska University, Lublin

International Union for Quaternary Research, Loess Focus Group

Kukla LOESSFEST '14 - 7th Loess Seminar

International Conference On Loess Research

In memoriam of George Kukla

8-9 September 2014 – Wrocław, Poland

Loess in Poland: 6 day Field trip, 10-15 September, 2014

abstract & field guide book

September, 2014, Wrocław, Poland

Institute of Geography and Regional Development, University of Wroclaw
Faculty of Earth Sciences and Spatial Management, Maria Curie-Sklodowska University, Lublin
International Union for Quaternary Research, Loess Focus Group

Kukla LOESSFEST '14 - 7th Loess Seminar in Wroclaw
International Conference on Loess Research in memoriam of George Kukla

Abstract & field guide book

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Kukla LOESSFEST '14 - 7th Loess Seminar Program

Monday September 8th
Room no. 336 (4rd floor), Institute of Geography and Regional Development, University of Wroclaw,
1 Uniwersytecki Sqr.

9.00 - Registration
11.45 - Opening Ceremony

I Session

Chairpersons: Ian Smalley and Ludwig Zöller

12.00-12.15 (19)
Przemyslaw Mroczek, Maria Lanczont, Zdzislaw Jary, Milestones of Polish loess research
12.15-12.30 (14)
Slobodan B. Markovic, Thomas Stevens, George J. Kukla, Ulrich Hambach, Kathryn E. Fitzsimmons, Phil Gibbard, Björn Buggle, Michael Zech, Zhengtang Guo, Qingzhen Hao, Haibin Wu, Ken O'Hara Dhand, Ian J. Smalley, Gábor Újvári, Pál Sümegi, Alida Timar-Gabor, Daniel Veres, Frank Sirocko, Djordjije A. Vasiljevic, Zdzislaw Jary, Anderss Svensson, Vidojko Jovic, Frank Lehmkuhl, János Kovács, Zorica Svircev, The Danube loess record – between illusion and reality. In memory to George J. Kukla
12.30-12.45 (9)
Pierre Antoine, Olivier Moine, Sylvie Coutard, Gilles Guerin, Upper Pleistocene loess-palaeosols records from Northern France in the European context: pedostratigraphy and periglacial level-marks from N. France to Poland
12.45-13.00 (27)
Shiling Yang, Zhongli Ding, Abrupt climate changes during the last two glacial-interglacial cycles as recorded in Chinese loess
13.00-13.15 (12)
Zdzislaw Jary, Piotr Moska, Jerzy Raczyk, The main loess-soil sections in SW Poland
13.15-14.30
Lunch time

II Session

Chairpersons: Pierre Antoine and Dominik Faust

14.30-14.45 (10)
Natalia Gerasimenko, Svetlana Sycheva, High resolution pedostratigraphy of the Upper Pleistocene loess-soil sections in the East European Plain
14.45-15.00 (24)
Tobias Sprafke, Christine Thiel, Birgit Terhorst, Sergey Sedov, Re-interpretation of the classic Lower Austrian Quaternary type localities
15.00-15.15 (18)
Olivier Moine, Odile Franc, Dominique Lalai, Philippe Alix, Emilie Goval, Pierre Gadiolet, Alexander Fülling, Vincent Gaertner, Vincent Robert, Sylvain Motte, Jean-François Pasty, The Middle/Upper Würmian loessic sequence of Quincieux (Rhône-Alpes, France): preliminary results of a new reference record with open-air human occupations within loess deposits of the Saône River near Lyon
15.15-15.30 (19)
Igor Obreht, Frank Lehmkuhl, Christian Zeeden, Slobodan B. Markovic, Ulrich Hambach, Janina Bösken, Eileen Eckmeier, Philipp Schulte, The Orlovat loess-paleosol section - possible link between lowland loess plateaus and upland hills slope loess sediments in the Pannonian Basin?
15.30-15.45 (11)
Erzsébet Horváth, Balázs Bradák, Gabriella Barta, Klaudia Kiss, Ágnes Novothny, Traces of the last glacial environmental changes in the loesses of Hungary – case studies
15.45-16.00 (26)
Svetlana Sycheva, Sergey Sedov, Manfred Frechen, Birgit Terhorst, Late Pleistocene Paleosol-Sedimentary Sequence Near Kursk, Russia: Refining Chronostratigraphy And Paleoecological Reconstructions For The East European Loess Area

16.00-16.15 (28)
Xiaoxiao Yang, Wenying Jiang, Shiling Yang, Zhaochen Kong, Yunli Luo, Vegetation and climate changes in the western Chinese Loess Plateau since the Last Glacial Maximum
16.15-16.30 (30)
Jan-Berend Stuut, Felix Temmesfeld, Patrick De Deckker, A 1myr record of aeolian activity near North West Cape, Australia: inferences from grain-size distributions and bulk chemistry of SE Indian Ocean deep-sea sediments

III Session: George Kukla
Chairpersons: Zdzislaw Jary, Slobodan B. Markovic, Ian J. Smalley and Ludwig Zöller

16.30-17.15 (15, 30, 22, 23)
Slobodan B. Markovic, Zdzislaw Jary, Ian J. Smalley, Nemanja Tomic, George J. Kukla and the mistery of loess dust
Ludwig Zöller, George Kukla and the revolution in loess research
Ian Smalley, After the Australopithecines; followed by George Kukla
Ian Smalley, When George met Slobodan: an important encounter in the history of loess investigation
17.30-19.15
Wroclaw – the old town excursion
19.30
Conference dinner (Art Hotel Restaurant, Kielbasnicza St. 20)

Tuesday September 9th
Room no. 336 (4rd floor), Institute of Geography and Regional Development, University of Wroclaw,
1 Uniwersytecki Sqr

IV Session
Chairpersons: Maria Lanczont and Randall J. Schaetzl

10.00-10.15 (23)
G.S. Soreghan, N. Heavens, M.J. Soreghan, Loess of Earth's Deep-Time (Paleozoic) Record
10.15-10.30 (22)
Ian J. Smalley, Slobodan B. Markovic, The Scheidig (1934) map of World-wide loess distribution
10.30-10.45 (16)
Sue McLaren, Ken O'Hara-Dhand, Ian Smalley, Loess in Ukraine: thoughts & speculations
[remembering P.A. Tutkovskii]
10.45-11.00 (17)
Sue McLaren, Ken O'Hara-Dhand, Ian Smalley, The Dnepr as a loess river (compare to the Danube)
11.00-11.15
Katarzyna Issmer, Glacial fingerprints within western Polish loess deposits as a univocal palaeoclimatic evidences
11.15-11.30 (11)
Coffee break

V Session
Chairpersons: Shiling Yang and Erzsébet Horváth

11.30-11.45 (21)
Randall J. Schaetzl, New types of source areas for loess on recently deglaciated landscapes: Learning from geography
11.45-12.00 (17)
Bradley A. Miller, Randall J. Schaetzl, Michael D. Luehmann, A method for distinguishing the original textural properties of loess that has been mixed with underlying sediment
12.00-12.15 (16)
Joseph A. Mason, Mark R. Sweeney, Paul R. Hanson, Wind-Aligned Landforms in Thick Loess of the Central USA: Mechanisms of Formation and Paleoenvironmental Significance
12.15-12.30 (24)
Thomas Stevens, Anna Bird, Pieter Vermeesch, Martin Rittner, Andrew Carter, Sergio Ando, Eduardo Garzanti, Huayu Lu, Jungshen Nie, Grzegorz Adamiec, Ian Millar, Lin Zeng, Hanzhi Zhang, Zhuwei Xu, Northern Tibet as a Pliocene-Quaternary dust source to the Chinese Loess Plateau

12.45-14.00
Lunch time

VI Session

Chairpersons: Joseph A. Mason and Thomas Stevens

14.00-14.15 (25)
Svetlana Sycheva, Olga Khokhlova, ^{14}C-dating of different materials and genesis of the Bryansk paleosol and loesses in the second part of the Late Pleistocene within the interfluves of the Russian Upland

14.15-14.30 (26)
Gábor Újvári, Mihály Molnár, Ágnes Novothny, János Kovács, Lessons from the AMS ^{14}C and OSL/IRSL-dating of the Dunaszekcso loess record, Hungary

14.30-14.45 (28)
Christian Zeeden, Joerg Zens, Lydia Krauß, Frank Lehmkuhl, Integrating age information from different localities for stratigraphic marker beds: application to the Eltville tephra (Western Europe)

14.45-15.00 (21)
Grzegorz Poreba, Zbigniew Snieszko, Piotr Moska, Przemyslaw Mroczek, An application of the OSL method, ^{137}Cs measurement and micromorphology study to study of Holocene soil erosion at the Biedrzykowice site (South Poland)

15.00-15.15 (29)
Kaja Zaremba, Variability of dust provenance during MIS2 and MIS3 at Beiguoyuan, the Chinese Loess Plateau

15.15-15.30
Coffee break

VII Session

Chairpersons: Przemysław Mroczek and Gábor Újvári

15.30-15.45 (13)
Cezary Kabala, Agnieszka Przybyl, Mateusz Krupski, Neolithic “chernozem episode” of soil formation on loess in south-western Poland

15.45-16.00 (9)
Dariusz Bobak, Maria Lanczont, Bernadeta Kufel-Diakowska, Jaroslaw Kusiak, Przemyslaw Mroczek, Adam Nowak, Marta Poltowicz-Bobak, Late Pleistocene settlement in the loess island area: a case study of the Magdalenian site Wierzawice 31 (SE Poland)

16.00-16.15 (13)
Maciej T. Krajcarz, Teresa Madeyska, Przemyslaw Mroczek, Magdalena Sudol, Krzysztof Cyrek, Marcin Szymanek, Magdalena Krajcarz, Loess and loess-like sediments in caves of Kraków-Czestochowa Upland (Poland)

16.15-16.30 (20)
Piotr Owczarek, Oimahmad Rahmonov, Magdalena Opala, Growth and fall of Ancient Panjiakent - the lost loess city on the Silk Road, Tajikistan

16.30-16.45 (29)
Wojciech Zglobicki, Justyna Warowna, Renata Kolodynska-Gawrysiak, Grzegorz Gajek, Malgorzata Telecka, Leszek Gawrysiak, Assessment of the geotourist value of loess geomorphosites (projected Geopark “Malopolski Przelom Wisly”, E Poland)

16.45-17.00
Coffee break

Poster presentations
Chairpersons: Sergey Sedov and Piotr Moska

17.00-18.00
Dariusz Bobak, Bayesian modelling of the chronology of the Middle-Upper Palaeolithic transition in Silesia and Moravia (31)

Roger Fagg, Ian Smalley, John Hardcastle observes the Timaru loess; sees signals of climate change, and fragipans (31)

Stanislaw Fedorowicz, Maria Lanczont, Chronostratigraphy and correlation of the Late Pleistocene loess profiles in western and central parts of Ukraine (32)

Qingzhen Hao, Luo Wang, Yansong Qiao, Bing Xu, Zhengtang Guo, Geochemical evidence for the dominant local provenance of middle Pleistocene loess deposits in southern China (33)

Marek Kasprzak, Zdzislaw Jary, Terrain morphology under loess cover tested using electrical imaging: case studies from SW Poland (33)

Renata Kolodynska-Gawrysiak, Jerzy Trzcinski, Przemyslaw Mroczek, Wojciech Zglobicki, Aneta Kiebala, Jacek Chodorowski, Andrzej Plak, Multi-proxy analysis of loess-paleosol and colluvial sequences of the closed depression – evidences of its origin and evolution, a case study from E Poland (34)

Malgorzata Kot, Maciej T. Krajcarz, Przemyslaw Mroczek, Konstantin Pavlenok, ?lisher Radzhabov, Svetlana Sneider, Marcin Szymanek, Karol Szymczak, Middle Palaeolithic loess site Katta Sai (Uzbekistan) (34)

Lenka Lisá, Ladislav Nejman, Petr Neruda, Zdenka Nerudová, Mikolaj Urbanowski, The importance of micromorphological evidence for the chronology of cave sites (35)

Maria Łanczont, Przemysław Mroczek, Paweł Zieliński, Maryna Komar, Beata Hołub, Loess background of the Magdalenian open-air site at Wilczyce (Sandomierz Upland, Poland): palaeogeographical remarks and geotouristic aspects (35)

Maria Łanczont, Teresa Madeyska, Oleksandr Sytnyk, Andriy Bogucki, Loess-Soil Sequences and Palaeolithic in the Carpathian Foreland (36)

Maria Łanczont, Slawomir Terpilowski, Andriy Bogucki, Andriy Yatsyshyn, Anna Godlewska, Pawel Zielinski, Beata Holub, Przemyslaw Mroczek, Barbara Woronko, Stratigraphic significance of the loess-soil and glacigenic deposit sequence at the Dubrivka site (NW Ukraine) (36)

Piotr Moska, Grzegorz Adamiec, Zdzisław Jary, Andrzej Bluszcz, OSL chronostratigraphy of a loess-palaeosol sequence in Bialy Kosciól using quartz of different grain sizes and radiocarbon dating (37)

Piotr Moska, Zdzisław Jary, Grzegorz Adamiec, Andrzej Bluszcz, Preliminary OSL dating results for loess deposits from Tyszowce (38)

Piotr Moska, Zdzisław Jary, Grzegorz Adamiec, Andrzej Bluszcz, OSL chronostratigraphy of a loess-palaeosol sequence in Zlota using different dating methods (38)

Piotr Owczarek, Paulina Baczek, Zdzisław Jary, Tree roots as a source of information about activity and dynamic of erosion processes in the loess areas - an example of study from the Sudetes Mountains, Poland (39)

Grzegorz Poreba, Ireneusz Malik, Assessment of soil erosion and sedimentation in loess gully based on dendrochronology study and radioisotopes records

Charlotte Prud'homme, Pierre Antoine, Olivier Moine, Elodie Turpin, Vincent Robert, Jean-Philippe Degeai, Earthworm calcitic granules (ECG): a new tracker of millennial timescale environmental changes in European loess deposits (39)

Cyprian Seul, Piotr Tabero, Bialy Kosciól - comparison of loess sediments and underlying silt sediments (40)

Ian J.Smalley, Slobodan B.Markovic, 23 Topics: looking forward in Loess Research (40)

Karol Standzikowski, Maria Lanczont, Przemyslaw Mroczek, New results of TL and OSL dating in Lublin – a case study: Zlota loess section (Sandomierz Upland, Poland) (41)

19.00
Conference dinner (Art Hotel Restaurant, Kielbasnicza St. 20)

Field trip: 10-15 September 2014

Day I (10th September, Wednesday) (42)
9.00 – departure from Wroclaw (9 Max Born Sqr.)
10.00 – 11.00 - Bialy Kosciól loess section
11.00 – 12.30 - Henryków (Gravettian archaeological site and Cistercian monastery)
13.00 – 14.30 – lunch at Wojslawice Arboretum
16.00 – 17.00 – Zaprezyn loess section
17.00 – 20.00 – dinner at Wegrów Vineyard
20.00 – accommodation at Dobra Castle

Day II (11th September, Thursday) (52)
8.30 – departure from Dobra Castle
10.30 – 10.45 – St. Anne's Hill (Geopark)
13.15 – 14.00 – dinner at Wieliczka
14.25 – 17.15 – Wieliczka Salt Mine
18.30 – 20.00 – Kosciuszko Mound (loess & archaeological sites in Cracow)
20.00 – dinner and accomodation at Zaczek Hotel (Cracow)
21.00 – Cracow Old Town

Day III (12th September, Friday) (56)
8.30 – 12.00 – Cracow Old Town (Rynek Underground)
12.00 – 15.00 – transfer Cracow – Jaksice (Vistula loess terrace) – Koprzywnica
15.00 – 15.30 – dinner at Koprzywnica
15.30 – 16.00 – Cistercian church of St. Florian in Koprzywnica
17.00 – 18.00 – Zlota loess section
18.00 – 20.00 – Vineyard and apple gardens at Zlota
20.00 – accommodation at Sandomierz

Day IV (13th September, Saturday) (63)
8.00 – 10.00 – Sandomierz Old Town
12.00 – 12.30 – Józefów (Late Weichselian dunes)
13.00 – 14.00 – Nature Reserve “Czartowe Pole”
14.30 – 15.30 – lunch at Narol
16.30 – 17.00 – Medieval stronghold at Czermno
17.00 – 18.00 – Tyszowce loess section
19.00 – dinner at Dobuzek

Day V (14th September, Sunday) (72)
8.30 – departure from Dobuzek
9.15 – 10.15 – Zamosc Old Town
12.30 – 14.30 – Centre of Lublin (lunch)
14.30 – 15.30 – transfer Lublin – Nałeczów (spa) – Kazimierz Dolny
15.30 – 18.45 – Kazimierz Dolny (loess gullies and old town)
19.00 – accommodation and dinner at Kazimierzówka Hotel (Kazimierz Dolny)

Day VI (15th September, Monday) (82)
8.15 – departure from Kazimierz Dolny
9.00 – 9.30 – Calvary at Piotrawin
11.00 – 12.30 – Krzemionki Opatowskie (complex of flint mines)
12.45 – 13.30 – lunch at Sudol
13.30 – 17.30 – transfer Sudol – Olsztyn (ruins of castle) – Czestochowa
17.30 – 19.00 – Częstochowa (Jasna Góra Monastery)
22.00 – arrival to Wrocław

Upper Pleistocene loess-palaeosols records from Northern France in the European context: pedostratigraphy and periglacial level-marks from N. France to Poland

Pierre Antoine[1], Olivier Moine[1], Sylvie Coutard[2,1], Gilles Guerin[3]

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[2] INRAP Nord-Picardie, 518 rue Saint Fuscien, 80000 Amiens, France, sylvie.coutard@inrap.fr
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In Northern France the loess cover from the Last glacial is represented by a sub-continuous cover rising up to 8-9 m in thickness in the best locations as leeward slopes (E-NE facing). In this large area, pedostratigraphic sequences from the last Interglacial-glacial cycle (Eemian-Weichselian) have been intensely studied, especially in the frame of active rescue archaeological programs that have provided hundreds of sequences. In spite of variations in the thickness of the different stratigraphic units, the sequences from the last Interglacial-glacial cycle exhibit a particularly constant pedosedimentary pattern including well identified pedological and periglacial marker horizons that can be followed towards the East in Belgium, Germany and Poland. In Northern France, the synthesis of the observations carried out on no more than 80 individual sequences during the last 20 years allows to draw a highly detailed pedostratigraphic (24 main units), and chronostratigraphic scheme that represents a unique database to discuss the relations between Palaeolithic occupations and environment. This frame can be summarised by the succession of four main chrono-climatic phases that follow the erosion of the interglacial brown leached soil (Eemian) during MIS 5d: (1) Early-glacial (112-72 ka) including a phase with grey forest soils (Early-glacial A: ~MIS 5a-5d) and a phase with steppe-like soils (Early-glacial B: end of MIS 5a). (2) Lower Pleniglacial (~70-58 ka): bedded colluviums reworking underlying units then typical homogeneous loess (first occurrence of typical periglacial conditions). 3) Middle Pleniglacial (~ 58-30): intense and short erosive episode (thermokarst) then formation of a brown soil complex (*Saint-Acheul-Villiers-Adam Complex*), very weak aeolian sedimentation during most of MIS 3. 4) Upper Pleniglacial (~30-15 ka): main networks of large ice-wedge casts / drastic acceleration of loess deposition (mainly between 27 and 23 ka) including tundra-gley horizons and large Ice wedge casts networks. The main objective of the presentation is to propose a summary of the data from Northern France and a global correlation scheme with surrounding areas. In this scheme, ice wedges cast networks and tundra gley horizons represent important level-marks for correlation.

Late Pleistocene settlement in the loess island area: a case study of the Magdalenian site Wierzawice 31 (SE Poland)

Dariusz Bobak[1], Maria Łanczont[2], Bernadeta Kufel-Diakowska[3], Jarosław Kusiak[2 (†)], Przemysław Mroczek[2], Adam Nowak[1], Marta Połtowicz-Bobak[1]

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[2] Department of Geoecology and Palaeogeography, Faculty of Earth Sciences and Spatial Management, Maria Curie-Sklodowska University, 2 cd Krasnicka Ave., 20-718 Lublin, Poland

The studies in recent years have brought new and important findings providing data on the *final Pleistocene* settlement in south-eastern Poland. One of the most important is undoubtedly the site in Wierzawice, discovered in 2009 by S. Czopek and excavated in 2009-2012.
The site is located in the foreland of the Carpathians in the central part of the Sandomierz Basin, on the eastern periphery of the mesoregion of the Kolbuszowa Plateau. It is located at a height of 188 m.a.s.l. in the lower part of the long, gentle slope exposed to the east belonging to the hill with the culmination at a height of 221.4 meters a.s.l. It gives the highest point with a wide view of the valley made by the San and Blotnia Rivers, providing a perfect vantage point.
The region of the site is associated with the Mesopleistocene glaciofluvial plain, overbuilt series of the Late Pleistocene silty / sandy layers of loess-like sediments with the thickness up to 10 m.
The area of the site, examined by the researchers, where the archaeological material has been uncovered, is almost 70 m^2. The main concentration of artefacts creating a central activity zone covers about 8 m^2. There have been found perfectly preserved remains on this small area, which we are able to interpret as a sign of short-term hunting camp (*halte de chasse*). Materials have been discovered in situ creating clusters which consist of inter alia small artefacts, including chips, as well as a very well-preserved structure - a hearth made of stones - boulders and sandstone tiles arranged in a circle with a diameter of about 50 cm. There were pieces of

charcoal and heated lithics in this area.
Another stones are the elements of spatial development. Some of them coincides with the assemblages, others bear traces of use.
Flint inventory consists of more than 3,500 artefacts, among which there are over 100 tools (including microliths, which represent 90% of items), and more than 20 cores, almost exclusively residual ones. It is possible to notice a spatial variation in tools occurrence. In the eastern part of the site, in the immediate vicinity of the mentioned hearth, the microliths were not only very numerous (about 100 items) forming concentrations, but at the same time they were almost the only tools in this area. As for the western part, they were quite rare in turn, but other types of tools have been recorded - almost exclusively burins, including Lacan burins. Similarly, the spatially limited occurrence of cores has been observed which were located in some distance from the structure after the hearth.
Microwear analyses have indicated the traces of use on microliths, burins and on one retouched blade; on the other hand, as for a few other recorded tools (a scraper, a borer, trunceted blades, blades and retouched flakes) the traces of use have not been observed. The microliths were used both as projectile points as well as tools - knives. They also for the most part do not carry signs of use.
What is more, the researchers have found the spots of *hematite dust* on the outskirts of the site, scattered on the surface of the sediment.
Considering charcoal, two dates C14have been obtained: 11560 ± 40 BP (Poz-36901) and 11,080 ± 130 BP (Poz-41200) (13471 - 13300 calBP and 13160 - 12741 calBP at confidence level of 95,4%). The C14 dates are confirmed by TL dating. In that way, it is one of the youngest Magdalenian sites in Central Europe.
The site at Wierzawice is an important site of the eastern border regarding the Magdalenian complex. Flint raw materials suggest links with both the areas situated in the north (chocolate and Swieciechów flint) and the east (Volyn flint) from the site.
This study was partly supported by the projects no 691–N/2010/0 from the Polish Ministry of Science and Higher Education “Palaeolithic Oecumene of the peri- and meta-Carpathian zone - a study of environment change in Western Ukraine and South-Eastern Poland in the Pleistocene, and its influence on early settlement and migration patterns (based on loess and cave sites)”. Particle size analyses were possible thanks to the equipment purchased in the Operational Program "Development of Eastern Poland" 2007-13. Priority Axis I: Modern Economy. Measure I.3. Supporting innovation. "The growth of the R and D potential of the Departments of Chemistry, Biology and Earth Sciences of the University of Maria Curie-Sklodowska in Lublin". Field work was funded by the Heritage Beaureau of Podkarpackie Voivodeship.

High resolution pedostratigraphy of the Upper Pleistocene loess-soil sections in the East European Plain

Natalia Gerasimenko[1], Svetlana Sycheva[2]

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The study of palaeosol catenas has been carried out in the cross-sections of the Upper Pleistocene deposits: Alexandrov quarry, Lypova Balka, Stari Kaydaky 9 and Kryva Luka (correspondingly, Kursk, Poltava, Dnepropetrovsk and Donetsk areas). The most complete sections occur in relief depressions, though stratigraphical subdivision of them should be controlled by direct correlation with plateau sections.
Palaeosols (different subtypes of luvisols) which are formed on slopes and bottoms of the palaeogullies (the Ryshkovo soil in the Alexandrov quarry and the lower Kaydaky soil in the Ukrainian sections) have all typical diagnostic features of the Eemian soils in Central Europe, or the Salyn' soil of Mezin complex in Russia (Morozova, 1981), as well as pollen successions of the Mikulino interglacial (Gerasimenko, 1988). The palaeogullies cut through the Dnieper loess, or overlie a till of the Dnieper (Saalian) glaciation. The last interglacial soils are overlain by pedosediments (Alexandrov quarry), or by the upper Kaydaky soils (grey forest soil or leached chernozems) in Ukraine. Later on, the gullies were filled with sediments of the last glaciation age: loesses and slope deposits (with cryogrenic features) alternating with 'in situ' interstadial soils. Similarity of the sedimentary successions and diagnostic features of palaeosols and cryogenic forms enables their interregional correlation.
The Early Glacial. Thin Tyasmyn loess (TL 90±10, Donetsk area) corresponds to the Seim solifluctional slope deposits in Central Russia. The Kukuevka forest-steppe meadow soil in Alexandrov quarry is correlated with the lower Pryluky meadow soil which is replaced in depressions by grey forest soil (95±8; Karmazinenko, 2009). The next Streletsa meadow chernozem (> 58,700 BP) corresponds to the upper Pryluky chernozem in Ukraine. Both are separated from the first Early Glacial soils by slope deposits or a thin loess (middle Pryluky and Mlodat' units), and both are overlain by thicker non-soil deposits of the Early Pleniglacial: Sekihodvor unit and Uday loess (75±4, Donetsk area).
The Middle Pleniglacial consists from three palaeosols and two loess units. In Ukraine, they are early Vytachiv (TL 47.5±4.4) and middle Vytachiv (36.9±3.4; Bokhorst et al., 2011) cambisols, and upper Vytachiv humic soil (^{14}C 26-32 kyr BP), and in Russia - Alexandrovka (^{14}C 49,600±700 BP),

Gidrouzel (< 39710±580 BP) and Bryansk (33,140±230 BP) palaeosols. The older soils were formed under cool forest-steppe, whereas the latest soil developed under steppe.
The Upper Pleniglacial is represented by the thickest loess which includes two weakly developed soils: Trubchevsk and Kamenobalka in Central Russia and two Dofinivka soil in Ukraine which are mutually correlated by ^{14}C dates between 17 and 14 kyr BP.

Similarity of stratigraphical subdivision of the palaeogully successions gives evidence that palaeoenvironmental information derived from these sections represents regional response to the global climatic signals.

Traces of the last glacial environmental changes in the loesses of Hungary – case studies

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The variations of the loess-paleosol sequences refer not only climate changes during the Pleistocene, but the differences in the local environmental conditions as well. The aim of our work is to compare the well and thoroughly investigated Sütto section with other loess profiles in different geographical and geomorphological settings (and) to discover the “inter-” periods and their transition to the following period.
Veroce is located in Northern Hungary, at a distance of about 50 km to the East from Sütto, on the left bank of River Danube. Various paleoenvironments were identified in the profiles of the abandoned brickyard influenced by different processes in the margin of fluvial-alluvial (Paleo-Danube) and proluvial (Southeastern pediment of Börzsöny Mountains) terrains. The multi-method investigation - grain-size analysis, total organic carbon, spectrophotometry, thermal analysis, investigations on secondary carbonates, Harden test, soil micromorphology and Fine-grained pebble examination (FPE), which is a new method in sedimentary petrography - started to reveal the development of the complex paleoenvironment.

The underlying alluvial facies is covered by loess and loess-like sediments with four paleosol intercalations in the age range of MIS6-MIS2. Whereas the MIS5e paleosol of Sütto is best preserved in a small paleovalley close to the edge of the plateau, the contemporaneous paleosols at Veroce conserved in distinct geomorphological settings, in local plateau position, in a paleovalley and in the lower part of the hill slope close to the alluvial plain. In the latter situation the pedogenesis was not as undisturbed as at Sütto thus reworking, sheet wash, pedimentation processes and gradual soil development took place.
Based on the chronological framework (luminescence and ^{14}C dating) the Sütto and Veroce profiles were compared. The studies suggested eolian accumulation at Sütto, whereas the results from Veroce demonstrated deposition of loess in the proluvial facies. Climate fluctuations of the Late Pleistocene had an enhanced influence on the different facies.

Glacial fingerprints within western Polish loess deposits as a univocal palaeoclimatic evidences

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Palaeoclimatology is the study of changes in climate taken on the scale of the entire history of Earth. It uses a variety of proxy methods from the Earth and life sciences to obtain data previously preserved within (e.g.) rocks, sediments, ice sheets, tree rings, corals, shells and microfossils; it then uses these records to determine the past states of the Earth's various climate regions and its atmospheric system. Studies of past changes in the environment and biodiversity often reflect on the current situation, and specifically the impact of climate on mass extinctions and biotic recovery.
These factors could be called as a fingerprints:

1. Lithosedimentological factor described by lithological features as a main lithofacies or sedimentological indexes as GSI or traditional grain-sizes indexes.
2. Chronostratigraphical and isotopic factor described by precise Dating of sediments.
3. Morphostratigraphical and landscape factor described by detailed geomorphological and palaeogeographical mapping.

Predominance of glacial and glacifluvial reliefs in the Central European Lowlands is obvious as a result of FIS (Fennoscandinavian Ice-Sheet) imprint at relief., as The palaeoclimatic factor of FIS influenced on development of the European glacial loess deposits.

The territory of Poland lies in the Central European Pleistocene periglacial and glacial morphostratigraphical zones. The study of the Quaternary continental palaeoenvironment at this region has a long tradition. In the last few years, classic disciplines such as geomorphology, sedimentology, palaeogeography, geoarcheology and palaeoecology are being conducted.

Actually focusing on multiproxy palaeoclimatic reconstructions from the Pleistocene to the Holocene needs high resolutions investigations similar to palaeolimnological investigations, providing to well palaeoclimatic results.

The glacial history of loess needs redefinition depends on analysed regions and focusing on new global results of investigation of glacial and aeolian systems.

Two decades of intensive detailed geoscientific investigations of glacial loess deposits as a part of aeolian system and the main palaeoclimatic factors at the western Poland area will be presented.

The main loess-soil sections in SW Poland

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In 1991, professor Henryk Maruszczak, as an editor, published a book entitled "Main sections of loesses in Poland". This volume includes five loess profiles from the south-western Poland: four Late Pleistocene sections located on Glubczyce Upland and Pleniweichselian loess sequence in Trzebnica (Trzebnica Hills). There were no profiles from the other loess areas of south-western Poland. At that time, twenty three years ago, it was connected with the unjustified opinion that loess in these areas is characterized by a slight thickness (1-4 m), stratigraphically is not differentiated because it does not contain a fossil soils.

This view has been radically changed over the past fifteen years. New Late Pleistocene loess-soil sequences have been found in this area: Ksieginice Male (Sleza Massif), Henryków, Bialy Kosciól and Dankowice (Niemcza-Strzelin Hills), Zlotoryja (Kaczawa Foothills), Skarszyn and Zaprezyn (Trzebnica Hills).

An important feature of most of these sites is that they are a kind of field experimental areas since they are prepared as vertical walls and are still available for further investigations. Therefore, these sections are suitable to tests and allow for modification of various methods of field work as well as verification of the results of laboratory tests.

The complete loess-soil sequence in southwestern Poland consists of two lithostratigraphic and three pedostratigraphic units: fossil soils complex S1 correlated with Eemian Interglacial and Early Weichselian (MOIS 5), loess unit L1L2 correlated with Lower Pleniweichselian (MOIS 4), fossil soils complex L1S1 correlated with the Middle Pleniweichselian (MOIS 3), loess unit L1L1 correlated with the Upper Pleniweichselian (MOIS 2) and the modern soil S0.

Chronostratigraphic research of the new loess profiles in southwestern Poland are mainly based on TL, OSL and radiocarbon methods. The Bialy Kosciól section is essential for the verification of chronostratigraphic studies. Twenty one samples from Bialy Kosciól have been dated using OSL and IRSL methods and 6 samples using AMS technique of radiocarbon dating.

Proxy data recorded in loess-soil sequences of the southwestern Poland allow to reconstruct major paleogeographic events in the last Interglacial-Glacial cycle. This record contains the global rhythm of climatic changes, which is recognizable in other loess sequences in Europe and all over the world.

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Neolithic "chernozem episode" of soil formation on loess in south-western Poland

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Chernozem-like soils with deep, black-colored and structural humus horizon, and strong redoximorphic features are widespread on loess and loess-like silt covers in the Silesian Lowland, south of Wroclaw (SW Poland). Their origin was initially explained following the original Russian concept of the continental chernozem; however, the occurrence of steppe vegetation during Holocene period has never been confirmed in this part of Europe. Taking an inspiration from gleyed, post-bog "black earths", a concept of the "meadow black-earths" was developed in Poland in the early 50's of the twentieth century. However, some slope soil sequences (catenas) in the Silesian Lowland consist of both strongly gleyed black earth and non-gleyed chernozem that gradually turns into Luvisol in the uppermost section of the slope. This indicates possibility of non-gleyed chernozem formation in the Silesian Lowland; however, does not determine their age. Recently, the chernozem-like soils (according to international soil classification WRB – Phaeozems, due to somewhat deeper occurrence of carbonates and transformed structure of humus horizon) were discovered in the Neolithic kurgans (earthen long barrows) located on loess hill summit near Muszkowice (ca 60 km south of Wroclaw). Megalithic kurgans belong to the Funnel Beaker culture (ca 3600-2800 years BC). At the margin and beyond the barrow, the buried chernozemic humus layer gradually turns into clay-enriched Bt horizon, very dark brown at the barrow's margin and light-brown as far as 15 m from the margin. Both the soil on barrow dome and in the surroundings are well-developed Luvisols, e.g. soils with subsurface clay accumulation and having bright-colored humus horizon, very poor in organic matter. Chernozems are not preserved in the soil cover of this area.

It is initially concluded that the intense Neolithic settlement on loess plains and hills in the Silesian Lowland led to a thick forest decline and the spread of meadow-forest vegetation (at least locally). This allowed humus accumulation and large activity of burrowing animals, necessary for the formation of deep "chernozemic" humus layer. On some lowland areas, occupied by humans continuously from Neolithic period, the "chernozemic" humus layers were preserved until today. However, in the re-forested areas, in particular on hill summits, the "chernozemic" layers disappeared completely due to intensive leaching and organic matter decomposition. The soils evolved back to Luvisols.

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Loess and loess-like sediments in caves of Kraków-Czestochowa Upland (Poland)

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Although debris, loams and clays are usually regarded as typical cave sediments, the loess-like and loess-containing sediments are common among clastic cave deposits of near-entrance facies of Kraków-Czestochowa Upland caves. The purpose of this presentation is to evaluate the significance of Polish in-cave loess layers as correlative horizons, and to present their stratigraphy and lithological variability – both lateral and vertical, their usefulness as lithostratigraphic markers and their correlation with typical open-air loess-paleosol sequences.

Late Weichselian loess layers are very common in caves of Kraków-Czestochowa Upland, as were recognized in almost each excavated cave and rockshelter. They were initially dated to LGM, however recent TL/OSL and C-14 dating indicates younger post-LGM age, 18-10 000 ys BP.

Older loess sediments are rare. Only few sites with at least two loess layers in superposition are known: Bisnik C., Bramka Rockshelter, Ciemna C. ("Oborzysko"), Koziarnia C., Mamutowa C., Nietoperzowa Cave, Perspektywiczna C., Saspowska Wschodnia C., Tunel Wielki C., Wylotne R., among them only two (Bisnik C., Nietoperzowa C.) with more than two loess layers.

Two types of loess-like sediments occur in the caves. The first one is typical aeolian loess: massive, with bigger thickness near entrance, declining toward the cave interior. In opposition to open-air sites, these sediments usually contain rock debris, abundant in bottom and top parts of the loess layer. The second type is deluvial loess, characterized by lamination, sandy and humuous intercalations, lack of debris, small thickness and variable distribution inside a cave, often in a form of tongues or lenses. At some sites aeolian loess is overlaid with deluvial loess. Deluvial loesses usually build a bottom part of interglacial or warm interstadial series, while aeolian loesses are connected with cold stages of Pleistocene.

