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International Symposium on

'Loess Deposits as Archives of Environmental Change in the Past'

NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF ARMENIA

Program and Abstract Book

YEREVAN, ARMENIA | SEPTEMBER 15 - 22, 2019

NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF ARMENIA
INSTITUTE OF GEOLOGICAL SCIENCES

International Symposium on

"Loess Deposits as Archives of Environmental Change in the Past"

September 15-22, 2019

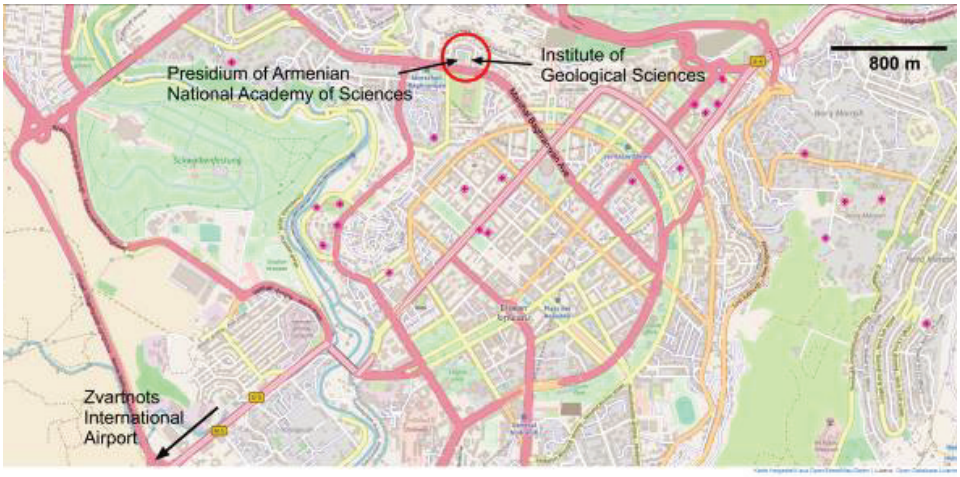
Yerevan (Armenia)

Base Metals

Ministry of Education, Science, Culture and Sport
Committee of science

CONFERENCE VENUE

The Armenian National Academy of Sciences is easy to reach: 0019 Yerevan, 24 Marshal Baghramyan Avenue.




Round Hall of the Presidium of the Armenian National Academy of Sciences

CONFERENCE PROGRAM

Sunday,	**September 15, 2019**
18:00	**Icebreaker and Registration**
	Icebreaker will be organized in the evening in the Geological Museum of the Institute of Geological Sciences of NAS RA, Yerevan, 24a Marshal Baghramyan Avenue
Montag,	**September 16, 2019**
09:00 - 9:10	**Opening and Welcome address by Director of IGS, Dr. Sci. Kh. Meliksetian**
09:00 - 9:40	**Introduction Dominik Faust & Markus Fuchs**
09:40 – 11:00	**Session I – Loess records - Stratigraphy and palaeoenvironmental information** **Chairperson: Pierre Antoine**
09:40 – 10:00	***Jary Z.**, Krawczyk M., Raczyk J., Skurzyński J.* Abrupt cold and warm events recorded in last glacial loess in Poland and Western Ukraine.
10:00 – 10:20	***Pötter St.**, Bösken J., Obreht I., Veres D., Hambach U., Scheidt S., Berg S., Klasen N., Lehmkuhl F.* Towards a regional palaeoclimatic synopsis of the last glacial cycle in the Eastern lower Danube basin – a comparative study of the key sites Vlasca and Balta Alba Kurgan.
10:20 – 10:40	***Stevens T.**, Orbe R., Bradak B., Sechi D., Andreucci S., Cossu G., Smalley I., Pascucci V* Loess on the edge of Europe: chronological and climate proxy analysis of Pegwell Bay loess, SE England.
10:40 – 11:00	***Flašarová K.**, Lauer T., Žatecká M., Trubač J., Strouhalová B., Kadlec J., Kolařík P.* Multiproxy evidence of Middle and Late Pleistocene environmental changes in the loess-paleosol sequences of Central Bohemia (Czech Republic).
11:00 – 11:30	**Coffee break**

11:30 – 12:50	**Session II – Loess records - Stratigraphy and palaeoenvironmental information** **Chairperson: Thomas Stevens**
11:30 – 11:50	***Gerasimenko N.*** The upper Middle Pleistocene loess-palaeosol successions in Central Ukraine
11:50 – 12:10	*Raphael S.,* ***Wolpert T.****, Pappusch M., Profe J., Murari M., Lomax J., Fuchs M.* Extending The Central German loess stratigraphy: new results from the Münzenberg section (Middle Hesse, Germany).
12:10 – 12:30	***Antoine P.****, Lagroix F., Jordanova D., Jordanova N., Lomax J., Fuchs M., Rousseau D.-D., Hatte C., Moine O.* Multiproxy approach of a unique Late Saalian (MIS 6) loess record in the Lower Danube at Harletz (Bulgaria).
12:30 – 12:50	***Ghafarpour A.****, Khormali F., Cheng L., Song Y., Forman S.* Pedogenic maghemite-magnetite likes it hot and dry? initial insights in to the impact of seasonal bias on the formation of pedogenic iron oxides in Northern Iranian loess-paleosol sequences from temperature dependence susceptibility.
12:50 – 13:50	**Lunch break**
13:50 – 15:10	**Session III – Palaeosoils in loess deposits** **Chairperson: Heinrich Thiemeyer**
13:50 – 14:10	***Khormali F.****, Kehl M., Vlaminck S., Frechen M.* Loess-paleosols and modern soils of Northern Iran, paleoclimatic implications.
14:10 – 14:30	***Khomutova T.E****., Dushchanova K. S., Kashirskaya N.N., Idrisov I., Borisov A.V.* Microbial communities of palaeosols in loess strata of the Eastern Ciscaucasia.
14:30 – 14:50	***Khokhlova O.S.****, Sycheva S.A.* Paleosols of the Early Paleolitic Site Bayraki (Transnisria).
14:50 – 15:10	***Meenakshi G.****, Shrivastava J.*, Chandra R.* Evidences of pedogenesis and smectitization in loess-palaeosols of the Dilpur Formation, Kashmir, India: Late Quaternary climatic reconstruction.

15:10 – 15:30	***Zech W.**, Andreeva D., Zech M., Bliedtner M., Glaser B., Hambach U., Zech R* The Upper Paleolithic Tologoi Record: a terrestrial key profile for the reconstruction of Late Quaternary environmental changes in southern Siberia
15:30 – 16:00	**Coffee break**
16:00 – 17:20	**Session IV – Loess provenances** **Chairperson: Frank Lehmkuhl**
16:00 – 16:20	***Fenn K.**, Millar I., Durcan J.A., Thomas D.S.G.* The provenance of loess-palaeosol sequences along the middle and lower Danube.
16:20 – 16:40	***Költringer Ch.**, Stevens Th., Kurbanov R., Baykal Y.* Detrital zircon U-Pb ages indicate Quaternary dust sources and transport pathways in Southern Russia.
16:40 – 17:00	***Faust D.**, Pachtmann M., Trigui Y., Meszner S.* Why are soils in loess-paleosol-sequences in Southern Tunisia sandy?
17:00 – 17:20	***Baykal Y.**, Stevens Th., Újvári G., Költringer Ch.* Using zircon U-Pb ages to detect concurrent last glacial loess provenance variability with dust activity in the Carpathian Basin.
19:00	**Conference dinner** **in the old town of Yerevan**

Tuesday	September 17, 2019
09:30 – 11:10 Uhr	**Session V – Contextualization of loess research** **Chairperson: Roland Zech**
09:30 – 09:50	***Lehmkuhl F.**, Bösken J., Pötter S., Römer W., Hambach U., Veres D., and the „loessmap team“* Geomorphology and (paleo) loess landscapes in Europe during the last glacial cycle at different spatial and temporal scales.
09:50 – 10:10	***Zeeden Ch.**, Hambach U., Necula C., Jordanova D., Panaiotu C., Rolf Ch., Veres D., Obreht I., Marković S.B., Lehmkuhl F., Kaboth-Bahr S.* Towards a European loess stack.
10:10 – 10:30	***Rousseau D.-D.**, Antoine P., Boers N., Lagroix F., Ghil M., Lomax J., Fuchs M., Debret M., Hatté Ch., Moine O., Gauthier C., Jordanova D., Jordanova N.* Dansgaard-Oeschger millennial oscillations are not restricted to the last climate cycle: the loess point of view.
10:30 – 10:50	***Fominykh L.A.**, Zolotareva B.N., Pinsky D.L.* Paleosols of extinct oases in the loess-ice plains of the Siberian Arctic.
10:50 – 11:10	***Vandenberghe J.**, Yang X., Wang X.* A diversified set of floodplain facies of reworked loess.
11:10 – 11:40	**Coffee break**

11:40 – 13:00 Uhr	**Session VI – Recent methodological approaches** **Chairperson: Christian Zeeden**
11:40 – 12:00	***Skurzyński J.**, Jary Z.,Raczyk J.* The geochemistry of Polish loess: implications for provenance, sedimentary sorting and weathering.
12:00 – 12:20	***Kolařík P.**, Strouhalová B., Trubač J., Flašarová K., Šefrna L.* Dynamics of n-alkanes in loess-derived soils of Czechia.
12:20 – 12:40	***Bösken J.**, Klasen N., Obreht I., Hambach U., Veres D., Zeeden Ch., Brill D., Burow Ch., Pötter S., Constantin D., Lehmkuhl F., Timar-Gabor A.* Luminescence dating challenges: about hiati and methodological considerations in loess-palaeosol sequences: the Urluia example, Romania.
12:40 – 13:00	***Zech R.**, Bliedtner M, Struck J., Strobel P, Suchodoletz H., Bazarradnaa E., Zech M.* Calibrating leaf wax pattern and compound-specific isotopes
13:00 – 14:00	**Lunch break**
14:00 – 15:40	**Session VII – Archaeology and Environment** **Chairperson: Keith Wilkinson**
14:00 – 14:20	***Zarikian N.**, Kandel A.W., Gasparyan B.* Insect remains from Aghitu-3 cave, Armenia.
14:20 – 14:40	***Malinsky-Buller A.**, Glauberman Ph., Sherriff J., Bo L., Frahm E., Gasparyan B., Timms R., Adler D. S., Wilkinson K* Alapars-1: a new paleoenvironmental sequence and stratified open-air Middle Palaeolithic site in the Central Armenian Highlands.
14:40 – 15:00	*Invited speaker **Petrosyan H.*** Tigranakert, white city.
15:00 – 15:20	*Invited speaker **Episkoposyan L.*** Disentangling genetic jigsaw of the Armenian population.

15:20 – 15:40	***Sayyed M. R. G.*** Palaeoclimatic variability during Deccan volcanic episode: insights from the intrabasaltic palaeosols (bole beds) occurring around Dhebewadi area of Satara District (Maharashtra, India).
15:40 -	**Coffee break and**
16:20	**Poster Session** **Chairperson: Daniel Wolf**
	Schmidt Ch.*, Hambach U., Veres D.* How can we date loess older than MIS 3? ***Fenn K.****, Thomas D.S.G, Durcan J.A., Millar I., Veres, D., Piermattei A., Lane C.S.* Local, regional or global climatic signal? a multiproxy analysis of complex loess sequences from the Bulgarian Middle Danube. ***Grigoryan E.****, Meliksetian Kh., Wolf D., Sahakyan L., Faust D., Sugden P., Savov I.P., Koopers A.* Late Middle Pleistocene tephra from VEI=6 eruption of Nemrut volcano (SE Turkey) preserved 350 km away in loess sequences in NE Armenia. **Balescu S.**, Dupuis Ch., Haesaerts P., Quinif Y. TL signatures of quartz grains from Northwestern European loess sequences. **Ghandhar S.**, Amini A., Solgi A., Rezaei H. Relationship of the main elements with particle size in the Golestan loess and comparison of its main elements with Asia and North America.
16:20 – 17:00	**Introduction to the field trip**
16:20 – 16:40	***Lilit Sahakyan*** Geology of the territory of Armenia.
16:40 – 17:00	***Daniel Wolf*** Introduction to the field-trips.

ABSTRACTS

ABRUPT COLD AND WARM EVENTS RECORDED IN LAST GLACIAL LOESS IN POLAND AND WESTERN UKRAINE

Zdzisław Jary[1], Marcin Krawczyk[1], Jerzy Raczyk[1], Jacek Skurzyński[1]

[1] *University of Wroclaw, Uniwersytecki Sqr. 1, 50-137 Wroclaw, zdzislaw.jary@uwr.edu.pl*

Loess is a widespread sedimentary rock, consists of fine quartz silt particles and transported by the wind. European Loess Belt was created under cold climate conditions, in the so-called periglacial zone – on the foreground of former continental glaciations. Climatic and environmental changes within this dynamic zone were indirectly recorded in loess-palaeosol sequences (LPS). Soils were developed during the warm periods whereas in cold periods the aeolian silt was deposited. In particularly cold periods permafrost started to develop. Some of these climatic/environmental changes were especially abrupt. The record of these abrupt changes were found in Polish and west Ukrainian LPS. The effects of rapid environmental changes caused by cooling of the climate are well visible in transition zones between palaeosols and loess. In some sequences the process of climate deterioration was so fast that newly deposited loess burried the soil surface without any distinct physical changes. It is well shown in lithological features (colours, grain size, carbonates etc.). However, the most spectacular proofs of environmental/climatic changes are structures connected with former permafrost. Several generations of ice-wedge casts occur in loess deposited during the last glaciation in Poland and in the Volhynia-Podolja Upland. They are evidence of average annual temperatures lower by a dozen or so degrees than those currently observed. Even more astonishment and the need for explanation is justified by the assumption that at least some of these horizons were formed as a result of sudden, short-term cooling (about 1000 years) followed by equally abrupt warming of the climate, when ice wedges and permafrost were thawed. We found and documented the occurrence of at least 3-4 generations of ice wedge casts in last glacial LPS in Poland: within L1LL2 loess, L1SS1 soil (?) and two horizons within L1LL1 loess. The occurrence of permafrost signified by particular ice wedge casts horizons is differentiated in space and time on research area. The research was performed under the National Science Centre project No. 2017/27/B/ST10/01854 entitled “Sudden COLD events of the Last Glacial in the central part of the European LOESS Belt - in Poland and in the western part of Ukraine (COLD LOESS)”.