Loess-like sediments in caves are carriers of archaeological and paleontological material, however in case of deluvial loess the primary position of excavated objects should be regarded with caution.

Loess stays among the most common cave sediments of near-entrance facies. Its sedimentological features allow to establish the climatostratigraphic position of sediments, and also to conclude on the preservation state of sediment series in a cave.

Leaf wax n-alkane distributions in Chinese Loess since the Last Glacial Maximum and implications for paleoclimate

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Leaf wax n-alkanes have been extensively investigated earlier in marine and lacustrine sediments and recently in loess for paleovegetation and paleoclimate reconstruction. In order to assess the validity of leaf wax n-alkane molecular proxies in paleoclimate reconstruction of loess deposits, the leaf wax n-alkanes were analyzed for a northwest-southeast transect including the Huanxian, Fuxian and Lingbao loess sections since the Last Glacial Maximum (LGM). The n-alkanes show a bimodal distribution, one centered at n-C14 or n-C16 without distinct odd/even carbon number preference and the other at n-C31 with a strong odd carbon number preference, indicative of both terrestrial plants and microbes source. From the LGM to the Holocene, the L/H (ratio of low- to high-molecular-weight n-alkanes) values increased and the CPI (Carbon Preference Index) values decreased for all the sections, while the (C27+C29)/(C31+C33) ratios increased at Huanxian and Lingbao but decreased at Fuxian. For a spatial view of the Loess Plateau, the L/H values display a southeastward increase in both the LGM and the Holocene, coinciding with the present northwest-southeast climatic gradient, while the CPI and (C27+C29)/(C31+C33) ratios do not show any regular pattern. Since warm humid climates favor the microbial production of short chain n-alkanes, the L/H ratio is therefore a reliable proxy for paleoclimate. In general, low CPI values are attributed to the addition of microbial n-alkanes and the degradation of n-alkanes from higher plants, which may well explain the temporal CPI pattern. In contrast to the temporal records, the spatial CPI pattern does not show any relationship with climate gradient, possibly resulted from a less pronounced spatial climate contrast than the temporal case. The comparison of the n-alkane and pollen records further shows that the widely used woody plant proxies (n-C27 and n-C29) and grass proxies (n-C31 and n-C33) are not applicable to the Chinese loess. Instead, the (C27+C29)/(C31+C33) ratio mainly reflect changes in the species of steppe vegetation. For a better understanding of leaf wax n-alkanes in Chinese loess, further investigations of n-alkane distributions in modern plants are needed.

The Danube loess record – between illusion and reality. In memory to George J. Kukla

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The Danube River drainage basin is the second largest river catchment in Europe, and contains a significant, thick and extensive loess region that preserves a record of a wide variety of modern and past environments. Indeed, the Danube River and tributaries may be responsible for the transportation of large volumes of silt that ultimately drive the loess formation in the middle and lower reaches of this large catchment.

European loess research started in the late 17th century with the work of Count Luigi Ferdinand Marsigli in the Danube Basin. Since that time numerous investigations have provided the basis for the stratigraphic framework proposed by Kukla (1977) in his correlations of loess sediments with deep-sea sediments. Loess-palaeosol sequences in the middle and lower reaches of the Danube River basin contain some of the longest and most complete continental climate records in Europe, covering more than the last million years.

The very size of the Danube loess belt and the large number of countries it covers presents a major limiting factor in developing a unified approach to the deposits that enables continental scale analysis. Local loess-palaeosol stratigraphic schemes have been defined separately in different countries and the difficulties in correlating such schemes, which often change significantly with advances in age-dating, have limited the number of basin-wide studies. A unified basin-wide stratigraphic model would greatly alleviate these difficulties and facilitate research into the wider significance of these loess records. Therefore we review the existing stratigraphic schemes and define a new Danube Basin wide loess stratigraphic based around a synthetic type section of the Mošorin and Stari Slankamen sites in Serbia. We present a detailed comparison with the sedimentological and palaeoclimatic records preserved in sediments of the Chinese Loess Plateau, with the oxygen isotope records from deep-sea sediments, and with classic European Pleistocene stratigraphic subdivisions. The hierarchy of Danubian stratigraphic units is determined by climatically controlled environmental shifts, in a similar way to the Chinese loess stratigraphic scheme. A new unified Danube loess stratigraphic model has a number of advantages including preventing problems resulting from the use of multinational schemes, a more transparent basis, and the potential to set Pleistocene palaeoenvironmental changes recorded in the Danube catchment area into a global context. The use of a very simple labelling system based on the already established Chinese loess scheme, facilitates interpretation of palaeoenvironmental information reported from the Danube Basin loess sites in a wider more accessible context that can be readily correlated world-wide. This stratigraphic approach provides, for the first time, an appropriate framework for the development of an integrated, pan-European and potentially pan-Eurasian loess stratigraphic scheme.

George J. Kukla and the mistery of loess dust

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During the long history of loess research the name of George J. Kukla appears as one of the most important. He started as a member of a Czech “dream team” of young and promising scientists led by professor Ambrož. Quite soon, his ideas about the signature of glacial cycles recorded in loess-paleosol sequences overcame the national level and became interesting to the leading authorities in the field of paleo-climatology centered around the idea of Renaissance of Milankovic's theory. Afterwards, George and his family moved from Prague to New York (Palisades) in Hollywood-like style. Entering the center of scientific developments, George usualy provided very specific views, often different than the majority of his colleagues. For example, in the era of Global warming he predicted the beginning of the next glacial phase in the close geological future.

George was the best ambassador of our community because of his amazing land-sea correlation which put loess in the center of global paleoclimate research. Thanks to him, dusty researchers all over the world have been treated with great respect as never before. We have to be able to maintain this legacy following George's great spirit.

Wind-Aligned Landforms in Thick Loess of the Central USA: Mechanisms of Formation and Paleoenvironmental Significance

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Linear scarps and troughs oriented northwest to southeast, and more than 10 km long, occur near the upwind edge of thick Late Pleistocene Peoria Loess deposits from the western Great Plains to the Mississippi River valley. The orientation of these landforms is consistent with wind directions inferred from Late Pleistocene dune sands and loess thickness trends. The troughs appear to be cut entirely in loess, not underlying deposits, and the scarps separate thick loess from areas where loess is much thinner or absent. Yardangs, the best-known landforms of eolian erosion, are generally attributed to abrasion by eolian sand and are seen as remnants of originally more continuous sediments. We propose two alternative mechanisms for wind-aligned trough and scarp formation in the central U.S.A. The first is direct suspension of loess by the wind, without abrasion by sand. Our experiments indicate this is possible under a wind regime similar to the modern one, if the loess is not protected by vegetation or cohesive crusts (Sweeney and Mason, 2013, JGR Earth Surface 18: 1-12). Deep linear troughs in western Nebraska that do not contain eolian sand are likely cases for this mechanism. The other mechanism we propose involves differential loess *accumulation*, rather than erosion of a continuous sheet of thick loess. Eolian sand moves through wind-aligned corridors where it is not limited by topography or wet soils, preventing significant new accumulation of loess there. Loess scarps mark the edges of those corridors; outside the corridors thick loess accumulates. Our research emphasizes that wind-aligned landforms in thick loess may originate through a variety of mechanisms, even if they are superficially similar.

Most evidence indicates that the wind-aligned landforms we studied developed in the Late Pleistocene. Our proposed mechanisms imply that vegetation was too sparse to limit either direct suspension of the loess or widespread movement of eolian sand, consistent with the occurrence of extensive active dunes across the central USA in the Late Pleistocene. Localization of the wind-aligned landforms is related to the presence of thick, coarse, and relatively noncohesive loess and/or sources of eolian sand, not to locally extreme winds.

Loess in Ukraine: thoughts & speculations [remembering P.A. Tutkovskii]

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Recent investigations of loess in Ukraine have focused on stratigraphic studies of material in the west of the country (Bogucki, Lanczont, Mroczek, Jary etc). Also there have been some interesting geochemical investigations which have pointed out contrasts between loess in Ukraine, and in the Danube basin (Buggle etc) and it seems likely that loess research activity in Ukraine will increase.

The loess in Ukraine can supply a test zone for the extended and improved PTD (1966) classification of events involved in the formation of loess deposits. It now becomes the PTDC (2013) system because it has become apparent that post-depositional events are as interesting as pre-depositional events. Provenance events (P) are particle making events - the formation of the material - the absolute origin of the loess deposit formation story. P events are sedimentological events, and so are T transport events. The material is transported by rivers, often for long distances, and subsequently transported again by aeolian action. D is the deposition event, where the loess deposit assumes its qualities, and where pedological processes begin. It has been proposed that this basic P1T1D1T2D2 sequence of events be named the 'Hardcastle sequence' to recognize his first proposal of this approach to loess deposit formation; the first steps towards a deterministic model of loess deposit formation.

As soon as the initial aeolian deposit is formed change begins (pedology intrudes); C events occur. C is important in Ukraine because C includes chernozemisation. The black soils formed in the loess help to define Ukraine- this is Black Earth country. The ground can become more loesslike during C time. It can be claimed that loess formation proceeds during C time 'Loess is not just the accumulation of dust'. P: the Ukraine loess might be classic glacial loess; Tutkovskii made the glacial connection. Examination of the large geomorphology of the system indicates that northern glaciers provide the energy for particle formation. T: a large river is in place for initial large scale particle transportation. Again the geomorphology suggests a river-deposit connection. D: classic aeolian deposition.

C: in particular chernozemisation in the loess matrix- and remarkably substantial A horizon formation; collapsibility can also increase in the C phase. Initial collapsibility depends on the formation of a metastable structure in the D phase. Movement of carbonates and clay minerals in the C phase enhances collapsibility (and makes deposit more loesslike).

The Dnepr as a loess river (compare to the Danube)

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The Dnepr was one of the rivers considered by Smalley et al. (2009) in their review of 'Rivers & Loess'. It is the main river of Ukraine. It is essentially flowing from north to south, so it is/was transporting material in a southerly direction. The implication is a northern origin for transported material.

The Dnepr debouches into the Black Sea, as does the Danube. In the context of world rivers relative to loess a simple classification might be into (1) rivers that start in high mountains and deliver, eventually, mountain loess (with possible desert interludes); (2) rivers that start in glaciarized terrain and deliver glacially produced loess material. The Dnepr is in class 2, as are the Volga and the Don. Loess material is delivered from regions affected by continental glaciations.

The Dnepr delivers a 'purer' form of glacial loess than the Mississippi/Missouri system which, in the case of the younger deposits, contains mountain material from the Rockies. The mountain system delivers loess in a much more continuous manner than the glacial system which is perforce very episodic.

The Dnepr may be the most significant loess river with respect to the delivery of glacial loess. Among the great loess rivers of the world we list the Yellow, the Mississippi/ Missouri, the Rhine & Danube, the Odra & Wisla, the Don, Volga & Dnepr. The Yellow is the great supplier of mountain loess from High Asia, and it looks as though the Odra and the Wisla, the Polish rivers, have enplaced material from the Carpathian and Sudeten Mountains (as the Rhine and Danube did with the Alps and the Carpathians). The Dnepr supplied glacial loess from the great continental glaciations of northern Europe.

The idea of the Danube as a 'loess river' has gained currency. Particle sources have been recognized, transport paths identified and deposition zones demarcated - an edifying and satisfactory picture develops. Now, can we do something similar for the Dnepr. There is an essential great contrast here - the Danube loess is mountain loess; the Dnepr loess is glacial loess. The PTDC system is available: T = Dnepr; C = Black Earth.

A method for distinguishing the original textural properties of loess that has been mixed with underlying sediment

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Particle size characteristics are perhaps the most useful data for research into loess source areas and transport direction. However, a common problem in such research is the determination of the original particle size distribution of the loess. This problem is especially acute where loess is = 1 m thick, enabling pedoturbation to mix some of the underlying sediment upward, into the loess. Due to the efficacy of eolian sorting processes, loess commonly has unimodal textural curves, usually peaking in the medium to coarse silt fractions. Mixing with sediments from below can, and often does, lead to bimodal textural curves, with the second curve being representative of the underlying sediment. We present, explain, and justify a new method for estimating the original particle size distribution of loess in these types of situations. We refer to this method as particle size filtering.

Our particle size filtering method utilizes detailed data from a laser particle size analyzer, which outputs about 100 discrete “bins” of data between 0 and 1000 µm. When graphed, these bin data create a smooth particle size curve. The filtering process consists of two parts: (1) removing the data for particle size bins enriched by coarser (non-loess) sediment, if it exists, and (2) interpolating new values for those bins. After the shape of the new, “filtered” curve is constructed, the values of all bins are then reproportioned to sum to 100%. Our filtering approach preserves as many observed bin values as possible and configures the shape of the modeled (new) portion of the curve, based on the shape characteristics of the preceding downslope side of the curve.

Thus, our approach avoids the errors that derive from fitted function approaches to this problem. Only particle size bins dominated by the coarser sediment are modeled and recalculated, i.e., as much of the original loess textural character as possible is preserved.
As an example of this method's utility, we present data from the Great Lakes region, USA where thin deposits of loess have been mixed with the underlying, sandy till and outwash. Particle size data for loess - before and after filtering - are used to illustrate how these filtered data can provide different and more accurate interpretations of loess textural distributions and source area estimations. An Excel macro and other resources for implementing this filtering method can be downloaded from:
http://www.geographer-miller.com/particle-size-analysis-toolpack/

The Middle/Upper Würmian loessic sequence of Quincieux (Rhône-Alpes, France): preliminary results of a new reference record with open-air human occupations within loess deposits of the Saône River near Lyon

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In 2013, the discovery of a small Upper Palaeolithic open air occupation, and the future extraction of loessic material for the construction of a new highway connection, motivated a large geological test pit performed by the Institut National de Recherches Archéologiques Préventives (INRAP) in Quincieux (Rhône-Alpes, France). From the base to the top, the 7.5-m-thick profile exhibits the following units: lower palaeosoil complex, laminated loess unit with ice-wedges and scattered large flat stones of alpine origin, upper palaeosoil, grayish clayey loam with sand beds, homogeneous loess unit and upper soil complex. Evidences of human occupation have been found in both palaeosoils.
To characterize the chronological, pedostratigraphical and environmental context of these human occupations, samplings have been performed every 5 or 10 cm for grain size, geochemistry, magnetic susceptibility and malacology. Palaeosoils are highlighted by higher values of magnetic susceptibility, total organic carbon content and molluscan abundance, and lower values of carbonate content. The interpretation of the grain size signal is more complex as the immediate proximity of the Saône River valley resulted in an enrichment in coarse wind transported particles and in a probable contribution of floods to the sedimentological input. Both palaeosoils yielded isolated or connected bones, some which having been fractured, cut or burnt. The upper one, only explored during the geological excavation and additional test pits yielded mainly Equus and Auroch/Bison, whereas the lower one presently excavated yielded some bones of Rhinoceros, Mammuthus, Rangifer, Megaceros (?) and a large predator. Lithic artefacts are very few in the lower palaeosoil, whereas the upper one yielded the initially discovered Upper Palaeolithic knapping workshop.
The unique ^{14}C and the six OSL datings yet available suggest a Middle Würm age around 40 ka for the lower palaeosoil and an Upper Würm age for all overlying deposits, and around 20 ka for the upper palaeosoil. This chronology is coherent with lithic technologies, but some points of the resulting chronostratigraphy differ from the synthetic one of northern France and Alsace. The Quincieux site is thus exceptional from both chronostratigraphical and archaeological points of view.

Milestones of Polish loess research

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Polish loess covers represent a small fragment of the northern part of the European loess belt ideally located north of two large mountain ranges - the Carpathians and Sudetes. History of loess research in Poland is dating back to the last decades of eighteenth century (Opatowiec loess section, Proszowice Plateau – Curosi, 1781-1784). It should be emphasized that the area of contemporary Poland is a zone of maximum limit of the Scandinavian glaciations in Central Europe. This is recorded by glacial tills documented in loess sections (especially the Horodlo Ridge-Plateau) or as buried glacial layers covered by younger loess deposited during the another glacial-interglacial cycle (Saalian till ? L2 loess layer). In addition, area of Poland is an important link between the western and eastern European loess covers. The size and compactness of loess patches partly reflect an increase in the climate aridity rising in the east (west: discontinuous ? east: continuous loess cover). Similar palaeoclimatic analogues are recorded in the thickness of loess covers (W: thin ~10 m? E: thick > 20 m) and their litho- and palaeopedological development (W: L1 ? E: L1 ... L3).
Furthermore, in the development of Polish loess covers can be seen the series of specific features typical for European loess - among others: clear links with the valleys of large rivers (the Vistula and the Oder and its tributaries), occurrence in a relatively narrow hypsometric level (180-400 m a.s.l) and characteristic relief (original - Aeolian, weavy and postsedimentary – erosive and denudation). Polish specificity of loess research is not only limited to decipher their litho- and pedostratigraphy, referring to the palaeoenvironmental and palaeoclimatic global trends. Important research issues are also the problems of evolution of loess regions in the Pleistocene, as well as in the Holocene and the Anthropocene. Separate research topic are the analysis of intra-loess Palaeolithic cultural layers (Gravettian and Magdalenian) and younger postsedimentary ones – mainly Neolithic.
The last three decades of Polish loess research are the period of close cooperation with scientists from Ukraine – especially from Lviv and Kiev. Joint international research (palaeogeographic and geoarchaeological) are conducted both in Poland as well as Ukraine.

The Orlovat loess-paleosol section - possible link between lowland loess plateaus and upland hills slope loess sediments in the Pannonian Basin?

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The Carpathian (Pannonian) Basin represents an important corridor for the dispersal of the anatomically modern human (*Homo Sapiens Sapiens sp.*) from Africa to Central Europe. This region currently is situated in a transition zone between Atlantic, Continental and Mediterranean climatic regions and therefore is potentially sensitive to past and present climate change. During mid to late Quaternary, huge amount of loess deposits have been accumulated in the Carpathian Basin. In the frame of the CRC 806 "Our Way to Europe", we investigate plateau like loess sections from the Carpathian Basin and also slope loess and loess-like sediments from the foothills of Carpathian Mountains, for a better understanding of climate and environmental change during the Last Glacial cycle. We assume that long and high resolution plateau loess from the lowlands comparing with upland sediment sequences of loess and loesslike sediments provide a more detailed insight into environmental change during Last Glacial cycle for the whole region.
The Orlovat section is located on the right side of Tamiš river in the Serbian part of the Banat region (Southeast Carpathian Basin). This section is part of small Tamiš loess plateau. The Tamiš loess plateau was probably much larger in the past, but influenced by strong erosion. However, this section is recognized as a transition section from pure loess plateaus to like loess sediments, and therefore this section is potentially important for a better understanding of paleoenvironmental conditions of the region. We use a multidisciplinary approach and comparing to already existing results of magnetic susceptibility, color analysis and OSL-dating.

Growth and fall of Ancient Panjiakent - the lost loess city on the Silk Road, Tajikistan

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Central Asia is dominated by the Pamir and Alay mountain systems (5,000 - 7,000 m a.s.l.). The relief of this area is dominated by high mountain ridges with glaciers and narrow and deep valleys. It's the hub from which the highest mountain ranges extend: Himalayas, Karakorum, Tien-Shan and Kunlun. Loess covers with a thickness of several tens of metres are observed in mountain valleys, along the largest rivers of the Pamir Alay mountain system (e.g. Zerefshan, Varzob, Vakhsh). This area, from at least 500 BC, was crossed by trade routes connecting the West and East, called “Silk Road”. One of the branches of this road was located on the northern part of Tajikistan along the Zerafshan River. The remains of Ancient Panjiakent are located on the border of Pamir Alay Mountains and Kyzyl Kum desert, where the Zerafshan River valley widens, on high river terrace with thick loess cover. The aim of this study was to analyze of geomorphic processes activity on the loess areas that could affect the growth and fall the Ancient Panjiakent city. The archaeological studies indicate, that the city appeared in the V century AD and fall in the VIII century AD because of Arab conquest. The geomorphological and sedimentological observations indicate, that the slopes of surrounding mountains are cut by numerous gullies and the higher river terraces are covered by thick loess-like deposits (colluvium?). Fast growth of the city affected the development of erosion processes due to deforestation. The loess deposits were displaced to the valley bottom. Increase of activity of these processes in the VI - VII century AD could influenced the soils erosion and decrease of ground water level. On the fall of the city in the VIII century AD could therefore affect not only the Arab conquest, but also reduced its importance as a result of unfavourable changes in the natural environment.

Assessment of soil erosion and sedimentation in loess gully based on dendrochronology study and radioisotopes records

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Although in the last decades studies on erosion at gullies has been carried out by researchers, few studies have specifically addressed the use dendrochronological analysis of roots in sediments or soil simultaneously with analysis of Cs-137 and Pb-210 radioisotopes in the same sediment or soil layers.

For this work samples from one of the numerous gullies of the Proboszczowicka Plateau (Polands, South,) were collected. This is a comprehensive study of soil erosion and sedimentation at gullies by two method dendrochronology and radioisotopes Cs-137 and Pb-210. To dendrochronology study were collected a samples of roots growing within depositional landfroms in the gully bottom as well as roots samples from the slopes (sidewall) of the gully. We have determined the age of the roots, assuming that it equals the minimum age of particular sediment horizons. In case of eroded sidewall of gully we determined by the time at which the roots where exposed by soil erosion.

Simultaneously with dendrology sampling were collected samples of soils and sediment to measure concentrations of radioisotopes: Cs-137 and Pb-210. The samples of soil and sediments for analyses of ^{137}Cs and ^{210}Pb isotopes content were collected in the same sediment or soil layers for which root dating was performed. Results of the study indicate that analysed landforms developed during the last 50 years. Diverse age of roots growing in sediment horizons allowed to determine at least 3 significant geomorphic events resulting in deposition of material in the gully bottom during the last 50 years. This suggests that relief of gullies could be shaped surprisingly fast, despite forest cover contemporary occurring there.

Studies also confirmed the potential value to use dendrochronological analysis of the age of roots growing within dated sediment horizons or exposed roots on eroded slopes simultaneously with analyses of ^{137}Cs i ^{210}Pb in sediment or soil.

An application of the OSL method, 137Cs measurement and micromorphology study to study of Holocene soil erosion at the Biedrzykowice site (South Poland)

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The process of soil erosion on the Polish loess areas began with the beginning of the Neolithic and continued intermittently until today. Areas used for agriculture located in the loess are the most susceptible to mechanical denudation associated with atmospheric precipitation. As a result, at the foot of the slopes and bottoms dry loess valleys have been accumulated reaching up to several meters thick Holocene sediments of various ages. Holocene colluvial sediments correspond to the phases of severe water soil erosion on the cultivated slopes, and fossil soils - to the phases of their stabilisation after the cessation of farming. The Holocene colluvial sediments could lay on fossil soil that formed in natural ecosystems until buried by slopewash due to agricultural use of the slopes. Less commonly, these sediments are present in sequence with fossil soils separating them.

The present study presents the results of OSL dating of colluvial sediments samples from Biedrzykowice profiles. The profiles are located in the southern Poland loess area, well documented archaeologically. This work presents the results of Optically Stimulated Luminescence (OSL) dating of Holocene slope sediments from Biedrzykowice (near Dzialoszyce, South Poland). Simultaneously with OSL dating the ^{137}Cs isotope measurement was done to find modern (last 50 years) sediments and activities of natural radio-nuclides in whole sediment profile were measured. In addition, to the OSL sampling, the samples for micro-morphology study were taken as well as for measure physic-chemical properties of the sediment. To recognize modern soil erosion in the study area, the seven soil cores from agricultural field located above studied profile were collected and isotopes Cs-137 and Pb-210 were measured. The studied sediment profile from Biedrzykowice contains two layers of Holocene slope sediments. The older layer was dated by OSL to 6-5 ka BP whereas the younger layer was dated to 1,0-0,5 ka BP. Those two layers are separated by fossil soil. The obtained OSL dating results were consistent with the results of archaeological exploration. The Biedrzykowice profile, located just 6 km from the Neolithic settlement in Bronocice.

It coul be told that Holocene colluvial sediments containing grains of quartz can be dated with certain approximation using the OSL dating method. Despite its some restrictions, it remains the only method suitable for direct dating of colluvial sediments.

New types of source areas for loess on recently deglaciated landscapes: Learning from geography

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Reconstruction of loess environments normally focuses on climate (wind speed and direction, as well as temperature conditions), paleovegetation, and loess source areas. Fortunately, because of the excellent sorting effects of wind, spatial patterns in loess deposits can help address many questions associated with loess environments. In the Great Lakes region of the US, we have been sampling the various loess deposits and mapping their textural and thickness characteristics in a GIS. To date, over 2000 loess samples have been collected and analyzed across a two state area. Here, most loess deposits are <2 m thick, and although commonly isolated spatially, they sometimes also overlap at their margins. Most loess deposits here have been derived locally from glacial landscapes associated with the retreat of MIS 2 ice, ca. 24-12 ka. Examples of such source regions include outwash plains, lacustrine plains, and (meltwater) valley train deposits. Recent work has even shown that ice-cored end moraines, which often take millennia to completely stabilize as the ice blocks melt, were important loess sources. Loess derived from "low relief" loess source areas like outwash and lacustrine plains is coarsest (and often quite sandy) near the source, becoming finer and silter downwind. Loess derived from hummocky moraines, however, is often finer-textured, suggesting that coarser loess particles were unable to escape the hummocky moraine landscape. Our research continues to examine non-traditional loess sources, using geographically informed data. This talk will be a summary of some of the key findings of that research, and will highlight the importance of spatial data in loess research.

After the Australopithecines; followed by George Kukla

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At the time of the 1st LoessFest in 1999 a list was drawn up (and subsequently published in *Earth Science Reviews*) of the twelve leading contributors to loess science. Obviously it was a slightly contentious list but the 12 who emerged were acknowledged to be leading loess people.

They were Leonhard, Lyell, Hardcastle, Tutkovskii, Richthofen, Obruchev, Berg, Grahmann, Russell, Fink, Liu and Kukla. What did they do to justify inclusion? How is their contribution to be briefly and neatly described?

Leonhard named and defined the material; Lyell told people, he spread the word; Hardcastle showed that it carried a palaeoclimatic message; Tutkovskii made links with glaciers and glacierization; Richthofen promoted the idea of aeolian deposition; Obruchev indicated links with deserts; Berg preferred it as a normal mineral soil; Grahmann mapped the loess in Europa; Russell wanted an in-situ formation process; Fink established the INQUA Loess Commission; Liu used loess to demonstrate the multi-event nature of the Quaternary; and Kukla linked loess into the rest of Quaternary stratigraphy, and emphasized its key role in Quaternary science. These were all turning points; this was loess history in the true Herodotus sense- a key moment is identified.

We can examine two key Kukla contributions: a famous paper and a notable chapter. In 1970 he published a paper called 'Correlations between loesses and deep sea sediments' in *Geologiska foreningens I Stockholm forhand-linger* [GFF](World List 21054) 92, 148-180. This was a very important paper and it essentially established the excellent linkages between the loess record and the deep sea record - at a time when the deep sea record was the default record of Quaternary events. Here was the loess record increasing its significance in Quaternary stratigraphy and palaeoclimatology. We step to the front.

In 1975 the book 'After the Australopithecines' appeared. This was edited by Karl Butzer and G.L. Isaac; a large tome of 911 pages containing papers by various significant authors - Nick Shackleton, Karl Brunnacker and George Kukla. The Kukla paper was called 'Loess stratigraphy in Central Europe' and it provided an authoritative view of loess in this important part of the world. We still notice and admire this work; it is one of the few chapters (as distinct from journal papers) which have remained significant and much cited. After 'After..' Kukla's significance increased, and so did that of loess stratigraphy.

The Scheidig (1934) map of World-wide loess distribution

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In 1934 Alfred Scheidig of the Saxon Mining Academy in Freiburg published his book 'Der Loess und seine geotechnischen Eigenschaften'. The book contained a map (fig.5) which became and has remained the standard map of loess distribution. Now, in 2014, 80 years after the initial publication it is a good time for a close look at the map, and an assessment of its continuing values. The first worldwide map is believed to be that of Keilhack 1920. This was a very simple map; it accompanied Keilhack's estimate that 9.3% of the continental crust is covered by loess. Scheidig 1934 offered considerable detail and divided loess in definite (nachgeweisen) deposits and possible/probable deposits (wahrscheinlich oder moglich). The map was used by Woldstedt 1960 in his Quaternary treatise - it is the standard map of loess distribution. Woldstedt made a few small changes - his map comes 'mit geringfugigen Anderungen'; as does our reproductions.

In 1965, for the Boulder INQUA Congress, N.I. Kriger prepared a world-wide loess distribution map. This does not compare well with the Scheidig map. Kriger chose an unfortunate base map projection; Scheidig (perhaps inadvertently) used a good Mercator-like projection. Mercator tends to emphasize the mid-latitude zones - which is where the loess occurs. Woldstedt changed the base projection slightly, and did not improve on the original. Trofimov 2001 followed Scheidig 1934 - there has been no better version.

We divide the map into obvious zones: South America, North America, Australia & New Zealand, Africa, China & India, Europe. We suggest that the most interesting cartographic zones could be (a) in Europe where the Danubian loess needs to be distinguished from the Dnepr loess and (b) into the far east of Europe where Scheidig indicated a huge expanse of possible loess, to the west of Tomsk and extending as far as the River Volga, which needs to be investigated and demarcated. Also the strange dispersion of possible loess in Australia needs to be investigated and improved.

When George met Slobodan: an important encounter in the history of loess investigation

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"If you are coming down through the narrows of the river Kiang,
Please let me know beforehand, And I will come out to meet you
As far as Cho-fu-sa." Ezra Pound

Meetings are important. In the 1830s Karl Caesar von Leonhard met Charles Lyell in Heidelberg, and the study of loess was truly launched. KCvL had defined loess, and given it status, by including it in his book 'Charakteristik der Felsarten'(1824). KCvL showed the loess to Lyell, who in turn, included it in his book 'Principles of Geology'. The 'Principles' had world-wide distribution, was very influential, and spread the word on loess.

In 1997 George Kukla met Slobodan Markovic; a meeting also with consequences. Each brought something interesting to the encounter. Kukla was a significant pioneer in loess stratigraphy and had made the exciting connection between the loess record and the data from deep sea sediments. Slobodan, in effect, brought Serbia, and thus smoothed access to what are arguably the best loess deposits in Europe. Serbian loess stratigraphy became the benchmark for European studies and provided a useful impetus to the wholesale study of loess in the Danube basin. KCvL + Lyell promoted Rhine loess; George + Slobodan promoted Danube loess.

There are other meetings that might usefully be described- that between Jim Bowler and Liu Tung-sheng, and Ed Derbyshire and Wang Jing-tai. It must have been close to the time of the launching of the INQUA Loess Commission that Julius Fink first encountered Marton Pecsi; a meeting of great loessic significance. The next great meeting should perhaps be seen as an encounter between scholars of the Chinese loess, scholars of the European loess and scholars of the North American loess- the troika needs to drive together. Correlations need to be made and a world-wide loess stratigraphy established.

[Personal note; at the 1977 INQUA Congress in Birmingham Ian Smalley of Leeds University met Derek Milne of the New Zealand Soil Bureau and expressed an interest in the NZ loess. From such chance encounters careers are shaped.]

Loess of Earth's Deep-Time (Paleozoic) Record

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Loess deposits are well recognized and studied as a climate archive for Earth's late Cenozoic record. Cenozoic loess is extra-tropical, generated by 1) physical (glacial) weathering in high-mid latitudes, or 2) deflation of ephemeral lacustrine/fluvial systems, or eolian abrasion in low-mid latitude deserts. Loess deposits of pre-Cenozoic age are less known, but emerging evidence indicates probable widespread loess in western tropical Pangaea during the Late Carboniferous-Permian. This paleogeographic setting is highly unusual compared to the extra-tropical loess of the Cenozoic. The purpose of this presentation is to report on the growing recognition of voluminous dust deposits preserved in the Late Carboniferous-Permian record of the western-central U.S. (western tropical Pangaea), the timing and sources of the loess, and implications for tropical paleoclimate.

Inferred paleo-loess deposits consist of red mudstone or siltstone in commonly structureless units, with local pedogenic or sub-aqueous overprinting. Thick, structureless units exhibiting a uniformly fine grain size and lacking other evidence for delivery (e.g. channels) are characteristic of interpreted paleo-loess. The thickest unit thus documented reaches nearly 1 km. Sedimentologic, sequence stratigraphic, and geochronologic data indicate that loess deposition pulsed on a glacial-interglacial, Milankovitch timescale. Provenance data indicate sourcing in the Central Pangaean Mountains (Ouachita-Appalachian) and Ancestral Rocky Mountains, including crystalline basement rocks.

The paleotropical setting is remarkably unusual relative to the Cenozoic, and requires semi-arid to arid conditions at the source, and a glacial-interglacial modulation of sourcing. Climate modeling (Community Climate System Model v.3) suggests that cold tropical climate with upland glaciation represents one scenario capable of replicating the conditions necessary for dust generation and mobilization from the Central Pangaean Mountains.

The Late Paleozoic has long been cast as climatically analogous to the Late Cenozoic, with glaciation limited to high southern latitudes. If more widespread (upland) glaciation occurred, then these vast deposits archive unusual climatic conditions, but moreover may have induced climate change. Regardless, loess of the late Paleozoic reveals fascinating insight into the Earth System of our most recent pre-Cenozoic icehouse.

Re-interpretation of the classic Lower Austrian Quaternary type localities

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The loess-paleosol sequences (LPS) of Paudorf, Göttweig and Krems-Schießstätte in the region around the city of Krems a. d. Donau, Lower Austria, were introduced by J. Fink in the 1960s as type localities of Quaternary stratigraphy. Characteristic paleosols in the outcrops were assigned to represent the single pronounced Würmian interstadial, the Riss/Würm interglacial and the long Mindel/Riss interglacial, respectively. With the contribution of Czech researchers around G. Kukla, significant revisions had to be accepted by J. Fink in the early 1970s. In fact, the type localities in morphologically active slope positions are not suitable for relative stratigraphy and require reliable numerical dating to correlate to or complement each other.

In the European loess belt, Lower Austria holds a bridge position between oceanic and continental climate. In the last years detailed re-evaluations of the complex former type localities were carried out. They are based on a multi-methodological approach including detailed micro-morphological investigations and a set of new pIRIR290 datings. The aim is to contribute to the understanding of regional paleoenvironmental development in the context of European paleoclimatic changes.

Based on our results we will discuss a preliminary Middle to Late Pleistocene stratigraphy of Lower Austria involving the former type localities and suggest first broader paleoclimatic conclusions. Regarding interglacials and representative paleosols, it will be shown that mainly Phaeozems and Cambisols developed in most Middle to Late Pleistocene interglacials, whereas advanced weathering resulting in the development of Luvisols is restricted only to the Early Middle Pleistocene. Although to date based on preliminary age assumptions, it is obvious that the pattern of interglacial paleoclimates is quite comparable to the paleosols in the Pannonian Basin (e.g. Paks, Stari Slankamen, Batajnica), whereas there are remarkable differences to the more advanced weathered pedocomplexes of neighboring Moravia (e.g. Brno Red Hill, Dolni Vestonice).

Northern Tibet as a Pliocene-Quaternary dust source to the Chinese Loess Plateau

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The Chinese Loess Plateau records past atmospheric dust dynamics over millions of years. Debate over the origin of this material limits interpretation of sedimentary climate proxies and understanding of the causes of past dust generation. Recent work using heavy mineral analysis and detrital zircon U-Pb age has suggested that at least during the Quaternary dust sources seem to have been related to the northeast of the Tibetan plateau, perhaps transported via the Yellow River and stored in local desert systems. However, some authors also emphasise the role of the Gobi Altai and there is little consensus on whether loess sources vary through time or across the Plateau. Here we analyse Quaternary-Pliocene loess and red clay from the Chinese Loess Plateau, as well as modern river samples from the upper reaches of the Yellow River for bulk geochemistry, heavy minerals, single-grain zircon U-Pb age and quartz luminescence characteristics. We analyse multiple sites and track source changes through the Quaternary-Pliocene. Generally, Yellow River samples from Qinghai and Gansu provinces yield signatures that are almost identical to those from the Chinese Loess Plateau. This suggests that dust on the Loess Plateau shares a source with modern fluvial sediment from the upper reaches of the Yellow River. While Quaternary provenance signatures strongly suggest a northeastern Tibetan Plateau origin, Pliocene dust may have come from more distal northwestern Tibetan plateau sources. There is also clear evidence of Quaternary dust source variation across the Loess Plateau, implying spatial complexity in sources. Abrupt changes in source appear in late Quaternary loess but consistent differences between glacial and interglacial periods are less apparent.