Keywords: loess, abrupt climate changes, periglacial features, Poland, Ukraine

TOWARDS A REGIONAL PALAEOCLIMATIC SYNOPSIS OF THE LAST GLACIAL CYCLE IN THE EASTERN LOWER DANUBE BASIN – A COMPARATIVE STUDY OF THE KEY SITES VLASCA AND BALTA ALBA KURGAN

Stephan Pötter[1], Janina Bösken[1,2], Igor Obreht[3], Daniel Veres[2,4], Ulrich Hambach[5], Stephanie Scheidt[6], Sonja Berg[6], Nicole Klasen[7], Frank Lehmkuhl[1]

[1] Department of Geography, RWTH Aachen University, Templergraben 55. 52056 Aachen, Germany, stephan.poetter@geo.rwth-aachen.de, [2] Interdisciplinary Research Institute on Bio-Nano-Science of Babes-Bolyai University, TreboniuLaurean 42, 400271 Cluj-Napoca, Romania, [3] Organic Geochemistry Group, MARUM-Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen, LeobenerStraße 8, 28359 Bremen, Germany, [4] Institute of Speleology, Romanian Academy, Clinicilor 5, 400006 Cluj-Napoca, Romania, [5]BayCEER& Chair of Geomorphology, University of Bayreuth, 95440 Bayreuth, Germany, [6] Institute of Geology and Mineralogy, University of Cologne, Albert-Magnus-Platz, 50923 Cologne, Germany, [7]Insitute of Geography, University of Cologne, Albert-Magnus-Platz, 50923 Cologne, Germany

The Lower Danube Basin hosts vast Pleistocene loess deposits. The thickness and the accumulation rates of the loess-palaeosol sequences (LPS) are the result of manifold interplaying factors, e.g. the available detrital material in the source area and the topography of the sink area. The aeolian deposits of the Lower Danube Basin were investigated thoroughly throughout the years, using a variety of geoscientific methods applicable on LPS. Many of the investigated LPS cover several glacial cycles, providing palaeoclimatic evidence from the middle to the Late Pleistocene. Some geomorphic situations lead to thicker loess accumulation during the last glacial cycle, enabling the study of high-resolution palaeoenvironmental archives for the last 125 ka and beyond. Here, we present two Late Pleistocene LPS from the Bărăgan steppe area in south-eastern Romania: Vlasca (VLA) and Balta Alba Kurgan (BAK). The two sections are approx. 100 km afar and were formed under different geomorphic situations resulting in differing accumulation rates. Vlasca, e.g. is located at the left bank of the lower Danube and has a thickness of ca. 27 metres, whereas BAK is exposed at a road cut near the Balta Alba alkaline lake ca. 15 km south of the Carpathian bending and covers presumably the last glacial cycle in ca. 15 metres. On that basis, we compare the results of VLA and BAK in order to investigate the differences and commonalities in palaeoclimatic dynamics between a riverine site (VLA) and a full steppe setting (BAK).Amidst climatic evolution patterns, the

geographic location as well as the geomorphic situations are considered to have a significant influence on the sedimentation dynamics as well as processes such as in-situ weathering or pedogenesis. Against this backdrop, the two sections provide valuable information about the formation of LPS under varying topography, potential dust sources and (recent) climate conditions. For both LPS, a multi-proxy approach using grain size analysis, magnetic susceptibility, colour spectroscopy and inorganic geochemistry (XRF) was conducted in order to unravel the palaeoclimatic dynamics. For chronological control, robust age models, mainly based on OSL dating, ^{14}C, palaeomagnetism as well as inter-archive correlation using marker horizons, were established.

Keywords: loess, palaeoclimate, multi-proxy approach

LOESS ON THE EDGE OF EUROPE: CHRONOLOGICAL AND CLIMATE PROXY ANALYSIS OF PEGWELL BAY LOESS, SE ENGLAND

Thomas Stevens[1], Ragna Orbe[1], Balazs Bradak[2], Daniele Sechi[3], Stefano Andreucci[4], Giulia Cossu[3], Ian Smalley[5], Vincenzo Pascucci[3]

[1] Department of Earth Sciences, Uppsala University, Villavägen 16, Uppsala, 75236, Sweden, thonas.stevens@geo.uu.se; [2] Department of Physics, University of Burgos, Av. de Cantabria, s/n 09006, Burgos, Spain;[3] Dipartimento di Architettura, Design e Urbanistica, Universita di Sassari, sede di Via Piandanna 4, I-07100 Sassari, Italy; [4] Dipartimento di Scienze Chimiche e Geologiche, Universita di Cagliari, Cittadella universitaria di Monserrato, Cagliari 09042, Italy; [5] School of Geology, Geography and the Environment, University of Leicester, Leicester, LE1 7RH, UK

A widespread but mostly thin (< 1m) loess cover exists in Southern Britain. Exceptionally thick loess occurs in the area lying either side of the Thames estuary, in north Kent and south Essex, where significant deposits of 3-4 m thickness occur, potentially even reaching 8 m in places. These deposits have been hypothesized to represent the most western extreme of the Eurasian loess belt and were likely deposited during the end of the last glacial period. While covering a narrow timeframe, the relative thickness of these deposits means they potentially preserve an extremely detailed record of past climate, dustiness and sediment-environment dynamics during a period of dramatic changes in global climate. However, to date, no detailed palaeoenvironmental proxy analysis, nor detailed independent dating work, has been conducted on these deposits, and major outstanding questions concerning the age, origin and nature of formation of these deposits remain outstanding. Here we address this using detailed mineral magnetic and particle size analysis coupled with high sampling resolution optically stimulated luminescence dating on one of the key sequences in this region; the c. 3.5 m sea cliff section at Pegwell Bay, Isle of Thanet, East Kent. This section comprises a soil/palaeosol complex at the top with two loess units (a calcareous lower unit and non-calcareous upper unit) overlying Palaeogene age Thanet Bed marine sands. Particle size data indicates that the entire loess section comprises relatively course, likely source proximal loess, with some mixing with sandy Thanet Beds at the bottom of the sequence. Mineral magnetic analysis suggests the presence of ultrafine iron oxides like magnetite and maghemite and can be used as a proxy of weathering in the section. Initial results suggest the presence of a palaeosol in the uppermost part of the section, but predominantly pure loess below. Luminescence testing indicates that a 63-90 μm quartz SAR optically stimulated

luminescence dating protocol is well suited for dating this material, which appears fast component dominated and provides reproducible results. Initial ages point to deposition commencing from the last glacial maximum. Further results will be critical in resolving many questions concerning the timing of deposition of this deposit, and constraining a major period of greatly enhanced dustiness in the region.

Keywords: Pegwell Bay, British loess, grain size, mineral magnetic, luminescence, dust

MULTIPROXY EVIDENCE OF MIDDLE AND LATE PLEISTOCENE ENVIRONMENTAL CHANGES IN THE LOESS-PALEOSOL SEQUENCES OF CENTRAL BOHEMIA (CZECH REPUBLIC)

Flašarová K.[1], Lauer T.[2], Žatecká M.[3], Trubač J.[4], Strouhalová B.[5], Kadlec J.[6], Kolařík P.[1]

[1]Department of Physical Geography and Geoecology, Charles University, Czech Republic, kristyna.flasarova@natur.cuni.cz,kolarip@natur.cuni.cz, [2]Department of Human Evolution, Max Planck Institute for Evolutionary Anthropology, Germany,tobias_lauer@eva.mpg.de, [3]Institute of Geology and Palaeontology, Charles University, Czech Republic, michaela.zatecka@natur.cuni.cz,[4]Institute of geochemistry, mineralogy and mineral resources, Charles University, Czech Republic, trubac@natur.cuni.cz,[5]Institute of Archaeology of the Czech Academy of Sciences, Czech Republic, strouhalova@arup.cas.cz, [6]Institute of Geophysics of the Czech Academy of Sciences, Czech Republic, kadlec@ig.cas.cz

Central Bohemia is a loess area on the border between continental and oceanic climate that has shifted in the past. Numerous profiles have been studied in the past century but without modern methods. This study is focused on a loess-paleosol sequence exposed in Dejvice, located near downtown Prague, Czech Republic, which was investigated during a rescue research, and a loess-paleosol sequence in Bůhzdař, situated 9 km NW of Prague, Czech Republic.Magnetic susceptibility and magnetic fabric (anisotropy of magnetic susceptibility) analyses were combined with geochemical approaches (total organic carbon, XRF elemental analyses, and XRD mineralogy, ^{13}C and ^{18}O stable isotopes) and particle-size distribution. Optically stimulated luminescence (OSL) dating was used to determine the chronology of the section which is essential for understanding the link between climatic shifts and depositional and post-depositional regimes.

Both sequences contain the records the climatic oscillations during the last two glacial stages and both were affected by erosion. The Dejvice sequence is 15 m thick and contains a partly eroded weakly developed paleosol classified as PK I (MIS 3), a Chernozem and a Luvisol of PK III (MIS 5e). The oldest detected paleosol is a Luvisol of PK IV (MIS 7). The Bůhzdař sequence is 5 m thick and contains apartly eroded weakly developed paleosol classified as PK I (MIS 3) and a Chernozem and a weak Luvisol of PK IV (MIS 7). Eemian paleosols are completely missing in the Bůhzdař sequence. The records preserved in the sections correspond well to other sections of same age in Europe and shows significant paleoclimate changes.

Keywords: OSL dating, Pleistocene loess-paleosol sequence, environmental magnetism, stable isotopes, particle-size distribution

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THE UPPER MIDDLE PLEISTOCENE LOESS-PALAEOSOL SUCCESSIONS IN CENTRAL UKRAINE

Gerasimenko Natalia

Taras Shevchenko National Unversity of Kyiv; 2a, 03127, Kyiv; n.garnet2@gmail.com

In the Ukrainian loess stratigraphy (Gozhik, Gerasimenko, 2011), two loess and two palaeosol units fit in the interval between the terrestrial correlatives of OIS 11 (Lower Zavadivka unit) and OIS 6 (Dnipro unit). Soil units, which include one palaeosol, and thin loesses were described in this interval. This paper shows that in sections with intense sedimentation, the Upper Middle Pleistocene soil units are well developed pedocomplexes, whereas the loesses are thick and, in the north, connected with levels of intense cryoturbations. These new sections have been studied (pedostratigraphy, grain-size and palynology) near the villages Gun'ki and Stari Kodaky (the latter 250 km south from the former). The previous study at Gun'ky 1 (Velichko, 1997) showed the Holsteinian age of small mammals from the alluvium at the base of the section. This was confirmed by our pollen study at Gun'ki 2 (G2). The new section (SK13), studied near the Stari Kodaky site (Vekitch, Sirenko, 1972), is located in palaeodepression. The TL-date 132.5±4.7 kyr was yielded here from the top of the thick Dnipro loess. Below Dnipro unit (till and glaciolacustrine loams at G2), the pedocomplex of Potyagaylivka unit (correlative of OIS 7) includes (from top to bottom): 1) Calcic Cambisol (at SK2) and gleysol (at G2); 2) Mollisol (at SK2 and G2); 3) 1 m thick loess-like loam (at SK2) and the level of ground wedges, 2.1 m in depth (at G2); 4) Mollisol (at SK2 and G2); 5) 1.1 m thick loess-like loam and the level of ground wedges (at G2); 6) Luvisol (at SK2 and G2). The content of clay is the largest in subunits 1 and 6. Pollen of mixed forest is found in subunit 6. The 3 m thick Oril loess (correlative of OIS 8) has up to 70% of coarse silt (at SK13), or dissected by ground wedges, up to 3.8 m in depth (G2). The underlying pedocomplex of Upper Zavadivka unit (correlative of OIS 9) consists of: 1) Luvisol (at SK13) or Ferric Luvisol (at G2), with pollen of broad-leaved forest; 2) thin loess-like loam (at SK13) and the level of ground wedges, 2.3 m in depth (at G2); 3) Mollisol (at SK13 and G2), replaced by Greyzem in palaeodepressions. The correlative of OIS 10 is a typical loess (4 m thick), which includes pollen of shrub birch (at G2). The pedocomplex of the Lower Zavadivka unit (OIS 11) consists of two leached Mollisols and Luvisol (at SK2), or the alluvi, laterally replaced by Alluvisol or Luvisol (at G2). Within the Potyagaylivka pedocomplex, the three soil subunits, separated by loess-like loams, could be related

to substages 7e, 7c and 7a. Within the Upper Zavadivka pedocomplex, the soils can be compared with substages 9e and 9a. During cold stages, cryoturbations occurred mainly in the northern site, whereas loesses were thicker in the southern site (small ground wedges are rare here). The palaeosols in the north are leached from carbonates or gleyed, and in the south, Mollisols include carbonates and many bioturbations. They were formed under steppe, though broad-leaved trees grew in gullies and valleys.

Keywords: pedolithostratigraphy, palynology, grain-size analysis, pedocomplex, cryoturbations.

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EXTENDING THE CENTRAL GERMAN LOESS STRATIGRAPHY: NEW RESULTS FROM THE MÜNZENBERG SECTION (MIDDLE HESSE, GERMANY)

Raphael Steup, Tilmann Wolpert*, Manuel Pappusch, Jörn Profe, Madhav Murari, Johanna Lomax, Markus Fuchs

Justus-Liebig-University Giessen, Department of Geography, 35390 Giessen, Germany, e-mail address: urs.t.wolpert@geogr.uni-giessen.de

presenting author *

The loess-palaeosol sequence (LPS) of Münzenberg is situated within the Middle Hessian Depression, Central Germany, a region characterised by comparatively limited knowledge of its loess stratigraphy. Therefore, Münzenberg can be considered as an important palaeoenvironmental archive in a transition zone between the more investigated northern and southern Central European loess areas. Furthermore, the Münzenberg section is of great significance for a better understanding of past local scale process dynamics within a loess landscape due to its specific slope position.

First stratigraphic descriptions of the Münzenberg LPS were published by Bibus et al. (1974, 1976). Starting in 2013 the section was revisited in several field campaigns and comprehensively analysed, using sedimentological parameters (grain size, carbonate content, magnetic susceptibility) as well as luminescence dating methods. Based on these analyses Steup & Fuchs (2017) were able to establish a first reliable chronostratigraphy for the loess sequence. According to their reinterpretation the section reflects the last and penultimate glacial/interglacial cycles and was divided into several subsequences including the following features: I) A strong developed basal soil sediment, most likely formed during MIS 7. II) Calcerous loess and strongly reworked soil sediments attributed to MIS 6. III) An important hiatus covering MIS 3, 4 and parts of the last interglacial. IV) Alternating layers of loess and initial soil formations (tundra gleys) with an intercalated ash layer (Eltville tephra) reflecting MIS 2.

In spite of these findings the pedo- and chronostratigraphic interpretation of the Münzenberg LPS, is now further complicated due to the exposure of a soil complex at the base of the profile during recent field work. Therefore, new analyses including micromorphological investigations of thin sections as well as characterizations of the geochemical composition using XRF-measurements are performed. In addition, the

established chronostratigraphic record is expanded, using different luminescence techniques ($pIRIR_{225}$, IR-RF).

In this presentation new results of the ongoing analyses of the Münzenberg section will be presented and linked to the already published data with an emphasis on the difficulties and problems associated with the luminescence dating process.

Keywords: loess-palaeosol sequences, luminescence dating, Upper-Middle Pleistocene, Central Germany

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MULTIPROXY APPROACH OF A UNIQUE LATE SAALIAN (MIS 6) LOESS RECORD IN THE LOWER DANUBE AT HARLETZ (BULGARIA)

Pierre Antoine[1], France Lagroix[2], Diana Jordanova[3], Neli Jordanova[3], Johanna Lomax[4], Markus Fuchs[4], Denis-Didier Rousseau[5], Christine Hatte[6], Olivier Moine[1]

[1] Laboratoire de Géographie Physique, Environnements quaternaires et actuels, CNRS UMR 8591, Meudon, France. Pierre.antoine@lgp.cnrs.fr, [2] Institut de Physique du Globe de Paris, Sorbonne Paris Cité, UMR CNRS 7154, Paris, France. [3] NIGGG, Bulgarian Academy of Sciences, Sofia, Bulgaria. [4] Department of Geography, Justus-Liebig University Giessen, Germany. [5] ENS, UMR CNRS 8539, LMD & CERES-ERTI, Paris, France. [6] LSCE, UMR CEA-CNRS-UVSQ 8212, Gif-sur-Yvette, France

The Harletz loess sequence is located in NW Bulgaria on the western bank of the Ogosta River, a tributary of the Danube. The sequence is exposed on a cliff face carved by the meandering Ogosta River. A 20 m high section, sitting on top of the river's alluvial plain was cleaned and a high-resolution continuous bulk sampling (5cm) was carried out to characterise grain-size, magnetic susceptibility, various parameters of the magnetic mineral assemblages, colour reflectance and organic carbon geochemistry. 16 samples have been collected for luminescence dating. Using a cyclo-stratigraphic approach of the sequence combined with dating constrains provided by both luminescence dates (Lomax et al., 2019), and the age of a tephra layer occurring at -12m depth within the main loess unit, we can demonstrate that the Harletz section exhibits a unique Late Saalian (MIS 6) loess accumulation in Europe (~ 10m thick) (Antoine et al., 2019). Overlying the basal brown soil complex (lower 4 m of the sequence) allocated to MIS 7, the main loess unit includes an exceptionally detailed succession of four incipient soil horizons and aeolian deposits never described in European loess sequences until now. The closest and best-dated high-resolution palaeoenvironmental archive suitable for comparison is the Lake Ohrid located 400 km to the SW. The evolution of the environment deduced from the Harletz pedosedimentary succession can be easily parallelized with the Ohrid palynological record. Indeed both records testify of a progressive step-by-step evolution characterising the evolution of the climate and of the environments during the transition between MIS 7 and MIS 6. Then, during the younger part of MIS6 (160-129 ka), steppe vegetation with overwhelming herbs (*Artemisia*) is dominant in the Lake Ohrid record, in good accordance with a global enhancement of the aeolian dynamics, especially well recorded in sections located close to the Danube River as

Harletz but also in Serbia, Bulgaria and Romania (L2 loess). According to this study, the silts and fine sands building the Harletz loess section would have been transported from the Danube braided river system located (at that time) at about 4.5 km to the NW. The main loess units are characterised by a very low content or a total absence of coarse sand particles. Finally, the weak development of Last glacial loess (4 m max.) likely results from a rapid infilling of the sedimentary trap during the Saalian, coupled with a strong anthropogenic erosion of the topsoil and of the upper part of the loess profile since the Early Holocene (Neolithic). The Harletz loess sequence thus provides a key climate and environmental record for SE Europe and is especially promising for furthering our understanding of climate oscillations persisting in this area through the MIS 6 glacial period with respect to central and Western Europe.

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PEDOGENIC MAGHEMITE-MAGNETITE LIKES IT HOT AND DRY? INITIAL INSIGHTS INTOTHE IMPACT OF SEASONAL BIAS ON THE FORMATION OF PEDOGENIC IRON OXIDES IN NORTHERN IRANIAN LOESS-PALEOSOL SEQUENCES FROM TEMPERATURE DEPENDENCE SUSCEPTIBILITY

Ghafarpour A[1], Khormali F[1], Cheng L[2], Song Y[2], Forman S[3]

[1] Dept. of Soil Science, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran (aghafarpour@yahoo.com); [2] State Key Laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences, Xi'an 710061, China;[3] Dept. of Geology, One Bear Place #97354, Baylor University, Waco, TX 76798-7354, USA

Loess deposits of Northern Iran provide excellent sedimentary archives for understanding past climate and environment changes in the continental interior. Temperature dependence of magnetic susceptibility (χ –T) has been widely used to determine changes in mineralogy of natural samples during heat treatment and has been widely used in the Chinese loess units and red clay sediments as it can further indicate the degree of pedogenesis of the paleosols (e.g. Song et al., 2018).In this study, we report the χ –T curves of loess and paleosols samples of northern Iranian loess for the first time.This approach aims at obtaining more detailed information about the interaction between climate factors, seasonal bias, pedogenesis process and magnetic signals of the loess units of two late Quaternary loess paleosol sequences (Mobarakabad and Aghband) in northern Iran.The detailed micromorphology and mineralogical analysis of the sections previously were presented in Ghafarpour et al. (2016).The heating curve of samples suggest the existence of detrital magnetite (a clear susceptibility drop near 585 °C) and detrital hematite (the Curie temperature at 675°C) in loess and paleosols samples of the sections. The further drop of magnetic susceptibility (MS) between ~300 °C and ~450 °C in the paleosolsof Mobarakabad sectionwhere mean annual precipitation (MAP) is ~ 680 mm/yris generally interpreted as the conversion of ferrimagnetic maghemite to weakly magnetic hematite. Also, in the weakly developed paleosol at Aghband section (MAP<300 mm) a weakness drop of MS between ~300 °C and ~450 °C is indicative of formation of pedogenic maghemite at the initial stage of pedogenic process from detrital magnetite (Maher, 1998). Our MS data showed that MS of paleosol in Unit 1 of the Mobarakabad section is greatly reduced. The χ–T curves of this paleosol suggests that the existence of detrital magnetite (a susceptibility drop near 585 °C) with a very

weak drop of MS between ~300 °C and ~450 °C that is indicative of absence of pedogenic maghemite grains. Therefore, pedogenic maghemite-magnetite is the major contributor to the contrasts in magnetic enhancement between the Iranian loess and paleosols. The study area is characterized by a seasonal bias when soil moisture is high from October to March, and then drops sharply in summer while air temperature reaches its peak in July–August. The χ–T curves of paleosol samples suggested that both high temperature and the loss of soil moisture during summer months may therefore befavorable of formation in situ, pedogenic maghemite-magnetite. Therefore our data might establish the seasonal nature of pedogenic maghemite-magnetite formation and this is in consistent with a divergent pathway model of production and transformation route of pedogenic ferrimagnetic minerals which proposed a wet season with periodically reducing conditions will lead to the formation of fine-grained ferrimagnetic magnetite, and that a dry season with oxidizing conditions will result in the rapid oxidation of the fine-grained magnetite to maghemite and then to hematite (Maher, 1998). Our work therefore supports previous finding that although rainfall is the key primary determinant of soil water content, seasonal interactions with temperature, and evapotranspiration, will influence the soil micro-environmental redox activity, and hence the resultant concentrations of pedogenic ferrites (Maher et al., 2003; Orgeira et al., 2011).

Keywords: temperature dependence susceptibility, seasonal rainfall, pedogenesis, Fe oxides, Iranian loess

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LOESS-PALEOSOLS AND MODERN SOILS OF NORTHERN IRAN, PALEOCLIMATIC IMPLICATIONS

Khormali, F.[1], Kehl M.[2], Vlaminck S.[2], Frechen M.[3]

[1]Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
fkhormali@gau.ac.ir; khormali@yahoo.com, [2] Institute of Geography, University of Cologne;
kehlm@uni-koeln.de stefan.vlaminck@geo.rwth-aachen.de
[3] Leibniz-Institute of Applied Geophysics, Hannover; manfred.frechen@leibniz-liag.de

The extensive loess deposits of Northern Iran occur in the two different loess provinces of the Alborz Mountain footslopes and the so-called Iranian Loess Plateau and reach a thickness of about 70 m. A pronounced precipitation gradient of about 800 mm year^{-1} over 80 km from north to south and corresponding vegetation from dry steppe over steppe grassland to forest vegetation provides condition for the formation of a variety of modern soils on loess and will have governed soil formation during the past as well. In this study we discuss the major properties of modern and fossil soils and suggest pedostratigraphic correlation of loess-paleosol sequences developed along assumed precipitation gradients of the past. Eight representative pedons were selected in a south-north direction on loess deposits. The climate data show that precipitation varies from 200mm in the upper north regions to up to 900mm in the southern areas on Alborz north facing slopes in less than 80 km latitudinal distance. Three loess-paleosol sections were also investigated on the south – north gradient. Sedimentological and pedological properties were investigated to characterize the development degree of soils and use them for correlation of loess-paleosol sequences at Neka, Toshan, Now Deh and Agh Band.

In the northern regions showing more aridic climate, Aridisols with gypsum and carbonate accumulations are formed. Organic matter accumulation and the formation of mollic epipedon are the dominant processes occurring in the steppe (rainfall of 400-600 mm). Calcification and formation of calcic horizons are typical for loess derived soils. In the north-facing slopes of the Alborz mountain ranges with the forest vegetation and higher rainfall, deeper leaching of calcite and formation of the argillic horizon are dominant. Soils are mainly Alfisols.

The loess-paleosol sequences reflect diachronic changes in dust accumulation rates and testify formation of interstadial or interglacial paleosols at land surfaces of the Middle to Late Pleistocene. Pedostratigraphy backed by luminescence dating show clear regional correlation of loess-paleosol sequences along the Alborz Mountains

foothills. Strongly developed paleosols reflect major soil forming periods during the Eemian Interglacial (~MIS 5e) and during interstadials of the Early Last Glacial (~MIS 5c, 5a), while weakly developed paleosols likely formed during interstadials of the last and penultimate glacials. If compared with paleosol formation in the Iranian Loess Plateau it appears very likely that pedogenesis of interglacial paleosols was governed by similar climate controlled trends to those reflected in the modern soils. The loess-paleosol sequences represent excellent records of (Late) Quaternary climate change in the area.

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MICROBIAL COMMUNITIES OF PALAEOSOLS IN LOESS STRATA OF THE EASTERN CISCAUCASIA

Tatiana E. Khomutova[1], Kamilla S. Dushchanova[1], Natalia N. Kashirskaya[1], Idris Idrisov[2], Alexander V. Borisov[1]

[1]-Institute of Physicochemical and Biological Problems in Soil Science Russian Academy of Sciences, ul. Institutskaya 2, 142290, Pushchino, Moscow region, Russia, khomutova-t@rambler.ru, [2]-Institute of Geology Dagestan Scientific Center Russian Academy of Sciences, ul. Yaragskogo 75, 367010, Makhachkala, Russia, idris_gun@mail.ru

The state of microbial communities in the buried palaeosols of the loess strata of the Khasavyurt plain (Eastern Ciscaucasia, Russia) were studied. The thickness of loess deposits was about 50 m. An exposed surface dark chestnut soil (Kastanozem) had a thickness of about 0.5 m, the next 3-3.5 m were almost pure light yellow loess. The buried palaeosols were observed in the upper part of the loess. Palaeosol 1 at a depth of 5-10 m and a thickness of about 2 m dated back to 10,850 ± 135 yrs BP was morphologically similar to chernozem-like soil. Palaeosol 2 dated back to 19,425 ± 185 yrs BP well pronounced at a depth of 15-20 m, intensely colored on the top was also of a chernozem-like type. The lower part of the loess stratum (10–15 m) was complicated by several horizons with obvious traces of soil formation processes (palaeosol 3). These horizons reflect the dynamics of erosion-accumulative processes during the loess accumulation and redistribution likely in the end of the Eopleistocene (Apsheron stage). The carbon of living microbial biomass was determined from the content of soil phospholipids (Khomutova et al., 2017), and compared with the carbon of the total microbial biomass, which includes both living and dead cells (Kashirskaya et al., 2010), and total organic carbon.