^{14}C-dating of different materials and genesis of the Bryansk paleosol and loesses in the second part of the Late Pleistocene within the interfluves of the Russian Upland

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The middle part of the last glacial (Valday, Wurm, Veyhsel) on the Central Russian Upland is characterized by a significant softening of severe periglacial conditions (mega-interstadial). During this period several buried paleosols were developed which dated back to the MIS-3 stage. The last of them is the most widespread in loesses of Russia and worldwide the Bryansk paleosol (33-25 ka BP) and its temporal analogues (Lohner Boden, Gräselberger Boden, Stillfried B paleosol, PKI pedocomplex, Gi / LMd (Komorniki) paleosol, Vytachiv Unit, Iskitim Unit and others). It is important geosol of the Late Pleistocene. We studied it in several sections including a natural reserve "Alexandrovsky quarry." In the walls of the quarry the Bryansk paleosol lies continuously as a single stratigraphic level on a large area of the ancient watersheds and slopes. It has a typical habit for this geosol: the A and AB horizons are concentrated in large cryogenic wedge structures. The carbonate horizon is located between structural spaces. The microstructure of the humus horizon of the Bryansk paleosol is characterized by 0.1-0.4 mm rounded aggregates (ooids) with clay plasma of ring orientation on the periphery and silty skeletal grains in the center. Such aggregates are characteristic for overwetted permafrost soils with high clay content in the plasma. In the Bk horizon the macro-forms of carbonate accumulations are represented by mycelium scattered in soil mass and hard nodules located in cracks and pores. On the microscale of observation the plasma in the Bk horizon is weakly impregnated by cryptocrystalline calcite, pores are encrusted with small-grained and needle-shape calcite. Carbonates in soil mass (or plasma on the microscale) in this horizon were formed simultaneously with the paleosol. Genesis of the Bryansk paleosol can be understood as follows. It was meadow soil in the periglacial forest-steppe which experienced the strong impact of cryogenic processes in the last stages of development. ^{14}C-age of the paleosol in the best conditions of burial is about 33 ka BP (based on humic acids), (Table 1). In the underlying loess with signs of gleyzation the ^{14}C-age was about 37-40 ka BP (based on collagen of the bones). As the movement of the quarry excavation deeper into the watershed, it became clear that the Bryansk paleosol coming to the surface is a part of the parent rocks for the background surface soils. The carbonate horizon of the surface Holocene Chernozem in its lower part superimposed on the Bryansk paleosol. However, the structure of profiles of the Holocene Chernozem and the Bryansk paleosol is dramatically different. The radiocarbon dates obtained on humus and carbonates from the Bryansk paleosol in the Alexandrovsky quarry showed similar values (15-16 ka BP) but much younger than usual ^{14}C-dates for this geosol. The same ^{14}C-dates were obtained for the Bryansk paleosol from other sections located near the Central Russian Upland (Taneevsky section, KBS-2012). These dates show that the Bryansk paleosols were rejuvenated in ancient times when they were exhumed due to their existence in the area of denudation and location on the elevated positions in the landscape. According to the ^{14}C-dates the paleosol studied was at the day surface about 15-16 ka years ago. Approximately in the range of 15-13 ka BP, this paleosol began bury by new portions of loess. In fact, the Late Valday loess (MIS-2 stage) was accumulated during the Late Glacial stadials. During the maximum of glaciation the study area was dominated by processes of denudation and cryogenesis. It is also possible to consider this paleosol as a polygenetic one that reflects not only the first stage of soil development in the Bryansk interstadial, but its further evolution during maximal glaciation prior to the beginning of the Late Glacial period.

Late Pleistocene Paleosol-Sedimentary Sequence Near Kursk, Russia: Refining Chronostratigraphy And Paleoecological Reconstructions For The East European Loess Area

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Aleksandrov quarry is located 10 km south of the Kursk city on the leveled watershed of Seim and Mlodat rivers in the west-center of European Russia. In its exposures one of the most detailed and complete paleosol-sedimentary record for the Late Pleistocene on the East European loess area is exposed. At present it is provided with a chronological scale based on a set of instrumental datings (C14 and OSL) and vast variety of research results (physical, chemical and mineralogical characteristics of paleosols and sediments, micromorphological observations, phytolith and pollen assemblages)

Paleosols of Aleksandrov quarry are under monitoring since the early 1990 s. The paleobalka with interglacial Ryshkov paleosol on its slopes and in the bottom was discovered This soil is correlated with Salyn soil of Mikulino interglacial of the upland positions according to Velichko et al. (1997). New OSL dates of the sediments below and above paleosol profile confirm that development period of Ryshkov paleosol is restricted to MIS5e and its Paleobalka is filled by Valdai colluvial-solifluction and loessic sediments and paleosols. According to the ^{14}C- dating and OSL dates, the two lower interstadial Kukuev and Streletsk soils belong to the early Valdai – MIS 5c and MIS5a respectively, while the two upper paleosols (Aleksandrov and Bryansk) belong to the Middle Valdai – MIS3. Pedogenetic features are specific for each paleosol. In particular Ryshkov paleosol is presented by Albeluvisol with typical morphological and analytical indicators of leaching, stagnic processes, clay illuviation typical for humid forest pedogenesis. It presents a sharp differences to the Holocene Chernozem typical for steppe ecosystems. These differences point to more humid climate during the Last Interglacial. Kukuev paleosol still presents signs of clay illuviation whereas overlying streletsk and Alexandrov paleosols have chernozem-type profiles and Bryansk soil is a Cambisol partly deformed by posterior cryogenic processes. Late Valday loess deposition was rather modest, so the top of Bryansk paleosol often corresponds to the base of the Holocene Chernozem profile.

The sequence of Alexandrovsky quarry provides more complete record of Late Pleistocene geological events, than standard Russian loess stratigraphy (Velichko 2005) and better possibilities for correlation with the global climate proxies.

Lessons from the AMS ^{14}C and OSL/IRSL-dating of the Dunaszekcso loess record, Hungary

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Reliable chronologies are prerequisites of appropriate proxy interpretations from terrestrial archives of Quaternary climate and environmental change. Loess records may provide a wealth of paleoenvironmental information, yet they are usually poorly dated. This mostly means low resolution dating of loess profiles and also imprecise chronologies, i.e. age-depth models that have uncertainties of millennial magnitude. This prevents us from addressing issues like synchroneity of abrupt climatic/environmental events on millennial time scales. Two different means of dating are commonly applied for loess sequences: luminescence and radiocarbon dating. Major problems are low precision of luminescence ages and the general lack of organic macrofossils (e.g. charcoal) in loess that can reliably be dated using ^{14}C. Other datable phases in loess are mollusc shells, rhizoliths and organic matter. Evidences are growing that rhizoliths are unreliable phases for ^{14}C-dating and organic matter ^{14}C ages are often seriously compromised by rejuvenation in loess sequences. Also mollusc shells are often regarded as unreliable material for ^{14}C-dating, as they may incorporate ^{14}C-de?cient (or dead) carbon from the local carbonate-rich substrate during shell formation, thereby producing anomalously old ages by up to 3000 years.

In this study an attempt has been made to address some of the dating issues and problems mentioned above by triple-dating (AMS ^{14}C and OSL/IRSL) of the Dunaszekcso loess-paleosol sequence (South-Hungary). While the OSL/IRSL techniques directly date the sediment (quartz and K-feldspar grains) and provide burial ages, radiocarbon yield ages from phases like organic matter, mollusc shells and rhizoliths and determines the time elapsed since the living system was last in equilibrium with atmospheric ^{14}C and became closed after burial.

As revealed in this study all loess rhizoliths sampled at three different depths (4.00 m: 9744-10156 2s age range in cal yr BP, 5.00 m: 8013-8167 cal yr BP and 6.00 m: 9534-9686 cal yr BP) yield Holocene ages, so absolute ages cannot be gained this way for loess deposition.

As charcoals are widely accepted as phases yielding very reliable ^{14}C ages, mollusc shell ^{14}C ages were tested against charcoal ages. Here we focused on molluscs with smaller (< 10 mm) shells as some evidence exists that some species do not incorporate dead carbon into their shells or at least in low amounts. Our results demonstrate that *Succinella oblonga and Vitrea crystallina* yield statistically indistinguishable ages (2s age ranges: 29990-30830 and 29600-30530 cal yr BP) when compared with the charcoal ^{14}C age (29960-30780 cal yr BP, depth 8.20 m), and others like Clausilia sp. and *Chondrula tridens* give slightly older ages than the charcoals and show larger age anomalies (500-900 14C yr).

Compared to the charcoal ages at 8.20-8.25 m depth, the post-IR IRSL225 age of 28520±1120 yr (2s age range: 26280-30760 yr) from a depth of 7.75 m match quite well the charcoal ages (Dsz-Ch1, 2s : 29960-30780 cal yr BP and Dsz-Ch2, 2s : 29350-30150 cal yr BP). At the same time, the post-IR OSL approach seems to slightly underestimate (2s : 20640-26960 yr), while the post-IR IRSL290 overestimate (2s : 30260-37100 yr) the expected/true age of deposition at the respective depth (7.75 m). At a depth of 4.00 m, slight underestimation of mollusc AMS ^{14}C ages (*Trochulus hispidus*, 2s : 22370-22740 cal yr BP, *Arianta arbustorum*, 2s : 24470-25120 cal yr BP) by post-IR OSL (2s : 17140-21980 yr) and a moderate to significant overestimation by OSL (2s : 26760-33800 yr) and post-IR IRSL290 (2s : 27660-35740 yr) has been recognized. Again, the post-IR IRSL225 age (2s : 23180-26900 yr) lies the closest to the AMS ^{14}C ages.

To decide which technique, AMS ^{14}C or OSL/IRSL yields more accurate ages is not possible without independent absolute chronological data based on another method. Yet, we think that the consistent ^{14}C ages of charcoals and small molluscs (two phases having very different origin and genesis) suggest that these ages are reliable and may re?ect the real age of sedimentation. Clearly, the precision of ^{14}C ages are an order of magnitude better (calibrated 2s age ranges 500-800 yr) than the luminescence ages (2s age ranges: 3700-7900 yr) and this may be another reason for creating age-depth models based purely on ^{14}C ages, if high precision is needed. The use of a mixture of ages (i.e. ^{14}C and OSL/IRSL) seems to counterproductive in this respect and we suggest to separate the results of the two techniques in modeling. OSL/IRSL-based age models are useful in checking the accuracy of ^{14}C-based chronologies for the last 50 ka and vice versa and proxy interpretations should be tested against both ^{14}C and OSL/IRSL age models independently.

Abrupt climate changes during the last two glacial-interglacial cycles as recorded in Chinese loess

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Thick loess deposits in the northern Loess Plateau are valuable archives of millennial-scale climate variability. In order to construct a comprehensive climatic record of millennial-scale variability for northern China, grain size was measured for 12,330 samples from eight thick loess sections. Between-section correlation of these grain size records shows that, although small depositional hiatuses may be present in places within a single section, most parts of the sections display continuous dust deposition throughout the past two glacial cycles. By correlating the eight records with the precisely dated Chinese stalagmite d^{18}O record, a stacked 249-kyr-long grain size time series was constructed, termed the "CHILOMOS" (Chinese Loess Millennial-Scale Oscillation Stack) record, which is the first high-resolution stack documenting millennial-scale variability in northern China.

The CHILOMOS record shows millennial-scale climatic events superimposed on a prominent cooling trend during the last and penultimate glaciations, consistent with the pattern of increasing global ice volume. However, this cooling trend is dampened in the stalagmite record and totally suppressed in the low-latitude ocean record. It follows that the Loess Plateau, far from the low-latitude ocean, is largely influenced by the northern high-latitude ice sheets, while the proximal stalagmites of southern China primarily document signals from the low-latitude ocean. In contrast to the Greenland ice core and stalagmite d^{18}O records, the CHILOMOS record exhibits relatively small-amplitude oscillations for the two interglacials, probably as a result of low dust sedimentation rates and relatively stable climatic conditions in the interglacial Loess Plateau. Cross-correlations of climatic records from high and low latitudes demonstrate that the millennial-scale abrupt changes originated in the northern polar area and were propagated into East Asia largely through the East-Asian winter monsoon. The stacked grain size record also confirms that the driest and coldest interval of the last 249 kyr occurred in the late MIS 6, and that MIS 7d was extremely cold and dry, similar to the stadial conditions of MIS 6.

Vegetation and climate changes in the western Chinese Loess Plateau since the Last Glacial Maximum

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Pollen analysis was conducted for loess deposits from three sites in the western Chinese Loess Plateau, i.e. the loess area west of the Liupan Mountains. The Weiyuan section (104°15'E, 35008'N, 2061m a.s.l.) is situated on the terrace of the Weihe River. The Huining section (104052'E, 36007'N, 1911m a.s.l.) is located on 'Yuan' – a high table–land consisting of thick loess. The Jingtai section (104028'E, 37006'N, 1883m a.s.l.), also on the 'Yuan', is located in the transitional zone between the Loess Plateau and the Tengger Desert. Results show that during the Last Glacial Maximum (LGM), in-situ vegetation was dominated by *Artemisia* and some drought–tolerant species such as *Echinops*-type, Chenopodiaceae, *Nitraria*, and Ephedra, while coniferous forest (mainly *Picea*) flourished in nearby river valleys. During the Holocene Optimum, *Picea* almost disappeared, and *Echinops*-type, Chenopodiaceae, *Nitraria* and *Ephedra* decreased; vegetation was characterized by *Artemisia, Taraxacum*-type, Polygonaceae and Leguminosae, implying the climate was warmer and wetter than during the LGM. During the late Holocene, Chenopodiaceae, indicator of man–managed habitats, increased in the study area, indicating enhanced human activity.

The climate was warmer and more humid in the loess areas east of the Liupan Mountains than in the west during both the LGM and Holocene Optimum. Likewise, a significant difference in specific plant types was observed between the east and west since the LGM. During the LGM, *Pinus* and some broadleaf trees emerged, but no *Picea* forest grew, while in the west, vegetation was characterized by desert shrub and desert steppe in situ, and by dark coniferous forests (mainly *Picea*) in nearby river valleys. During the Holocene Optimum, treeline advanced upward as a result of increased temperature. *Picea* thus withdrew from the western loess areas. Therefore, temperature is the major factor controlling the growth of *Picea* in the Chinese Loess Plateau.

Integrating age information from different localities for stratigraphic marker beds: application to the Eltville tephra (Western Europe)

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Stratigraphic marker beds are often used in geosciences for regional and global correlation. For various reasons dating those layers directly proves to be difficult sometimes. In those cases ages from above and below such a horizon represent minimum- and maximum-ages. These are often determined from more than one location and this gives the possibility to combine these ages, test their consistency and finally derive an age in agreement with the findings from most localities. We present a novel approach to integrate the age information from different localities and produce a combined age consistent with both stratigraphy and most of the dating results. Such an approach relies on few assumptions, most importantly the correctness of ages and their reported uncertainty.

The Eltville Tephra derived from an unknown eruption in the Eifel volcanic field is an important maker bed in Rhine-Meuse Area nearby the boundary between the deposition of reworked and primary loess during the LGM (ca. 20 ka). The Eltville Tephra is usually imbedded in loess and dates from directly above and below come almost exclusively from luminescence dating. As different luminescence dating techniques were applied to samples over- and underlying the Eltville Tephra, a systematic bias towards younger or older ages of the sum of these techniques seems unlikely.

Therefore all reported ages may be taken into account for a simulation allowing only for ages consistent with stratigraphy, i.e. ages from above the Eltville Tephra being younger than ages below this regional marker bed. However, some datasets are clearly inconsistent with geochronology due to unknown reasons. These can be excluded from statistical experiments to obtain a more precise result.
Here we present the statistical approach to deal with ages from various localities, demonstrate its potential using well understood artificial data, and also apply it to obtain a datum for the Eltville Tephra with a reproducible uncertainty. This has the potential to improve on existing dates for various other stratigraphic marker beds especially in the terrestrial realm, where often dates for (or around) correlative sediments are obtained from various localities.

Assessment of the geotourist value of loess geomorphosites (projected Geopark "Malopolski Przelom Wisly", E Poland)

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Forms of relief, particularly gullies, in the loess areas in the western part of the Lublin Upland constitute elements of geoheritage most easily recognized by tourists. The high aesthetic and landscape value of loess geomorphosites adds to their attractiveness. The area of the projected geopark is typified by intensive tourist traffic centred in the area of a town with outstanding cultural heritage assets. Loess and forms of loess relief have been studied by Lublin-based geographers for many years and the knowledge accumulated in this field is very extensive. Additional information is provided by materials collected for the purposes of the projected Geopark "Malopolski Przelom Wisly" ("Malopolska Vistula Gap"), including an inventory of more than 220 geosites, among which nearly 60 sites are associated with loess. All this enables a detailed analysis of their geotourist value and attempt at translating the analysis results into practice.
The study objective is to assess the geotourist value of loess landforms and identify groups of sites in relation to which various measures should be taken in order to increase the possibilities of their tourist use. A total of 57 sites assessed, taking into account 18 assessment criteria subsumed under five categories: scientific, educational, functional, environmental protection and tourist value. The application of cluster analysis to the results of geotourist valuation made it possible to distinguish groups of sites with similar sets of characteristics. The correlations between the particular assessment categories were also identified. Furthermore, in order to determine the spatial variation of the tourist value of loess areas, it was assessed based on the selected natural environment and tourist infrastructure characteristics (eight criteria). Regions with a suitable potential for the development of the tourist function were thus identified. The assessment of the spatial variation of the scientific, educational and economic characteristics of geosites, in conjunction with the results of tourist valuation, provides the basis for the formulation of guidelines concerning the appropriate management of the tourist assets of the projected geopark.

Variability of dust provenance during MIS2 and MIS3 at Beiguoyuan, the Chinese Loess Plateau

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The Chinese Loess Plateau represents one of the most detailed and relatively continuous dust records. Establishing the source(s) is critical, not only to interpret loess as an archive, but also to understand dust transport in the atmosphere, enable accurate modelling and predict future climate change.
Despite various methods applied, the source(s) and transport mechanism of dust on the Chinese Loess Plateau are still contested. Areas to the West and North-Northwest of Plateau have primarily been suggested. A recent application of U-Pb dating of zircons in loess provenance has eliminated some of the proposed sources (e.g. deserts to the North of the Plateau), though spatial and temporal variability still remain contentious. Other research has suggested a potential for abrupt provenance shifts within individual loess units. Although variability within individual units, i.e. on a millennial scale, is seen in many proxies, a high resolution approach has not been applied in provenance.

Consequently, it has not been demonstrated how representative samples are of the units from which they are derived. If provenance varies within units, conclusions drawn on an assumption of homogeneity could be flawed. This could be responsible for the spatial variability of sources previously proposed.
This research investigated a loess sequence at Beiguoyuan at high resolution to evidence whether such a shift appears. U-Pb dating of zircons was applied in combination with a novel use of garnet geochemistry to assess differences within individual units and also between loess and palaeosol. The dissimilarities between samples were analysed using a multi-dimensional scaling statistical method.
This study showed that loess records variability in provenance on millennial timescales. Additionally an abrupt shift in loess was recorded at c. 20.5-19.5ka in two adjacent samples. The first indicated Songpan as its source, and the second was linked to the Gobi Altay Mountains. This encompassed the North-Northwest variability in source suggested by earlier studies. Consequently, it was concluded that individual loess samples are not necessarily representative of the whole unit's source. Conversely, palaeosols did not reflect this variability on either a millennial or orbital scale.

George Kukla and the revolution in loess research

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George Kukla's personal experience with political “revolutions” was, I suppose, not very pleasant, perhaps because his own scientific thinking was too revolutionary and always searching for transgression of borders set by conventional thinking. As one of the first loess researchers he realized that loess stratigraphy can be divided in numerous cycles and each cycle itself allowed for a much more refined stratigraphy than recognized before. His first fundamental work based mainly on detailed research of the Dolní Vestonice section in Southern Moravia, CR, resulted in a most detailed stratigraphy of the last glacial-interglacial cycle reflecting paleoclimatic and paleoenvironmental change on a scale comparable to later detected Dansgaard-Oeschger cycles in Greenland ice cores. It became known as Czech standard stratigraphy and quickened many scholars of European loess. Besides soil physical and soil chemical properties analyzed in the laboratory very careful observations in the field were crucial for his working style and methodology. I remember well when at our first common field trip to Kutna Hóra George demonstrated to me the graded bedding of typical marker loess on a scale of less than one mm or how to distinguish “pellet sand” from a humus zone. Taking into account that past climatic gradients existed as well as present-day gradients the “standard stratigraphy” proved applicable through the European loess belt. I experienced very penetrating discussions and lots of new insights during loess field trips with him between Eastern France and Ukraine. Already with his work on European loess he managed to establish loess stratigraphy as an equally important tool for Quaternary paleoclimate and paleoecology with respect to marine cores and ice cores. The interdisciplinary work “Last interglacial climates” (2002) for which George acted as the principal author of 23 experts can be regarded as a highlight presenting the state of the art with respect to the last glacial-interglacial cycle.
George was always very open for new methods if his critical mind could be convinced. The application of paleomagnetic dating to the long Loess-Paleosoil Sequences (LPS) of former Czechoslovakia and Lower Austria proved for the first time the existence old loess in Europe ranging back to the beginning of the Quaternary. In his famous work “Pleistocene Land-Sea Correlations, I. Europe” (1977) George Kukla presented a scheme which became fundamental for later loess research. But he did not restrict his scientific work to Europe. He was among the first researchers to apply magnetic susceptibility measurements in the field to the LPS of the Chinese Loess Plateau (CLP), to correlate the results with the Marine Isotope Stratigraphy and, thus, establish an age model for the entire Quaternary. His dedicated supports for younger researchers successfully lead to the adaptation of the CLP stratigraphic scheme to the longest European LPS in Vojvodina (Serbia) and a well-based correlation with the CLP.
When I had the chance to visit George at the Lamont-Doherty Earth Observatory (LDEO) in 1993 he asked me to give a seminar lecture on “Can TL dating ever supply reliable ages for loess?” I knew that it was not an easy task to point out problems, limitations and fallbacks of TL dating of loess but nevertheless to demonstrate the perspectives of the method at least for the last glacial cycle. Apparently, my attempts were not useless and finally culminated in a common paper (2004) comparing Central European key sections exhibiting last interglacial, Lower and Middle Weichselian LPS.
During all his scientific life as a leading loess researcher George Kukla fought for the acknowledgement of the Milankovic theory and the astronomical tuning of the Quaternary time scale. But George did not restrict to the past. As a member of the Intergovernmental Panel on Climate Change (IPCC) he advocated his knowledge of past climate change for better understanding of future climate development. Thereby, he continued arguing against too simplifying mainstream thinking, e.g. by pointing out that the last glacial started with global warming.
We not only lost an invaluable friend, colleague and mentor for young scientists. We are also missing a lateral thinker who inspired science for almost half a century.

A 1myr record of aeolian activity near North West Cape, Australia: inferences from grain-size distributions and bulk chemistry of SE Indian Ocean deep-sea sediments

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The terrigenous fraction of sediments from a deep-sea sediment core recovered from the northwestern Western Australian continental slope offshore North West Cape, SE Indian Ocean, reveals a history of Western Australian climate throughout the last 1 myr. End-member modelling of a data set of grain-size distributions (n=593) of the terrigenous sediment fraction allows to interpret the record in terms of aeolian and fluvial sediment deposition, both related to palaeo-environmental conditions in the North West Cape area. The data set can be best described by two aeolian end members and one fluvial one. Changes in the ratio of the two aeolian end members over the fluvial one are interpreted as aridity variations in northwestern Western Australia. These grain-size data are compared with bulk geochemical data obtained by XRF scans of the core. Log-ratios of the elements Zr/Fe and Ti/Ca, which indicate a terrigenous origin, corroborate the grain-size data. We postulate that the mid- to late Quaternary near North West Cape climate was relatively arid during the glacial and relatively humid during the interglacial stages, owing to meridional shifts in the atmospheric circulation system. Opposite to published palaeo-environmental records from the same latitude (20°S) offshore Chile and offshore Namibia, the Australian aridity record does not show the typical southern hemisphere climate variability of humid glacials and dry interglacials, which we interpret to be the result of the relatively large land mass of the Australian continent, which emphasises a strong monsoonal climatic system.

Bayesian modelling of the chronology of the Middle-Upper Palaeolithic transition in Silesia and Moravia

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The recent advances regarding the geochronology of the Quaternary period and in the calibration of radiocarbon dates allows placement of archaeological phenomena into the timescale of the last glaciation much more precisely than few decades before. Especially, the progress in sample preparation methods, as ABOx and ultrafiltration, allows to significantly increase precision of the radiocarbon dates on the edge of the range of the radiocarbon method. On the other hand, new statistical concepts of interpreting the dates, i.e. Bayesian approach to modelling of the age also allows to reach more precise dating of cultural events and sequences of them.
Based on the Bayesian approach mentioned above, I'm presenting the model of the transition from the Middle to Upper Palaeolithic in the area of Central Europe, especially in Silesia and Moravia.
The study is supported by the National Science Centre (contract No. DEC-2012/05/N/HS3/01533).

John Hardcastle observes the Timaru loess; sees signals of climate change, and fragipans

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John Hardcastle (1847-1927) made several important loess-related observations in New Zealand in 1889 & 1890. He is best known for his 'invention' of loess stratigraphy, his observations of loess as a 'climate register', but he made significant contributions in other areas. He outlined the event-sequence approach to loess deposit formation in 1889, well before the better known exposition in 1966; the basic sequence for loess deposit formation P1T1D1T2D2 could well be named the Hardcastle sequence. He pointed out the problems of silt particle formation as an important question, emphasizing the role of glacial action, and he drew attention to the occurrence of bird crop stones in loess deposits, as possible markers of deposition stages. Moa stones in particular may give information about New Zealand deposits.
The Timaru loess, investigated by Hardcastle, has been proposed by J.D. Raeside as the type section for NZ loess. JH was probably the first person to describe fragipans (characteristic hard layers) in loess. The fragipan was not properly defined and named until the Guy Smith proposals in the 1940s, but Hardcastle offered detailed descriptions in 1890.
As the site of important loess investigations, and possessing impressive stratigraphy, the Timaru loess could be proposed as an international loess section for New Zealand. Hardcastle's stratigraphic observations were probably among the first relatively sophisticated palaeoclimatological observations made. The INQUA Loess Focus Group could recognize the Timaru Loess (the Dashing Rocks section) as the representative loess section for New Zealand - a reference section for studies of loess stratigraphy and chronology (hopefully to be preserved and curated by the local government authorities and interested parties).

Chronostratigraphy and correlation of the Late Pleistocene loess profiles in western and central parts of Ukraine

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A large series of radiometric dates[1], which include the luminescence (OSL and TL), radiocarbon, U-Th and Ar-Ar dates, has been obtained for the samples collected from five Ukrainian loess sections of the well-recognised and documented stratigraphy on the basis of a wide range of research. Moving from west to east and south-east of Ukraine, these are the following profiles: Korshiv (Volhyn Upland), Volochysk (Podolia Upland), Nahirne (Dnieper Upland), Maksymivka (Dnieper Lowland) and Roksolany (Black Sea Lowland). These research sites have deposits of various ages, but their common link is the occurrence of loess and soil layers which were formed between MIS 7 and MIS 2, i.e. in the past 250 000 years.
The objective of the project was to establish chronostratigraphy of individual sections, correlate them and compare with the Pleistocene stratigraphy in north-west and Central Europe.
In total 150 samples were collected for dating, on the basis of which 370 dates were obtained, including 345 luminescence dates (222 TL dates and 123 OSL dates). The dating was performed by S. Fedorowicz (University of Gdansk), J. Kusiak (Maria Curie-Sklodowska University in Lublin) and S. Prylypko (Institute of Geological Sciences UAS in Kyiv). A total of 259 dates were performed by thermoluminescence laboratories (including 125 in Gdansk, 90 in Lublin and 44 in Kyiv). The Laboratory of the Institute of Physics of the Silesian Technical University in Gliwice obtained ??84 OSL dates. In addition, 18 samples were dated with the AMS-C-14 method, 7 samples with the U-Th method and 2 samples with the Ar-Ar method. The material for dating came from loess, paleosols, volcanic ash and snail shells.
Currently two stratigraphy schemes of loess and palaeosols are used in Ukraine - the scheme by Bogucki (1986) and Bogucki and Lanczont (2002) in the western part and by Veklitch (1993) and Gozhik et al. (2001) in the central part. According to the geological time-scale for the last 270 000 yrs in Europe north of the Mediterranean (Cohen and Gibbard, 2012) the loess and soil units delimited in these schemes formed in the following periods:

[1] The dating was performed as a part of the research project N N306 474138 of the Ministry of Science and Higher Education entitled "Correlation of primary loess profiles of Ukraine on the basis of luminescence dates". Project director - S. Fedorowicz.

Loess-palaeosol unit		Pleistocene stratigraphic units in Western Europe	MIS	Formation period (yrs)
Loess L3	Dnieper	Drenthe	8	before 243 000
Pedocomplex S2	Korshiv/Kaydaki	Schöningen	7	243 000 - 191 000
Loess L2	Tyasmyn	Warthe	6	191 000 - 130 000
Pedocomplex S1	Horokhiv/Pryluki	Eemian and Early Glacial	5	130 000 - 71 000
Loess L1	Uday	Weichselian	4	71 000 - 57 000
	Dubno/Vitachiv		3	57 000 - 29 000
	Bug			
	Dofinivka		2	29 000 -14 000
	Prychernomorsk			

The TL dates were the only ones which allowed determining the time of the deposition of sediments within the entire time range and in most cases confirmed earlier stratigraphic findings; they also fall within the timeframe of the NW and Central European stages. Good inter-laboratory correlation of the TL dating results was obtained for the sections Maksymivka (Gdansk, Lublin and Kyiv) and Korshiv (Gdansk and Lublin). All the luminescence dates of the youngest samples (from MIS 2 to MIS 4) show similar values. The OSL dates of the older samples are underestimated.
The TL and OSL dates for the youngest sediments (MIS 2, 3 and 4) in the profile Roksolany were inconsistent with the geological interpretation as all were older than 100 000 years. The first results of the dating with the Ar-Ar method of the tephra layer in the MIS 2 sediments of this section show million-year dates, which indicates redeposition of volcanic ash.
Age of soil deposits younger than 40 000 years was determined, based on the AMS-C-14 dates of humus material. Some of them proved to be inconsistent with the stratigraphic interpretation of the profiles. The dates obtained from the snail shells collected at the Korshiv site should be treated only as a result of methodological research. Only some of the seven dates from individual shells were within the time of the formation of the sediment layer in which they occurred.

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Geochemical evidence for the dominant local provenance of middle Pleistocene loess deposits in southern China

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The provenance of middle Pleistocene loess in the middle and lower reaches of the Yangtze River, the most intensively investigated loess deposits outside the Loess Plateau region in China remains a matter of debate. Identification of the provenance will provide crucial insight into the environmental context for the occurrence of aeolian dust deposits in the humid subtropical region of the present day. The predominant and traditional view is that the southern loess materials were mainly blown from the deserts in northern China, as is the case with the well-documented loess on the CLP. Our previous geochemistry studies show the clear distinction in immobile (major and trace) element ratios between samples from southern China and the Chinese Loess Plateau. However, these investigated sections are located in the southern bank of Yangtze River. It is still not known if the southern loess to the north of Yangtze River, the major distribution region of southern loess, came from northern deserts or local area.
In this study, the southern loess deposits of last glacial period from 20 sites to the north of Yangtze River are sampled. The major element components of <20 micron fractions of these samples analyzed. The results show clear difference from samples on Chinese Loess Plateau in geochemical components of Ti/Al, Si/Al ratios with a great spatial variability variety between sites, suggesting a local dust source. We argued that the occurrence of aeolian dust deposits in the present-day subtropical regions reflect the intensified aridfication in the floodplain in the region during glacial periods.

Terrain morphology under loess cover tested using electrical imaging: case studies from SW Poland

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The two dimensional electrical resistivity tomography (2D ERT) is one of geophysical methods, which allows in a relatively easy way to recognize subsurface geological structures, differentiating them in terms of geoelectrical features. In contrast to *ground-penetrating radar* (GPR), result obtained from ERT does not depend on horizons shield emitted radar signal and is well suited for studies of complex geological situations. However, it requires caution in interpretation because measurement effects depend on many factors affecting electrical conductivity of a ground, among which a prominent place stand out soil wetness (water content), its structure (grain size, porosity, air content) and the temperature and mineralogical composition.
The aim of the work is to determine an extent to which current land topography of loess cover refers to older assumptions of relief and to what extent electrical imaging method is useful in the diagnosis of topography under loess cover. For this purpose, ERT measurements were taken at three sites in loess areas with different morphology: (i) Zaprezyn in the Trzebnickie Hills

area, where under a loess cover fluvioglacial and morainic sediments occur, (ii) Wysoki Kosciól on southern morphological edge of the Trzebnickie Hills with similar geological structure, and (iii) Bialy Kosciól, where fluvioglacial deposits occurring under loess sediments water cover older Neogene sediments and crystalline rocks of the Sudetic Foreland.
As a result of the work we concluded that electrical imaging allows us to uniquely identify loess deposits from the older, buried surface. In surveyed sites we observed both a reproduce a shape of covered surface by loess sediments (sites Zaprezyn, Wysoki Kosciól) and a clear modification of the shape compared to the covered surface with a burial of concave forms (an example of hypothetic valley, the Bialy Kosciól example). In all cases, the loess cover smoothes most pronounced elevation. Its morphological evolution, depending on an activity of flowing water actually, is also traceable on the basis of the tomograms. The electrical imaging allows us to include to distinguish differences in a thickness of loess deposits, local torrential cones and areas at risk of erosion.

Multi-proxy analysis of loess-paleosol and colluvial sequences of the closed depression – evidences of its origin and evolution, a case study from E Poland

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Closed depressions (CDs) are reported in loess landscapes in various parts of Europe. The anthropogenic and natural origin of CDs is highly debated in literature. The objective of the studys was identification of processes which created and transformed the closed depression in loess area of Naleczów Plateau in E Poland. The Naleczów Plateau is composed of loess, whose thickness vary from a few to up to 30 m. The loess cover formed mainly during the last glaciation and loess accumulation lasted until 15,000–12,000 BP. 1761 closed depressions were documented within the Naleczów Plateau (493 km^2). Their greatest concentration is on the plateau tops where 72% of all forms were found. They have mainly oval shape, longer axis from 25 to 50 m (53% forms) and depth less than 2.5 m. The detailed study within closed depression (CD) which were cut by deep and long road trench were conducted. The analysed exposure, 20 m long and 7 m high, presents cross-section of closed depression formed in loess cover. It allowed direct geological and geomorphological observations and documentation of loess-paleosoil and colluvial sequences in CD. The studied form were 40 m long, 26 m wide, 0.7 m depth. Field work and following laboratory analysis were conducted: morphological, micromorphological, microstructural, geochemical, physico-chemical, OSL, 14-C dating. The original bottom and slopes of this form were development on the in situ loess. The periglacial structures such as deformed ice-wedge relicts, ice cracks, ice lenses in the bottom of closed depression were documented. Microstructural features of loess showed participation of the suffosion in CD development, confirm by quantitative characteristics.
Examined CD was filled up with 1 m Neoholocene soil-sediment sequences, which covered the Late Glacial-Holocene subfossil soil. They consist of 2 layers of colluvial sediments, separated by Neoholocene subfossil soil. They are record of two stages of CD infillings in the Holocene, connected with human agricultural activity during last 5,000 years.

Middle Palaeolithic loess site Katta Sai (Uzbekistan)

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The transition from Middle to Upper Palaeolithic in Central Asia is still poorly recognized phenomenon. Recent DNA analysis shown that at least three human species inhabited that area during these times: Neanderthals, anatomically modern humans and Denisovans. Investigation of Katta Sai archaeological site is a part of project focused on Palaeolithic adaptation strategies and human evolution in Tian Shan piedmont. The site is situated on the hill (1277m a.s.l. and about 150m above the valley bottom) near the Yangiobod town, about 100km ESE from Tashkent. It was discovered in 2006 and excavated in 2013. Apart of

Holocene settlement, one Palaeolithic cultural layer was discovered in loess-like sediment, app. 1.0-1.5m below the modern ground surface. The whole excavated profile is as follows (downward):

- layer 0 – organic horizon of the modern soil, thickness up to 10cm;
- layer 1 – A-horizon of the modern kastanozem soil, up to 40cm;
- layer 2 – deluvial loesses and loams, up to 110cm;
- layer 3 – A- and AB-horizons of kastanozem paleosol 1 with carbonate concretions, up to 100cm;
- layer 4 – loess, up to 60cm; cultural horizon is preserved inside this layer, with multiple lithic artifacts knapped in flake

  technology; snail shells (*Fruticicola lantzi, Pseudonapaeus sogdianus, Laevozebrinus eremita*) are common; the layer's bottom and inner lamination exhibit inclination (about 18°) which suggests that cultural level is re-deposited and disturbed by slope processes;
- layer 5 – A- and AB-horizons of kastanozem paleosol 2 developed on substratum of deluvial loams and sands, up to 200cm;
- layer 6 – debris of magmatic rock rubble, with not known thickness.