The content of organic carbon in the upper horizon was 2.8%, decreasing to 0.4% at a depth of about 1 m, in loess the carbon content was 0.1-0.2%, and in palaeosols reached 0.9 - 1.3%. The entire studied stratum was inhabited by microorganisms. The total microbial biomass, including living and dead cells, in the exposed surface soil was 3.6 mg/g, at a depth of 1 m decreasing to 2.7 mg/g. In loess it decreased from 1.8 to 0.3 mg/g, and in palaeosols was 1.5-2.8 mg/g. The share of microbial carbon in total organic carbon in the upper layer was 13%, significantly higher in palaeosols (21-74%), and maximal in loess layers (31-93%). However, the main part of microbial carbon were dead cells, living cells comprised less than 14% of the communities. Living microbial biomass was maximal in the upper horizon (290 μg C / g), decreased

to 42 μg C/g in the lower part of the loess, and palaeosols submerged in loess layers differed by significantly higher amounts of living microbial biomass, which constituted 28-20% of the values in the upper layer. From the data obtained, it can be assumed that the upper 3 m depth of the studied profile is involved in the process of soil formation. Palaeosols differed from the loess strata and maintained in a certain extent their microbial communities, despite their deep location and long-term burial.

The work was supported by the Russian Science Foundation (grant 19-18-00406).

Keywords: Khasavjurt loess strata, palaeosols, microbial biomass

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PALEOSOLS OF THE EARLY PALEOLITIC SITE BAYRAKI (TRANSNISRIA)

Khokhlova O.S.[1], Sycheva S.A.[2]

[1]Institute of Physical, Chemical and Biological Problems of Soil Science of Russian Academy of Sciences, ul. Institutskaya, 2, Puschino, Moscow Region, Russia, e-mail: olga_004@rambler.ru;
[2]Institute of Geography of Russian Academy of Sciences; Staromonetnyi Line, 29, Moscow, Russia

The structure of the pedo-sediments stratum of the Early Paleolithic site Bayraki was studied. The site is the most western of well-known sites in Europe at such an early age. It is located on the ancient (the 7th Kitskanskaya) terrace of the Dniester River near the town of Dubosari (Transnistria). The structure of the covering complex of this terrace includes three paleosols of the Middle and Early Pleistocene age of different genesis. Soils are superimposed on each other and better represented in the filling of uneven erosional paleo-cuts. The lowermost soil is hydromorphic (Gleysols) and lies above a series of alluvial layers. It is characterized by a sharp-edged structure and Fe–Mn spots. The formation of this soil completed the alluvial regime and meant the beginning of development of the terrace above the floodplain. Such a surface was already quite suitable for human colonization, as evidenced by the second horizon of finds of the Olduvan culture artifacts (the horizon of finds is HF 2). The oldest layer of finds (HF 3) is within the channel alluvium and it is re-deposited. The reddish-brown soil or pedosediment lies above the Gleysols. A fragment of the soil profile with metamorphic and carbonate horizons was preserved *in situ* within the filling of the paleo-cutting, and crotovinas filled with the material of these horizons are present in the underlying colluvium. The youngest, the uppermost horizon of artifact finds (HF 1), is situated within red-colored soil. The brown soil or pedosediment located above the red-brown one was also better preserved in the fillings of the paleo-cuts. The soil profile includes humus-accumulative, transitional and carbonate horizons. Some soil features were preserved: a granular-nut structure, clay cutans and papules, Mn-Fe and carbonate nodules, as well as ancient crotovinas filled with humified material. According to its characteristics, the soil is quite comparable with the chernozem-type soils of open steppe spaces. The micromorphological study of the soil-sedimentation sequence showed that the material of all soil layers has traces of displacement, was originally carbonate, but the degree of carbonate content changes depending on the genetic characteristics of a particular soil. Also, all the layers had signs of bio-turbation, which were abundant in the uppermost brown paleosol and

sporadic – in other paleosols. In the brown soil, the maximum variety of carbonate accumulations, including carbonate coatings, infillings, cryptocrystalline nodules, needle and phytomorphic calcite in the voids. The microstructure is granular. In the red-brown soil, there are signs of movement of Fe-clay material; the microstructure is both granular and angular; carbonate accumulations are presented by coatings in voids, partially masked by Fe oxides. In the Gleysols, the microzones of different colors with Fe oxides are clear visible; there are speckled, crossstriated and granostriated b-fabrics; carbonate coatings and nodules are rare and they are masked with Fe oxides. In the lower part of this profile, Fe-Mn thin coatings appear in the voids and Fe-Mn spots are scattered in groundmass. Three horizons of finds of the Olduvan culture are associated with paleosoils. People began to settle in the Dniester floodplain more than a million years ago, repeatedly returning to the river valley. The trend of soil formation in the Early Pleistocene indicates the growing cooling and dryness of the climate in the Early Pleistocene.

This study is supported by the RSF, project no. 16-17-10280.

EVIDENCES OF PEDOGENESIS AND SMECTITIZATION IN LOESS-PALAEOSOLS OF THE DILPUR FORMATION, KASHMIR, INDIA: LATE QUATERNARY CLIMATIC RECONSTRUCTION

Meenakshi G.[1], Shrivastava J.[1]*, Chandra R.[2]

*[1]Department of Geology, University of Delhi, 110007, India, [2]Department of Earth Sciences, University of Kashmir, 190006, India, *Corresponding author's email: jpshrivastava.du@gmail.com*

Previous studies documented warm-arid to semi-arid climate attendant to inter-bedded loess-palaeosols of the late Quaternary Period. Yet, these revelations lack in in-depth clay data; thus, present clay composition based palaeoclimatic reconstruction is attempted. X-ray diffraction data revealed abundance of illite, chlorite followed by mixed layer complexes. Further, their relative abundance endorsed threefold sub-division with smectite and chlorite/smectite dominated lower, chlorite dominated middle and illite and chlorite dominated upper parts of the Shankerpora section. Although, lower and upper parts of the Burzahama section correlated well with the middle and upper parts of the Shankerpora section, respectively.

Compositionally, such clay types contain high Fe, but, low Mg and K contents. Low K values suggest smectitization of illite with the loss of K^+ ions and formation of Al and Mg rich smectite end members. However, Fe, Al and Mg rich illite end members form illite solid solutions. Moreover, K^+ and Al^{3+} substitution by Si^{4+} ions in the tetrahedral layer led to smectitization, but, net layer charge later balanced by Fe^{3+} and Mg^{2+} ions in the octahedral layer. Barring a few, almost all the loess-palaeosols show pedogenesis induced smectitization, initiated just prior to and continued after glaciations. However, pore-water and melt-water played significant role during smectitization. Progressive illite to low-charged smectite conversion via series of illite derivatives is accountable for early diagenetic in-situ smectitization and led to recognize glaciation induced pedogenesis in the palaeosol layers prior and successive to loess layers. They show almost similar chemico-minerlogical attributes to those of the Chinese Loess Plateau loess-palaeosol layers, thus, inferred identical palaeoclimate that existed beyond Kashmir Himalayan region. Moreover, two glaciations followed by last glacial maxima (and intervened by three interglacial periods) recognized in this area are consistent with the globally recorded MIS 6, MIS 4 and MIS 2, however, with three alternate cool (includes pre and post glaciation periods of ~30 ka) and warm periods (~10 ka).

Keywords: clays; XRD; loess-palaeosol; pedogenesis; palaeoclimate; glaciation.

THE UPPER PALEOLITHIC TOLOGOI RECORD: A TERRESTRIAL KEY PROFILE FOR THE RECONSTRUCTION OF LATE QUATERNARY ENVIRONMENTAL CHANGES IN SOUTHERN SIBERIA

W. Zech1, D. Andreeva2, M. Zech3, M. Bliedtner4, B. Glaser5, U. Hambach6, R. Zech4

[1]Soil Science Department, University Bayreuth, Germany, [2] General and Experimental Biology, RAS, SB, Ulan-Ude, Russia, [3] Institute of Geography, Technical University Dresden, Germany, [4] Geographical Institute, University Jena, Germany, [5] Biogeochemistry, Martin-Luther University, Halle, Germany, [6] Institute of Geomorphology, University Bayreuth, Germany

Up to now our knowledge about the Quaternary environmental evolution in Transbaikalia, the region SE of Lake Baikal, is mainly based on palynological studies of lake sediments (e.g.: Bezrukova et al., 2013). Terrestrial records like Tologoi, were mainly studied by paleontological (Erbajeva et al. 2011) but less with innovative pedological methods (e.g.: White et al., 2013; Andreeva et al., 2013). Here we present biomarker and stable isotope results from the key section Tologoi (N: 51°44´44,1´´;E: 107°28´22,9´´; altitude 535 m asl; MAP = 264 mm, MAT = -1.1°C).

The whole record is about 20-25m thick and developed in silty-sandy sediments (Ivanova et al., 2018). Here we focus on the upper 4.5 m of the profile, sampled every 10 cm. It likely reflects environmental fluctuations during the last 45 ka with relatively favourable conditions between 45 to 30 ka (Kargin Interstadial), 17.5 to 12.6 ka (including likely Bölling Alleröd), ca 11.5 to 7.5 ka (Early Holocene with a short interruption at about 9.5 ka). These more climatically favourable intervals are characterized by reduced values of magnetic susceptibility, lower sand contents, reduced ratios of SiO2/R2O3 and K2O/MgO but elevated ratios of Ti/Zr. Some proxies like SiO2/R2O3, K2O/MgO and Ti/Zr let assume that the gLGM between ~30 to 17.5 ka was interrupted by a warm spell at ca. 25 ka.

Since proxies resulting from leaf-wax biomarkers have been suggested during the last decades as promising tools for the reconstruction of Quaternary environments, the n-alkanes were analysed. The results allow the conclusion that woody species dominated only during the Holocene. Compound specific analyses of δD in long-chain alkanes reveal more positive values in warm mode sediments and more negative ones in cold mode sediments documenting climatic deterioration. Towards the mid

Holocene the density of the forest cover reached its maximum (alkane ratios <1) correlating with maximum δD values.

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Acknowledgement: The study was supported by the Russian Foundation for Basic Research, and the Universities of Bayreuth and Halle.

THE PROVENANCE OF LOESS-PALAEOSOL SEQUENCES ALONG THE MIDDLE AND LOWER DANUBE

Fenn K.[a], Millar I.[b], Durcan J.A.[a], Thomas D.S.G[a]

[a] *Oxford University Centre for the Environment, South Parks Road, Oxford OX1 3QY, UK*
[b]*NIGL, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK*

Sediment provenance is a powerful tool in understanding sediment system dynamics, and through them climate. Yet detailed provenance investigations are not very widespread in loess research. Investigations of loess-palaeosol sequences can provide unique insights into sediment dynamics, production, transport and deposition over various time- and spatial- scales, from local to continental. However, provenance information needs to be examined alongside high resolution absolute chronologies, to identify drivers of the process, link with other archives and quantify rates of process over the longer term.

Great advances in understating provenance of loess deposits on the Chinese Loess Plateau (c.f. Nie et al., 2015) have been made by moving away from bulk sample analysis to single grain resolution of analysis, in particular U-Pb dating of detrital zircons. Comparatively limited single-grain work has been done in Europe to date. Here we present the results of provenance analysis from three loess-palaeosol sequences along the Danube, in Croatia, Serbia, and Bulgaria. For the first time in loess provenance research, U-Pb dating was combined with Hf isotopes from single grain zircons in a systematic manner, to investigate multiple loess-palaeosol units at high resolution. By supplementing this work with chronologies based on optically stimulated luminescence dating we have been able to investigate provenance changes over time at each site. We demonstrate some small provenance shifts within individual sections, likely linked to changes in fluvial activity, variation between sites on short spatial scales, and discriminate some previously proposed sediment sources. We also compare our new single-grain zircon datasets with existing published potential source geochemical records to explore the primary sediment sources and sediment transport pathways on a source to sink scale.

Keywords: Provenance, Geochemistry, U-Pb, zircon, Hf

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DETRITAL ZIRCON U-PB AGES INDICATE QUATERNARY DUST SOURCES AND TRANSPORT PATHWAYS IN SOUTHERN RUSSIA

Chiara Költringer[1a], Thomas Stevens[1], Redzhep Kurbanov[2,3], Yunus Baykal[1]

[1]Dept. of Earth Science, Uppsala University, Sweden; achiara.koltringer@geo.uu.se; [2]Faculty of Geography, M.V. Lomonosov Moscow State University, Leninskie Gori, MSU, 1, Moscow 119992, Russia; [3]Laboratory of Evolutionary Geography, Institute of Geography RAS, Staromonetny, 29, Moscow 119017, Russia

Loess is an excellent record of aeolian mineral dust and has great potential for the understanding of past dust source, transport pathways and atmospheric circulation. Nevertheless, in many regions the precise sources of loess and dust deposits are poorly constrained. In the South of Russia, including the Azov Sea region and the Northern Caspian lowland centered on the Lower Volga River, sequences of relatively under studied loess deposits crop out in sections along incised gullies, river and stream channels. The nature, source, transport and accumulation of these Late Quaternary dust deposits remain poorly known, as well as their implications for understanding Caspian Sea and Black Sea history and past river dynamics. Located in the middle of the vast Eurasian loess belt bracketed by the well-studied loess regions of Europe and East Asia, this area represents a missing link in addressing Eurasian continental atmospheric circulation and dustiness. Resolving the provenance and transport of loess in the South of Russia is therefore crucial for developing full understanding of climate and dust evolution in Eurasia. U-Pb dating of detrital zircons from loess and potential source sediments is a powerful tool to determine loess provenance. It has shown striking success in overcoming ambiguities in deciphering multiple sources from bulk sample geochemical data in a number of loess regions. Here we present high n (n > 300 per sample) zircon U-Pb age datasets from loess in the Azov Sea region, Southern Russia, the Northern Caspian lowland, the Southeastern Caspian coast, as well as from samples of possible source regions, obtained via multi collector laser ablation ICPMS. Considering Late Quaternary paleoclimate conditions, the possibility of multi-step fluvial transport, and not least sediment availability allows contemplation of a number of possible sources of loess in the region: the floodplains of the Volga River and Don River, sands of the Caspian Sea, desert sediments from Central Asia, eroded bedrock material from the Caucasus and Crimea and moraine/loessic material from the East European/Russian plain. First results show remarkable differences in U-Pb age spectra for different loess deposits in the Caspian

and Black Sea regions despite their close local proximity, indicating a relatively near-source origin for the aeolian dust. From U-Pb age spectra of potential source material we infer the importance of river transport for loess deposits in the region. Zircon U-Pb age fractions do not vary at different stratigraphic levels within the individual loess sections, suggesting stable late Quaternary sources. We will discuss these results and the implications for aeolian dust transport in the Caspian and Azov Sea basins.

Keywords: loess provenance, loess transport, zircon geochronology, Southern Russia

WHY ARE SOILS IN LOESS-PALEOSOL-SEQUENCES IN SOUTHERN TUNISIA SANDY?

Dominik Faust*, Maximilian Pachtmann*, YesmineTrigui*, Sascha Meszner*

**Dept. Physical Geography, Fac. of environmental science, TU Dresden, Germany, e-mail: Dominik.Faust@tu-dresden.de*

The Sahara is the world's largest hot desert and therefore it is and was one of the biggest global dust emitter today and during the past. Several environmental archives indicate fluctuations of aridity during the Quaternary. The interpretation of Loess-Paleosol-Sequences (LPS) may help to enlarge our understanding of these fluctuations.

Thick and widespread distributed Desert Margin Loess-deposits are quite rare. In surrounding areas of the village of Matmata in southern Tunisia, Quaternary Loess deposits are still preserved. Especially valley and depression floors are covered by up to 30 m of clayey and silty Loess with intercalated sandy Paleosols.

Our first results from the Matmata loess area in Southern Tunisia will be presented aiming toreconstruct the Quaternary environmental changes between Loess deposition and soil formation.

More than 11 LPS have been investigated so far in order to build up a solid loess stratigraphy for this region. The deposits show a clear internal stratigraphy of loess units interrupted by intercalated reddish sandy paleosols. These soils have clear features of $CaCO_3$-leaching in the main soil horizon, whereas lower parts show a strong enrichment of carbonate (Cc-Horizon).

These features should be a result of more humid conditions under which soil formation could happen in contrast to arid loess forming environments. However, soils and loess within the same sequence show distinct analytical results. A look into the sediment sources may contribute to understand this phenomenon.

Our chronostratigraphy frame will be based on several OSL age estimations.

USING ZIRCON U-PB AGES TO DETECT CONCURRENT LAST GLACIAL LOESS PROVENANCE VARIABILITY WITH DUST ACTIVITY IN THE CARPATHIAN BASIN

Yunus Baykal[1], Thomas Stevens[1], Gábor Újvári[2,3], Chiara Költringer[1]

[1]Department of Earth Sciences, Uppsala University, Uppsala 75236, Sweden;[2]Department of Lithospheric Research, University of Vienna, A-1090 Vienna, Austria; [3]Institute for Geological and Geochemical Research, Research Centre for Astronomy and Earth Sciences, Hungarian Academy of Sciences, H-1112 Budapest, Hungary

Atmospheric dust plays a fundamental role in the Earth's climate system. Its deflation in source regions, transport in atmospheric suspension and final deposition all drive and respond to climate change. Past atmospheric dust dynamics are potentially recorded in loess deposits. Recently, the most precise age model for European dust deposits based on high resolution ^{14}C dating from Dunaszekcső, Hungary revealed a close link between central European and Greenland dust activity, which in turn corresponds with last glacial climate fluctuations on centennial-millennial timescales. Despite this quantitative link, our understanding of dust-climate interaction is limited by uncertainties over the source of the material. Multiple hypotheses regarding the origin and transport pathways of the loess deposits in the Carpathian Basin under varying atmospheric conditions during glacials and interglacials have been proposed. However, the application of provenance indicators including clay mineralogy, Sr-Nd isotopes, heavy mineral assemblage and zircon U-Pb ages yielded ambiguous results. For the present study, samples for detrital zircon U-Pb dating have been selected according to the abrupt changes in dust accumulation rate observed at Dunaszekcső during the time slice of 36 to 24 ka b2k aiming to detect temporal variability of the material's provenance. The resulting U-Pb age spectra are dominated by the Danube sediment signal possibly overriding other sources of similar age signature. Nevertheless, marginal variation in the abundance of Neoproterozoic components and the occurrence of age components older than 1.1 Ga through time can be observed. Detrital zircon U-Pb data from river sediments of the surrounding Danube, Drava, Raba, Mur and Tisza serve as reference data for potential sources while individual age components can be retraced to igneous protosources in the respective catchment areas. Knowledge of patterns in dust source and transport pathway variability during major changes in last glacial dustiness may help to understand the atmospheric mechanisms underlying the sub-orbital timescale North Atlantic climate fluctuations.

Keywords: loess provenance, detrital zircon U-Pb dating, 14C dating, dust activity, last glacial climate fluctuations, Carpathian Basin

GEOMORPHOLOGY AND (PALEO) LOESS LANDSCAPES IN EUROPE DURING THE LAST GLACIAL CYCLE AT DIFFERENT SPATIAL AND TEMPORAL SCALES

Lehmkuhl F.[1], Bösken J.[1], Pötter S.[1], Römer W.[1], Hambach U.[2], Veres D.[3], and the „loessmap team“

[1] Department of Geography, RWTH Aachen University, Germany; [2] BayCEER & Chair of Geomorphology, University of Bayreuth, Germany; [3] Institute of Speleology, Romanian Academy, Cluj-Napoca, Romania

Loess is widely distributed in Europe. It spreads along the northern European loess belt, spanning from northern France to Poland, the intramontane basins of the central European low mountain ranges, the valleys of large river systems such as Rhine and Danube, and the Eastern European Plain.

Throughout Europe, the thickness of these loess deposits varies between some decimeters to several tens of meters. These variations/differences are the results of a complex interplay of climate and geomorphology, controlling accumulation, preservation, and erosion of loess. The northern European loess belt, e.g., was strongly influenced by periglacial environments and thus has a complex stratigraphy including erosional unconformities. Loess in southeastern Europe, however, is mostly found on broad loess plateaus, mainly in the Middle and Lower Danube Basin and north of the Black Sea. Due to their plateau setting and the absence of periglacial influences, these LPS have a simpler stratigraphy and are some of the thickest and most complete terrestrial archives of Quaternary paleoclimate in Europe.

Here, we present a new map of the distribution of loess in Europe. Spatial data representing the geology, geomorphology and the soil properties from 18 different countries were assembled in order to create a seamless map. Additionally, we discuss the depositional settings throughout the continent, regarding the topography, the distance to potential source areas as well as (paleo-) climatic patterns. We examine the influence of (local) topography on sediment deposition using the intersection of loess distribution and elevation data as well as on exemplary loess-paleosol sequences from the Lower Danube using marker horizons such as the Campanian Ignimbrite tephra.

TOWARDS A EUROPEAN LOESS STACK

Christian Zeeden[1], Ulrich Hambach[2], Cristian Necula[3], Diana Jordanova[4], Cristian Panaiotu[3], Christian Rolf[1], Daniel Veres[5], Igor Obreht[6], Slobodan B. Marković[7], Frank Lehmkuhl[8], Stefanie Kaboth-Bahr[9]

[1] Leibniz Institute for Applied Geophysics, Stilleweg 2, 30655 Hannover, Germany, Christian.Zeeden@leibniz-liag.de, [2] BayCEER & Chair of Geomorphology, Universitätsstr. 30 95447 Bayreuth, University of Bayreuth, Germany, [3] Faculty of Physics, University of Bucharest, N. Balcescu 1, 010041 Bucharest, Romania, [4] National Institute of Geophysics, Geodesy and Geography, Bulg. Acad. Sci., Acad. G, Bonchev bl.3, 1113, Sofia, Bulgaria, [5] Romanian Academy, Institute of Speleology, Str. Clinicilor, nr. 5, 400006, Cluj-Napoca, Romania, [6] Organic Geochemistry Group, MARUM-Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen, Leobener Str. 8, 28359 Bremen, Germany, [7] Chair of Physical Geography, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia, [8] Department of Geography, Templergraben 55, 52056 Aachen RWTH Aachen University, Germany, [9] Institute for Geosciences, University of Potsdam, Karl-Liebknecht-Straße 24-26, 14476 Potsdam-Golm, Germany

Stacking of paleoclimate and paleoenvironmental data in a stratigraphic framework is a valuable approach for eliminating noise in individual records and extracting a shared pattern. At the same time stacking may smooth out local differences and features, especially when datasets have different temporal resolution. Creating a common time scale is prerequisite, although it may not need to be correct in detail (Lisiecki and Raymo, 2005).

For the marine realm (e.g. Karner et al., 2002; Lisiecki and Raymo, 2005) and Asian loess proxies (e.g. Ding et al., 2002; Sun et al., 2006) stacked composite records of paleoclimate evolution exist. These stacks have been very valuable as long, continuous and representative reference datasets. Yet, loess data from continental Europe has been compared in a qualitative manner (Marković et al., 2015 and references therein). We hold the opinion that a systematic and quantitative evaluation of (dis)similarities of representative (and not clearly locally controlled) loess datasets of the magnetic susceptibility from Europe will lead to a better understanding of (dis)similarities, and possibly also (spatial?) geographic trends (Zeeden et al., 2018) arising from variabilities of aeolian dust fluxes and (paleo)climate conditions.

Therefore, we aim at placing available magnetic susceptibility data from European loess sites (situated in South-Eastern Europe) on a common stratigraphic age scale and

develop a European Loess stack, initially for the last ~500,000 years. In this contribution, we discuss the timescale for the European loess deposits, and present preliminary results of stacking several datasets. Both methodological considerations and initial results will be discussed. Finally, we compare the initial loess stack to other geoarchives from the area.

Keywords: Loess, stack, Europe, loess-paleosol sequences

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DANSGAARD-OESCHGER MILLENNIAL OSCILLATIONS ARE NOT RESTRICTED TO THE LAST CLIMATE CYCLE: THE LOESS POINT OF VIEW

Denis-Didier Rousseau[1,2], Pierre Antoine[3], Niklas Boers[4], France Lagroix[5], Michael Ghil[1, 6], Johanna Lomax[7], Markus Fuchs[7], Maxime Debret[8], Christine Hatté[9], Olivier Moine[3], Caroline Gauthier[9], Diana Jordanova[10], and Neli Jordanova[10]

[1] Ecole Normale Supérieure, Laboratoire de Météorologie Dynamique, UMR8539 CNRS, Paris cedex 05, France, [2] Lamont Doherty Earth Observatory, Columbia University, New York, USA [3] Laboratoire de Géographie Physique, Environnements quaternaires et actuels, CNRS, Meudon, France, [4] Potsdam Institute for Climate Impact Research, Potsdam, Germany [5] Institut de Physique du Globe de Paris, Sorbonne Paris Cité, University Paris Diderot, UMR7154 CNRS, Paris, France, [6] Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, CA 90095-1565, USA, [7] Department of Geography, Justus-Liebig-Universität Gießen, Gießen, Germany, [8] Normandie University, UNIROUEN, UNICAEN, CNRS, M2C, Rouen, France, [9] Laboratoire des Sciences du Climat et de l'Environnement, Université Paris-Saclay, Gif-sur-Yvette, France, [10] National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Block 3, 1113, Sofia, Bulgaria

We have demonstrated a strong correlation between millennial variations of loess accumulation rates in Europe, and the North Atlantic climate oscillations known as Dansgaard-Oeschger (DO) interstadial –stadial cycles that punctuated the last climate cycle (Moine et al., 2017). Stadials are cold and dusty glacial conditions; they are even colder when associated with the huge iceberg discharges from the Northern Hemisphere ice sheets known as Heinrich events (Rousseau et al., 2017a). DO interstadials are warm phases, with reduced dust concentration in the atmosphere, following abrupt temperature increases in the North Atlantic (by more than 10°C in Greenland in less than 100 years). These interstadials correspond to paleosols found in European loess series (Antoine et al. 2015), whose type depends on the interstadial duration. Longer interstadials correspond to more mature paleosols (Rousseau et al., 2017b). In parallel, a recent model (Boers et al., 2018) was shown to replicate the observed characteristics in $\delta^{18}0$ variations, such as the sawtooth shape of the DO cycles, with abrupt warming and slower cooling to glacial conditions, as well as the time intervals between successive DO events over the past 130,000 years, and also the opposite phasing of the observed climate signal in the Greenland ice cores and in Antarctica: when Greenland warmed, Antarctica cooled and conversely. This model has provided, moreover, a unified framework to explain the major characteristics of

millennial climate variability, including both DO cycles and Heinrich events during the glacial intervals of the last climatic cycle (Boers et al., 2018). New investigations of European loess records from MIS 6 reveal the occurrence of alternating loess intervals and paleosols (Antoine et al., 2019, Lomax et al., 2019), similar to those from the last climatic cycle. The paleosols are correlated with interstadials described in various Northern Hemisphere records, including GLt_syn, the synthetic 800 kyr record of Greenland $\delta^{18}0$ due to Baker et al. (2011). Therefore, referring to the interstadials described in the record of the last climate cycle in European loess sequences, the MIS 6 interstadials can confidently be interpreted as DO-like events of the penultimate climate cycle (Rousseau et al., 2019). If this interpretation is correct, DO events and DO cycles are not restricted to the last climate cycle. Our most recent results herein clearly indicate that these millennial oscillations are solely due to mechanisms intrinsic to the climate system, and imply that their understanding requires further investigations that need to encompass at least the last two climate cycle.

Keywords: Paleosols, Incipient Weathered Horizons, Interstadials, Marine Isotope Stage 6, Dansgaard-Oeschger Events

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PALEOSOLS OF EXTINCT OASES IN THE LOESS-ICE PLAINS OF THE SIBERIAN ARCTIC

Fominykh L.A., Zolotareva B.N., Pinsky D.L.