Discovered cultural level represents a not-Levallois Middle Palaeolithic industry, quite distinct from other Middle Palaeolithic assemblages known from Central Asia. The stratigraphic position between weekly developed kastanozem above and well developed one below suggests MIS 4 age of cultural level. However this conclusion is preliminary and will be verified with use

The importance of micromorphological evidence for the chronology of cave sites

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Three Neanderthal caves are the subject of this study. There are great differences in their geomorphological positions, the amount and type of sedimentary infill, as well as the formation processes. Pod Hradem Cave and Kulna Cave are located in a small karstic area in southern Moravia, Czech Republic, while Stajnia Cave is located further north in the Kraków-Czestochowa Upland, Poland.
Pod Hradem Cave sedimentary record covers the period of MIS4 up to the beginning of the Holocene. MIS2 is not recorded in studied section. Patterns observed in thin sections show repeated phases of frost action which took a place during and after the sediment formation. The layers with Neanderthal occupation differ from the other sediments mainly by a dense accumulation of small pieces of organic matter, high concentration of bones and a high concentration of phosphate. The microstructure of those layers seems to be influenced by frost action, which is probably post-sedimentary.
The intensively studied Kulna Cave differs from the other investigated sites by its position and geomorphology which influenced the amount of preserved deposits and different formation processes. The central part of the cave featuring mostly MIS2 deposits commonly shows micromorhological features typical of frost action. The entrance part is more variable and MIS2 deposits are preserved just in the uppermost part of the section. Distinct loess like yellow deposits of 7b layer reflect colluvial erosional phases during MIS3 and they are archaeologically sterile. Rip-up clasts from an old palaeosol were recorded there. The sedimentary layers containing Neanderthal artefacts differ from other studied caves mainly by their high variability. The different sediments show features related to frost action as well as stable Interstadial conditions. The concentration of phosphates and anthropogenic features is low.
The micromorphological observations of sediments from the Neanderthal Cave Stajnia show minimal influence of frost action. Sediments are extremely rich in phosphates and the anthropogenic influence is clearly indicated by the presence of ash deposits, charcoal and burned bones.

Loess background of the Magdalenian open-air site at Wilczyce (Sandomierz Upland, Poland): palaeogeographical remarks and geotouristic aspects

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Loess deposits in the environs of the Late Magdalenian site at Wilczyce (Fiedorczuk, Schild, 2002) were investigated in detail in order to identify the conditions of loess accumulation, to reconstruct the natural environment during the activity of Palaeolithic hunters' groups, and to estimate the degree of transformation of the primary (Late Glacial) relief (Łanczont et al. in press).

The studied area occurs in the middle Opatówka River valley, which dissects the most north-eastern part of the loess plateau. This latitudinal valley is rather deep (~40 m), which is related to the proximity and low erosion base of the Vistula River gorge valley. The undulating-flat plateau is strongly dissected by dry erosion-denudation valleys, which are also dissected by the dense, branched systems of gullies. In the immediate vicinity of the Opatówka River valley the landscape is characterized by the occurrence of loess isolated hills as well as promontories that are connected by narrow ridges with the main part of the plateau. Between the promontories the Opatówka River valley is very narrow and of gorge nature. Its wider sections are basin-shaped and have flat bottom. The Late Magdalenian site occurs on the top of one of the highest loess promontories, which are good observation points. The hunting base camp of Palaeolithic people was located in a depression formed in the intersection of periglacial polygonal structures represented by degraded ice wedge casts. Their infillings are rich in the Magdalenian artefacts (Fiedorczuk, Schild, 2002; Schild (ed.), 2014).

In the site surroundings the loess cover, a dozen or so metres thick, is characterized by varying lithology, structure, physico-chemical features and age. The deposits represent mostly the last glacial cycle, and their stratigraphic position is confirmed by the occurrence of erosion/denudation surfaces and paleosols of different stratigraphic rank. The following pedostratigraphic units have been distinguished in the loess cover: 1) pedosediments representing the interphase stages of intensified pedogenesis in the loess deposits (MIS 2 and 4); 2) subarctic, polygenetic, brown soil of interstadial rank (MIS 3); and 3) mature forest-steppe pedocomplex (MIS 5). Strong, post-depositional transformation of relief is recorded as a much denuded Holocene soil cover. The estimated thickness of deposit layer removed from the loess culmination with the archaeological site is over 1.5 m so carbonate loess is exposed and artefacts are found only within the zone of periglacial structures, almost on the ground surface.

Because of its scientific significance the Wilczyce site should be protected by law. Due to its geo- and archaeotouristic attraction it perhaps may be promoted as a geoarchaeological park with the reconstructed Magdalenian camp. The site is located in the region extremely rich in the settlement traces of the Palaeolithic (e.g. Raj Cave), Neolithic (the main opencast mine of striped flint in Krzemionki Opatowskie) and younger cultures.

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Loess-Soil Sequences and Palaeolithic in the Carpathian Foreland

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In the peri- and meta-Carpathian zones, i.e. in the areas situated to the N and NE of the Carpathians, in Poland and Ukraine, there are several centres of loess Palaeolithic sites. Some of them have been known since the beginning of the 20th century, others have been discovered in the last 20 years owing to several research projects conducted as a part of the Polish-Ukrainian cooperation. Realization of the latest project (from the Polish Ministry of Science and Higher Education: “691-N/2010/0 Ukraine”) included excavations and large-scale natural studies conducted in new sites as well as additional, supplementary research in the earlier known sites. As a result we examined a dozen or so sites, most multilayered, representing the period from the Penultimate Interglacial to the end of the Last Glacial.
The oldest traces of settlement are found in the Ternopil Upland; they occur in the Korshiv soil (MIS 7) in the Velykyi Glybochok I site, layer III. Traces of human stay are also found in the same site (layer IIIB) in an initial soil within the Wartanian loess (MIS 6). More Middle Palaeolithic, Mousterian materials, characterized by Levallois technique or with Micoquien features, occur in the Eemian forest soil (MIS 5e), which is known in Ukraine as Gorohiv soil. The most important sites of this age are Yezupil I (layer III) in the Prydnistrov'ja region and Velykyi Glybochok I (layer IIIA). Slightly younger Middle Palaeolithic cultural layers occur in a solifluction package formed after the interglacial optimum, in the sites of the Prydnistrov'ja region (Yezupil I – layer II; Halych II) and Podolia Upland (Ihrovytsia I – layer II; Pronyatyn; Vanzhuliv-Zamczysko – layer III). These redeposited materials date from the Last Interglacial or are younger (MIS 5c?).
Materials representing different Upper Palaeolithic cultures or technocomplexes occur in interstadial soils: subarctic cambisols or other weakly developed one-horizon tundragley soils (MIS 3). In the eastern part of the Carpathian foreland such findings are rare and culturally not typical, e.g. in the Yezupil I (layer I), Ihrovytsia I (layers I and IA), Vanzhuliv Zamczysko (layer II) sites. Richer and culturally diverse artifacts (from Aurignacian to Gravettian) occur in the Polish sites, e.g. Zwierzyniec and Spadzista Street in Cracow, and Jaksice II – to the west of Cracow, in the Vistula River valley.
Artifacts of the youngest Upper Palaeolithic cultures, e.g. Epigravettian in the Halych I and Magdalenian in the Hlomcza and Wiczyce sites, are found in the initial soils formed during the phases of milder climate in the upper Pleniglacial (MIS 2) or within wedge cryogenic structures with polygonal pattern. Final Palaeolithic artifacts are found in the Nowa Biala 1 site (Bialka River valley, Podhale region).

Stratigraphic significance of the loess-soil and glacigenic deposit sequence at the Dubrivka site (NW Ukraine)

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Dubrivka site is located in the Ukrainian Carpathian Foreland, in the Central European belt of periglacial loess, and in the marginal zone of the Scandinavian ice sheet.
The sequence of loess-soil and glacigenic deposits is about 16 m thick and overlies preglacial fluvial deposits of the Dniester River terrace VI. The complex of loess/loess-like deposits is about 12 m thick and contains 4 interglacial paleosols (from S1 to S4). The soil S1 is covered by a thin loess series (L1) and separated from the soil S2 by a loess bed (L2), which is extremely thick (at least 4.5 m). The soil S2 is separated from the soil S3 by a thin layer of loess-like deposits (L3). The soil S3 is superimposed on the soil S4, which is developed on the loess L5 or on glacigenic deposits. All paleosols are forest lessivé soils with well-developed Eet and Bt horizons.
The glacigenic complex, about 4 m thick, is composed of terminoglacial lacustrine deposits (silt – bottomsets; single gravel clasts – dropstones; diamicton – flow tills), which are generally covered by a continuous bed of subglacial diamicton – basal till. Chronostratigraphic position of the loess-soil and glacigenic deposits is determined by TL dating. The TL ages of paleosols are

from the interval 119 ka (substratum of the soil S1) - 444 ka (substratum of the soil S4), a those of terminoglacial deposits range from 435 to 455 ka.
Therefore, the described sequence is a record of the Pleistocene complete and continuous rhythm of climate changes from MIS 2 to MIS 12. According to the stratigraphic schemes of the western and central Ukraine, and those of the areas affected by the European continental glaciations, the distinguished units are correlated as follows: loess L1 = Weichsel/Wisla/Valdai Glacial (MIS 2-4); soil S1 (Horokhiv/Pryluky soil) = Early Glacial-Eemian Interglacial (MIS 5); loess L2 (Tyasmyn loess) = Saale III/Warta/Dnieper 2 Glacial (MIS 6); soil S2 (Korshiv/Kaydaky soil) = Schöningen/Lublin Interglacial (MIS 7); loess L3 (Dnieper loess) = Saale II/Odra/Dnieper 1 Glacial (MIS 8); soil S3 (Luck/Potaygaylivka soil) = Reinsdorf/Zbójno Interglacial (MIS 9); soil S4 (Sokal/Zavadivka) = Holstein/Mazowsze Interglacial (MIS 11); loess L5 (Tiligul loess) and glacigenic deposits = Elsterian 2/San 2/Oka Glacial (MIS 12).
The described sequence well corresponds to the classic stratigraphic scheme of Middle and Upper Pleistocene. The presented stratigraphic picture does not confirm the recently suggested idea that the Elstera 1/San1/Don ice sheet (MIS 16) reached the East Carpathian Foreland.

OSL chronostratigraphy of a loess-palaeosol sequence in Bialy Kosciól using quartz of different grain sizes and radiocarbon dating.

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For loess to be useful in climatic reconstructions a 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.
The current work presents OSL ages derived from two different quartz grain size fractions, coarse (90–125 µm) and medium (45–63 µm) but also results for polymineral fine grains (4–11 µm) are presented. 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 Bialy Kosciol loess profile.
In the current study we attempt to investigate the differences between the previously obtained results for coarse grained quartz fraction and new results obtained for medium grained quartz fraction and polymineral fine grains fraction. Ages obtained for coarse and medium 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 return underestimated ages in comparison to the medium grained quartz. Those differences reach 25% for the two deepest samples.
In this work we report also preliminary luminescence ages for the polimineral fine grains fraction, for this fraction equivalent doses were determined using post-IR IRSL. Those results are quite similar to the previously obtained coarse grained quartz ages but for two oldest samples observed differences are about 70-90% (polimineral fraction gives much older results).
Those results, obtained for lithostratigraphic units II and I which correspond to MOIS 4 and 5, confirm the earlier established MOIS chronology and strengthen the chronological correlation of the loess profile at Bialy Kociol with other loess profiles in Europe.
All presented result were obtained with support of Polish National Science Centre, contract number 2011/01/D/ST10/06049

Preliminary OSL dating results for loess deposits from Tyszowce

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The Polish loess record provides an excellent high-resolution archive of climate and environmental change, providing evidence for the interaction between accumulation and erosion of aeolian and fluvial sediments during the Middle and Late Pleistocene. For this reason, a prominent place among the extensive research repertoire of this specific sediment is occupied by luminescent dating. It is one of important tools for determining the age of loess from the last 150-200 ka, which in turn contributes to the creation of loess chronostratigraphy and its correlation with a continuous maritime climatostratigraphic record. 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 Tyszowce (23°42'E, 50°37'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).
All presented result were obtained with support of Polish National Science Centre, contract number 2011/01/D/ST10/06049

OSL chronostratigraphy of a loess-palaeosol sequence in Zlota using different dating methods

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Loess formations in Poland display a close relationship with cooling and warming periods of the Northern Hemisphere during the Pleistocene. Loess sequences sensitively record regional palaeoclimatic and palaeoecological changes. In general, loess is typical for 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 glaciofluvial/fluvial 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 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 Zlota (21°39'E, 50°39'N). Two different fractions were investigated, the polymineral fine grains fraction (4-11µm) and medium quartz grains (45-63µm). For the fine fraction equivalent doses were determined using post-IR $IRSL_{290}$ and for medium quartz SAR OSL was used. Obtained OSL chronostratigraphy for the last 40k years was also confirmed by radiocarbon dating. Ages obtained for different fractions show a good agreement between themselves but for the oldest part of the loess profile can be observe an underestimation of the obtained result compared to geological point of view.
All presented result were obtained with support of Polish National Science Centre, contract number 2011/01/D/ST10/06049

Tree roots as a source of information about activity and dynamic of erosion processes in the loess areas - an example of study from the Sudetes Mountains, Poland

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Erosional processes are common phenomenon in the loess areas. Gully initiation and evolution usually result from combination of natural and anthropogenic causes. Intensity of these processes are connected with several factors, e.g. loess thickness, type of vegetation cover, slope gradient and quantity and intensity of rainfall events. The aim of this study is to determine the activity of erosional processes in the forested gully systems on the basis of exposed tree roots analysis. The study area is located in the SW Poland in the Sudetes Forefield. Several isolated loess patches, which differ in sediment thickness (max. 10-15 m), occur in this part of the Sudetes Mountains. The detailed research were carried out in four forested gully systems. 60 samples of exposed tree roots (*Fagus silvatica, Acer platanoides, Carpinus beteulus*) were collected during field research. Anatomical changes of wood (changes of vessel size, scars, the appearance of early and late wood) occur, when the tree roots are exposed. These changes allow to date vertical and horizontal erosion episodes. The age of exposed roots indicates that gully systems analysed were transformed several times during last 100 years. The bottoms and slopes of the gullies were intensively eroded and undercuted especially in the 60s and 70s last century (1964, 1973, 1974, 1978). The vast majority of roots was exposed in 80s and 90s last century, especially during extreme rainfall events in 1986, 1994 and 1997. Lack of synchronisation of data along the length of gully systems is connected with their multi-phase development in local scale. First signals appear in the gully heads and small tributaries. Dendrochronological method is precise tool to analyse contemporary erosional processes in the loess areas. Using of different research materials (exposed roots, cores from tilting trees) can allow to determine the age and intensity of geomorphic processes.

Earthworm calcitic granules (ECG): a new tracker of millennial timescale environmental changes in European loess deposits

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Earthworm calcitic granules are composed of rhomboedric calcite crystals, organized in a radial crystalline structure. These granules are secreted by several earthworm species, mostly Lumbricus terrestris and L. rubellus, which release them at the surface and the upper part of the soil. They have been found in calcareous Quaternary deposits, especially in loess. In this study, we performed the first continuous record of ECG abundance in two loess sequences from northern France (Havrincourt and Villers-Carbonnel), and one sequence from Germany (Nussloch P3). These loess sequences are typical of the Last glacial period (Weichselian). The aim of this research is to evaluate the reliability of ECG as a new palaeoenvironmental indicator in loessic context. Firstly, counting ECG with a diameter greater than 1 mm highlights a link between their concentration and the stratigraphy boundaries. Indeed, ECG concentration is very high in tundra gley and at the top of brown soil horizons, whereas it very low to absent in typical loess. Mollusc abundance shows similar variations. Otherwise, the sedimentological study of the sequences, show that there is a good correlation between these two biological indicators, the total organic carbon (TOC), and the carbonate content curves. ECG abundance variations suggest, in agreement with molluscs, warmer conditions during the development of tundra gleys and boreal brown soils. The operation of this new bio-indicator allows us to strengthen the detection of rapid climate changes (over thousands year timescales) within the last glacial loess.

Bialy Kosciól - comparison of loess sediments and underlying silt sediments

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The loess section at Bialy Kosciól is located in the area of Niemcza-Strzelin Hills and belongs to the continous loess cover with thickness greater than 3 m. The aim of the study is to compare some lithological features of loess and the silty sediments occuring below them in the outcrop. The size of particles is one of the most important features of loess deposits.To assess the lithological characteristics of the samples taken by particle size analysis was performed areometric without shredding particles (microaggregates) and the shredding particles (dispersion). Microaggregate method of particle grain-size distributions indicates the conditions of Aeolian transport. The dispersion characteristics show the sediment features earlier developed in the source area. For selected samples were also carried out studies of absorption by Enslin and measurement losses on ignition.
The phase composition of the samples was determined with the help of XRD and UV-Vis-NIR measuring techniques. Mineral identification from diffraction data (XRD) was based on angular positions (2 Theta) and relative intensities of diffraction peaks. Results of XRD investigations have revealed that the main component of all investigated samples is quartz. The intensity of diffraction lines characteristic for quartz, what can be used as a measure of its content in the samples, is the highest in the sample 26, lower but comparable in samples 10 and 23, and the lowest and almost equal in the samples 32, 33, 36 and 38. All samples contain also smaller amounts of illite, kaolinite, muscovite and feldspars. Samples 10 and 23 contain also calcite, the content of which is higher in the sample 23. One can not exclude the presence of very small amounts of goethite in the samples. Basing on intensity of diffraction lines characteristic for illite and kaolinite one can divide investigated samples onto two groups. Samples 10, 23 and 26 belonging to the first group (loess cover) , have considerable higher intensities of reflections characteristic for these minerals than samples 32, 33, 36 and 38 forming the second group (silty sediments). On the other hand, sample 26 belonging to the first group contains the highest amount of quartz, but does not contain calcite. The results of UV-Vis-NIR investigations have shown that all recorded spectra are similar and comprise absorption bands at 480, 660, 920, 1410, 1920 and 2208 nm. Here again, basing on intensity of absorption bands one can divide samples onto two groups. Samples 10, 23 and 26 constituting the first group have intensities of absorption bands lower then samples 32, 33, 36 and 38. Absorption bands at 1410 and 1920 m can be attributed to overtones and combinations vibrations of fundamentals of water or OH groups. Absorption band at 2208 nm the most probably can be produced by vibrations of Al-OH and Fe-OH groups. Such bands occurred in the spectra of illite and kaolinite. On the other hand, absorption bands at 480, 660 and 920 nm are the most likely connected with the presence of iron ions in the crystal lattices of minerals constituting samples and are characteristic for spectra of goethite and hematite. These bands are responsible for the beige color of the samples.
Based on the analysis of the aggregate dispersion and the particle size, it can be distinguished the typical loess from the grains of different origin. Some features of mineral deposits showed similarity and some differences of loess sediments with underlying layer.

23 Topics: looking forward in Loess Research

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In 1900, David Hilbert - most famous of mathematicians- at a mathematical congress in Berlin, presented a list of 23 problems and topics of interest which kept his fellow mathematicians busy for the 20th Century. We attempt something similar, on a smaller and more modest scale (as befits humble earth scientists). Here are 23 topics for consideration by loess scholars: for 21st Century? For 2014!

01. Words. Better as an adjective than a noun maybe? Loess ground, soils, material, deposits etc.
02. Particles. It is a particulate material; it needs to be seen as such; more thought on particle nature, and formation.
03. Structures: loess is a structure, a packing, this is central to the idea of loess.
04. Bonds: interparticle forces; long range and short range bonds

05. Collapse: the defining dynamic event.
06. Mineralogy.
07. Dust/loess relationships. Loess as large dust.
08. Places. India, Africa, Australia, Siberia - there are places to be explored and mapped.
09. pL Loessification: small scale loessification.
10. PTDC systems: defineable events in the formation of a loess deposit: P provenance, T transport. D deposit, C change.
11. New dating techniques. Here is stratigraphy - this is an action zone. Loess stratigraphy will be central to loess research for many years
12. Climate: loess records climate - precision grows. Palaeoclimatology can be accessed via loess.
13. Rivers. Large rivers may transport loess material. The loess/river connection requires further study.
14. Planets: Mars, Titan, others maybe.
15. Erosion: the disruption of the packing.
16. Deformation. Not just the classic collapse of the open structure but the interesting properties of remoulded loess; the ' Teton Dam' problem.
17. Cyclicity. Milankovitch provided a cyclic underpinning for the Quaternary; we link his cyclic structures to the observations on loess deposits.
18. Larger animals: Mammoths mostly. All sorts of vertebrates including Homo e. Moas.
19. Smaller animals. Cyanbacteria certainly. Snails, sand martins, bee-eaters ...
20. Agriculture: loess improves soils.
21. Civilization: loess promotes civilization.
22. Language. Many aspects of loess study remain regional. The history is written in German; a vast amount of literature is in Russian.
23. Computer worlds: a new setting for loess research.

A more detailed version of this list is available on the 'Loess Ground' blog. It is a proposed list, an initial list, in this abstract forms a very short list, a subjective list - additions and modifications are invited. Loess research is burgeoning- there is room for many suggestions and proposals. And the nature of the list may need adjusting - do we need 10 words per entry, or 100 or 1000?

New results of TL and OSL dating in Lublin – a case study: Zlota loess section (Sandomierz Upland, Poland)

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The exposure in Zlota village (= Polanow Samborzecki) is the only site in the eastern part of the Sandomierz Upland where the younger loess deposits are accessible to direct investigations. The section is located about 150 m to the NE from the old exposure at Zlota. This section is typical of the Sandomierz loessy region, and in respect of its lithological and pedological structure it well corresponds to other, historical key sections (e.g. Sandomierz, Polanow Samborzecki).
The presented results of TL and OSL dating (with the use of RISO apparatus) of the loess-soil sequence (S1-L1-S0), which was formed during the last glacial-interglacial cycle, are the first ones obtained by physicist M.Sc. Karol Standzikowski who is employed in the TL Laboratory in UMCS (Lublin). His investigations are the continuation of the studies conducted by the late Dr Jaroslaw Kusiak.
The material for investigations was taken from eleven selected layers and soil horizons. Each of them was double sampled in order to compare possible errors of sampling methods (into black aluminium bags or metal tubes). Age determination was supplemented by particle-size analysis. The dating results were obtained for quartz grains of the 45-56 µm fraction, which constitutes about 20% of a deposit.
The obtained dating results have led to the following preliminary conclusions:
1. There are no distinct differences in dating results depending on the sampling method.
2. In each case the TL ages were older from the OSL ones (the differences were about a dozen or so percent).

Day I - 10th September, Wednesday

- (A) Wrocław
- (B) Biały Kościół (loess section)
- (C) Henryków (Gravettian archaeological site and Cistercian monastery)
- (D) Wojsławice (Arboretum)
- (E) Zaprężyn (loess section)
- (F) Węgrów (vineyard)
- (G) Dobra Castle

170 km

Bialy Kosciól - the key loess section of the Niemcza-Strzelin Hills

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The loess section in the vicinity of the village Bialy Kosciól is located in an old clay-pit, several meters from the road linking the Strzelin and Henryków (? = 17°01'30''E, f = 50°43'30''N). The loess profile is situated on the west slope of the Olawa valley at an altitude of approximately 185 m above sea level.

The loess cover in the surrounding area was previously described by Raczkowski (1969) and Ciszek (1997). The complete loess-soil sequence at Bialy Kosciól has been excavated and characterized by Ciszek et al. (2001) and Jary et al. (2002, 2004, 2008, 2011). Preliminary results of pollen analysis were presented by Komar et al. (2004, 2009). Mineralogical characteristics of loess from Bialy Kosciól based on heavy minerals analysis were published by Chlebowski et al. (2004a, 2004b). Characteristics of lithostratigraphic units and interpretation of periglacial phenomena were discussed by Jary (2007, 2009, 2010) and Jary and Ciszek (2013). The results of TL and OSL dating of loess profile from Bialy Kosciól have been presented by Fedorowicz et al. (2004), Fedorowicz (2005, 2006), and Moska et al. (2011, 2012).

The loess profile at Bialy Kosciól has been presented several times to participants of International Symposiums (11th Polish-Ukrainian Seminar "Stratigraphic Correlation of loess and glacial deposits in Poland and Ukraine" – Wroclaw, September 2001; 4th International Loess Seminar - Strzelin, October 2004; 5th International Loess Seminar – Wroclaw-Srebrna Góra, September 2008; Closing the gap - North Carpathian loess traverse in the Eurasian loess belt, International Workshop, 6th Loess Seminar in Wroclaw, May 16-21 2011).

Detailed pedosedimentary sequence with short description of the basic units is presented on figure 1.

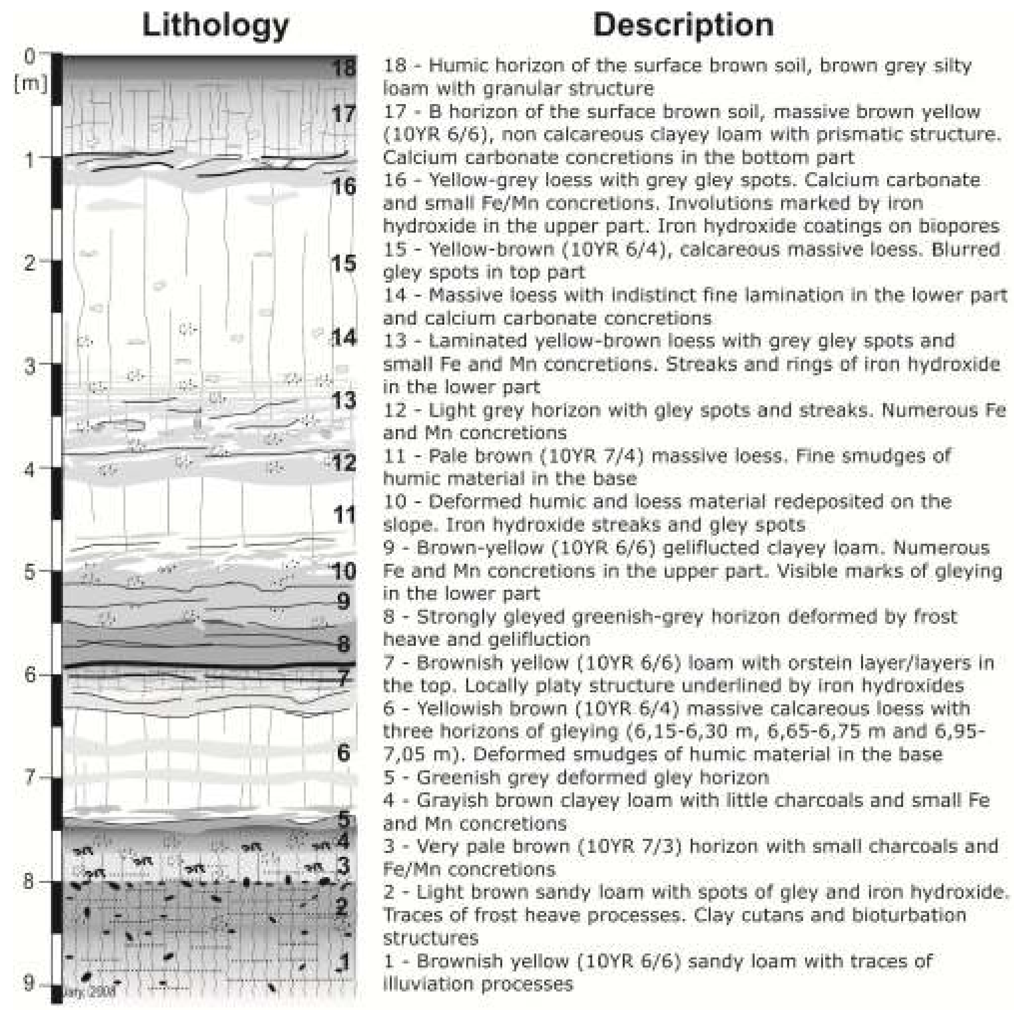

Fig. 1. Pedosedimentary sequence and description of the basic units in the Bialy Kosciól loess section

Bialy Kosciól loess-soil sequence consists of five litho-pedostratigraphic units (Fig 2) developed during the Late Pleistocene and Holocene: two polygenetic fossil soils/soil sets (S1 and L1S1) and two calcareous loess units (L1L1, L1L2). In the top of the younger loess unit recent soil has developed (S0).

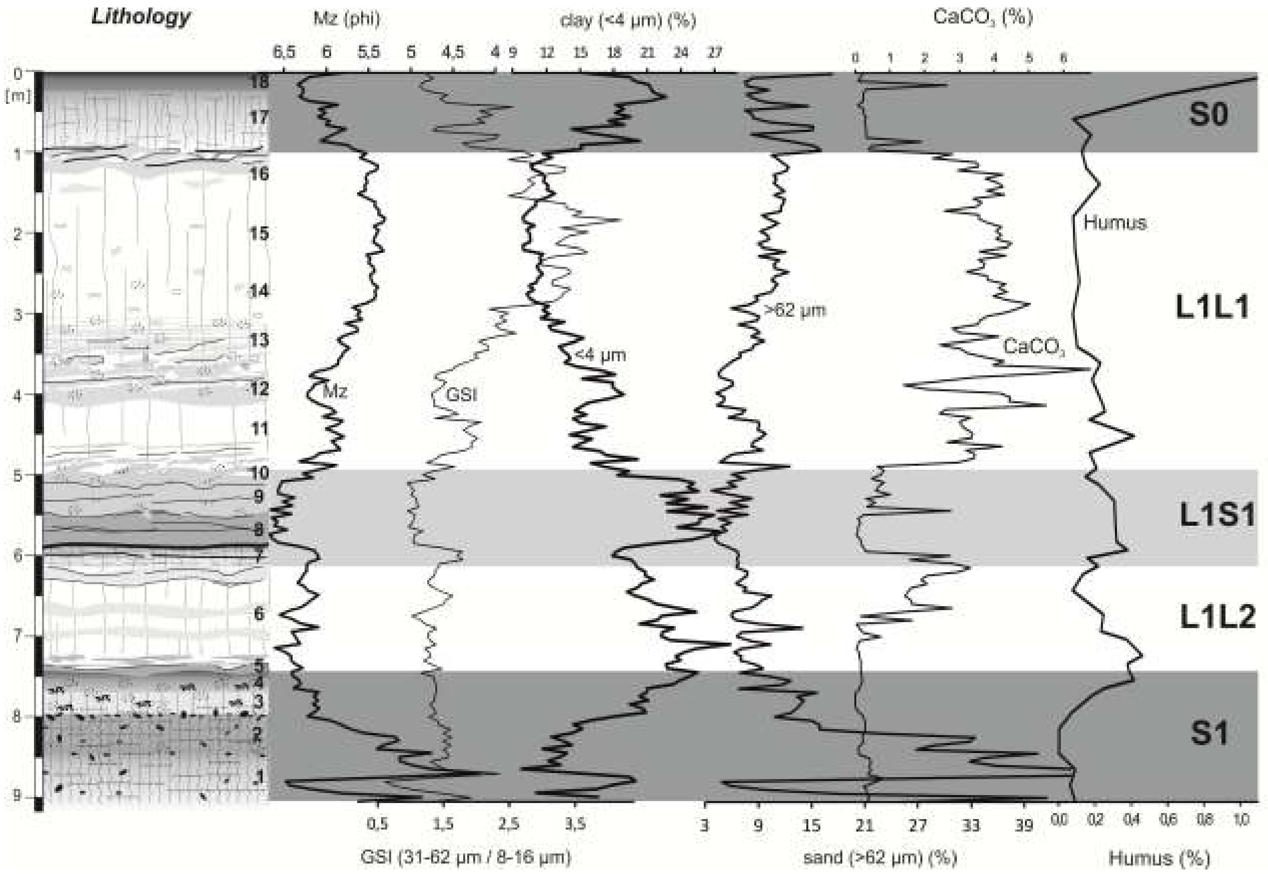

Fig. 2. Grain size characteristics (GSI - Grain Size Index), calcium carbonate and humus content in Bialy Kosciól loess-soil sequence (S0,L1L1,L1S1,L1L2,S1 - labelling system acc. Kukla and An, 1989, modified by Markovic et al., 2008)

In the lower part of the investigated sequence, polygenetic pedocomplex S1 with well-developed Bt (illuvial) horizon was formed on heterogenic, sandy-clay substrate. The upper part of pedocomplex consist of an accumulation (A) and eluvial (E) horizons and clear visible transitional horizon EA with charcoal clusters. There are evidence of periglacial and other deformational processes within the palaeosol set (e.g. cryo-desiccation cracks, desert pavements) which demonstrate the complex history of the S1 pedocomplex. In the final phase of the development the top of pedocomplex has been transformed by gley and gelifluction processes.

The palaeosol set was probably formed during three intensive soil formation stages: Eemian Interglacial (Marine Oxygen Isotope Stage 5e), Brörup and Odderade Interstadials (MOIS 5c and 5a). Cold periods, which interrupted three stages of pedogenesis, are correlated with Herning (MOIS 5d) and Rederstall (MOIS 5b) stadials. Eemian-Early Weichselian soil complex S1 at Bialy Kosciól was formed probably during 2-3 stages of forest-type pedogenesis. The final, steppe soil forming phase, characteristic for eastern part of Poland, has been weakly developed.

Above the pedocomplex lower loess unit L1L2 was deposited probably during the Lower Pleniweichselian (MOIS 4). This calcareous loess unit is about 1,5 m deep. Some weak tundra-gley horizons can be distinguished within this lithostratigraphic unit (Fig. 1).

In the top of L1L2 loess unit successive fossil soil complex L1S1 was developed with strong evidence of tundra-gley soil processes formation. L1S1 soil separates two main stages of loess accumulation during the Last Glacial. It is the only carbonate free soil in the Last Glacial loess sequence at Bialy Kosciól. Substrate of this soil is characterized by high indexes of chemical weathering indicating a considerable role of transformation by soil processes (Fig. 3). However, morphological characteristic and presence of periglacial phenomena suggest tundra-gley type of pedogenesis. Chronostratigraphic position of L1S1 soil is correlated with the whole MOIS 3. Climatic changes during MOIS 3 on investigated loess areas in SW Poland were, probably, not rapid and/or significant enough to evoke effective processes of loess accumulation. The top of L1S1 soil was deformed by gelifluction, frost heave and other periglacial processes.

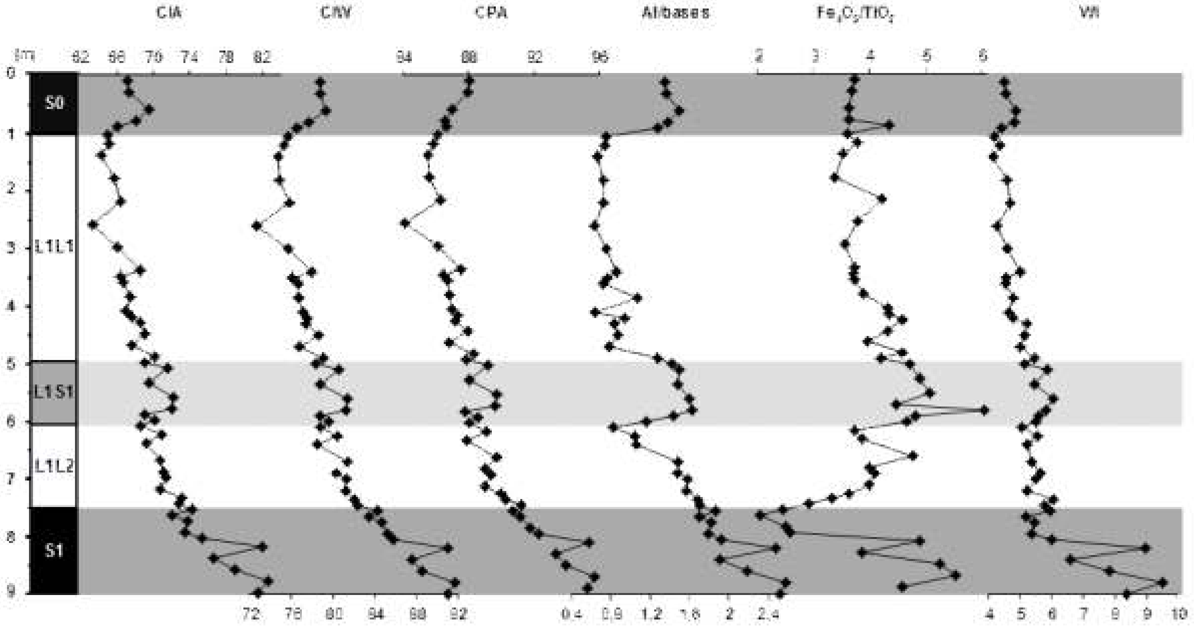

Fig. 3. Chemical weathering indices in Bialy Kosciól loess-soil section (CIA – chemical index of alteration acc. Nesbitt and Young, 1982; CIW – chemical index of weathering acc. Harnois, 1988; CPA - chemical proxy of alteration acc. Buggle et al., 2011; Al/bases acc. Retallack, 2001; Fe2O3/TiO2 acc. Muhs, 2001; WI – Weathering Index acc. Pye and Johnson, 1988)

Over the gelifluction horizon the L1L1 loess unit occurs. This calcareous loess was deposited during Upper Pleni-weichselian (MOIS 2). In the lower part of L1L1 loess the weak tundra-gley soil with numerous ferruginous concretions was developed. However, there are few other weak tundra-gley horizons within L1L1 unit which are evidence for short climate variations in the time of loess accumulation. Nevertheless, its recognition is not unambiguous. It can be related to climate change of the loess sedimentary environment. Rapid changes of grain size composition and other proxies within L1L1 loess unit suggests sudden changes of environmental conditions.