Institute of Physical-Chemical and Biological Problems of Soil Science RAS, Institutskaya St., 2 Pushchino, Moscow region, Russia lfominyck@rambler.ru

Unique Pleistocene loess-ice strata with a grid of powerful ice veins can be found in the landscapes of the Siberian Arctic and the North American continent up today. Their upper relief-forming horizon, called "yedoma," was formed in the areas escaped glaciation and marine transgressions affected by an extremely dry and continental climate conditions. The analysis of the key stratigraphic sections has showed that the permafrost deposits formed till Holocene interglacial under constant climate of the northeast Asia are preserved even in conditions of active thermokarst processes. The existence conditions of "mammoth fauna" in Pleistocene is one of the secrets because the yedoma uplands (plakors) were occupied by the low-productive tundra-steppes herbal associations and the permafrost landscapes represented by extended yedomas (with alases corresponded to the modern regions of Central Yakutia). Primitive peat-gleyic soils have formed along grooves of the permafrost microrelief over the ice veins, and steppe and tundra-steppe areas were separated. High continentality of climate caused combination of thermally contrast areas with extreme temperature gradients between soil and air and extreme hydrothermal conditions on the different elements of meso- and microrelief. There are two breaks of ice complex in yedoma area. Modern interfluve plakors are represented by the multimeter strata of aleurite and loam with strong ice veins extending into the vertical cliffs of natural outcrops along the river, lake, and sea banks. Ground "pillars" between ice veins have a monotonous structure, cold gray colors, and permeated with the thread-like thin roots of herbs. The second type of yedoma cliffs are ground outcrops, with thermoerosive hollows, groups of cemetery mounds (baidzherakhs). There are buried alases where ancient soils and peatbogs alternating with loam overlapping horizons, and abundance of bones of large mammals from "mammoth" fauna since the alases served as the pastures for giant herbivores and other mammals. Thermoerosion processes sometimes reveal whole corpses of ancient animals. The bone remnants are often covered with gray-blue mineral vivianite. Paleosols and overlapping their deposits have also been salinized. The stratification of the ice complex (yedoma) has been insufficiently studied therefore the combination of biostratigraphic and climate-

stratigraphic methods including radiocarbon dating provides with incomplete data. The problem of ice complex genesis is still unsolved however further studies taking into account geological and cryolithological formation conditions will provide with the data on its development as whole and in particular.

A DIVERSIFIED SET OF FLOODPLAIN FACIES OF REWORKED LOESS

Vandenberghe Jef [1,2], Yang Xun[2], Wang Xianyan[2]

[1] Institute of Earth Sciences, De Boelelaan 1085, VrijeUniversiteit, 1081HV Amsterdam, The Netherlands (jef.vandenberghe@vu.nl); [2] School of Geography and Ocean Science, Nanjing University, Xianlin Boulevard 163,Nanjing 210023, China (youngxun87@163.com; xianyanwang@nju.edu.cn)

Sediment series of fluvial terraces typically consist of fine-grained floodplain deposits overlying coarse-grained channel deposits (facies a). Here, we focus on a diverse assemblage of floodplain facies of reworked loess (facies b-c) at one site (Jingxin) in the Hanzhong tectonic basin in central China. The vertical sedimentary sequence shows gradually changing energy conditions as illustrated by the sedimentary structures and grain-size composition. Apart from the highest energy in the channel facies a, a high-energy floodplain environment (facies b) prevailed in water-logged conditions with small-sized, laterally migrating channels interfingering with aggrading horizontal sheets of overbank deposits in alluvial pools and swamps and finally terminating with soil formation. This facies was followed by the establishment of a floodplain with much lower energy (facies c and d) in which phases of stability (and soil formation) alternate with flat sheets in overbank position or dipping foresets in channel bars.

The channels of facies b and c are filled with coarse-grained sand and gravel that, however, is considerably smaller than in the channel facies a. The channel facies b shows trough-crossbedding, bar forms and features of erosion and lateral migration. The fine-grained alluvial sheets of facies b and c are dominantly silts with a grain-size that is typical for monsoonal loess (around 20-35 μm) with variable admixtures of fine background loess and coarse fluvial sand. The monsoonal loess is on average slightly finer-grained than on the more northern Central Loess Plateau. The backswamp pools are mainly filled with this silty (reworked) loess although a small but constant amount of fine clay (0.8-0.9 μm) is present, interpreted as a reworked weathered loess that was re-deposited in the very calm conditions of stagnant pool. It is typical that the original grain-size distribution of the loess does not change substantially by the reworking process in the floodplain.

The palaeosols vary in color from light to dark brown and are further characterized by CaCO3 precipitation, prismatic structure, slight clay illuviation and the occurrence of roots. They are interpreted as Bw or Bt horizons of luviccambisols formed during

interglacial periods. These climatic conditions follow the commonly supposed glacial conditions of the channel facies (a). The successions show a recurrent sedimentary composition and a clear cyclicity from dry and wet floodplain sedimentation terminating by stability with soil formation.

THE GEOCHEMISTRY OF POLISH LOESS: IMPLICATIONS FOR PROVENANCE, SEDIMENTARY SORTING AND WEATHERING

Skurzyński J.[1], Jary Z.[1], Raczyk J.[1]

[1] *University of Wrocław; Uniwersytecki Sqr. 1, 50-137 Wrocław, jacek.skurzynski@uwr.edu.pl*

The loess of Poland makes up the central part of Northern European Loess Belt, which is considered as classic ice-sheet loess, blown probably from northern outwash plains. However, the local sediments, delivered largely by the Wisła River and tributaries or the Great Odra Valley had been also considered as a potential sources, based on a number of widely analyzed pedo-lithological features, such as grain-size or magnetic properties (e.g. Jary and Ciszek, 2013 and the references therein). The data regarding geochemistry of Polish loess are scarce (Skurzyński et al., 2019 and the references therein). In this study, the geochemical properties (ICP method) of the Late Pleistocene loess-palaeosol sequences (LPSs) in Poland (Biały Kościół, Złota and Tyszowce) were examined in order to constrain the provenance of Polish loess, considering simultaneously the weathering signature and effect of sedimentary sorting. In all analyzed Polish LPSs the chemical composition, especially rare earth elements (REEs) content, is mainly controlled by source, due to absence of extreme chemical weathering (e.g. CIA from 53.6 to 76.5, Th/U from 2.98 to 4.82, Ce anomaly from 0.96 to 1.15 etc.). The chondrite-normalized REEs distribution patterns are rather uniform in each sample, characterized by steep light REEs (La_N/Sm_N = 3.34 – 4.41) and very flat heavy REEs (Gd_N/Yb_N = 1.02 – 1.51) values, and by constant negative Eu anomalies (Eu/Eu^* = 0.45 – 0.66). Those patterns are similar to UCC (Upper Continental Crust) reflecting the quite well-mixed nature of the sediments (it's supported e.g. by the Th/Sc vs Zr/Sc plot, with samples clustered far from igneous differentiation trend, following a trend of zircon addition). However, the more flat heavy REEs (HREE) pattern, related to the UCC, suggests that the source area were enriched with HREE. The biggest European area of high HREE values in floodplain sediment (which can represent a mean sample of the catchment basin) occur over crystalline rocks of the almost whole Norway, northern Sweden and south-west Finland and one of the lowest values were found for the glacial-related cover from north Germany and Poland (Salminen et al., 2005). Despite to low amounts of HREE, the Polish floodplain sediments are characterized by the low Gd_N/Yb_N values, the same as for the Polish LPSs, which are quite rare in Europe. It suggests that Polish

loess were likely deflated from the relatively fresh and sedimentary sorted material of nearby outwash plains, and that the variability of REEs absolute abundances (e.g. La = 18.9 – 40.9) is related to the quartz erichment/dilution effect. The research had been performed under the National Science Centre project no. 2017/27/N/ST10/01208 for Jacek Skurzyński.

Keywords: Loess; Palaeosol; Geochemistry; Poland; Late Pleistocene

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DYNAMICS OF N-ALKANES IN LOESS-DERIVED SOILS OF CZECHIA

Kolařík P.[1], Strouhalová B.[2], Trubač J.[3], Flašarová K.[1], Šefrna L.[1]

[1] Department of Physical Geography and Geoecology, Charles University; Albertov 6, 128 43 Praha 2, Czechia, me@petrkolarik.com; [2] Institute of Archaeology of the Czech Academy of Sciences, Prague, Letenská 4, 118 00 Praha 1, Czechia,[3] Institute of Geochemistry, Mineralogy and Mineral Resources, Charles University, Albertov 6, 128 43 Praha 2, Czechia

The research of plant wax *n*-alkanes preserved in soil and other environments as a way to understanding environmental changes in the past has experienced a surge in interest in recent years. The plant wax *n*-alkanes preserved in soils reflect vegetation history, different plant forms (typically grasses vs. trees) can be discriminated based on the presence of *n*-alkanes of various chain lengths. The fact that vegetation is heavily influenced by climate and the possibility of carbon dating these *n*-alkanes preserved in soil mean that *n*-alkanes have a great potential as a paleoproxy. This is of particular interest in European Chernozem regions where $\delta^{13}C$ cannot be reliably used to reconstruct past vegetation. However, considerable post deposition changes in *n*-alkanes have been observed. In particular, long-chain *n*-alkanes have been shown to degrade over time. We are studying the dynamics of *n*-alkanes using a combination of *n*-alkane chain-length differentiation and carbon dating on a number of loess-derived soil (namely Chernozems and Luvisols) sites in Czechia with well-described vegetation history, with the aim of ascertaining the changes in *n*-alkanes over time in relation to the specific chemical and physical properties of these particular soil types. The understanding of these changes will provide a valuable contribution to the highly debated topic of soil development, vegetation history as well as environmental history as a whole in the Central European loess region and in a broader context serve as a reference for future use of plant wax *n*-alkanes as a reliable paleoproxy.

Keywords: Chernozem, dating, Holocene, Luvisol, n-alkanes, vegetation

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LUMINESCENCE DATING CHALLENGES: ABOUT HIATI AND METHODOLOGICAL CONSIDERATIONS IN LOESS-PALAEOSOL SEQUENCES: THE URLUIA EXAMPLE, ROMANIA

Janina Bösken[1,2], Nicole Klasen[3], Igor Obreht[6], Ulrich Hambach[5], Daniel Veres[2,7], Christian Zeeden[5], Dominik Brill[3], Christoph Burow[3], Stephan Pötter[1], Daniela Constantin[2], Frank Lehmkuhl[1], Alida Timar-Gabor[2]

[1] Department of Geography, RWTH Aachen University, Germany, Janina.boesken@geo.rwth-aachen.de, [2] Interdisciplinary Research Institute on Bio-Nano-Science of Babes-Bolyai University, Cluj-Napoca, Romania, [3]Institute of Geography, University of Cologne, Germany [4] Organic Geochemistry Group, MARUM-Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen, Germany, [5]BayCEER& Chair of Geomorphology, University of Bayreuth, Germany, [6]Institute of Speleology, Romanian Academy, Cluj-Napoca, Romania,
[7]Leibniz Institute for Applied Geophysics, Hannover, Germany

Loess-paleosol sequences are in the focus of paleoenvironmental research because they offer presumably quasi-continuous terrestrial records of environmental change. As such, reliable dating approaches are essential. Age models can be based on different methods, e.g. correlative approachesand absolute dating approaches. For the Urluia loess-paleosol sequence, which provides a high-resolution record covering the Last Glacial Cycle in the Lower Danube-Black Seaarea (Romania),correlative and luminescence age models do not agree with each other (Bösken et al., 2018). While the performance of the luminescence data speaks for a reliable chronology, the radiometric ages of the samples presumably covering theMIS4-5 interval do not fit the stratigraphic evidence. As ages in the lower half of the section do not increase with depth, field saturation has been suggested, while new measurements indicate that laboratory saturation has not been reached.This contribution presents a detailed luminescence dating approach using OSL and pIRIR protocols for fine-grain quartz and polymineralsamples. Furthermore, the question whether the observed discrepancy between the dating results and the stratigraphy represents a regional pattern or perhaps intrinsic luminescence properties are responsiblewill be discussed.

Keywords: OSL; pIRIR; paleoclimate; geochronology; Lower Danube

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CALIBRATING LEAF WAX PATTERN AND COMPOUND-SPECIFIC ISOTOPES

Roland Zech[1], Marcel Bliedtner[1], Julian Struck[1], Paul Strobel[1], Hans von Suchodoletz[2], Enkhtuya Bazarradnaa[3], Michael Zech[2]

[1] Institute of Geography, University of Jena, Löbdergraben 32, 07743 Jena, Germany; [2] Institute of Geography, Faculty of Environmental Sciences, Technical University of Dresden, 01062 Dresden, Germany; [3] Institute of Plant and Agricultural Sciences, Mongolian University of Life Sciences, Mongolia

Long-chain n-alkanes are leaf waxes, which are relatively well preserved in various archives, including lake sediments and loess-paleosols, over thousands of years. Several studies have shown differences in the n-alkane homologue pattern depending on the type of vegetation. Therefore, n-alkanes have potential to serve as "biomarkers", and their homologue pattern, as well as their stable isotopic composition (D and 13C) are increasingly used for paleoenvironmental and –climate reconstruction. However, regional calibrations are necessary. Plant and topsoils samples from an altitude transect in the Caucasus, Georgia, confirm the homologue pattern known from Central Europe, i.e. C31 dominance for grass/herb/steppe samples and C29 dominance for deciduous trees, in this case hornbeam forest (Bliedtner et al., 2018). Our calibration study from Mongolia (Struck et al, 2019) reveals that Poaceae and Cyperaceae tend to have a C31 chain length maximum, while Artemisia and Caragana have more C29. The compound-specific 13C signals are not statistically different between the collected plant species, but the compound-specific 13C signals become enriched with increasing temperature and aridity, likely related to drought stress and water use efficiency. Compound-specific D shows no enrichment with increasing aridity, probably due to very good adaptation to prevent evapo-transpirative water loss.

Keywords: (alkanes, biomarker, isotopes, calibration, Georgia, Mongolia)

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INSECT REMAINS FROM AGHITU-3 CAVE, ARMENIA

Zarikian N.[1], Kandel A.W.[2], Gasparyan B.[1]

[1]Institute of Archaeology and Ethnography, National Academy of Sciences of the Republic of Armenia, Charents St. 15, 0025 Yerevan, Republic of Armenia, [2]The Role of Culture in Early Expansions of Humans (ROCEEH), Heidelberg Academy of Sciences and Humanities at the University of Tübingen, Rümelinstr. 23, 72070 Tübingen, Germany

Archaeological insect remains and their ichnological traces are often given less attention than their vertebrate and molluscan counterparts. Whether this is due to accidental or intentional neglect on the part of the researcher, entomological insights can nevertheless be valuable additions to the interpretation of past events. Insects and related arthropods were undoubtedly as ubiquitous and economically important in human prehistory as they are today. Insect remains can illuminate taphonomic issues, as well as inform about mortuary practices, diet and subsistence, and paleoenvironmental conditions, to name a few. Many innovative entomological techniques have been applied to archaeological questions and deserve mention. However, the goal of this presentation is to contribute to a more holistic understanding of two archaeological contexts at Aghitu-3 Cave in southern Armenia.

The insect remains documented from Aghitu-3 were identified at the Institute of Archeology and Ethnography of the National Academy of Sciences of the Republic of Armenia. The samples were derived from two archaeological horizons (AH) of the site, AH II (Holocene) and AH III (Upper Paleolithic) and were concentrated mainly in six squares. The assemblage was not in a good state of preservation, as the samples were highly fragmented. Nonetheless, the condition of the fragments allowed us to identify 90 incomplete sub-fossilized particles from different parts of the insect body. Based on our preliminary identification they belong mainly to three orders: Coleoptera, Hymenoptera and Diptera. The presence of these groups of insects indicates high floral diversity and various agricultural and forest ecosystems in the area surrounding the cave. Hymenoptera and Diptera are observed hovering near flowers or foliage and flying over sandy areas as main pollinators. Coleoptera represent a predatory feeder and indicate the existence of tombs and dead bodies, or in the case of dung beetles, the presence of animals living nearby. Some of the identified insect remains appear in the Upper Paleolithic context (AH III). However, they are all related to Late Hellenistic and Medieval occupations of the cave, related with keeping animals inside the cave, or perhaps to the use of dung as flooring material, and both ritual and funerary practices inside the cave. This is confirmed by

the presence of wheat seeds, skeletal remains of cattle, and several Late Hellenistic graves discovered during excavation.

Keywords: Aghitu-3 cave, Armenia, Insects, paleoenvironment.

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ALAPARS-1: A NEW PALEOENVIRONMENTAL SEQUENCE AND STRATIFIED OPEN-AIR MIDDLE PALAEOLITHIC SITE IN THE CENTRAL ARMENIAN HIGHLANDS

Ariel Malinsky-Buller[1], Phil Glauberman[2,3], Jenni Sherriff[4], Li Bo[5,6], Ellery Frahm[7], Boris Gasparyan[2], Rhys Timms[8], Daniel S. Adler[9], Keith Wilkinson[4]

[1]MONREPOS, Archaeological Research Centre and Museum for Human Behavioural Evolution, Neuwied, Germany, [2]Institute of Archaeology and Ethnography, National Academy of Sciences, Yerevan, Armenia, [3]Xi'an Jiaotong-Liverpool University, Suzhou, China, [4]Department of Archaeology, University of Winchester, Department of Archaeology, Winchester, UK, [5]Centre for Archaeological Science, School of Earth, Atmospheric and Life Sciences, University of Wollongong, Wollongong, New South Wales, Australia. [6]Australian Research Council (ARC) Centre of Excellence for Australian Biodiversity and Heritage, University of Wollongong, Wollongong, New South Wales, Australia. [7]Yale Initiative for the Study of Ancient Pyrotechnology, Department of Anthropology, Yale University, New Haven, CT, USA, [8]Department of Geography, Royal Holloway University of London, London, United Kingdom, [9]University of Connecticut, Department of Anthropology, Old World Archaeology, Storrs, CT, USA

The open-air Middle Paleolithic site of Alapars-1 is situated ca. 25 km north of Yerevan,in the foothills of the Gutansar volcano and immediately adjacent to a rhyolitic – obsidian dome. Excavations in 2015-16 revealed a sequence of Middle Paleolithic hominin occupations within a thick alluvial-aeolian sequence comprising evidence for dynamic landscape formation processes in the Armenian volcanic highlands during marine oxygen isotope stages (MIS) 5 and 4/early 3.Three Middle Paleolithic lithic assemblages were excavated,exhibiting differential artefact densities and discard patterns suggesting variability in technological organization. The lecture will present the results of sedimentological,tephra and geochemical analyses of sediment together with dating by optically stimulated luminescence. Our results from the Alapars 1 excavations reveal variability within patterns ofMiddle Paleolithic land-use in relation to these changing depositional environments. Thesefindings also add to the growing corpus of Middle Palaeolithic sites dating to the Late Middle Pleistocene and Upper Pleistocene in the Armenian highlands.

PALAEOCLIMATIC VARIABILITY DURING DECCAN VOLCANIC EPISODE: INSIGHTS FROM THE INTRABASALTIC PALAEOSOLS (BOLE BEDS) OCCURRING AROUND DHEBEWADI AREA OF SATARA DISTRICT (MAHARASHTRA, INDIA)

Sayyed M. R. G.

Department of Geology, Poona College of Arts, Science and Commerce, Camp, Pune 411001, India (Email:mrgsayyed@yahoo.com)

Geochemical characterization of the intrabasaltic red boles (Deccan palaeosols) occurring around Dhebewadi area of Maharashtra has been attempted to get insights about their palaeoclimatic conditions of their formation. For this study the bole beds exposed at four different elevations in a hill near Dhebewadi were collected along with associated basalts. CIA and PWI values do not show much variations indicating the palaeoweathering conditions did not change much, however WPI values show some variations. Bole beds from the lower elevations show higher hydrolysis but lower calcification indicating somewhat humid, fairly leached and well-drained conditions. All the bole beds seems to have formed under similar temperatures but the rainfall seems to have been slightly variable. Most of the bole beds show oxidizing conditions, although quite variable. While A-CN-K plot reveal weathering trends towards smectite formation in all the red boles,none of them show any lateritization effect indicating their incipient weathering. With respect to the parent basalts the bole beds show considerable fractionation of the REEs indicating intensely weathered residual products. The negative Eu anomalies and positiveCe anomalies indicate over-all oxic environments during the formation of red boles. From the (Gd/Yb_N) versus Eu/Eu^* plot it is concluded that the red boles were formed by in-situ basaltic weathering without differentiation or recycling. In summary the red boles,occurring at four different elevations, were formed by considerable chemical weathering under somewhat humid, fairly leached and well-drained conditions under variable rainfall conditions.

Keywords: Palaeoweathering, bole beds, palaeosols, Deccan traps, India.

HOW CAN WE DATE LOESS OLDER THAN MIS 3?

Christoph Schmidt[1], Ulrich Hambach[1], Daniel Veres[2]

[1] Chair of Geomorphology & BayCEER, University of Bayreuth, 95440 Bayreuth, Germany
[2] Institute of Speology, Romanian Academy, 400006 Cluj-Napoca, Romania

Loess palaeosol sequences (LPS) are important terrestrial archives for environmental changes. Thus, they require accurate chronologies of their formation to take full advantage of the palaeoclimatic information contained and to facilitate interregional and land-sea correlations. During the past decades, optically stimulated luminescence (OSL) dating has evolved as the method of choice for establishing direct chronologies of loess deposition. However, despite reliable ages for loess <50–60 ka, age underestimation has been reported beyond that threshold using the quartz OSL single-aliquot regeneration (SAR) protocol. Recently, it has been claimed that the post-infrared infrared stimulated luminescence (pIRIR) signal from potassium-rich feldspar at elevated measurement temperature (e.g., 290 °C, $pIRIR_{290}$) has sufficient long-term stability to accurately date loess up to MIS 6 or even older. Furthermore, infrared radiofluorescence (IR-RF) of potassium-rich feldspar was also suggested to be devoid of signal loss over time with saturation doses corresponding to an upper dating limit of ~200–400 ka in loess environments. Given the crucial importance of reliable dating tools for Upper and Middle Pleistocene loess records, the question arises as to which of these luminescence methods actually are capable of providing accurate ages for loess >60 ka. As test sites we selected three long and stratigraphically well constrained LPSs from the lower Danube area (Dobrogea, Romania) reaching back to 500 ka at least. In an attempt to obtain age information for the S1 palaeosol and bracketing loess deposits representing (early) MIS 5 in the Eurasian loess stratigraphic scheme, we compare different dating efforts using a range of measurement protocols. In total, 15 samples from the S1 palaeosol and bracketing sediments at Vama Veche, Mircea Voda and Urluia were analysed with four different protocols (quartz: OSL-SAR; polyminerals: $pIRIR_{290}$ multiple-aliquot, $pIRIR_{290}$-SAR, IR-RF-SAR).

OSL-SAR ages obtained for silt-sized quartz samples taken from the supposed MIS 5 palaeosol range from 59 to 240 ka and are stratigraphically not always consistent. While the older ages seem to be overestimated, samples from below the palaeosol from Mircea Voda and Vama Veche yield much younger ages than expected (~85 ka). Giving additive laboratory doses on top of the natural dose of polymineral samples does not result in higher IRSL signals, so that no meaningful multiple-aliquot

additive-dose ages could be calculated. The more surprising is that the pIRIR290-SAR protocol results in finite ages that largely comply with multiple-aliquot regenerative-dose ages of some samples as well as stratigraphic expectations at Mircea Voda and Vama Veche but which are highly scattered and possibly overestimated at Urluia. IR-RF tests on some polymineral silt-sized samples are not entirely conclusive.

We discuss our findings from a methodological viewpoint, and given the difficulties inherent to each of the applied methods, it still appears challenging to routinely date loess older than MIS 3 at our study sites with luminescence methods.

LOCAL, REGIONAL OR GLOBAL CLIMATIC SIGNAL? A MULTIPROXY ANALYSIS OF COMPLEX LOESS SEQUENCES FROM THE BULGARIAN MIDDLE DANUBE

Fenn K.[a], Thomas, D.S.G[a], Durcan, J.A. [a], Millar, I. [b], Veres, D. [c], Piermattei, A. [d], Lane, C.S.[d]

[a] *Oxford University Centre for the Environment, South Parks Road, Oxford OX1 3QY, UK*
[b] *NIGL, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK*
[c] *Romanian Academy, Institute of Speleology, Clinicilor 5, 400006, Cluj-Napoca, Romania*
[d] *Department of Geography, University of Cambridge, CB2 3EN, UK*

In Central and Eastern Europe loess-palaeosol deposits are considered relatively straightforward sedimentary sequences, with glacials represented by loess deposits and interglacials preserved as one or two palaeosols. Despite several studies investigating short-term pedogenesis and embryonic soils in Western European loess belts, not many of these features have been described in Central and Eastern Europe. We present records from two nearby loess sites (2km apart) in Slivata, North Bulgaria that preserve thin soil like features, similar to the ones previously described at Stayky (Veres et al., 2018) and Nussloch (Moine et al., 2017). In a first of its kind analysis we combine a multi-proxy investigation (grain size and magnetic susceptibility) with high resolution luminescence chronology, tephra and provenance approaches, to interpret complex stratigraphic and sedimentary loess-palaeosol records. We propose that these features are likely colluvial deposits rather than pedogenetic features. We also suggest that while the signal of big climatic changes is represented in loess sequences, it is the local and regional influences, such as palaeotopography, hydrology, geomorphology or local palaeoclimatic conditions, that are preserved within individual loess units rather than the tele-connection with distant archives of global change. Further, we present the results of geochemical analysis of a tephra layer discovered at Slivata, which we confidently correlate to Cape Riva (Y-2) tephra. This is the most northly terrestrial discovery of the Cape-Riva tephra which has implications both for the loess and tephra communities, providing a new tephrostratigraphic marker for loess sites and other Mediterranean palaeoclimatic archives during LGM.

Keywords: Luminescence (OSL), Cape Riva (Y2) tephra, Provenance, U-Pb dating, Quaternary

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LATE MIDDLE PLEISTOCENE TEPHRA FROM VEI=6 ERUPTION OF NEMRUT VOLCANO (SE TURKEY) PRESERVED 350 KM AWAY IN LOESS SEQUENCES IN NE ARMENIA

E. Grigoryan[1], Kh. Meliksetian [1], D. Wolf [2], L. Sahakyan[1], D. Faust [2], Sugden, P. [3], I.P. Savov [3] and A. Koopers [4]

[1] Institute of Geological Sciences, Armenian National Academy of Sciences, 24a Marshal Baghramian Ave. 0019, Yerevan, Armenia (corresponding author,e-mail: Edmgri15@gmail.com), [2] Institute of Geography, Technische Universität Dresden, Helmholtzstr. 10, 01062 Dresden, Germany, [3] School of Earth & Environment, University of Leeds, Leeds LS2 9JT, UK, [4] Argon Geochronology Laboratory, College of Earth, Ocean and Atmospheric Sciences, Oregon State University 104 CEOAS Admin Bldg, Corvallis, OR, USA

Fine volcanic ash layers (0.1-1.5 m thick) were identified during recent Armenian-German study of Pleistocene loess deposits in Lesser Caucasus Mts. The ash layers outcrop within the Sarigyugh, Sevkar and Achajur Late Quaternary sections near the town of Idjevan in NE Armenia. The depositional age of the upper part of these loess sequences was dated by OSL and range between 150 and 39 Ka, while tephra layer was attributed to late Middle Pleistocene (MIS 6 stage), by Wolf et al., (2016).

We used $^{40}Ar/^{39}Ar$ age determinations of sanidine from the volcanic ash layers from the Sarigyugh section and these yielded 194±8 Ka. Voluminous Neogene-Quaternary volcanism of Armenian highlands in the Lesser Caucasus and eastern Anatolia is quite common and related to Arabia/Eurasia continental collision. Often this volcanism is characterized by diversity of compositions and eruptions styles, including a number of very large VEI≥5 caldera-forming eruptions.

To trace the provenance of tephra, we performed detailed geochemical (bulk rock major, trace elements, Sr-Nd isotopes) and petrological (in situ SEM/EPMA) study of the volcanic ash samples. Our results revealed well pronounced peralkaline affinity (peralkaline trachyte composition) that is unusual for the volcanism of Pleistocene collision zone setting of the Lesser Caucasus region. That compositions failed to link the Idjevan ashes with any of the known and proximal young volcanoes in the region, including the Samsari (S. Georgia), Elbrus (Georgia/Russia), Gegham, Vardenis and Syunik volcanic highlands (Armenia) and Ararat (E.Turkey).