In the top of L1L1 unit the modern brown soil S0 has developed

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Henryków 15: geoarchaeology of the Early Gravettian site in loess, a case from Lower Silesia (SW Poland)

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Previous studies on the Gravettian in Central Europe did not pay much attention to the issue of the marginal areas occupation, because the main research interest was focused on analysis of remains from the area of classic settlement areas, like the middle Danube valley or southern Moravia. Consequently, little is known about the mechanisms associated with occupation of areas which lie to the north of the Carpathians and the Sudetes, both in terms of chronology as well as system of mobility, settlement, raw material procurement and food acquisition.

The results of excavations on the open-air archaeological site at Henryków (SW Poland, Lower Silesia), presented in our poster, show that the exploitation of upland territories located to the north of the Sudetes, started very early, i.e. in the so-called Early Gravettian period. A settlement horizon was covered by loess sediments in the Late Weichselian, and charcoal samples from the horizon were dated by the radiocarbon method to ca. 28.5 - 31.5 kyr BP. This age was confirmed by dating of mineral deposits using the OSL method (ca. 29 kyr BP). Based on geoarchaeological studies, the period of human stay at the Henryków site plausibly associated with development of the soil complex of the Komorniki/Lohner Boden type. Archaeological data indicate that the stay was linked with hunting activity. The features of the Henryków site, typical for marginal occupation, suggest that during the visit tool kits were reconstructed, stocks were replenished and fire was used. The erratic flint from local glacial deposits was used.

The whole dataset obtained by our research suggests that traces from Henryków should be treated as a result of pioneering expeditions. This mobility probably never had a more stable character, like in the later period of the Gravettian complex development.

Cistercian Abbey in Henryków

Piotr Owczarek

Institute of Geography and Regional Development, the University of Wroclaw, pl. Uniwersytecki 1, 50-137 Wroclaw, Poland

Henrykow is a small village located about 60 km south of Wroclaw within the Sudetes Foreland. It was mentioned for the first time in documents from 1222, when the Duke Henry I the Bearded gave his permission to found a branch of the Cistercian monastery here. The abbey is very important for polish history. A Latin chronicle, "The Book of Henryków", compiled at Henryków abbey in the 13th century contains the first known sentence written in the Polish language. The words were spoken by a peasant, one of the monastery servants, to his wife: 'day ut ia pobrusza a ti poziwai' (Allow me, I shall grind, and you take a rest). This historic, written Polish text, is now kept in the Library of the Museum of the Archdiocese in Wroclaw. Very precious the Cisterian complex, both historically and architecturally, comprises: the Church of the Assumption of the Blessed Virgin Mary and the St. John the Baptist Church, the monastery, the farm buildings and surrounding park with centuries-old trees. The monastery church has been preserved untouched. The church is dating back to the 13th century. It is dominated by its Baroque décor and furnishings, with paintings by Michael Willmann. This Baroque artist became known as the "Silesian Rembrandt". Particularly worth seeing are the Gothic tombstone of Bolko II and his wife Bonne de Savole „Guta" dating back to the mid-14th century and the monastic choir stalls placed in the chancel, originating from the 16th - 17th century. The abbey was reconstructed between 1681 and 1702, but many medieval elements have been retained, such as portals and other stony architectural elements.

Sudetes Mountains and Forefield

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The Sudetes form the northeast rim of the Bohemian Massif, one of the Precambrian cornerstones of Europe. This hercynian massif (ca. 300 km long) stretches from eastern Germany along the northern border of the Czech Republic to south-western Poland. The highest peak of the range is Sniezka (1,603 m a.s.l.) in the Karkonosze mountains on the Poland-Czech Republic border. The Sudetes are divided into three major parts: Western, Central and Eastern Sudetes. Most of the rock material forming the Sudetes is Paleozoic, but some of the gneisses are Archean, ranking among the oldest rocks in Europe. Crystalline rocks predominate: metamorphic (mainly various kinds of gneiss and schist) and igneous (plutonic, such as granite; or volcanic, such as porphyry). Sandstones, which built central part of the Sudetes (e.g. Table Mountains) are Mesozoic (Cretaceous). The tectonic forces of the Alpine orogeny uplift the area again. During the Ice Age, the Scandinavian ice sheets spread to the northern edge of the mountains. In the Karkonosze Mountains mountain glaciers were up to five kilometres long and carved several cirques. One of the most important fault lines drawn during the Alpine cycle is the 150 km long Sudetic Marginal Fault. It runs NW-SE and forms the clear edge of the mountains, separating them from Sudetes Forefield. This hilly area, culminated at 719 m a.s.l. (Sleza Hill), is built of different Paleozoic (gabbro, granite) and Tertiary (basalt) rocks. The Sudetes Forefield is covered by several isolated loess patches, which differ in sediment thickness (max. 10-15 m). One of these patches is obsered within Niemcza-Strzelin Hills. This massif, culminated at 392 m a.s.l. (Gromnik Hill), are located in the eastern part of the forefield. There are numerous loess gullies.

The Arboretum in Wojsławice

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The Arboretum in Wojslawice is located 50 km south of Wroclaw and about 2 km from the small historic town of Niemcza. The terrain here is unusually varied. Wojslawice lies in a spot where deep gorges and streams cut through beautiful hilly oakwoods (Strzelin-Niemcza Hills), and benefits from a specific microclimate in a hollow protected from drying, cold winds.

The famous plant collector, Fritz von Oheimb was the first to realise the special advantages provided by this location. In 1880 he bought Wojslawice as a property of more than 150 ha and began a new arboretum within the old natural park. The existing plantings of gigantic Beeches, Horse Chestnuts, Limes, Yews and ancient Oaks provided a structure around which the new garden could develop. The Arboretum grew gradually, enlarged step by step, marked out with paths, then blended into the natural landscape to eventually give the impression of a park far more extensive than its initial 6 ha. At the beginning of the 20th century many conifers were planted – Spruces, Firs, White Cedars, Douglas Firs, Junipers and Scots Pines. Also plants like the Japanese Maple, the tree Peony and Azaleas were introduced in Wojslawice. Such plants had never been grown in this part of Europe before, and their successful acclimatisation and cultivation alerted plant collectors to the possibilities of introducing new species into Poland. Two generations of the von Oheimbs carried out many years' observations and acclimatisation studies for the German Dendrological Society, which selected the park of Wojslawice as a dendrological experimental station.

Wojstawice is famous for its unique collection of Rhododendrons and Azaleas which furnish the slopes of the Arboretum with an abundance of colorful flowers in May and June. At present there are over 600 taxa of plants of the *Ericacae* family including *Rhododendron*, which are difficult in cultivation. The collection of this genus, now composed of 300 different species and varieties, ranks among the richest and oldest in Poland. The oldest evergreen varieties are 60–90 years old and have reached a height of 5 m. Most of the varieties were grown in the Seidel nurseries near Drezno and are best suited to Polish climatic conditions. Deciduous Azaleas are also a great attraction, especially the yellow flowered form, the Pontic Azalea, a species protected in Poland. This Azalea blooms in spring before the leaves appear, and the flowers are strongly fragrant. The Azalea flowers earlier than the evergreen Rhododendrons.

The Arboretum is home to some tree species not found elsewhere in Poland – the Cedar-of-Lebanon (*Cedrus libani*), Japanese Umbrella Pine (*Sciadopytis verticillata*). Another unusual resident in Wojslawice is the Giant Sequoia (*Sequoiadendron giganteum*), the tallest tree in the world. In their native California these trees reach heights of 100 m and 12 m in stem diameter. Some are around 3–4 thousand years old. Also here is the American Swamp Cypress (*Taxodium distichum*) typically producing “knees”, i.e. knobbly wooden outcrops when growing in a swamp environment.

The forest floor is rich in species protected in Poland, e.g. spring Snowflake, Snowdrop, Tiger Lily, Ostrich Fern and Mezereon.

The Arboretum in Wojslawice was declared a “natural monument“ and in 1988 became a branch of Wroclaw University Botanic Garden. The site allows the study of acclimatisation of new species, particularly those very difficult or impossible to cultivate in other parts of Poland. The collection is constantly being enlarged, especially to include threatened, protected species and latterly old and vanishing shrub and tree varieties. At present the Arboretum contains over 2500 species and varieties.

The Arboretum in Wojslawice:	58-230 Niemcza, Wojslawice 2 tel. +48 71 322 59 57 fax. +48 74 837 64 69
e-mail:	arboretum@biol.uni.wroc.pl
The year of establishment	1811
Area	about 60 ha with 5 ha of “old park”
Number of species and varieties	ca. 5500
Geographical location	50°43' N, 16°50' E, 250–310 m above sea level
Opening hours	from 1st May to 30th September open every day 9.00 am – 6.00 pm (In May and June: on Saturdays, Sundays and holidays from 8.00 am to 8.00 pm)

Zaprezyn – the Late Pleistocene loess-soil sequence in the Trzebnica Hills

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The loess section in the vicinity of the village Zaprezyn (? = 17°12'00''E, f = 51°14'45''N) is located in marginal zone of the Trzebnica Hills (northern part of the Silesian Lowlands) on the elevation of 165 m above sea level. It is situated only ca 70 km towards the south from the maximum range of the Last Glaciation. The area is cut by small denudation valleys on general course N – S.
The loess profile in Zaprezyn was first presented during the 2nd Loess Seminar organized by Institute of Geography and Regional Development in 1993 (Jary and Kida, 1993). The section was described by Snieszko (1995) and Szponar (1998) and commented by Maruszczak (2001). Snieszko (1995) divided the younger loess cover (4-5 m in thickness) into upper part (rich in calcium carbonates) and lover part with gley horizons. The lessive soil with levels A-E-Bt occurs below this unit. This soil is developed on the silty diamicton underlayed by sandy-gravelly deposits. Snieszko (1995) correlated the fossil forest soil with the soil complex Nietulisko according Jersak (1973). Large amount of charcoals (*Pinus silvestris*) was found in accumulation horizon of this soil.
New data were published by Szponar (1998). This author collected two samples from modern and fossil soil and focused on the high content of neutral amino acids. The humic substances extracted from accumulation horizon of the fossil forest soil have been dated (29,6±0,76 ka BP, Gd-9209) by Szponar (1998) who suggested that this is tundra-forest soil developed during the Denekamp interstadial. This genetic and stratigraphic interpretation has never been accepted (Maruszczak, 2001; Jary, 2007). In 2003 Szponar and Szajdak published new data on amino acids investigation of modern and fossil soils in Zaprezyn (in this paper this section is named Kepa) recommending application of this method in stratigraphic research.
The loess section in Zaprezyn has been presented several times to participants of International Symposiums (4th International Loess Seminar - Strzelin, October 2004; 5th International Loess Seminar – Wroclaw- Srebrna Góra, September 2008; Closing the gap - North Carpathian loess traverse in the Eurasian loess belt, International Workshop, 6th Loess Seminar in Wroclaw, May 16-21 2011) organized by the Department of Physical Geography of the University of Wroclaw (Jary and Ciszek, 2004; Fedorowicz et al, 2004; Jary et al., 2008, 2011). Characteristics of lithostratigraphic units and interpretation of periglacial phenomena were discussed by Jary (2007, 2009, 2010) and Jary and Ciszek (2013). Jary (2007) presented new results of radiocarbon dating (AMS technique) of Zaprezyn loess section. Charcoals taken from the humic horizon of the fossil forest soil have been dated as >50 ka BP (Poz-6939), humic substances from older tundra-gley soil - 26.2 ± 0.6 ka BP (Poz-7649) and radiocarbon age of humic substances from younger tundra-gley soil is 18.8 ± 0.12 ka BP (Poz-7998).
The investigations of the loess profile in Zaprezyn have been carried out in 2003-2004 on vertical section (S exposition) of 3-6 m height and 60 m wide. Detailed pedosedimentary sequence with short description of the basic units is presented on figure 1.

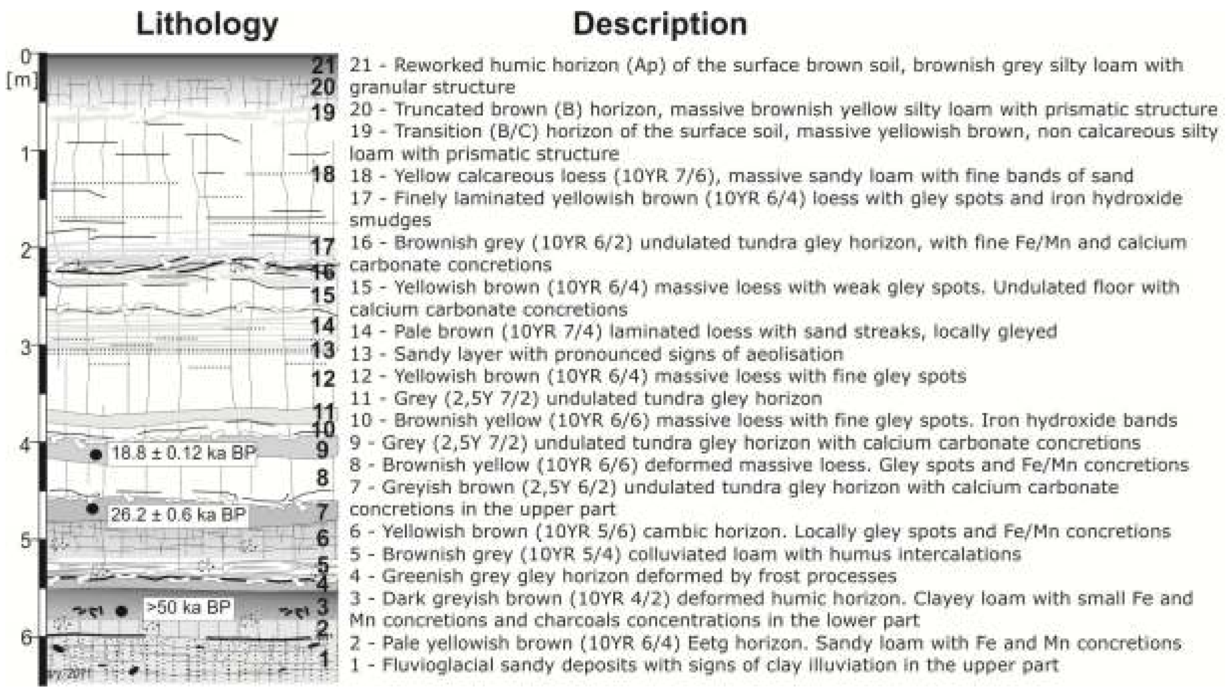

Fig. 1. Pedosedimentary sequence and description of the basic units in the Zaprezyn loess section

The investigated site is the northernmost loess outcrop in south-western Poland. The proximal position in relation to ice sheet influenced in huge degree on the course of sedimentological, soil and weathering processes. This factor influenced on specific characteristics of the loess profile in Zaprezyn which sometimes make difficult the correlation of this loess section with other loess sites located south.

Zaprezyn loess-soil sequence consists of five litho-pedo-stratigraphic units (Fig 2) developed during the Late Pleistocene and Holocene: two polygenetic fossil soils/soil sets (S1 and L1S1) and two calcareous loess units (L1L1, L1L2). In the top of the younger loess unit recent soil has developed (S0).

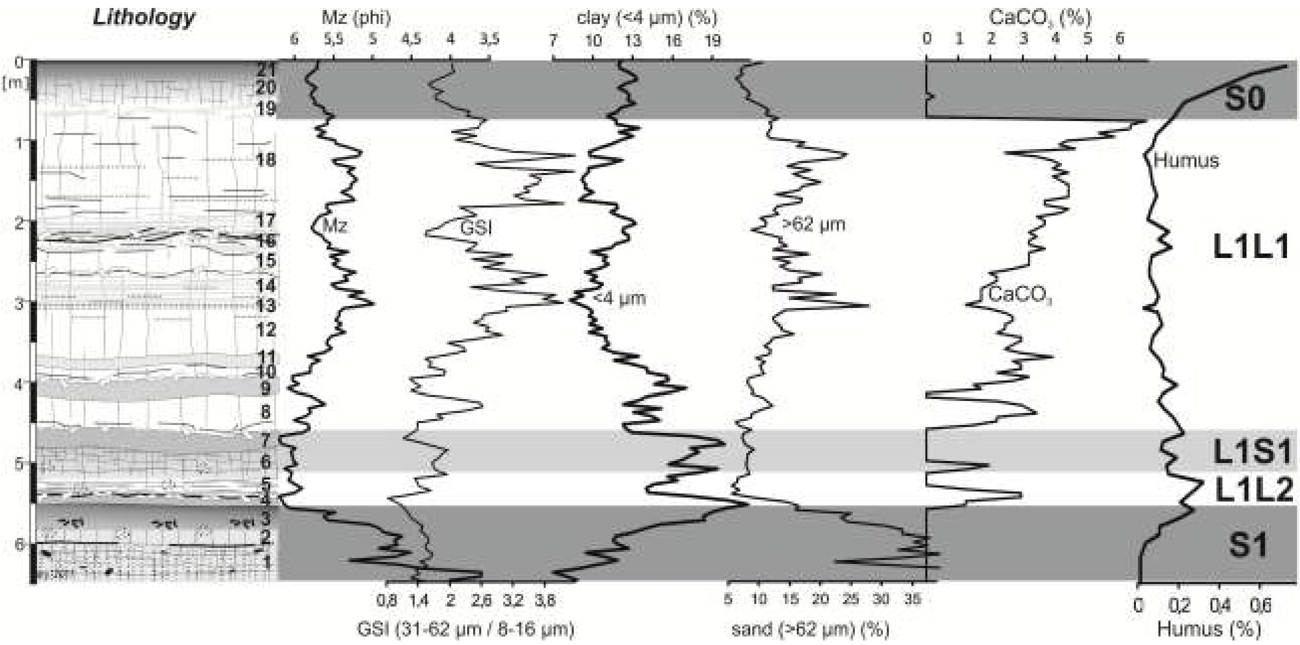

Fig. 2. Grain size characteristics (GSI - Grain Size Index), calcium carbonate and humus content in Zaprezyn loess-soil sequence (S0,L1L1,L1S1,L1L2,S1 - labelling system acc. Kukla and An, 1989, modified by Markovic et al., 2008)

Last glacial (younger loess) in Zaprezyn section is underlain by well-preserved fossil soils complex (S1) developed during the Last Interglacial and Early Weichselian. Traces of illuviation proves that it was forest soil with welded weak steppe soil. The illuvial horizon is not distinct due to lithological properties of its substrate (sandy material).

Above this pedocomplex L1L2 loess unit occurs. The boundary between S1 and L1L2 units is sharp like in other loess sections in SW Poland. L1L2 unit is thin and consists of loess/soil colluvium and calcareous loess.

L1S1 soil unit is represented by undulated tundra gley horizon underlying by weak cambic horizon.

The L1L1 calcareous loess unit is interbedded by several tundra gley horizons often deformed or cut by erosion processes on inclined slope surfaces. The sequence of soil forming and erosional phases are probably connected with sudden climate changes. This could be related to proximity of this site to the Ice Sheet margin. L1L1 loess unit is represented by massif and laminated facies. They are usually intercalated by sandy intercalations mainly in the upper part. In the top of L1L1 unit the modern brown soil S0 has developed.

Zaprezyn loess section is the only site in SW Poland where two generations of ice wedge casts were noticed. This record indicates twofold expansion and disappearance of permafrost during the last glacial period in Trzebnica Hills and a considerable climatic gradient between northern and southern part of the SW Poland.

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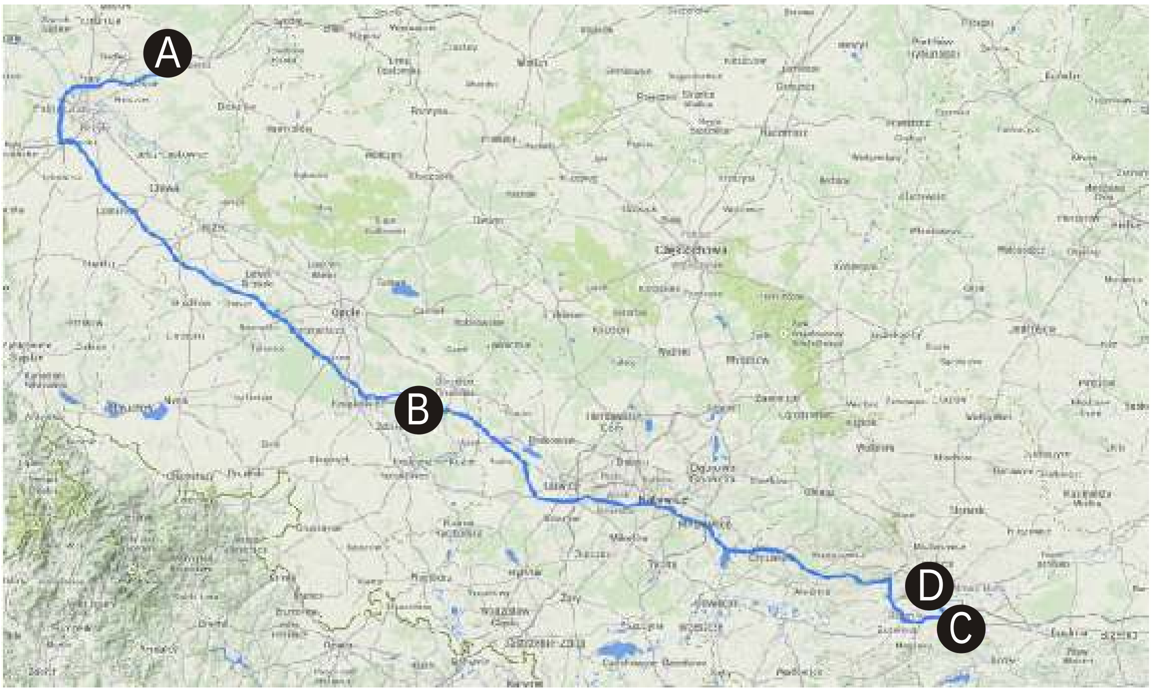
Day II - 11th September, Thursday



- A Dobra Castle
- B St. Anne's Hill (Geopark)
- C Salt Mine in Wieliczka
- D Cracow
  (Kościuszko Mound & Gravettian sites; Rynek Underground; Old Town)
- D Rynek Underground (Museum of Cracow)
- D Cracow Old Town

348 km

St. Anne Hill (Góra Sw. Anny)

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The St. Anne Hill (400 m a.s.l.) is the highest part of the Silesian Upland. The hill is protected as Geopark, one of three in Poland. On a relatively small area of 5.051 ha some of the most beautiful and well preserved profiles of middle Muschelkalk (Central-Triassic) with numerous examples of fauna can be seen. The top of the hill is built of Tertiary basalt and other vulcanite rocks. The geological processes were very complicated in this area and now we can find the rocks showing the signs of contact metamorphism, deformations, faults, hollows, karst forms. Slopes of the hill are covered by loess with clearly visible gullies. St. Anne Hill is famous pilgrimage centre. The monastery buildings, at the top of the hill, are Baroque; the church was rebuilt in 1665 and the other buildings, which form a quadrangle on its south side, date to 1733–49.

Wieliczka, where the salt is more important than the loess

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Wieliczka is small town (population: 20,000) situated in southeast part of the Kraków metropolitan area, in the area of Wieliczka Foothills mesoregion where the thin loess covers only the slopes of older Carpathian flysch rocks. There are no any known loess sections, only relief has the erosional features typical for loess regions (gullies). It is the area very susceptible to dangerous mass movement processes (especially landslides).

In the town and especially under the topographic surface is located “The Wieliczka Salt Mine” – one of the world's oldest operating salt mines, which has been in operation since the Middle Ages. The mine, built in the 13th century, produced table salt continuously until 2007, as one of the world's oldest salt mines still in operation. Commercial mining was discontinued in 1996. The museum “Wieliczka” Salt Mine is one of the most valuable monuments of material and spiritual culture in Poland. Each year it is visited by more than one million tourists from all over the world. It is also a world class monument, featuring among twelve objects on the UNESCO's World Cultural and Natural Heritage List.

The salt mine reaches a depth almost 330 metres and is over 287 kilometres long.

A staircase (378 wooden steps) provides access to the mine's 64-meter level. A section of the mine, some 22 chambers connected by galleries, is open to the public as a museum. The tourist route (3 km long – 2 % of the length of the mine's passages) leads through an eerie world of pits and chambers, all hewn by hand from solid salt. Some have been made into chapels, with altarpieces and figures, others are adorned with statues and monuments - all carved out of salt - and there are even underground lakes. The most famous is the ornamented Chapel of St Kinga, where every single element, from chandeliers to altarpieces, is of salt. Other highlights are the 36 m high Stanislaw Staszic Chamber with its panoramic lift and the salt lake in the Eram Baracz Chamber, whose water contains 320 g of salt per litre.

The rock salt is naturally gray in various shades, resembling unpolished granite rather than the white or crystalline look that many visitors may expect. The mine is a product of work of tens of generations of miners, a monument to the history of Poland and to the Polish nation – a brand, present in Polish consciousness for centuries.

Loess cover and Palaeolithic sites in Cracow

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Cracow city is commonly not associated with loess deposits because of its geological-gemorphological situation. Cracow is first of all associated with the Jurrasic limestones, which form the cores of hills occurring in the city centre, including the Wawel Hill with the royal castle on its culmination. In the past these limestones were main local building material. Their white colour is one of characteristic features of the oldest stone buildings of Cracow.

Loess covers in the Cracow area are the fragments of two main loess regions: Carpathian Foothills and Cracow Upland. They occur in the southern part of the city (Wieliczka-Gdów Plateau and Wieliczka Foothills), in its central part (Sowiniec Horst – Vistula and Rudawa interfluve), and in its northern part (Proszowice Plateau and Ojców Plateau) (Fig. 1A). Loess deposits form a mantle on the slopes and culminations of hills composed of the Carpathian flysch rocks or Jurrasic limestones. The only continuous and quite thick (up to 15 m) loess patch occurs in the edge zone of the Proszowice Plateau, near the Vistula River valley. The mentioned geomorphological units are characterized by different situation and structure of loess. In the southern and central part of the city the loess covers occur in relatively high hypsometric positions (100-120 m over the modern floor of the Vistula River valley), at the altitude of over 300 m a.s.l. (i.e. Sowiniec Horst: 320-380 m a.s.l). The northern part of the city (Nowa Huta) is situated on the loess terrace and plateau with fertile steppe chernozems reaching here their westernmost extent in Poland. All mentioned loess areas of Cracow are characterized by typical loess relief of erosion and erosion-denudation nature.

In the oldest part of Cracow the loess patches occur on the Sowiniec Horst (Fig. 1B) overlooking the city. On the culminations of this massif there are two important mounds – historical monuments (each about 35 m high), together with the Austrian earth fortifications (19th century), and its slopes are cut by gullies and dry valleys following tectonic faults. Loess overlies the Jurrasic limestones and Miocene sandy-silty deposits. This is mainly the Vistulian loess of slope facies, commonly layered and sandy, in places underlain by older loess deposits with the Eemian soil in their top (Łanczont et al. 2013; 2014). The Vistulian loess is stratigraphically diverse that is accentuated by the occurrence of interstadial and interphase paleosols and numerous hiatuses. Several archaeological Palaeolithic sites found in the Sowiniec area are buried under loess deposits. The northern slopes of the horst are especially noteworthy because two important archaeological sites (Zwierzyniec and Spadzista) are situated there (Fig. 1B). The latter is the most known Palaeolithic loess site of open-air type in Cracow.

The most important unit in the loess deposits of the Kraków-Spadzista site is an intraloess set of 2-3 initial gley paleosols, which is correlated with the younger part of MIS 3. These soils were formed in cold periglacial conditions, in open, mosaic steppe landscape, with groups of coniferous trees in refugia and willow shrubs in valley bottoms. The soil deposits are disturbed to varying degrees by solifluction, and very rich in artefacts (mainly mammoth bones, but there are also found bones of arctic fox, bear, wolf, woolly rhinoceros and horse, as well as flint tools) forming the Gravettian cultural layer. The site is often seen as a classical example of Late Gravettian (Willendorf-Kostienkan) settlement known from Central Europe, but it strongly differs from other Gravettian sites dated to 25-20,000 ka BP because of its very high proportion of shouldered points (Wilczyński et al. 2012). Also the presence at the Kraków Spadzista site of a massive woolly mammoth bone accumulation is striking, as the mammoth remains dominate at the whole site (Wojtal, Sobczyk 2005). This site was frequently inhabited during short term visits in the period 25-20 ka years BP (Wojtal, Sobczyk 2005; Wilczyński et al. 2012). On the base of analyses of lithic materials, faunal remains and radiometric data it was possible to conclude that Krakow Spadzista site was frequently inhabited, during few weeks or months, by groups of Gravettian hunters. The analysis allowed to identify three possible activity zones, which are characterized by presence of different groups of flint tools, bone/ivory tools, fireplaces and different faunal assemblages. It is possible to distinguish zones: of camp area, of lithic workshop and animals processing area and the last one - accumulation of mammoth bones. Location of the camp was probably conditioned by mammoth migrations along the watershed ridge between the Vistula and Rudawa rivers, as well as by hunting practices. The camp was located in the karst depression near the high tectonic edge of the Sowiniec Horst (Łanczont et al. 2013, 2014).

This geoarchaeological study was partly supported by the project no 691–N/2010/0 from the Polish Ministry of Science and Higher Education.

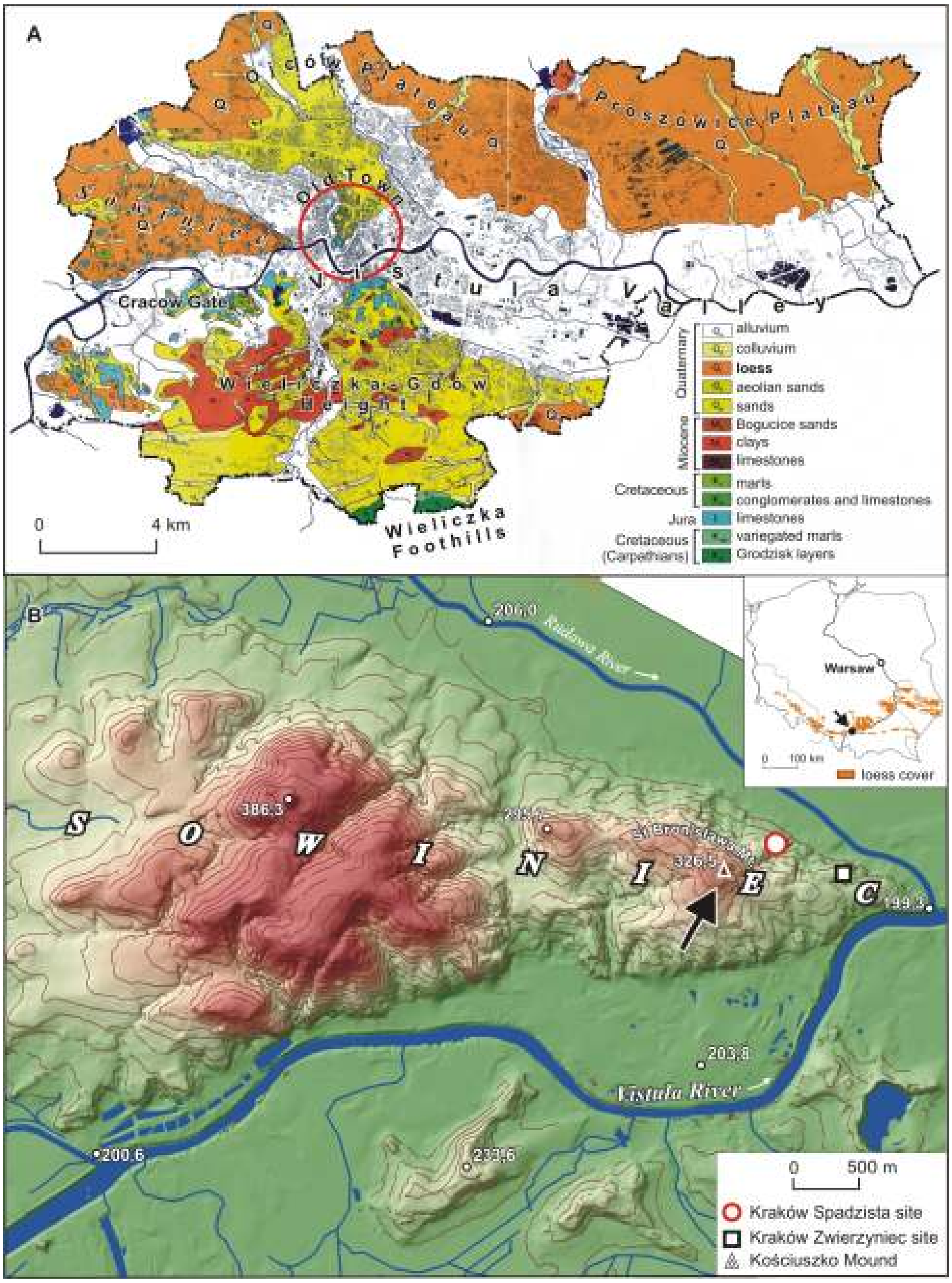

Fig. 1. Loess in the Cracow area: A) simplified geological map (Gradzinski and Gradzinski, 2013); B) hypsometric model of the Sowiniec Horst after Lanczont et al. (2014)

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Day III - 12th September, Friday

- **A** Cracow
- **B** Jaksice (Vistula river loess terrace and Gravttian archaeological site)
- **C** Koprzywnica (Cistercian church of St. Florian)
- **D** Złota (loess section, vineyard and apple gardens)
- **E** Sandomierz

163 km

Loess terrace and Gravettian artefacts at Jaksice (Vistula Lowland, Sandomierz Basin)

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The Gravettian site at Jaksice is connected with the loess terrace of the Vistula River. Such terraces commonly occur in the valleys of big rivers of the South Polish Uplands. In 2013 the archeological excavations at the Jaksice site were carried out together with geological and geomorphologic works (Wilczynski et al. 2014). It is a good example of the cooperation between archaeologists (Cracow) with (palaeo-) geographers (Lublin).

Village Jaksice is located in the left-bank part of the Vistula River valley, where two geomorphological units belonging to the Sub-Carpathian Sandomierz Basin meet, namely the asymmetric valley (part of the mesoregion called as the Vistula Lowland) and the Proszowice Plateau, which borders on the Miechów Upland (part of the Malopolska Upland) in the north (Fig. 1A). The Proszowice Plateau, covered by a thick loess mantle, descends to the Vistula River valley forming a 30-50 m high edge. In places an additional relief element occurs, the loess terrace (called also the middle terrace), which forms a narrow (0.2-1 km) bench with slightly inclined surface rising 13-15 m over the modern river's water-level. In the Jaksice vicinity the terrace edge has a winding shape, which was formed due to undercutting by the Vistula River's meandering channel in different periods. At the foot of the plateau edge (and terrace) there is a floodplain cut by a system of palaeochannels belonging to several generations. Isolated meander hills, which are the remains of a loess terrace, rise over this floodplain on the right bank of the Vistula River, to the west of Jaksice (Gebica, 1995; Starkel, 2001; Gebica, Starkel, 1987).

The archaeological site is located where the loess terrace is wedging out to the east, and the bottom of the Vistula River valley directly borders on the edge of the Proszowice Plateau, which forms a narrow, clearly isolated upland patch occurring between the Vistula River and its left-bank tributary, the Szreniawa River (Fig. 1A). The upland relief is characterized by great relative heights and a dense net of dry erosion-denudation valleys. That is why the former loess plateau is cut into many hills of a remnant nature. Almost opposite the site is the confluence of the Raba (a Carpathian river) and the Vistula rivers. The Vistula River channel is directed to the north, to the contact zone with the Proszowice Plateau, by an alluvial fan of the Raba River (and by fans of other Carpathian tributaries).

The Jaksice II site is located in the easternmost part of the Pleistocene loess terrace, which is a relatively narrow bench snuggled against the eastern side of the Proszowice Plateau between the Vistula and Szreniawa rivers. It is located on the scarp of a road gully, at the mouth of a complicated system of erosion-denudation valleys. These valleys cut the loess cover of the interfluve and almost surround a loess remnant hill (Gajówka Mt., 264.8 m a.s.l.), one of several isolated hills (separated by the erosion-denudation valleys) ringing the site area from the north. These hills form a narrow, over 10 km long watershed belt running from Smilowice (280.7 m a.s.l.) through Jaksice to Witów (Szreniawa River mouth) in the east with the culminating point named St. Tekla's Mt. (250.2 m a.s.l.) (Fig. 1B). Relative heights in the edge zone reach 100 m.

The above-mentioned dry erosion-denudation valley at Jaksice is the largest form of such type in the edge zone of the described area. Its lower section has a wide and flat bottom. The longer (~ 800 m), western part of the erosion-denudation system reaches the watershed where it meets a similar, even more complicated and longer (~2 km) valley system opened directly to the Szreniawa River valley. The junction of both valleys could function as an ecological corridor crossing the watershed high elevation.

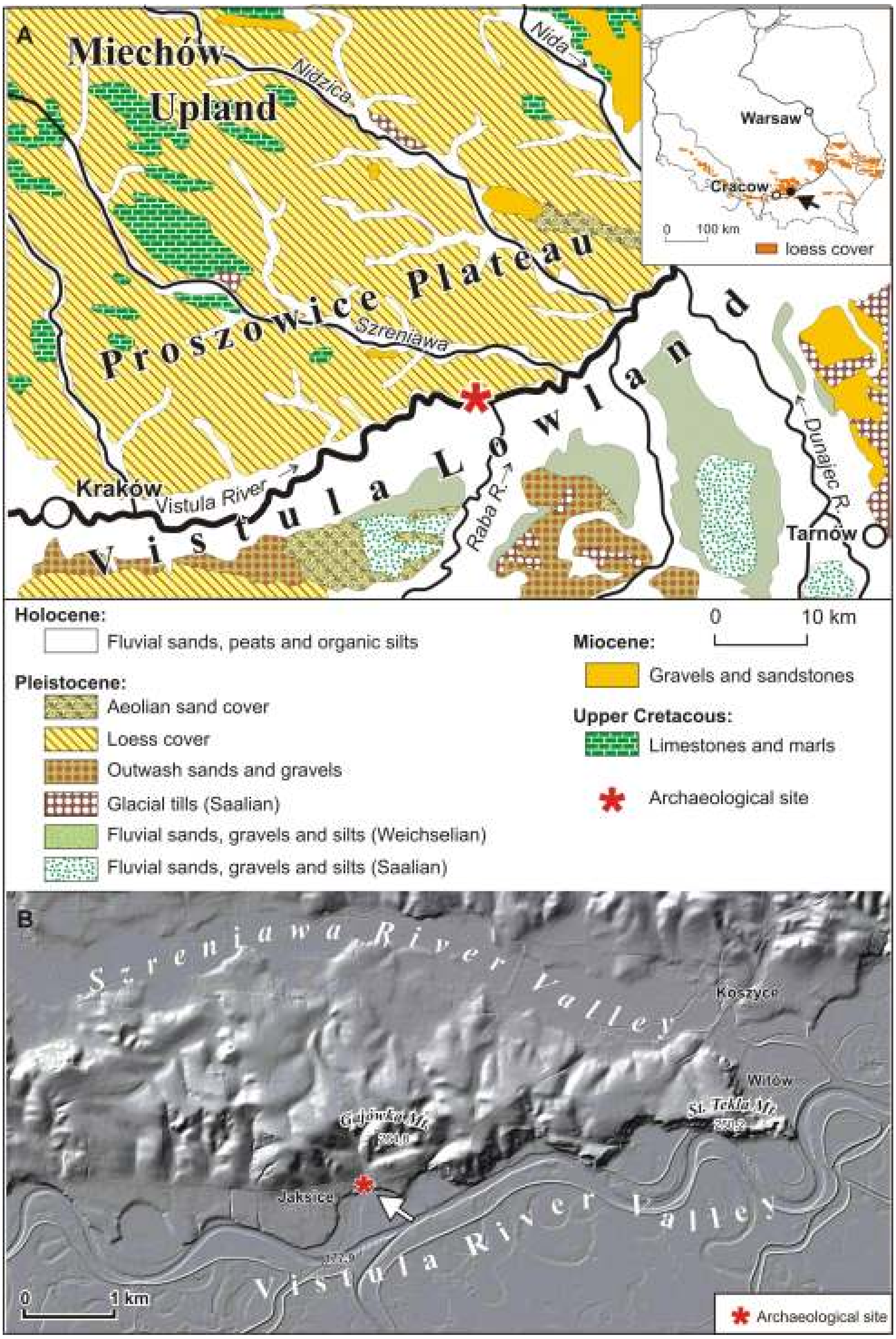

Fig. 1. Loess cover in the vicinity of Jaksice (after Wilczynski et al. 2014 – modified): A) surface rocks; B) shaded relief map

Results of geoarchaeological studies, recently published by Wilczynski et al. (2014), show that the site was part of a hunting camp inhabited by groups of Late Gravettian hunters 24,000-20,000 14C yrs BP. Archaeological and palaeontological assemblages consist of, among others, ivory artefacts and manufacturing debris, mollusc shell pendants, hematite fragments, and numerous backed lithic artefacts. The site also yielded a great quantity of bone remains from woolly mammoth and reindeer, which vastly outnumber the remains of other mammal species. These two species were the main sources of meat and raw material for the Gravettian hunter-gatherers at this site. The lithic assemblages include certain forms characteristic of Eastern European Gravettian sites (such as numerous backed artefacts, especially rectangles). The archaeological artefacts occur on the surface of interstadial brown soil developed on fluvial deposits. This palaeosol (and Gravettian layer) is covered by periglacially deformed, almost 7 m thick loess layer.

This geoarchaeological studies were partly supported by the project no 691–N/2010/0 from the Polish Ministry of Science and Higher Education.

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Zlota – last interglacial-glacial loess-soil sequence near Wisla river

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The Zlota profile is situated in the marginal, eastern part of the Sandomierz Upland, 7 km south-west of Sandomierz, just next to the Sandomierz-Cracow national road (? = 21°39'45''E, f = 50°39'15''N). It is the upper part of the left slope of the Vistula River valley at the height of 172 m above sea level, about 20 m above the modern valley bottom.

There are two separated and independent outcrops distant from each other by 60 meters. The old loess exposure is situated in the brickyard inactive nowadays. Another quarry was illegally created in 2010. The older profile (Samborzec or Polanów Samborzecki) has been studied for a long time, but the first detailed results were presented by Grykierczyk and Waga (1993) and Dolecki with Lanczont (1997, 1998, 2001). The palaepedological description was published by Konecka-Betley (2005), micromorphological data - Mroczek (2008), selected TL datings – Kusiak (Kusiak, Lanczont 2000; Kusiak 2007). Palynological characteristic of lower units were presented by Komar et al. (2009). Complex palaeogeographic interpretation based on selected multi-proxy analyses was published by Jary (2007).

The new loess quarry (created in 2010) has been presented to participants of International Workshop "Closing the gap - North Carpathian loess traverse in the Eurasian loess belt", (6th Loess Seminar in Wroclaw, May 16-21 2011).

Detailed pedosedimentary sequence with short description of the basic units is presented on figure 1.

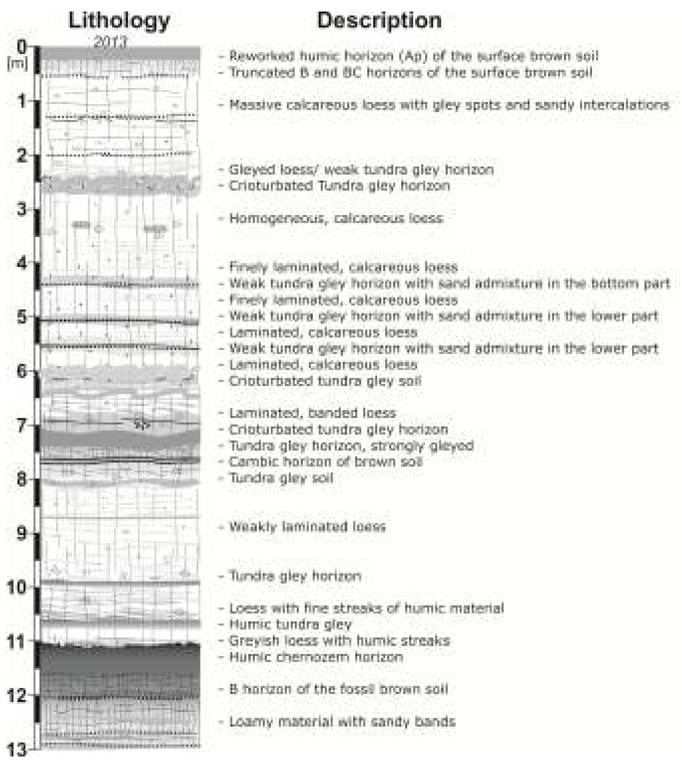

Fig. 1. Pedosedimentary sequence and description of the basic units in the Zlota loess section

The 13 m high profile in Zlota consists of five litho-pedostratigraphic units (Fig. 2) developed during the Late Pleistocene and Holocene: two polygenetic fossil soils/soil sets (S1 and L1S1) and two calcareous loess units (L1L1, L1L2). In the top of the younger loess unit recent soil has developed (S0).

The S1 pedocomplex in Zlota consists of two main genetic horizons:

- a thick welded humus A horizon (chernozem type),
- a B horizon of brown forest soil.

The dark gray humus A horizon of the granular structure is from 0,4 to 0,6 m thick within the Zlota loess exposure. There are usually two welded humus subhorizons separated by a weakly noticeable erosion surface. Below this horizon the remainders of eluvial and poorly preserved gray humus accumulation horizon of the forest soil can be noticed in some places. The B horizon is brown with a characteristic prismatic or blocky structure. It is distinctly deformed by bioturbations. The record of illuviation processes is much weaker in the lower part of B horizon. The parent material of the pedocomplex consists of alluvial loam. The humus A and upper part of B horizons are decalcified. In the lowermost part of S1 pedocomplex strong enrichment of carbonate is recorded.

Several stages of soil formation within S1 pedocomplex in loess-soil sequence in Zlota can be distinguished. The first stages are connected with forest type pedogenesis. Usually this type of soil forming processes is correlated with the Eemian Interglacial (MIS 5e). However in the case of Zlota, the Early Weichselian forest stage cannot be excluded. The final stages of chernozem type pedogenesis are most probably related to both Early Weichselian Interstadials Brorup and Odderade (MIS 5c and MIS 5a) or only to the last one.

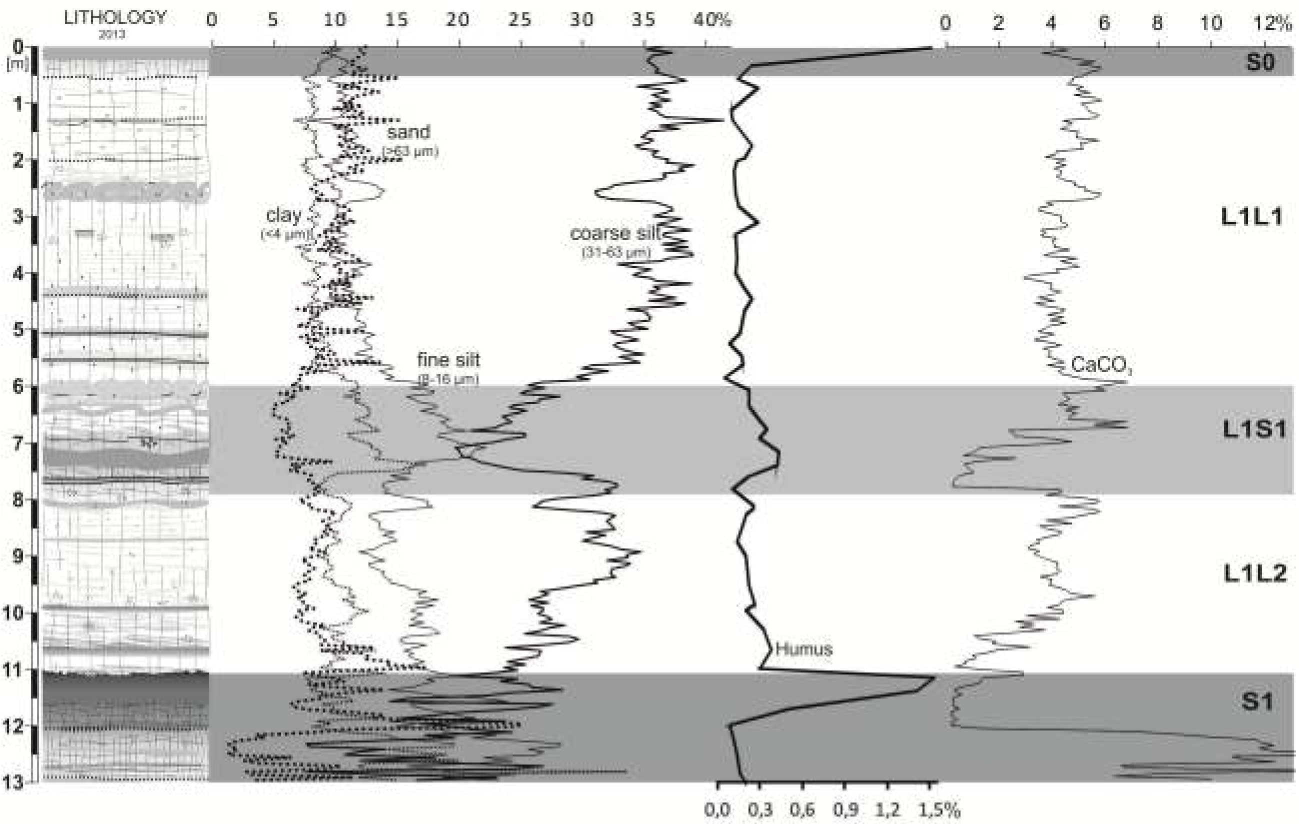

Fig. 2. Lithology, grain-size characteristics and content of humus and calcium carbonate in Zlota loess-soil sequence (S0,L1L1,L1S1,L1L2,S1 - labelling system acc. Kukla and An, 1989, modified by Markovic et al., 2008)

The stages of S1 formation were interrupted by phases of cold continental climate. These cold and dry phases are recorded by wedge-like structures interpreted as the cryogenic wedges with primary mineral infilling. Wedge-like structures in Zlota section are filled with dark, humic material derived from the chernozem horizon. The period of pedocomplex formation was terminated by sudden climate deterioration. The topsoil parts were strongly eroded.

The thickness of L1L2 loess unit in the Zlota section exceed 3 m in some places. The considerable thickness and diversity of L1L2 unit is Zlota is connected with the location of this section in the marginal zone of loess cover. The close proximity to the Wisla river valley and the presence of morphological edges favored the processes of loess deposition and local redeposition. L1L2 unit is separated from the lower S1 unit by erosion boundary. There are several incipient gley/humus horizons within L1L2 unit in Zlota, which confirmed previous observations from Polanów Samborzecki (Dolecki and Lanczont, 2001; Dolecki 2002; Jary, 2007). They have usually limited extent and varied thickness - from several to dozen of cm.

The content of organic matter decreases towards the top of the L1L2 unit contradictory to the calcium carbonate content. The amount of CaCO3 in the lower part of L1L2 is close to zero, but there is an increasing trend towards the top. There are several subunits of L1L2 secondarily enriched with calcium carbonates. Its amount exceeds 6%(Fig. 2). Grain size distribution is highly variable in the lower part of the L1L2 unit and usually tend to be more homogeneous toward the top. The average particle size also increases upward.

The characteristics of the L1L2 loess unit in Zlota indicate that it was formed as a result of penecontemporary aeolian deposition and slope reworking. With a time dynamic of slope processes decreased and the rate of accumulation of dust relatively increased. The initial gley horizons observed within L1L2 unit in Zlota differentiate this unit into several stratigraphic subhorizons. They may evidence short-term, climate induced cyclic changes in loess deposition (Jary 2007, Jary and Ciszek 2013).

The thickness of the L1S1 unit reaches 2 m in the Zlota section. It consists cambic horizon and humic horizons of gley soils deformed by the cryoturbation and gelifluction. The presence of initial forms of colloidal clay concentration in cambic horizon in the neighbouring Polanów Samborzecki has been confirmed by micromorphological research performed by Mroczek (2008). The upper part of L1S1 soil in Zlota consist of carbonate, laminated loess and gley horizon deformed by periglacial processes. The lower part of L1S1 soil in Zlota section is carbonate-free and shows variation in different parts of the outcrop. Considerable diversity of L1S1 soil has also been registered in neighbouring Polanów Samborzecki by Grygierczyk and Waga (1993), and Dolecki and Lanczont (2001).

The thickness of L1L1 loess unit is usually very differentiated both on local and regional scale. There are six meters of L1L1 loess in the Zlota section. The variability of the L1L1 loess thickness is mainly a result of the processes of syn- and postdepositional redeposition. It is recorded in the lithology of loess showing stable and unstable periods during the loess accumulation. The most remarkable grain-size changes in the Zlota loess-soil sequence occur in the lower part of this unit (directly above the Middle Pleniweichselian soil unit L1S1). These parts of the section are usually deformed by cryogenic processes and show evidence of slope redeposition.

The L1L1 loess unit in Zlota profile contains considerable amounts of calcium carbonate (4-6%) – the highest among the Late Pleistocene loess (Fig. 2). It can be interpreted as a proxy of the relatively high loess accumulation rate as well as the degree of continentality of loess sedimentary environment (Jersak, 1973). However, the content of calcium carbonates in the vertical profile in Zlota is significantly differentiated. There are many alternating enrichment and depletion zones.

There are several weak tundra-gley horizons within L1L1 loess unit in Zlota, which are the evidence of the short climate variations in the time of loess accumulation. The most important is located ca 2,5 m below the present surface.

Grain-size analyses demonstrate systematic increasing of coarse silt (31-63 µm) fraction percentage towards the top of L1L1 unit in Zlota section. It is well expressed in the lower part of this unit. It can be interpreted as the evidence of growing rate of loess accumulation, which can be associated with fresh silt availability and decreasing distance to loess alimentation areas. The increasing content of coarse silt coincides with decreasing trend of fine silt (8-16 µm) and increasing trend of sand (>63 µm) percentages towards the top of the profile. There are several sandy layers within L1L1 loess unit in Zlota indicating the severe conditions during the L1L1 accumulation. The average content of clay (< 4 µm) is relatively stable ranging from 6 to 10%.

In the top of L1L1 loess unit the recent soil S0 occurs. The S0 soil in the Zlota section is represented only by a weak humus horizon reworked by agricultural activity and horizon with initial signs of pedogenesis below. The calcium carbonate content in these horizons is similar to the L1L1 unit ranging from 4 to 6%. There are no substantial changes in grain-size characteristics comparing with L1L1 loess. These features prove that probably 2-3 m of the upper part of former loess sequence in Zlota has been eroded presumably during the time of agricultural activity.

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Loess and wine at Zlota (Sandomierz Loess Region)

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The Vineyard "Winnica nad Jarem" is situated about 1.5 kilometer north-east from the Zlota loess section.

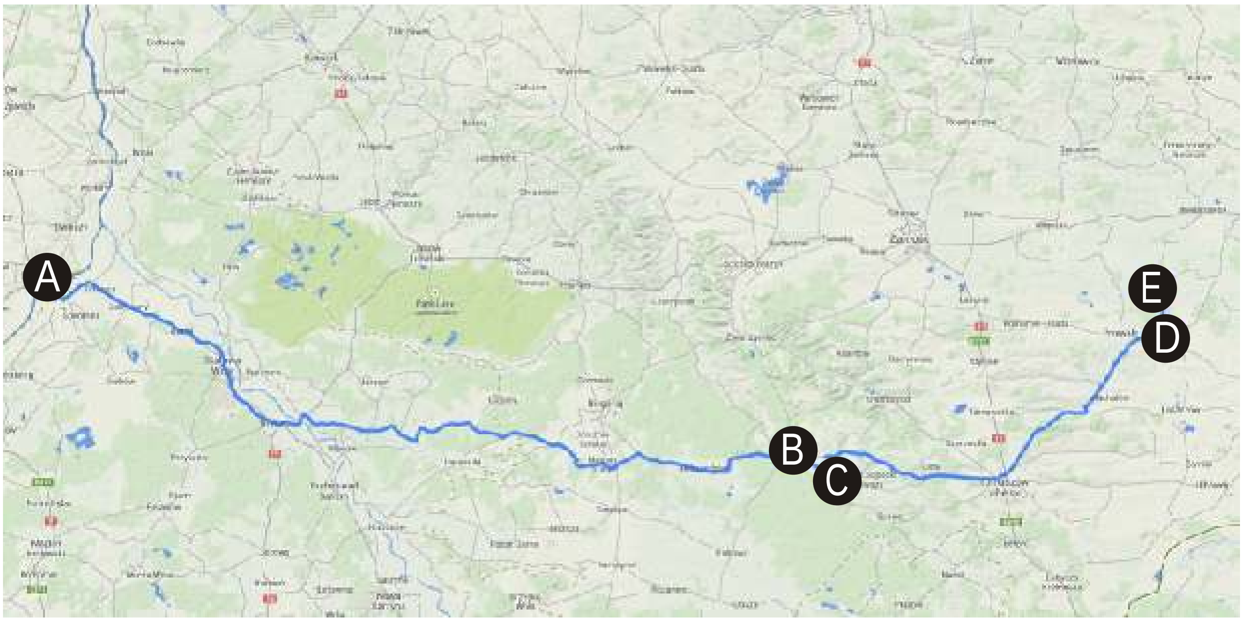
Wine production in Poland is a small industry with only several wineries registered to sell and produce grape table wines. There exists a very lively amateur winery and viticulture scene throughout the country with especially strong grouping in the regions near the Wroclaw in the south-west, Kraków in the south, the Podkarpacie region and Kazimierz Dolny in south-east. A large group of vineyard are located in areas with the loess regions in the belt of South Polish Uplands and in the Carpathians. The climate here is not very favorable for growing grapes. Additionally, the tradition of their cultivation is not long, but in the Middle Ages, vineyards were common in the convents (e.g. Kraków, Sandomierz, Lublin, Torun).

Plantation of grapes-bearing vines called "Winnica nad Jarem" ("Vinyard above the gully") has short tradition of wine production (2009). Vineyard is located on the loess south-oriented slope at an altitude ca. 190 m a.s.l. The first plantings made in 2009, they decided to same white varieties: Bianca, Muscat, Hibernal. In spring 2010, the new types were plant – Regent, Rondo, Zweigelt. In total, about 2,300 vine plants.

The soil cover developed on the analyzed loess slope is typical for Sandomierz loess region. There are well developed, fertile Luvisols, but partly eroded. The humus surface soil horizon is developed on primary Bt-argic horizon. The calcareous loess is on the depth about 1 meter. The climate is specific its selected mean annual values (2003-2013) are as follow: temperature: 8,8 oC; precipitation: 560 mm; number of days with: rainfalls - 141 and snowfalls – 55; duration of the vegetation season: 220 days.

Next to the vineyard are plantations of apple trees. Sandomierz region is known for its apple production.

Day IV - 13th September, Saturday



(A) Sandomierz Old Town

(B) Józefów (Late Weichselian dunes and Miocene limestones)

(C) Hamernia (waterfalls on Sopot River)

(D) Tyszowce (loess section)

(E) Czermno (Medieval stronghold and Pleistocene terrace of Huczwa River)

(D) Tyszowce

184 km

Loess and landslides in the area of Old Town Hill in Sandomierz

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Sandomierz (population: 25,000; area: 30 km^2) is one of the most famous Polish towns located on loess, with early medieval foundation. It is picturesquely located town on the edge of Sandomierz Upland, declining in the form of huge loess slopes into the Vistula valley and the Sandomierz Basin (lowland). The loess area where the town stands is cut through by a rich network of gullies – one of the best known is the Gully of Queen Jadwiga (~460 m long, up to 10 m deep and height difference ~50 meters) situated inside the center of town.

Relief of loess plateau in the vicinity of Sandomierz has an erosion character. In the loess literature, the town is known as the key-profile with the same name composed of loess-soil sequence reflecting the environmental changes of the last 5. isotope stages. This profile is no longer generally available. The Old Town occupies the loess promontory, at the end of which the royal castle is situated. Natural boundaries of the peninsula are loess edges, steeply sloping towards the bottom of the Vistula river valley.

Over the centuries, as well as nowadays in the town were recorded landslides, causing numerous damages of the building. Recent events of this type took place during the night July 26/27, 2011. Then, during the three hours was recorded torrential rainfall of 140 mm (total annual: 640 mm, average annulal 2003-2013: 604 mm). The changes in relief of slopes were documented around Old Town's Hill. The largest damages were reported on the south-east side, where completely destroyed were the concrete 25-meter height stairs (so-called. "Goat stairs") between the historic buildings: Collegium Gostomianum and House of Dlugosz (Fig. 1)..

Nowadays, a major tourist attraction of Sandomierz is the Old Town. The atmosphere of the town is unique, partly due to the split between its old and new sections, which are so explicitly separated from each other. The remnants of its enormously rich 10-century long history survive to this day in their original form. The density of architectural and artistic gems is remarkable in an area so small. Most of them are located in the Old Town (~1 km2), set in almost rural surroundings. Worth seeing are:

a. The Market Square with its Gothic Cathedral - constructed in 1360, renovated in the baroque style in the 18th century. The church was erected on the place of the original Romanesque collegiate church (mentioned since 1148), which was destroyed during the Mongolian (13th c.) and the Lithuanian (1349) invasions. The interior of the church is decorated with a complex of magnificent rococo altars (second half of 18th c.) at aisle piers. On the walls of the aisles there is a set of 16 paintings, of which twelve create the "Calendarium" cycle, whereas four paintings under the gallery present scenes from the history of Sandomierz (1708-37). In the treasury of the Cathedral there are numerous incunabula and the Reliquary of the Holy Cross Tree offered to Sandomierz Collegiate church by the King Ladislaus Jagiello who thus acknowledged the merits of the Sandomierz knighthood in the Grunwald battle (1410).

b. The Gothic Town Hall (1349) later redesigned into a form of an extended rectangle and topped with an attic in the Renaissance style (17th c.). There are the section of the Regional Museum, Club of Sandomierz Cultural Society, presentable rooms of the Town Council and the Office of Civil State.

c. The royal-founded brick and stone Gothic Castle - erected on the place of the former fortress from the 10th century. In 1525 it was transformed into a Renaissance residence. Originally it consisted of four wings embracing an arcaded courtyard. The castle was blown up by the Swedish army in 1656. Only the western wing was preserved and was used as a prison since 1821. Now it is the seat of the Regional Museum.

d. The House of John Dlugosz - an old mansion founded in 1476 by John Dlugosz (Polish priest, chronicler, soldier, diplomat, historian and the author of the first history of Poland). The building has two and a half room lines and a spacious hall to which two late Gothic portals lead. In the 16th century the building was topped with an attic. In the years 1934-1936 it was overhauled and "regothicised". Since 1937 the collections of the Diocesan Museum have been situated here. The most interesting exhibits are: the Gothic painting "the Three Saint Women", the painting "the Virgin Mary with the Holy Infant" by Lucas Cranach, the sculpture "the Virgin Mary on the Throne" (13th c.), a collection of liturgical garments (15-18th c.) and miniature organs (17th c.).

e. The Opatowska Gate – built in the 14-16th centuries – one of the best preserved town gates in Poland. Close by there are remains of the mediaeval city walls, including so-called "Needle's Eye".

f. The Underground Tourist Route – consist of underground merchant cellars from 15-17th centuries, stretching under the town-houses situated in the Market Squere, about 500 m long. The deepest level is at 12 m.

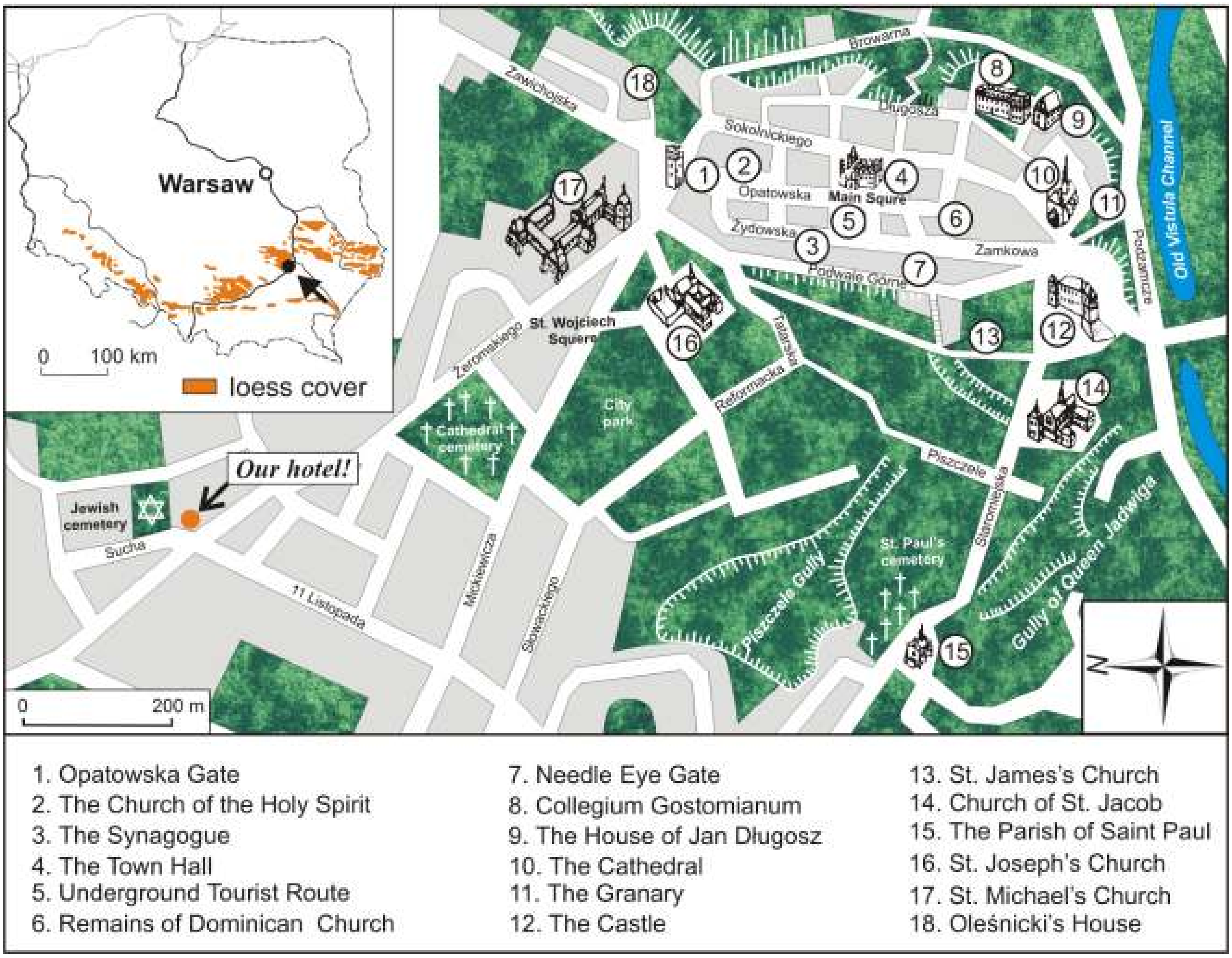

Fig. 1 Centre of Sandomierz

Fluvio-aeolian succession in the Józefów site (Tomaszów Roztocze)

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The Józefów site is located within a small parabolic dune (3 m high and 450 m long), which is a SW edge component of the dune complex oriented WNW-ESE (Fig. 1B). This form closes the mouth of the denudation valley, opening to a basin-like lowering between the inner and outer hills of the southern edge of the Tomaszów Roztocze, to the SE of the village of Józefów (Fig. 1 A). It is a small flat-bottomed basin-like valley, 1.8 km long and 150-300 m wide. From the north two smaller valleys open into it. The surface area of the catchment above the site is approx. 3.75 km2 with the relative height of 31 m. This area is built of deluvial and fluvial sands that fill up the depression and denudation valley. The hill and plateau slopes are built of Upper Cretaceous gaizes and Neogene detrital limestones, at places covered with glacial till.

In the outcrop dissecting the dune and the deposits in its substrate, three lithofacial complexes have been documented (Fig. 1 C):

1. The fluvial complex, which consists of two cycles of sedimentation, with the decreasing scale of the lithofacies up the profile. The lower cycle is formed of sands of the medium-scale diagonal trough stratification (St). Within this cycle, syngenetic ice-wedge casts and common fine fissure structure were recorded.

The upper cycle is built of variously-grained sands showing medium- and small-scale diagonal trough stratification (St). Laterally they transit into the horizontally stratified sands

(Sh). The contact with the underlying cycle is erosion-deformative, underlined by the presence of small (1-5 cm diameter) and slightly rounded clayey intraclasts involved in the large-scale involutions. The ceiling of the unit is built of fine-grained sands of ripplemark lamination (Sr) and silty sands of wavy lamination (SFw). Similarly to the bottom of the cycle, there are syngenetic ice-wedge casts. The measurements of structural direction elements indicate a clear dominance of the western direction.

2. The fluvio-aeolian complex is composed of sands and fine- and medium-grained, horizontally stratified sands (Sh), with interbeds of silty sands of wavy lamination (SFw) or ascending ripplemarks (SFr(c)). Sporadically there are sands with a diagonal trough stratification (St) of the medium-scale or even single medium- or small-scale troughs. Moreover, sets of sands of the translational stratification as well as climbing-adhesion-ripple structures. Within this complex, three generations of small-scale involution structures were found. Within the highest level of involution there are water-escape structures. The orientation of directional elements is variable; however, two directions W and ESE can be delimited, with the western direction represent mainly by the trough structures. At the top of that complex a weakly developed buried soil is preserved, indicating stabilization of land surface at the end of fluvio-aeolian sediments deposition. The paleosol shows variability of morphology along the exposure. In the eastern part it consists of 5-10 cm thick humus horizon with characteristic "finger-like" structures often met in so called "Usselo" paleosol. Such morphology suggests an initial estimate for the age of the buried soil as the Late Glacial (presumably Allerød?). In the middle part of the exposure the humus horizon disappears and only lack of stratification in a 10-15 cm thick zone and post-gleyic Fe mottles represent lower part of a truncated soil.

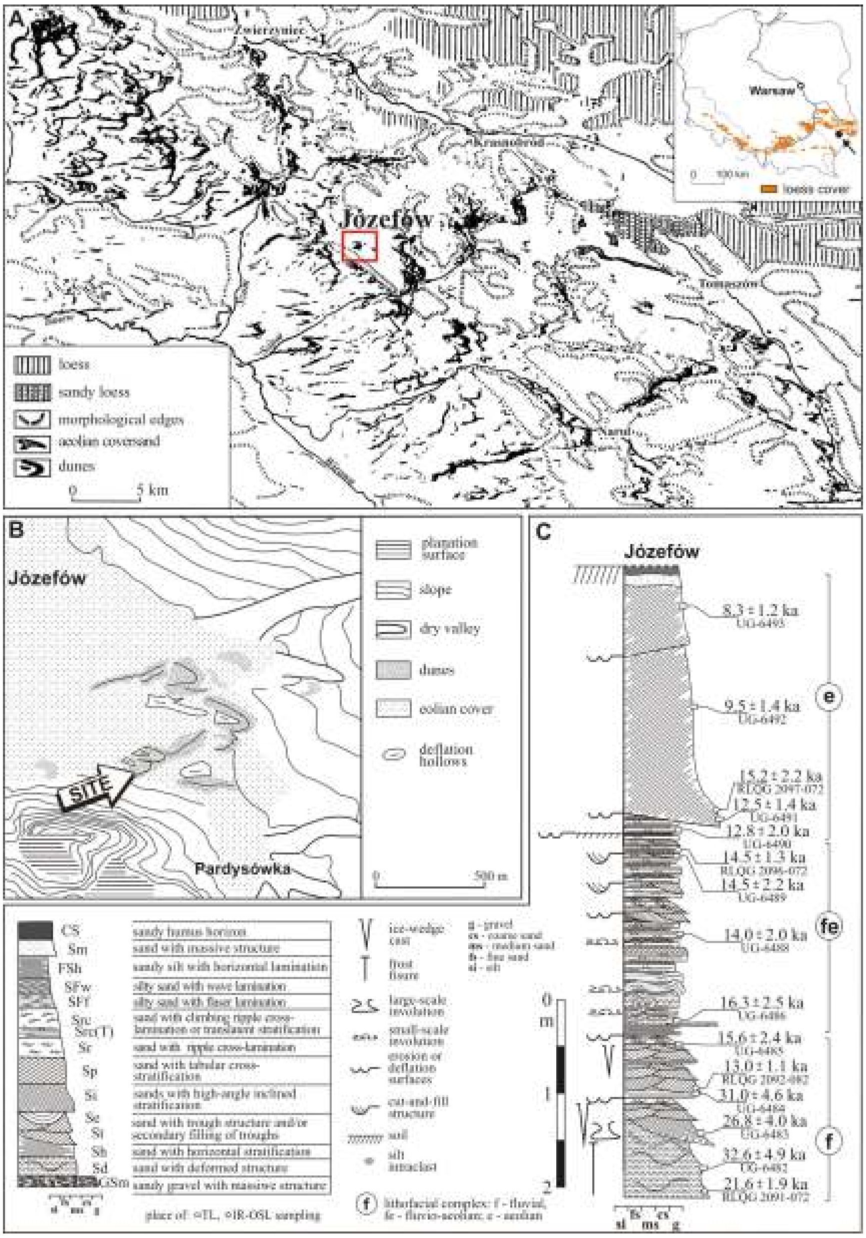

Fig. 1. Location of the study site in relation to (A) dune distribution in the Roztocze Tomaszowskie Region according to Buraczynski (1993) and (B) geomorphological situation of the site vicinity. (C) Sedimentary succession at the study site, with location of periglacial structures and TL and IR-OSL ages of deposits

3. The eolian complex consists of two lithofacial sets. The lower level is built of the loamy-sandy rhythmite with horizontally stratified sand (Sh) and sandy loams of the horizontal (SFh) or wavy lamination (SFw), or massive structure (SFm). This level is discontinuous. Its upper limit is a concave erosion surface. The upper complex builds the bulk of this complex. It is built of medium- and fine-grained sands with the diagonal inclined stratification (Si), with the large-scale reactivation surfaces. The structures of the upper lithofacial complex generally exhibit the eastern orientation.

The presented sedimentary profile was dated using the TL and IR-OSL methods. The fluvial complex is described by the dates 46.9±7.0 ka in the bottom cycle, as well as 32.6±4.9 and 26.8±4.0 in the upper one. In contrast, the IR-OSL dates give a significantly younger age: the lower cycle - 21.6±1.9 ka, and the upper one - 13.0±1.1 ka. The fluvio-aeolian complex was dated using the TL method at 16.3±2.5 to 14.0±2.0, while using the OSL method at 14.5±1.3 ka. For the aeolian complex the following TL dates were obtained: 13.1±1.7 ka in the lower lithofacial set and 12.8±2.0 to 8.3±1.2 ka for the upper set. In addition, at its bottom the IR-OSL date of 15.2±2.2 ka was obtained.

The studied succession is the result of filling up a small dry valley at the end of the Weichselian. It was formed by the interaction of two sedimentary environments - fluvial and aeolian. Initially the deposits were accumulated in a shallow sand-bottomed braided river, which functioned in the permafrost conditions associated with the progressive cooling in the Pleniglacial.

At the end of the Pleniglacial the nature of deposition changed into the fluvio-aeolian. The fluvial deposition was limited only to the episodic flows that re-deposited the wind-accumulated sediments. This situation was made possible by the gradual degradation of permafrost, which increased drainage, and thereby the upper part of the alluvial deposits got overdried. This accumulation cycle was completed by the development of vegetation, the effect of which is the level of a fossil soil.

In the Late Glacial the two-phase aeolian accumulation dominated. In the Older Dryas the sand-silty cover was accumulated, while in the Older and Younger Dryas as well as early Holocene sands were deposited within the mobile dune. This was related to the total disappearance of permafrost.

The investigations at the Józefów site were supported by the grant NN 306 197639 from the Polish Ministry of Science and Higher Education, and continued under the statutory research funds of the Faculty of Earth Sciences and Land Management of the Maria Curie Sklodowska University, Lublin, Poland.

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Nature Reserve “Czartowe Pole” (the Sopot River valley, Tomaszów Roztocze)

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The Czartowe Pole Nature Reserve is situated in the valley of Sopot – smalll river of Tomaszów Roztocze. The Sopot River valley transversely cut southwestern part of the region. Rock shoals are uncovered in the bed of river and they form two series of thresholds (Polish szypoty – transverse rock thresholds). The first series is eroded in Upper Cretaceous gaizes, and the second one in Tertiary organodetritus limestone. The azimuth of the thresholds is NW-SE and they are linked with the run of the Roztocze region. The heights of the thresholds are less than 1.0 m. The highest of them are in the beds cut in Miocene rocks.

The Czartowe Pole Nature Reserve is named after a legendary meadow on which the devils (Polish czarty) were once believed to dance and play. Polish term “szumy” means picturesque rock thresholds in Roztocze region which stacked like stairs, where the cheerful sound of falling water is heard. These thresholds can be admired in several places on the gap sections of Roztocze rivers.

Strictly protected is the area of 26.66 hectares. The highest part of the steep slopes of the river valley is covered by the pine forest extending below into the mixed moist coniferous forest (dominated by pine, spruce and fir). The bottom of the valley is covered mainly by riparian forests (found here alder), and in places marshy meadows.

Educational and nature trail leads through part of the reserve "Czartowe Pole" under strict protection and introduces visitors natural, landscape and cultural values of this magical place. The path is well organized for the tourists; there were constructed wooden stairs, platforms and handrails to help navigate.

The path has a length of approx. 1.4 km. On the route we find, among the others, a monument erected in 1931 by soldiers of the Officers School staying here during the summer maneuvers. Today it is a place of national memory devoted partisans fighting in the vicinity with the German occupiers. there are also the ruins of an old iron-mill (an old forge) of the Zamoyski Family Fee Tail.

Tyszowce loess section – the huge L1L1 loess accumulation and three generations of ice wedge casts

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The Tyszowce section (? = 23°42'45''E, f = 50°36'30''N) is located in the north part of the Sokal Plateau-Ridge which is a latitiudinal cretaceous hump with thick (10-30 m) loess cover. From the north and south the region is limited by distinct edges to over ten meter high. The profile at Tyszowce is located at the height of 226 m above sea level in the northern margin of loess cover, close to the Huczwa River about 30 m above the modern valley bottom.

The loess at active brickyard locally reach a thickness of 19 m. The stratigraphy was presented more closely elsewhere (Maruszczak 1974; Wojtanowicz, Buraczynski 1978). The latest characteristic of the section was also published by Jary (2007).

The Tyszowce profile can be considered as the representative for loess of the Sokal Plateau-Ridge. It is characterized by the occurrence of numerous fossil soils, horizons of cryogenic structures and lithologically differentiated layers. The description of the section concerns only the Late Pleistocene sequence.

The data presented below have been gathered during the last stage of research performed in Tyszowce quarry. In November 2012 nineteen-meter thick Late Pleistocene loess-soil sequence was excavated.

The 19 m high section in Tyszowce consists of five litho-pedostratigraphic units (Fig. 1) developed during the Late Pleistocene and Holocene: two polygenetic fossil soils/soil sets (S1 and L1S1) and two calcareous loess units (L1L1, L1L2). In the top of the younger loess unit recent soil has developed (S0).

The S1 pedocomplex in Tyszowce consists of two main genetic horizons:

- a thick welded humus A horizon (chernozem type),
- a Bt horizon of leached brown forest soil.

The dark brownish gray humus A horizon of the granular structure is from 0,4 to 0,8 m thick within the Tyszowce loess exposure. Below this horizon the eluvial horizon of the lessivage soil can be noticed in some places. The B horizon is brown with a characteristic prismatic or blocky structure. The humus A and Bt horizons are decalcified.

Similar to Zlota section, the stages of S1 formation were interrupted by phases of cold continental climate recorded by development of wedge-like structures interpreted as the cryogenic wedges with primary mineral infilling. These wedges are filled with dark, humic material derived from the chernozem horizon. The upper parts of S1 were strongly crioturbated and eroded as a result of sudden climate deterioration which terminated the period of pedocomplex formation.

The thickness of calcareous L1L2 loess unit in Tyszowce section is differentiated (from 1 to 3 m). The content of organic matter decreases slightly towards the top of the L1L2 unit. The amount of $CaCO_3$ exceeds 8% (Fig. 1). Grain size distribution is highly variable in the lower part of the L1L2 unit. The average particle size increases upward.

The thickness of the L1S1 unit reaches 2 m in the Tyszowce section. It consists cambic horizon and gley humic horizons deformed by cryoturbation and gelifluction. In some places L1S1 soil is almost completely eroded. The carbonate content in the lower part of L1S1 soil in Tyszowce is significantly reduced.

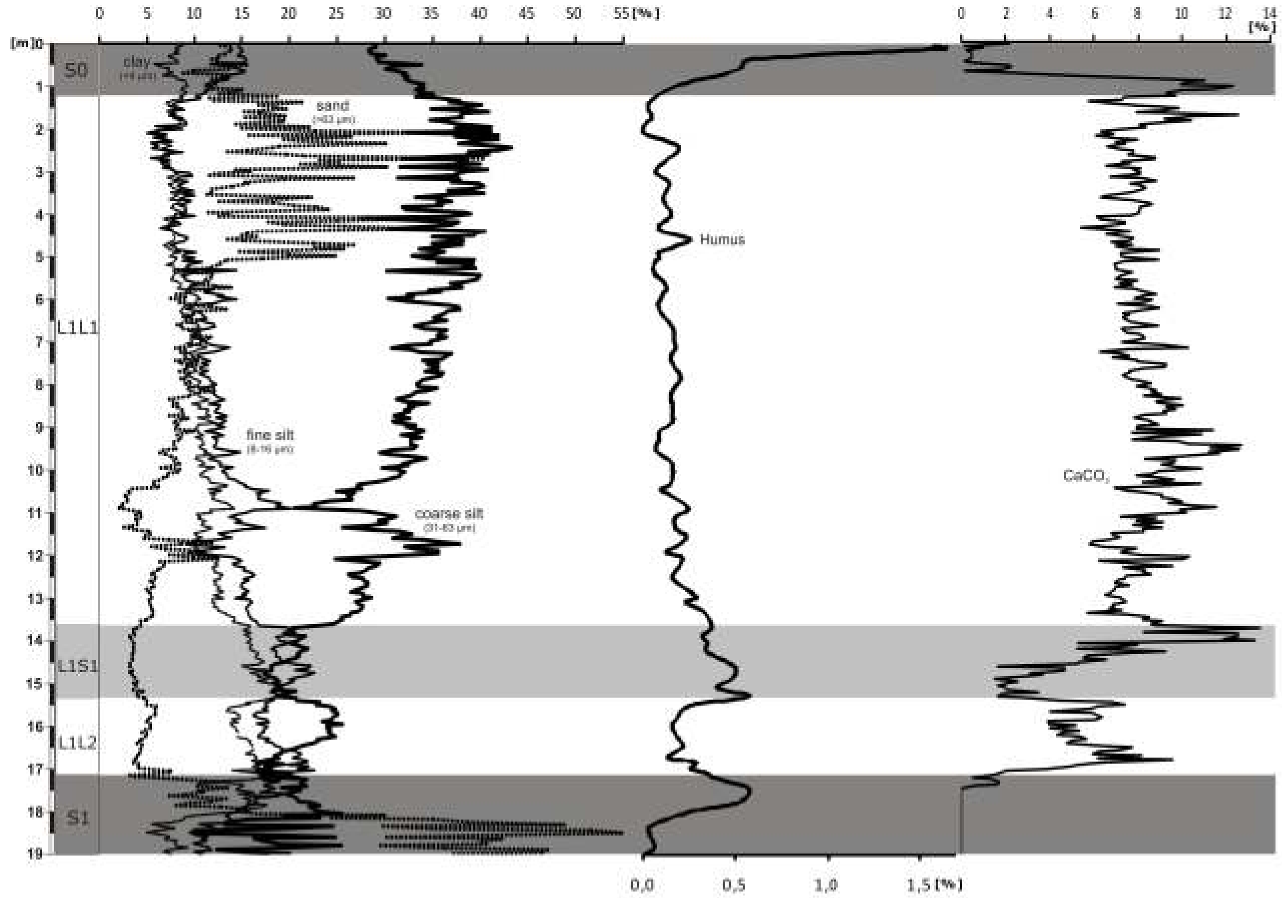

Fig. 1. Grain-size characteristics and content of humus and calcium carbonate in Tyszowce loess-soil sequence (S0,L1L1,L1S1,L1L2,S1 - labelling system acc. Kukla and An, 1989, modified by Markovic et al., 2008)

The thickness of L1L1 loess unit in Tyszowce section is differentiated but usually considerable. In the vertical section excavated in 2012 it exceed 13,5 meters. This calcareous loess unit is interbedded by several tundra gley horizons in the Tyszowce section. The L1L1 loess unit in Tyszowce profile contains considerable amounts of calcium carbonate (6-12%) – the highest among the Late Pleistocene loess (Fig. 1). It usually confirms the high loess accumulation rate as well as the degree of continentality of loess sedimentary environment. The content of calcium carbonates in the vertical profile in Tyszowce is significantly differentiated. There are many alternating enrichment and depletion zones.

Grain-size analyses demonstrate systematic increasing of coarse silt (31-63 µm) fraction percentage towards the top of L1L1 unit in Tyszowce section. It can be interpreted as the evidence of growing rate of loess accumulation, which can be associated with fresh silt availability and decreasing distance to loess alimentation areas. The increasing content of coarse silt coincides with decreasing trend of fine silt (8-16 µm) percentages towards the top of the profile. There are several sandy layers within L1L1 loess unit in Tyszowce indicating the severe conditions during the L1L1 accumulation. In the upper part of L1L1 loess unit the content of sand reaches 15-30%. The average content of clay (< 4 µm) is relatively stable ranging from 6 to 12%.

In the top of L1L1 loess unit the recent soil S0 occurs. The upper part of former loess sequence in Tyszowce has been partly eroded during the time of agricultural activity.

Tyszowce loess section is a unique site where three generations of ice wedge casts were noticed.

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The fluvial sediments as the potential source of loess material – case study: Huczwa River terrace (stronghold at Czermno, Hrubieszów Basin)

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Czermno is the small village in the eastern part of Lublin Voivodship, but it is very important archaeological site. According to historians in the early Middle Ages, Czerwien/Czermno was one of the largest and most important centre (capitol) of Cherven Towns region. The area of the entire complex is estimated between approximately 75 and 150 hectares; a part of this area is marshy and waterlogged. Almost 30 yares ago, the discovery was made to the north-west of the earthwork of relics of timber causeways (presumably they linked open settlements established on the holms rising within the marshy valley of the Huczwa). These causeways were dated by dendro-chonology to the period 12th-13th century.

Started in 2013, the cooperation of archaeologist with Quaternary geologists in exploration of Czermno can not only give the answer about the stronghold location. The geoarchaeological analysis of the site can also explain the origin of loess dust sources accumulated in Pleistocene (Weichselian) on the neighbouring loess mesoregions.

The site at Czermno comprises the main stronghold, situated on a well-drained holm between the channel of the Huczwa River (tributary of the Bug) and its small tributary – Siniucha River (Fig. 1A).

From geomorphological point of view, the stronghold is situated in the Hrubieszów Basin (Fig. 1A) formed in the Upper Cretaceous soft carbonate rocks (marl and chalk). It is the subregion of western, marginal part of the Volhynia Upland region, situated between two loess plateau-ridges: Horodlo (north direction) and Sokal (south). Both meso-regions have thick and continuous loess cover accumulated not only during the last loess cycle. Czermno is located, about 5 km from the place where the Huczwa River leaves the Sokal Plateau-Ridge.

According to the analysis of drilled sediments, during the Weichselian glaciation a large, shallow lake had formed in a basin-like widening of the Huczwa River valley. It was the result of a progressive aggradation in the higher-order valleys, favoured the accumulation of material transported from the loess plateau. In the conditions of varying flow or most often stagnating water, were deposited alternating layers of subaqueous silt, silty sand and sand, mainly strongly carbonate. At the end of the Pleistocene and the beginning of the Holocene these deposits were incised by rivers to a depth of several metres. At present they are exposed on the surface of the higher (Pleistocene) terrace. In Czermno, this terrace is in the shape of a fan, which was formed because the tributary river was drift-dammed by the recipient. Several basin-shaped, curving small valleys, generally with WSW-ENE elongation, are the abandoned channels of the Sieniocha River. In the Holocene the terrace was overgrown by a forest under which the top part of deposits became decalcified and lessivé soils developed. These soils survive in several locations and occur on the ground surface or under anthropogenic deposits. Hydromorphic soils developed in waterlogged depressions. Gyttja and peat formed in the oxbows on the Holocene floodplain.

The stronghold complex was located on the old, Pleistocene fan of the Sieniocha River near its confluence with the Huczwa River (Fig. 1B). The stronghold and adjacent settlements were built on the higher-lying surface of the fan, while old river channels were deepened and functioned as moats. The material dug up from the moats was used in building a 1.5-3 m high embankment (consisting of the packages of different horizons of well developed soil, as well as carbonate silt and sand from the substratum) on the uneven surface of the fan. This embankment was a base for the earth-and-timber rampart around the stronghold. The carbonate organic-mineral deposit is the remnant of this rampart as evidently the product of decomposition of the earth-and-timber structures (peat was also used as infill, especially in the southern stretch of the rampart (Fig. 1C). This deposit is up to 4 m thick. Similar earthworks were found on the outer edge of the settlement, where an earth-and-timber rampart was built over an embankment. However, much of this rampart was lost to modern agrotechnical practices. In contrast, the ramparts of the stronghold are well preserved. Their height reaches 5-7 m and slopes are steep: 10-15o from the inner side, and 20-30o from the outer side. The moats became shallower by several decimetres due to peat sedentation.

The geoarchaeological studies are supported by the project "Gold apple of Polish archaeology. The stronghold complexes at Czermno and Gródek (Cherven Towns) – chronology and function in the light of past and current research" ("Złote jabłko polskiej archeologii. Zespoły grodowe w Czermno i Gródek [Grody Czerwieńskie] - chronologia i funkcja w świetle badań dawnych oraz weryfikacyjnych)"; project no. 12H 12 0064 81

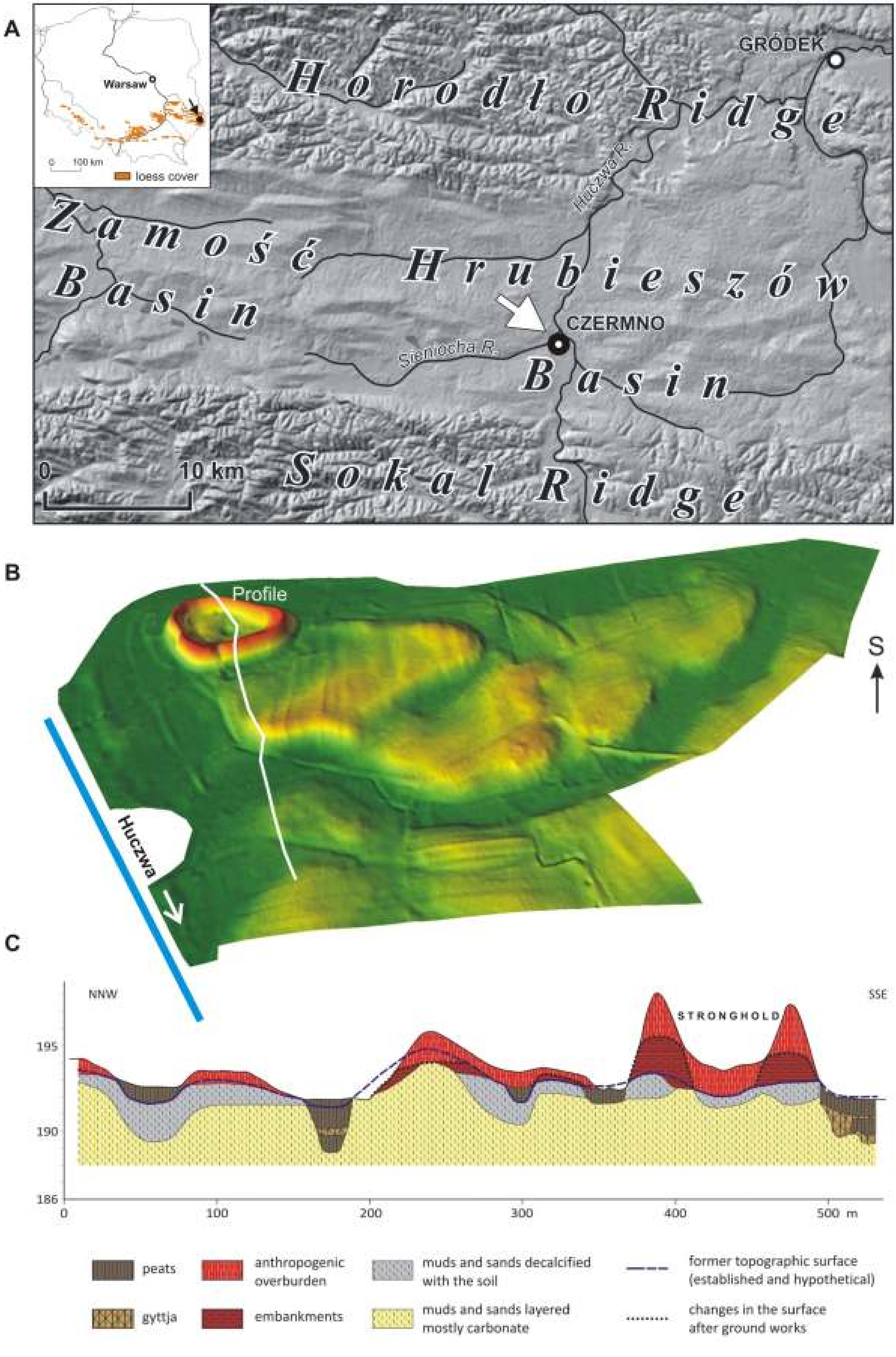
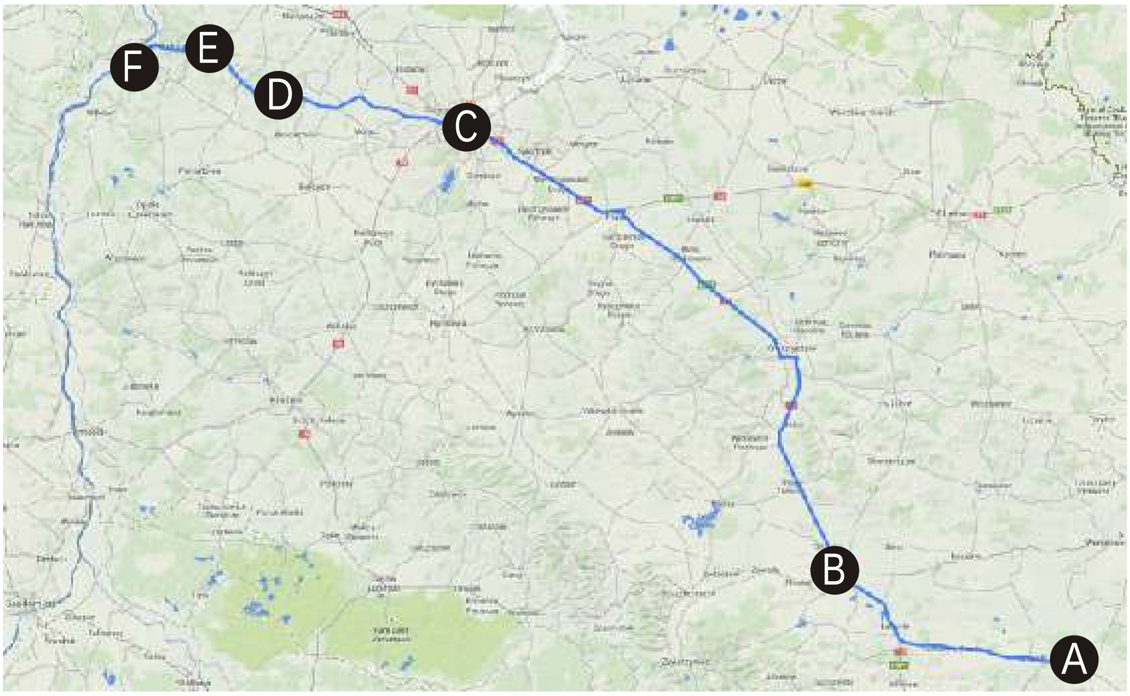


Fig. 1. Archaeological site at Czermno: A) location of the site on the map with geomorphic regions; B) 3D relief model of the stronghold vicinity (the white line is the cross section); C) exemplary geological cross section

Day V - 14th September, Sunday



A Tyszowce

B Zamość (Pearl of Renesaince)

C Lublin (Medieval town on loess)

D Nałęczów Spa

E Celejów (loess gullies)

F Kazimierz Dolny (Renaissance town; loess relief; Gap of Vistula River valley)

178 km

Zamosc – ideal town, pearl of Renaissance

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Zamosc (ca. 70 000 inhabitants), situated in the south-western part of Lublin Voivodeship, about 90 km from Lublin, 247 km from Warsaw and 60 km from the border with Ukraine. The town is situated in subregion Zamosc Basin, which is the part of the Lublin Upland. The surface rocks are the thin loess cover and also periglacial and fluvial sediments.

The historical city centre was added to the UNESCO World Heritage List (1992) as a unique example of a Renaissance town in Central Europe, consistently designed and built in accordance with the Italian theories of the "ideal town," on the basis of a plan which was the result of perfect cooperation between the open-minded founder, Jan Zamoyski Chancellor and Hetman (head of the army of the Polish-Lithuanian Commonwealth), and the outstanding Italian architect, Bernardo Morando. Zamoyski wanted to build a private city in the middle of nowhere, and the architect Morando knew how to do it. They worked together for 25 years and created a masterpiece which we can still admire today. Zamosc was founded in the year 1580 on the trade route linking western and northern Europe with the Black Sea. Modelled on Italian trading cities, and built during the Baroque period, a native of Padua, Zamosc remains a perfect example of a Renaissance town of the late 16th century, which retains its original layout and fortifications (Zamosc Fortress), and a large number of buildings blending Italian and central European architectural traditions.

At the end of the sixteenth century Zamosc was one of the most impressive fortresses in the Polish-Lithuanian Commonwealth. The city was belted with powerful bastion fortifications, curtains and moats. The defensive qualities of the fortress were determined by the natural conditions, since the city was founded at the Labunka river and its tributary Topornica river, surrounded by the extensive marshy valley.

As a result of the merger of the fortress and the main city and thanks to the terrain, the fortress had a shape of irregular heptagon, consisting of 7 curtains and 7 bastions placed in the bends. Jan Zamoyski, the founder and owner of the city, paid a lot of attention to the defense functions of the city. In the founding document, he pledged to consolidate the city with ramparts and a moat. The city was founded in the areas that used to be threatened or attacked by the Tatars. In the case of emergency, the powerful fortress could give shelter to people fleeing from threatened areas.

In the 17th century the city was thriving during the most extensive and fastest development period. It attracted not only the Poles but also many other nationalities (e.g. the Cossacks in 1648 during the uprising against the Polish-Lithuanian Commonwealth and during the Swedish Deluge in 1656). The Swedish army, like the Cossacks, failed to capture the city. Only during the Great Northern War Zamosc was occupied by the Swedish and Saxon troops.

Between 1772 and 1809, the city was incorporated into the Austrian Empire's Crown Province of Galicia. In 1809 the city was incorporated to the Napoleonic Duchy of Warsaw whereas after the fall of Napoleon, following the decisions taken during the Congress of Vienna in 1815, Zamosc became a part of the Kingdom of Poland, also called Congress Poland, which was controlled by the Russian Empire.

In 1821 the government of the kingdom bought off the city and modernized the Zamosc fortress. As a result, many buildings were restructured losing their original form and style. The modernized fortress played a big role during the November Uprising in 1830-1831 and surrendered as the last Polish resistance point. The fortress was finally destroyed in 1866, giving rise to the robust spatial development of the city.

After Poland regained its independence in 1918, Zamosc witnessed the outbreak of a communist revolt, suppressed by the Polish troops under the command of Major Leopold Lis-Kula. Two years later, during the Polish-Soviet War, the Soviet army surrounded the city but failed to capture it.

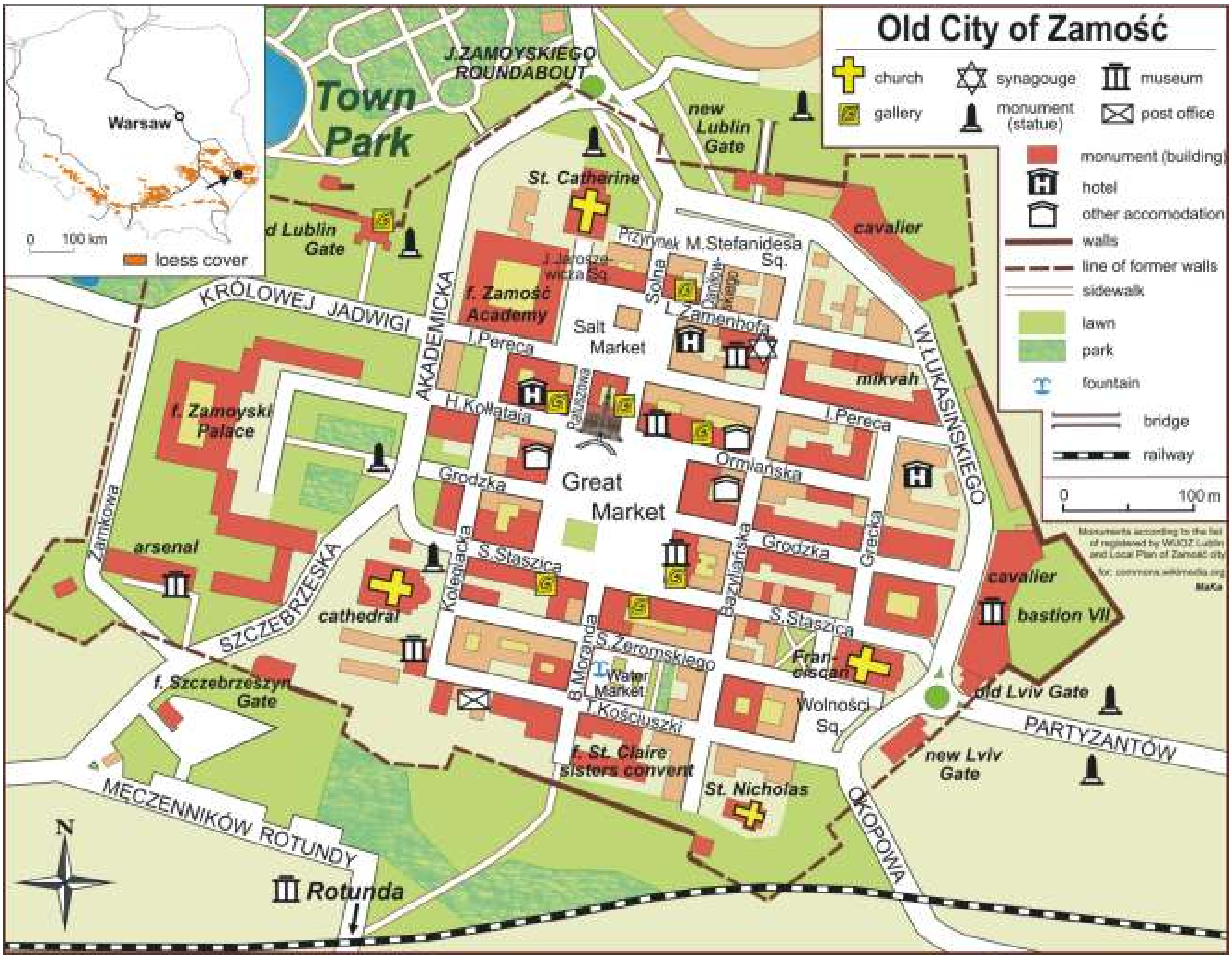

Fig. 1. Scheme of Old Town in Zamosc

The interwar period was a period of fast city development when its boundaries were widened as well as many new institutions and centers, especially those relating to cultural and educational life, were created.

Following the German invasion and outbreak of World War II (September 1939) Zamosc was seized by the German army. Shortly, the Nazis created an extermination camp in the Zamosc Rotunda. In 1942, Zamosc County, due to its fertile chernozems, was chosen for further German colonization in the General Government as part of Generalplan Ost. The city itself was initially to be renamed "Himmlerstadt" (R. Himmler visited Zamosc in August 1942), later changed to "Pflugstadt" (Plough City).

After the World War II the town became an important center of food, furniture and clothing industry. In the 1970s and 1980s the population grew rapidly (from 39.100 in 1975 to 68.800 in 2003), as the city started to gain significant profits from the old trade routes linking Germany with Ukraine and the ports on the Black Sea.

Significance of loess cover in urban development of Lublin – from early medieval to modern times

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Lublin is the greatest city of eastern Poland (population: ~350,000.; area: ~150 km^2), an important administrative and economic centre. It is also a significant academic centre (~80 000 students). Irrespective of the state to which Lublin belonged, it was always the main city of large administrative-political units, and for a short time (July 1944 – January 1945) even the capital of Poland. The city was founded almost 700 years ago (AD 1317) but archaeological investigations indicate that it is 300 years older.

Submeridionally valley of the Bystrzyca River is a natural axis of the city and at the same time a sharp morphological boundary (Fig. 1). The valley divides the city into two parts, which are different in respect of relief and surface deposits (loess in the left-bank area, and Pleistocene non-loessy silty-sandy deposits in the right-bank area). The oldest quarters of Lublin are located in the eastern part of the Naleczów Plateau, which is typically loessy mezoregion of the north-western part of the Lublin Upland. Generally, loess is underlain by the Upper Cretaceous opokas and marls and Palaeocene gaizes. These rocks are also covered by the Saalian tills and their residua. Loess deposits occurring in Lublin are of Vistulian age but older ones have been found in borings. The city area is characterized by typical loess relief of denudation or erosion-denudation nature, which has been considerably transformed by economic activity lasting hundreds of years. A characteristic relief feature is the occurrence of dry erosion-denudation valley systems, which are separated by the relatively narrow plateau zones. Typical loess gullies or road gullies do not occur in Lublin in our times.

The main settlement centres of the early medieval Lublin were located on the loessy promontories (the so-called loessy hills) in the edge zone of the plateau, near the valleys of the Bystrzyca River and its main left-bank tributary – Czechówka River (Mroczek, 2014). Very steep and distinct loess scarp of accumulation-erosion nature is 20-30 m high in this area. This zone is also characterized by the greatest thickness of loess deposits reaching a dozen or so metres. Their thickness considerably decreases in a westward direction.

The most recognizable in the relief are two hills – Castle Hill and Old Town Hill. The first one is in our times an isolated “island” composed of the Upper Cretaceous rocks covered by loess. Historical castle complex on its culmination consists of several buildings, the oldest of them dating from the thirteenth and fourteenth centuries (“donjon” i.e. defensive tower, and Holy Trinity Chapel with Byzantine-Ruthenian polychrome). The Old Town Hill is relatively well-preserved medieval town. Many buildings were built in the specific Lublin Renaissance style, i.e. Renaissance of typical Italian features but with local modifications. Loess in the form of fired bricks was the main building material (Huber and Mroczek, 2012).

Important parts of the research on the loess cover in the Lublin area are not only investigations conducted on the loess hills-promontories and continuous loess plateau but also in the cellars of the Old Town. The underground corridors and chambers form a two- three-level system. The highest levels are cut in loess deposits, and the lower – in the Upper Cretaceous rocks. The cellars are open to the public as the Lublin Underground Tourist Route, which is almost 300 m long.

The natural loess scarps are still well visible in the modern Lublin, especially close to the valley of the Bystrzyca River, near its confluence with the Czechówka River (Zmigród-Old Town-Wieniawa/Kalinowszczyzna). The appearance of this part of the city has been changed to a considerably degree during the Second World War. Jewish quarter, densely packed with largely wooden buildings, existed on the loess slopes and in their foots till 1942 when it was destroyed. In the same circumstances the Wieniawa quarter (typical Jewish suburb being a separate small town) was demolished.

The last few decades were characterized by a significant expansion of the city. Till the end of the epoch of socialism the large residential quarters were built on fertile soils in the watershed zones of the loess plateau, and transport corridors with the rank of national roads – in the dry valley systems. Such location of roads causes sometimes drainage problems during torrential rainfalls. Industrial plants were located in the right-bank, non-loessy part of the city.

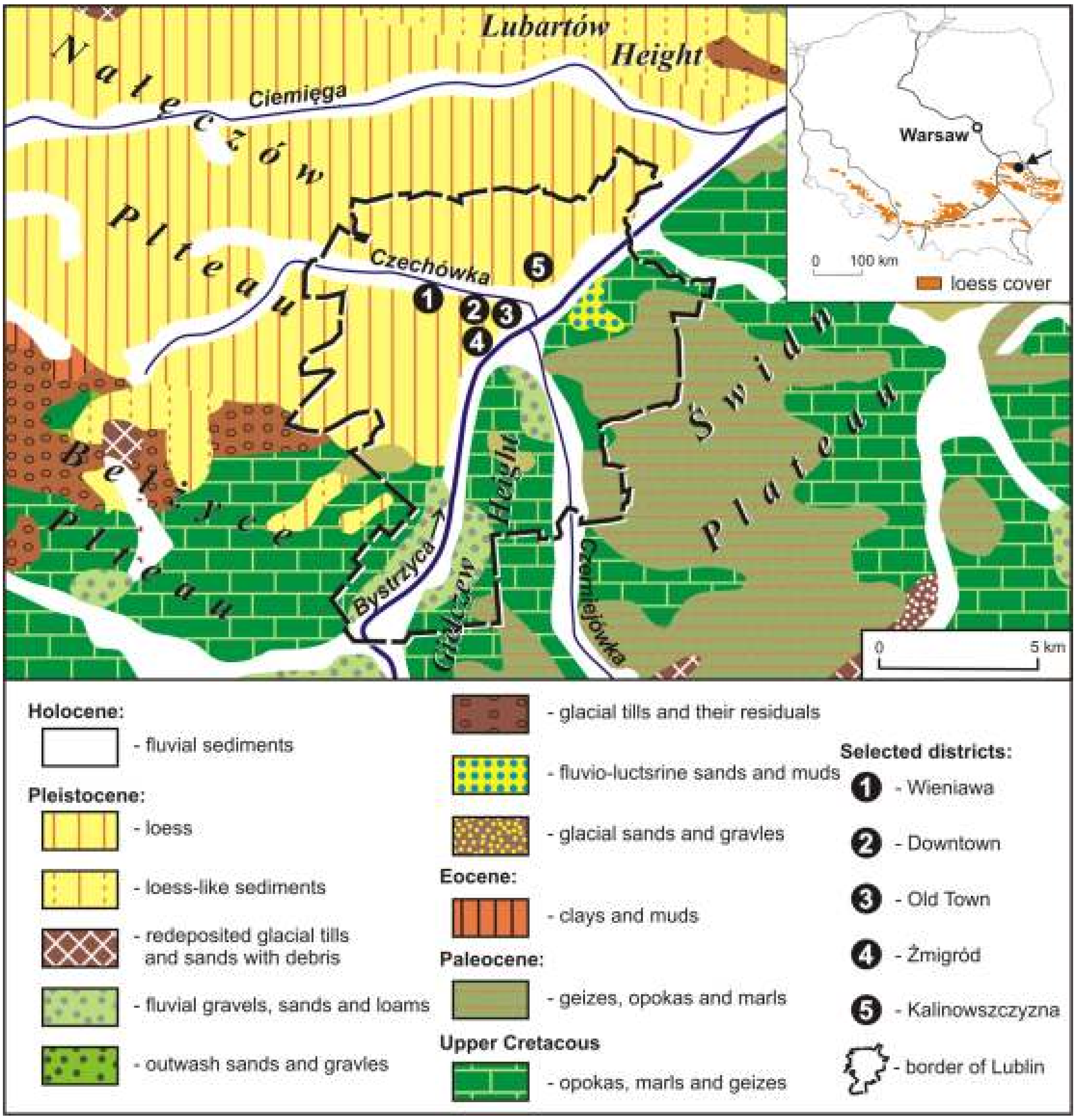

Fig. 1. Geological map of Lublin (based on Huber and Mroczek, 2012)

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The land of loess gullies – western edge of the Naleczów Plateau

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The thickness of the youngest Weichselian (L1) loess cover in the westernmost part of the Naleczów Plateau is up to 30 m (Fig. 1). Undoubtedly, it is the most famous loessic area in Poland, with unique, very high density of gullies – 10 km/km², and locally exceeds 15 km/km^2. This indicators rank among the highest in Poland or even in Europe. The varied loess relief and specific development of the gullies make them one of the most famous natural touristic attractions in the triangle-shaped area (Naleczów – Kazimierz Dolny – Pulawy). However, the extremely cut is the area only with greatest relative heights (50-100 m), covering the western edge of the plateau (near the Vistula River valley), and the area along the valley of Bystra River.

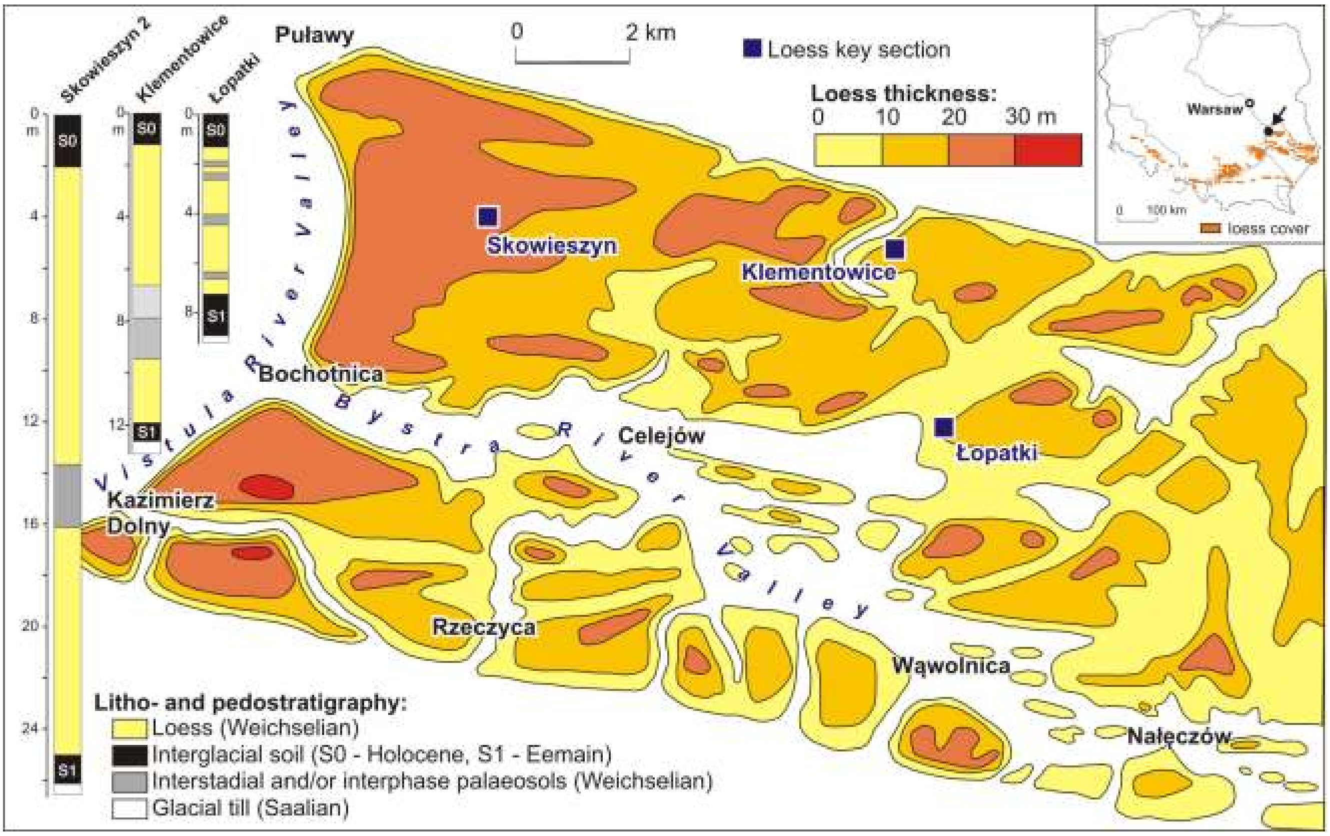

Fig. 1. Thickness of loess cover in western part of the Naleczów Plateau (after Harasimiuk and Henkiel, 1975/76 with changes) and characteristic of selected loess-key sections: Klementowice (Harasimiuk et al., 1972), Lopatki (Maruszczak, 1985), Skowieszyn 2 (Harasimiuk and Jezierski, 2001)

The thickness of loess cover thinner to the east – where does not exceed 20 m. All the loess patches with a thickness greater than a few meters, are elongated in a direction close to the latitudinal. The boundaries of the loess cover have the diverse nature: in places loess passes gradually in other deposits, but often meets morphological edges on the course WNW-ESE or W-E (Harasimiuk, Henkiel 1975/1976).

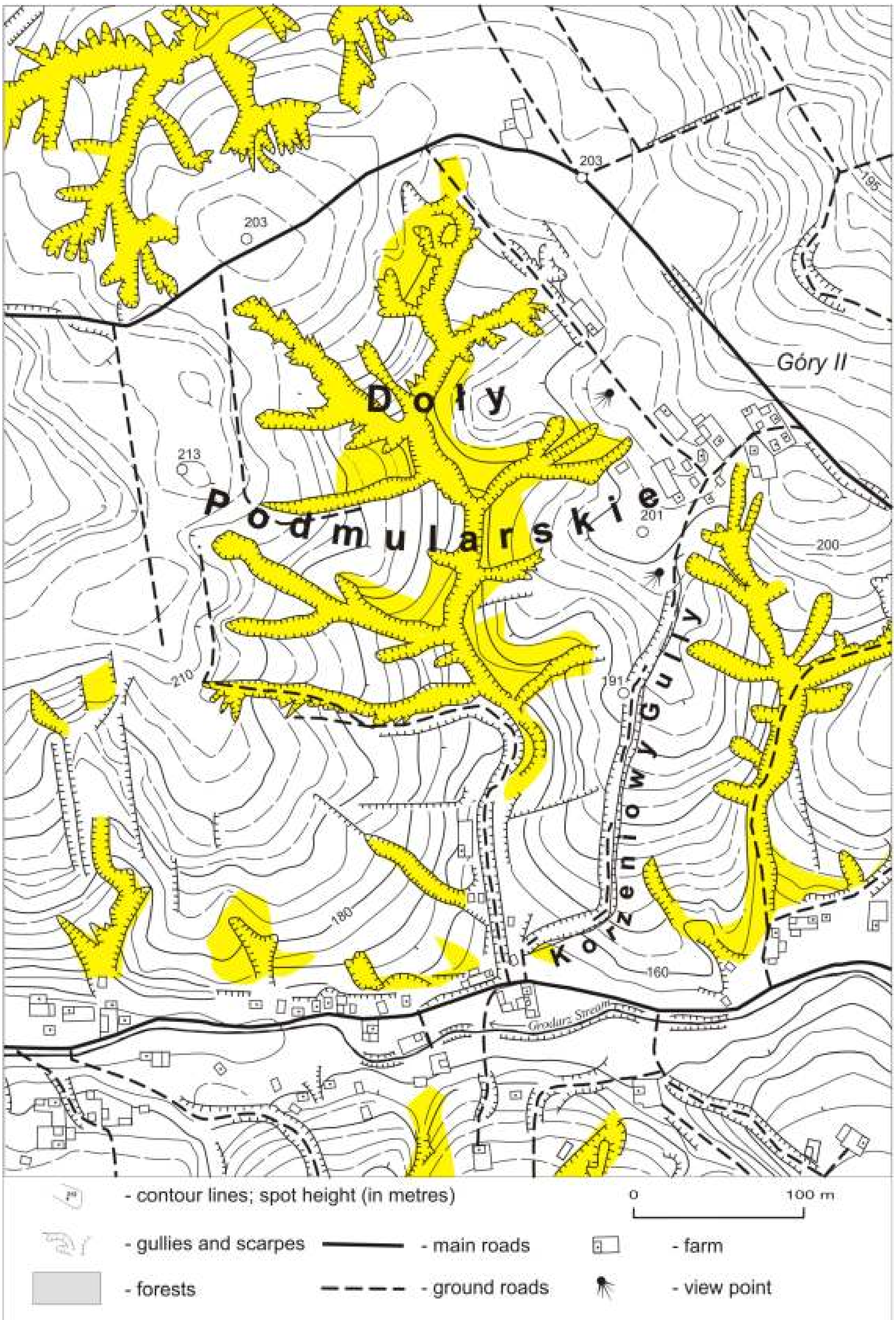

Fig. 1. „Root" road gully and "Doly Podmularskie" gully system in Kazimierz Dolny (W Naleczów Plateau)

In Kazimierz Dolny the most spectacular and picturesque is typical road gully called as “Root” ("Korzeniowy") Gully situated close to “Podmularskie Doly” gully system. The total length of the form is 550 m, the height differences is more than 60 m the maximum high of the walls is more than 8 m and the medim width – about or less than 5. On account of water accessibility, settlement in the Kazimierz Dolny area concentrated in the valleys. In order to connect farmsteads with the fields situated in the loessic interfluve, roads had to be built on slopes. Horse hooves, wheels of the vehicles, and most of all, water runoff during the snow-melt and heavy rains caused erosion and sinking of the road surface at a fairly fast rate of several centimetres a year. Gradually, the roads turned into gullies. The properties of loess, which is easily washed out and but capable of sustaining vertical walls, were favourable to the process. Trees overgrowing the scarps of road gullies stabilised their slopes. They are tree-species typical of dry-ground forest, such as: lime, maple, hornbeam and oak.

The “Podmularskie Doly” catchments is one of the best known gully systems in the Naleczów Plateau. According to Dotterweich et. al (2012), it is compound system of different age gullies with well recognized phases of erosion and subsequent filling in the Bronze Age and around the 10th to 11th centuries. According to authors the most severe deepening and expansion of the gully took place in the 17th century and in the mid-19th century.

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Kazimierz Dolny – Renaissance town on loess

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Kazimierz Dolny is a small town (2,300 inhabitants) situated on the gully-cut western part of loess Naleczów Plateau (NW Lublin Upland). The town lies on the right bank of the river Vistula (Fig. 1). It is a considerable tourist attraction as one of the most beautifully situated little towns in Poland. It is also situated inside the Kazimierz Landscape Park in the north part of the Vistula Gap in Malopolska region. The Vistula river cannot meander in the narrow valley-floor, but frequently changes the channel. In spite of river regulation, it forms sandy, osier-covered bars and mid-channel islands. Many rare species of birds nest there.

It enjoyed its greatest prosperity in the 16th and the first half of the 17th century, due to the trade in grain conducted along the Vistula do Gdansk. It became an economic backwater after that trade declined, and this freeze in economic development enabled the town to preserve its Renaissance urban plan and appearance. Since the 19th century it has become a popular holiday destination, attracting artists and summer residents. Both the urban architecture as well as the attractive landscape of Kazimierz D. and the surrounding countryside have become well known in Poland and beyond its borders. Nowadays, there are five renaissance tenement houses survive in Senatorska Street (the Celej Family house, the White House and the Little Heart House) and in the Market Square (the Przybylo Family house). The Przybylo's house and the houses of St. Christopher and St. Nicholas in particular have preserved the original architecture and stucco work characteristic of the "Lublin Renaissance". The walls are topped with attics which cover the steep roofs constructed so as to meet the requirements of the humid climate. Both the tenement houses and the churches, and - earlier - the tower and the castle, were built from opoka extracted from local quarries.

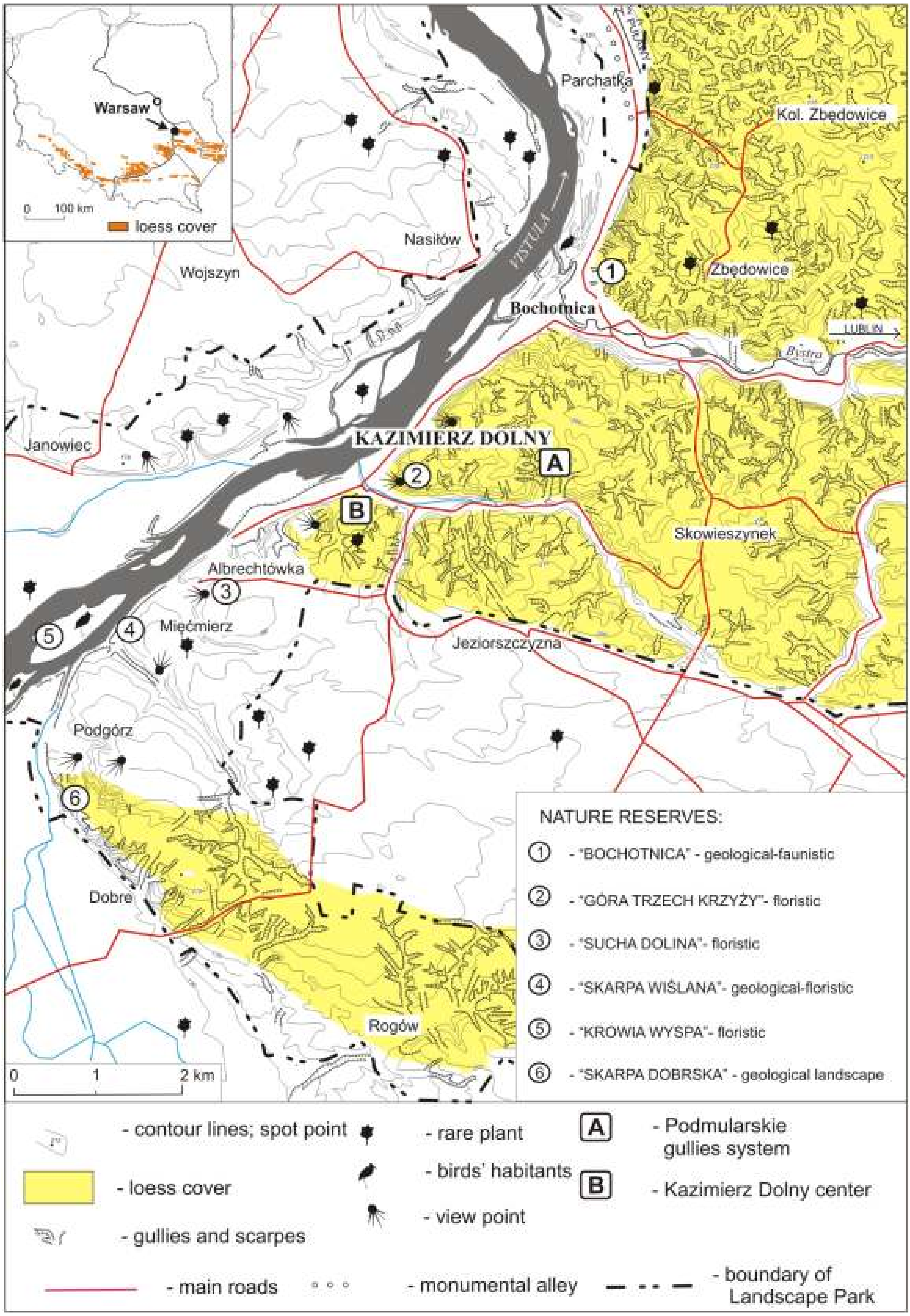

Fig. 1. Surroundings of Kazimierz Dolny

In 1994 the President of the Polish Republic published a decree naming Kazimierz Dolny a centre of historical importance. The absence of industrial activites of any sort permitted flora and fauna to flourish and some rare species may be found in the area. To protect all these as well as the buildings, within Kazimierz Dolny was created, in 1979, a "Landscape Park" which includes the whole area of the Kazimierz Dolny community (with total area 15.000 hectares). Some nine important parts have been designated as nature reserves. One of them is called "Krowia Wyspa" (Cows Island, faunal reserve in an ait of the Vistula) and harbours a large breeding ground for water fowl of all sorts.

In the park there are many footpaths which encourage visitors to walk around and enjoy the lovely views and the surroundings.
In the town centre around the market place and the adjacent streets, visitors can admire the renaissance buildings. From the "Baszta" (or Tower), the ruins of the castle (XIV-XVI c.), and the "Hill of the Three Crosses", one can enjoy a panoramic view of the town, which fits in so well into the overall natural countryside and forms a harmonized entity. During the holiday season a number of performances take place such as the all Polish festival of orchestras and folk singers, concerts in the Parish Church, a vintage car rally, a film and art festival, a students` song festival and many other activates of a cultural-artistic character.

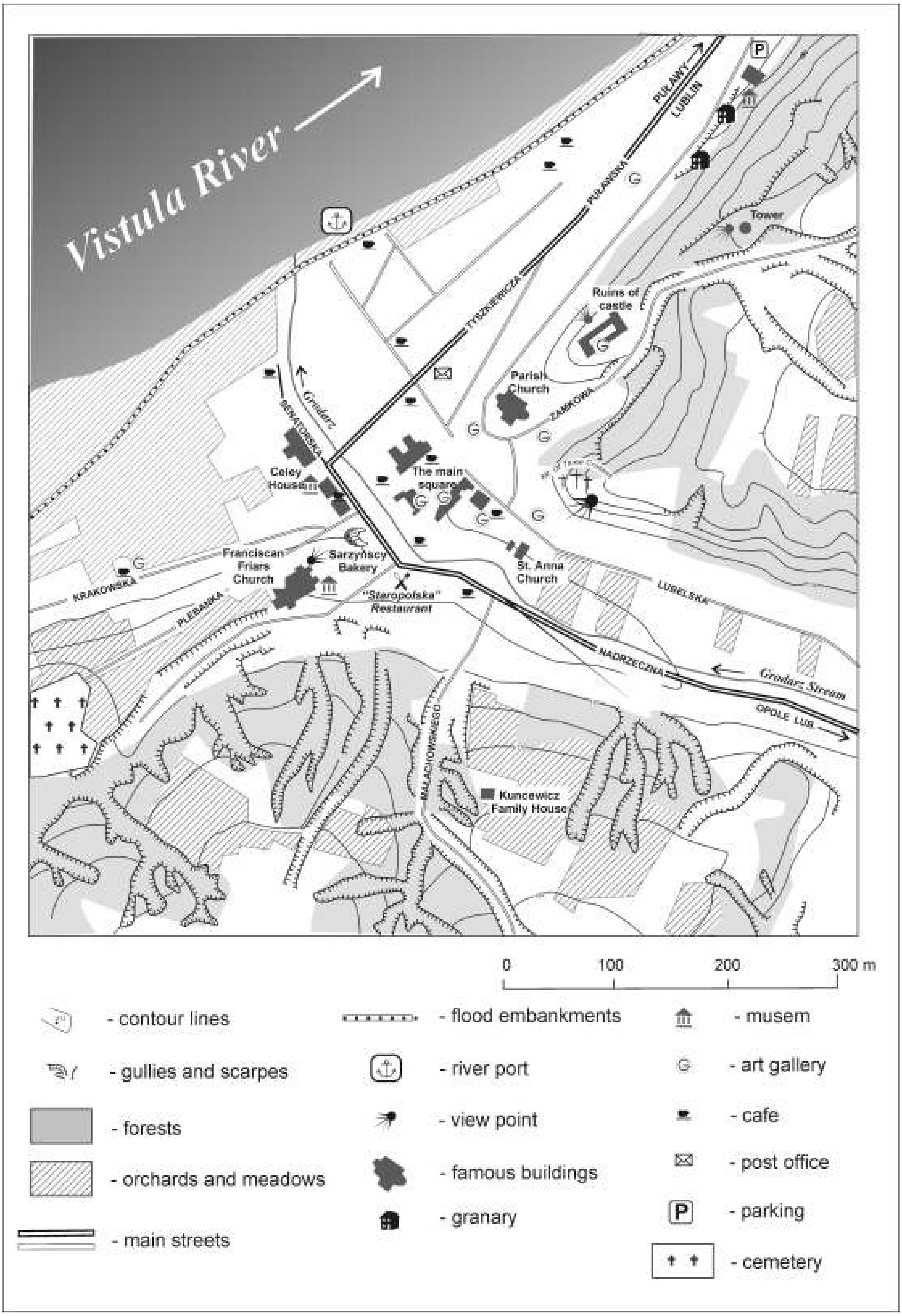

Fig. 2. Plan of Kazimierz Dolny

Day VI - 15th September, Monday

A Kazimierz Dolny

B Piotrawin (the Way of Cross)

C Krzemionki Opatowskie (Neolithic and Early Bronze Age complex of flint mines)

D Olsztyn (ruins of royal castle)

E Częstochowa (Jasna Góra Monastery)

F Wrocław

520 km

Glacial erratic sculpted by the wind at the Calvary in Piotrawin (Malopolska Gap of the Vistula River)

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Piotrawin is a small village situated on the eastern edge of the valley of the Vistula. It is also the oldest Roman Catholic parish in the Roman Catholic Archdiocese of Lublin. The most valuable historical monuments of Piotrawin is a complex of St. Stanislaus B. M. Sanctuary composed of:

a. church (1437-1441) - the oldest church in Lublin region and one of the most valuable Gothic buildings in Poland. It is oriented with the world directions, the interior has unique baroque decor. There is also the oldest and largest collection in Poland votive paintings (XVI-XVII century),

b. chapel erected over the tomb of the resurrected Peter Strzemienczyk (1441),

c. Way of the Cross (2007) with stations are decorated by glacial boulders. Additional attractions are the heads of sandstone column of the basilica, whose construction was never started (1770-1777).

Boulders used for the construction of the Way of the Cross are a Scandinavian (Saalian age) erratics commonly found in the vicinity of Piotrawin. These are granite boulders with a specific cut on the one of the walls. Polished surface was used as a natural array for determining the numbers of individual stations. Origin of this surface is undoubtedly Aeolian and the age is probably the Late Glacial, but it can be older – Weichselian (especially the Pleniglacial climatic pessimum). In any case, the Late Glacial period is considered as the period of increased activity of Aeolian processes recorded in the relief of western part of the Lublin Upland (Chodel Basin) in the form of dunes accumulated in the periglacial environment. The specific cut on the boulders is the result of Aeolian corrasion which modified surfaces of the erratics exposed to long-term destruction by the wind from one direction.

In the Lublin region, on the areas without continuous loess cover, glacial sediment (Saalian or Saalian age) are a common type of surface sediments, therefore the boulders were often used as a local building material (e.g. surface roads, walls of buildings) or as a sculpture material (monuments , memorial plaques, sculptures etc.).

Krzemionki Opatowskie – complex of unique flint mines (Ilza Foreland, Kielce Upland)

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Krzemionki Opatowskie is the small village located about eight kilometers north-east of the Polish city of Ostrowiec Swietokrzyski and the north edge of Sandomierz loess region. From geological poit of view it is north part of the Holy Cross Mountains Anticlinorium.

There was discovered (1922) the unique flint mines for the extraction of Upper Jurassic (Oxfordian) banded flints It is one of the largest known complex of prehistoric flint mines in Europe together with Grimes Graves in England and Spiennes in Belgium.

The total mining area is 4.5 km long and 25–180 m wide, covering an area of 78.5 ha. There are more than 4000 mine shafts known with depths of 2-4 meters deep with wells measuring from four to twelve metres in diameter. Some of the shafts are connected by short horizontal passage for the purposes of access or drainage called adits. They are 55-120 cm in height covering an area of about 4.5 km. Rare Neolithic pictures are engraved on the walls of some of these adits.

It is the Neolithic and early Bronze Age complex of flint mining. The exploitation of Jurassic flint began about 3900 BC and lasted until about 1600 BC. During Neolithic times the mine was used by members of the Funnelbeaker culture who spread the flint mining area far up to 300 km. The Globular Amphora Culture also used the pits and even more intensely, enlarging the area of exploration to about 500 km.

The flint at Krzemionki was exploited from the 4th millennium through the middle of the 2nd millennium BC (3500-1600 BC) by people of the Linearbandkeramik, Globular Amphora and Mierzanowice Cultures who excavated flint mainly by hatchets. Banded flints from Krzemionki were used mainly for the manufacture of axes and chisels. Abundant quantities of these tools were traded as far away as 660 km from the Krzemionki mines. The main period of the mines' exploitation was 2500-2000 BCE. Flint mining at Krzemionki began to decline beginning in 1800-1600 BCE. In following centuries, the Krzemionki mining area was only sporadically visited. The area's numerous small limestone quarries were used for lime production during the first half of the 20th century.

The site is one of Poland's official national Historic Monuments (1994). Its listing is maintained by the National Heritage Board of Poland. The unique mine workings are now developed as an underground tourist trail (465 m long), leading through ancient mine workings with deepened floors, in order to ensure comfort for visitors.

Kraków-Czestochowa Upland

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The Kraków-Czestochowa Upland, also known as the Polish Jurassic Highland or Polish Jura, is part of the Jurassic System of south–central Poland, between the cities of Kraków, Czestochowa and Wielun. The highest part, culminated at 514 m a.s.l., is located on the north of Krakow and it is called Ojców Upland. The Kraków-Czestochowa Upland consists of a hilly landscape with Jurassic limestone rocks and cliffs. About 1,800 caves were discovered in the upland. The relief developed since the Paleogene, under climatic conditions changing considerably. Its main component is a peneplain, crowned by monadnocks. The upland was covered at least once by Scandinavian ice sheet. Glacial sands occur between monadnocks and form flat areas with clearly visible dunes. This area posses unique cultural landscape with archeological objects and relics of ancient inhabitation. Great historical value of this area is confirmed by the numerous ruins of medieval castles.

These castles, called „Eagle-nests", are a chain of medieval strongholds picturesquely situated on limestone rocks, gorges, cavities, etc. Most of them were erected by the King Casimir III the Great (1333–1370), to protect western frontier of Poland when the Krakow was country's capital city. Most of castles were destroyed during the Swedish invasion called the Swedish Deluge (1655-1660). One of the largest castles were built near Czestochowa in the Olsztyn village. Olsztyn Castle dated back to the late 13th century but was made a powerful Gothic stronghold by 1349. In the mid-15th century the fortress was turned into a palatial residence, conquered by Swedish forces in 1656. Its ruins consist of the 14th-century 35-m-tall round tower (once the starvation-death dungeon), adjacent remnants of the residential quarters with a large cave underneath, and the square watchtower (the oldest part). St. John the Baptist Church (1719-1726), located below the castle, was built with stones from the ruins.

Pauline monastery of Jasna Góra (Czestochowa)

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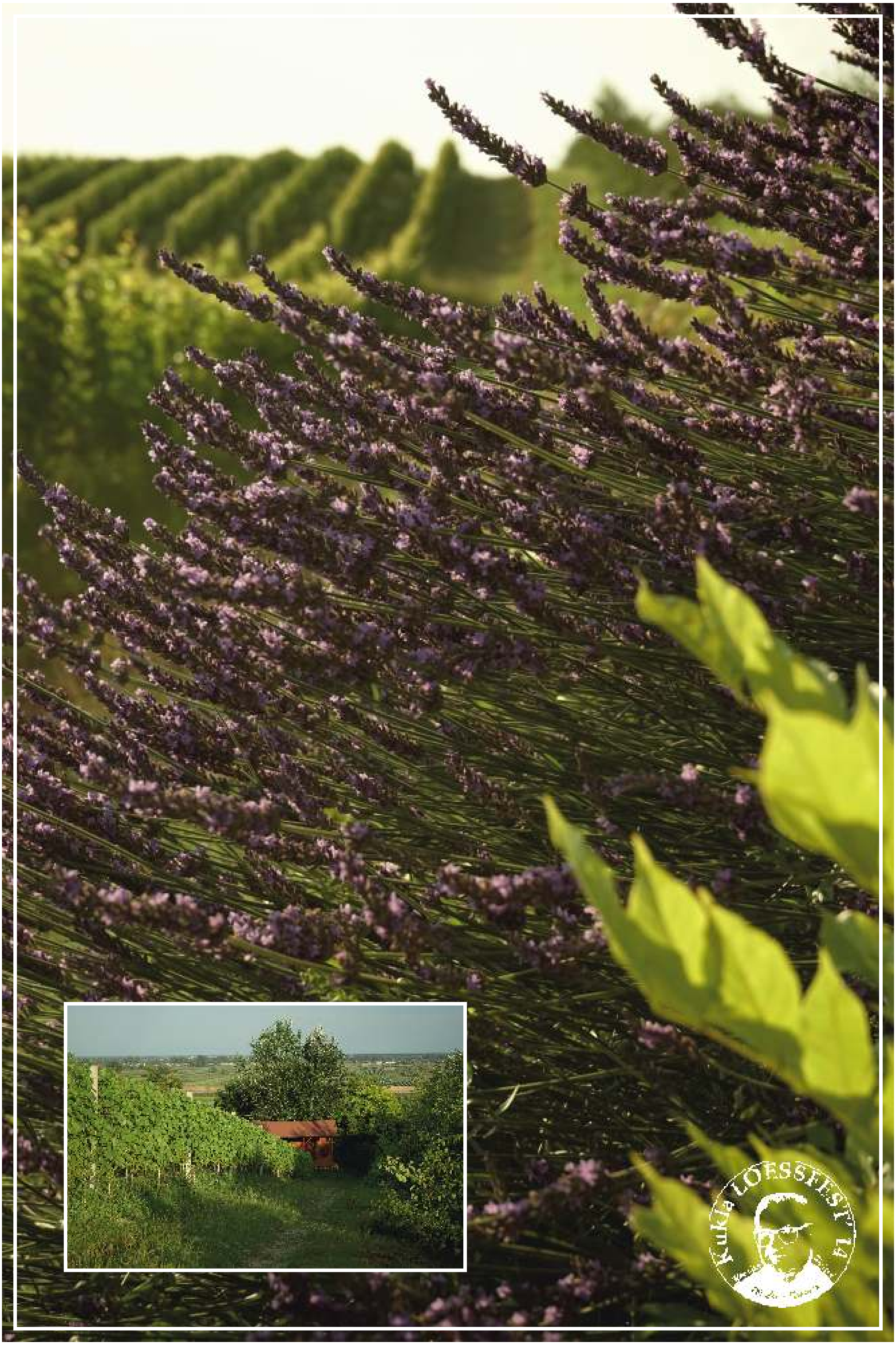
Czestochowa (240,027 inhabitants) - city in south Poland on the Warta River, located in Kraków-Czestochowa Upland. It is 13th most populous city in Poland. It is the largest economic, cultural and administrative centre in the northern part of Silesian Voivodship.

The city is known for the Pauline monastery of Jasna Góra with Black Madonna painting (Polish: *Jasnogórski Cudowny obraz Najswietszej Maryi Panny Niepokalanie Poczetej*), the most famous Polish shrine to the Virgin Mary and the country's greatest place of pilgrimage (ca. 5 million per year). The site is one of Poland's official national Historic Monuments, as designated September 16, 1994 and tracked by the National Heritage Board of Poland.

The monastery was founded in 1382 by Pauline monks who came from Hungary at the invitation of Wladyslaw, Duke of Opole. Nowadays, the monastery complex form buildings of different architectural styles. Small 15th-century gothic chapel with the image of the Black Madonna, is the heart of the sanctuary. It adjoins vast church of 1695, which is considered as one of the most beautiful baroque churches in the Central Europe. The fine 105-meter-tall tower crowned with viewing galleries dates back to 1620, with the peak rebuilt after the fire of the early 20th century. The adjacent mid-17th-century early-baroque monastery contains the Great Refectory of 1644, the Knight Hall of 1647, and the 18th-century library with huge unusual collection of old books. Fortifications date from 1643 while baroque and classical majestic gates are a century younger. Earlier fortifications were discovered in the basement.

Notes



Winnica nad Jarem (Vineyard over the Ravine) in Złota near Sandomierz

Location of the sites presented during the field excursion

Korshiv (Ukraine) 2011

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