Considering the relatively low Al_2O_3, high content of K_2O, Na_2O and key trace elements (such as Zr, Ta, Nb, Y, Rb, Cs) we conclude, that the volcanic ashes in Sarigyugh, Sevkar and Achajur closely resemble tephra from the AP-1 explosive

eruption of Mount Nemrut volcano, located in SE Turkey, ~350 km far from the studied loess sections. According to $^{40}Ar/^{39}Ar$ dating of several pumice samples of AP-1 proximal deposit, the age of this eruption is 189.9±5 to 194.5±1.85. (Sumita & Schmincke, 2013b) i.e. perfectly matching our new $^{40}Ar/^{39}Ar$ age determination (194±8 Ka).

In addition, isopachs of AP-1 eruption deposit show extension of tephra fall to NE from Mount Nemrut (Sumita & Schmincke, 2013a), towards Armenia, strongly supporting our geochemical and geochronology-based constraints about origin from Mount Nemrut volcano. The estimated volume of the AP-1 Plinian eruption may exceed 30 km^3 (Sumita & Schmincke, 2013a), indicative of VEI=6 eruption. Estimated eruption column height for such eruptions may reach >35 km (Newhall & Self, 1982) and thus, tephra may be transported for long distances and deposited by wind.

Mount Nemrut volcano is located near Lake Van (SE Turkey) and is one of the most active and voluminous volcanoes in the entire continental collision zone between Arabia and Eurasia. Historical eruptions of Nemrut volcano are dated to 1441 according to historical observations (in “Memory Notes of Armenian Chronicles” of the 15th century). In the past it also produced a large number of Plinian eruptions, including Middle-Late Pleistocene and Holocene (Sumita and Schmincke, 2013a; Ulusoy et al., 2012; Çubukçu et al., 2011; Yilmaz et al., 1998) and we will discuss the significance of these eruptions for the geological evolution and the human geography of the region.

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TL SIGNATURES OF QUARTZ GRAINS FROM NORTHWESTERN EUROPEAN LOESS SEQUENCES

Balescu S.[1], Dupuis Ch.[2], Haesaerts P.[3], Quinif Y.[2]

[1] University of Lille, Laboratoire HALMA CNRS (UMR 8164) Bâtiment de Géographie, Campus Cité scientifique, 59655 Villeneuve d'Ascq Cedex, France, sanda.balescu@univ-lille.fr; [2] University of Mons, Fundamental and Applied Geology, 9 rue de Houdain, 7000 Mons, Belgium; [3] Belgian Royal Institute of Natural Sciences, Earth and Life History, 29 rue Vautier, 1000 Brussels, Belgium.

In the present study, we examine the TL signature of quartz grains (40-50 microns) from loess accumulated during the Weichselian (MIS 2-4) and Saalian (MIS 6) glaciations in Northwestern Europe (Belgium, Netherlands, Germany, Northwestern France, Channel Islands). The quartz TL signature is used herein for characterizing the loess deposits and for tracking dust provenance. Six groups of loess with distinct quartz TL signatures have been identified. In parallel, a heavy mineral analysis of the same loess deposits has been performed; the green amphibole (GA) is used as an index mineral. The spatial and temporal variability of the quartz TL signature and GA content suggest multiple dust sources and temporal provenance changes. Furthermore, the same combined quartz TL signature and GA analyses were applied to potential source materials (alluvial and estuarine sediments from major river systems as the Seine, the Somme and the Rhine; glacial and proglacial sediments related to the Scandinavian ice sheet). Our results indicate that the Northwestern European loess derive from two major proximal sources, following dominantly northwesterly to westerly wind tracks: (1) the fluvial sediments from the braided alluvial plains and (2) the fluvio-marine material exposed on the emerged continental shelves of the English Channel and the southern North Sea Basin. By contrast, a distal glacial source from the outwash plains of the Scandinavian ice sheet seems to be excluded. Overall, the results of the present study suggest that the combined quartz TL signal and GA analyses are likely promising diagnostic methods to identify sources in loess studies.

Keywords: Northwestern European loess, quartz TL signature, heavy minerals, loess provenance, Weichselian, Saalian

RELATIONSHIP OF THE MAIN ELEMENTS WITH PARTICLE SIZE IN THE GOLESTAN LOESS AND COMPARISON OF ITS MAIN ELEMENTS WITH ASIA AND NORTH AMERICA

Somayeh Ghandhari[1], Arash Amini*[2], Ali Solgi[1], Hamed Rezaei[2]

*[1] Department of Earth Sciences, Science and Research Branch, Islamic Azad University, Tehran, Iran, ghandhari.s@yahoo.com, [2] Department of Geology, Faculty of Sciences, Golestan University, Gorgan, Iran, a.amini@gu.ac.ir, *corresponding*

Loess are sediments that contain more than 70 percent of the particles in size of the silt, but there are a wide range of particles in different sizes from sand to clay. Golestan loess has been divided into three zones based on the characteristics of particle size and engineering properties. Zone 1, with an area of about 60,000 hectares, is known as the mountainous loess. Zone 2, with an area of about 338,000 hectares, is expanded in the center and eastern part of the province. Zone 3, with an area of about 78,000 hectares, is related to the northern Maravetape loess sediment at the vicinity of Atrak River on the border between Iran and Turkmenistan and close to Alagol and Almagol lakes and barchans at the northeast of Aq Qala village In this study, 16 stations were sampled and geochemical analysis was performed. The study showed that the particle size of the Golestan loess decreases from zone 3 to 1. Moreover the amount of sand, coarse silt and mean particle size reduced and increase in fine silt and clay contents. Investigating the results of the geochemistry versus the particle size in the studied samples showed that the SiO_2 content decreased with increasing particle diameter in the Golestan loess. Both Al_2O_3 and Fe_2O_3 decreased with increasing particle diameter, indicating that these elements are likely concentrated in phyllosilicate clay minerals. Some Fe_2O_3 may also reflect the presence of chlorite. Increasing MgO with coarser size shows a decrease in concentrations with coarser size particle. It appears K_2O element is most likely representing clay- and fine-silt-sized micas. During the major part of the Quaternary, during periods of sea level decline, Asia and North America were connected as an adjoining land. So the comparison between Asia and North America can be important. Comparison of the main elements of Golestan loess with the Asia and North America loess showed that Golestan loesses are in the range of Al_2O_3 and Fe_2O_3 in the range of Tajikistan's Loess. Fe_2O_3 is less than Alaska and Al_2O_3 less than Alaska, Nebraska and more than Mississippi River valley loess. Also, Fe_2O_3 is equal to the Chinese Loess Plateau and Loess Yakutia (northern Siberia) and Al_2O_3 is lower than the Yakutia and the Chinese

Loess Plateau. Golestan Loesses are Cao equal to the Chinese Loess Plateau and Tajikistan, and more than the Yakutia losses. But compared to North America, Cao has a higher Cao than Alaska and Nebraska, and Cao and Mgo are less than Mississippi River valley loess. Plots of Na_2O vs. K_2O shows that the studied regions in the Golestan province have different amounts of Na_2O. These loesses are located in the immediate vicinity of the Tajikistan and Chinese Loess Plateau, and the Yakutia loess have less Na_2O and K_2O. These results are important because the Loess mineralogy can be estimated by particle size before geochemical experiments.

Keywords: Loess, particle size, geochemistry, Golestan province, Iran

MID-CONFERENCE FIELD TRIP PROGRAM

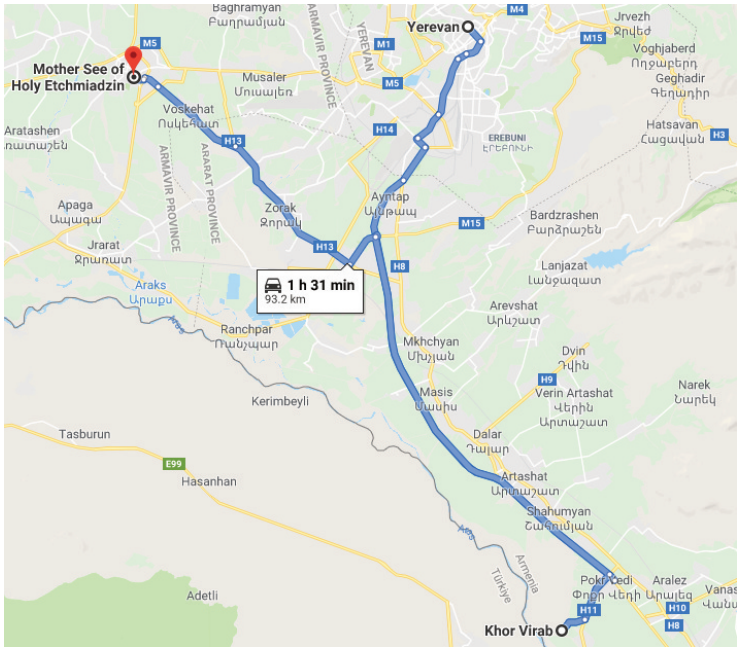
MID-CONFERENCE FIELD TRIPS FOR ACCOMPANYING PERSONS
(2 Days, September 16th and 17th)

September 16th

Start from the Institute of Geological Sciences, 9.00 AM

- Khor Virap monastery

Khor Virap monastery is located in the Ararat plain in Armenia, near the closed border with Turkey. The Ararat Mountain is making an amazing landscape. The taller peak reaches 5.165m, whereas the small one is just 3.900m high; they are separated from each other by a distance of 11.3km. The Khor Virap Monastery is a shrine and a pilgrimage site important to the Armenian Christianity. The church complex is built atop the pit
(= virap in Armenian), where St. Gregory the Illuminator was cruelly imprisoned, sometime at AD 288 by the heathen Armenian King Trdat III. St. Gregory suffered his imprisonment in that pit for 14 years until upon miraculously curing the king of a loathsome disease; the king freed him and converted himself and Armenia to Christianity. In 301, Armenia was the first country in the world to be declared a Christian nation.



- Lunch in Etchmiadzin town at 13.00-14.30

- Vagharshapat town. Visit of the Church of Saint Gayane and Church of Saint Hripsime (7th-century) AD.

St. Hripsime church (7th Century AD)

St. Gayane church (7th Century AD)

The fifth century Armenian historian Agathangelos wrote that the young and beautiful Hripsime who at the time was a Christian nun in Rome, was to be forcefully married to the Roman emperor Diocletian. She and the abbess Gayane among other nuns fled the tyrant emperor and left to Armenia. The Armenian king Tiridat III fascinated by the beauty of the same nun Hripsime, also wished to marry her. Getting the negative answer, the king ordered to kill all the nuns. These events occur in 301 in Vagharshapat, a few days before Grigor Lusavorich (Enlightener) was set free. According to the legend, in the very place where Gayane was killed, a church was built.

September 17th

Start from the Institute of Geological Sciences, 9.30 a.m.

- Visit of the Cascade - a giant stairway made of limestone is one of the most spectacular tourist attractions in Yerevan city. In order to get to the Arts Center, there is an escalator inside the Cascade, equal to the length of the complex, providing a commode means of reaching to the top for those who do not love climbing the stairs or are simply unable.

The spectacular view to Yerevan from the top of Cascade

- Visit of the Erebuni Urartian fortress and Museum, 11.00-12.00

The citadel of Erebuni fortress

Erebuni fortress is an Urartian fortified city, located in Yerevan. It was one of several fortresses built along the northern Urartian border and was one of the

most important political, economic and cultural centers of the vast kingdom. The name Yerevan itself is derived from Erebuni. It was founded by Urartian King Argishti I (786–764 BC) in 782 BC.

- Visit of the Matenadaran museum in Yerevan, 13.00-14.00

Matenadaran - Scientific Research Institute of Ancient Manuscripts after Mesrop Mashtots is a repository of ancient manuscripts, research institute and museum in Yerevan. It holds one of the world's richest depositories of medieval manuscripts and books, which span a broad range of subjects, including history, philosophy, medicine, literature, art history and cosmography in Armenian and many other languages.

Matenadaran - Scientific Research Institute of Ancient Manuscripts

- Lunch 14.30-16.00

- State History Museum of Armenia, 16.30-17.30

The State History Museum of Armenia is located in the center of the capital. The excursion in the Museum will cover several departments, such as archeological, medieval etc.

LIST OF PARTICIPANTS

Amini Arash	Golestan University, Gorgan, Iran	a.amini@gu.ac.ir
Amiri Zaniar	University of Agricultural Sciences and Natural Resources, Gorgan, Iran	zaniar.amiri2020@gmail.com
Antoine Pierre	CNRS, Meudon, France	pierre.antoine@lgp.cnrs.fr
Aramyan Ellada	Ministry of Nature Protection and Natural Resources of Republic of Artsakh	ellada.aramyan@mail.ru
Avagyan Ara	Institute of Geological Sciences, NAS, Armenia	avagn1064@gmail.com
Balescu Sanda	University of Lille, France	sanda.balescu@univ-lille1.fr
Baykal Yunus	Uppsala University, Sweden	yunus.baykal@geo.uu.se
Boesken Janina	RWTH Aachen University, Germany	janina.boesken@geo.rwth-aachen.de
Chiara Költringer	Uppsala University, Sweden	achiara.koltringer@geo.uu.se
Episkoposyan Levon	Institute of Molecular Biology, NAS, Armenia	lepiskop@gmail.com
Faust Dominik	Technische Universität Dresden, Germany	Dominik.Faust@tu-dresden.de
Fenn Kaja	Oxford University Centre for the Environment, UK	kaja.fenn@hertford.ox.ac.uk
Flašarová Kristýna	Charles University, Czech Republic	kristyna.flasarova@seznam.cz
Fuchs Markus	Justus-Liebig-Universität Gießen, Germany	markus.fuchs@geogr.uni-giessen.de
Gasparyan Boris	Institute of Archaeology and Ethnology, NAS, Armenia	borisg@virtualarmenia.am

Gerasimenko Natalia	Taras Shevchenko National Unversity of Kyiv, Ukraine	n.garnet2@gmail.com
Ghafarpour Amin	University of Agricultural Sciences and Natural Resources, Gorgan, Iran	aghafarpour@yahoo.com
Grigoryan Edmon	Institute of Geological Sciences, NAS, Armenia	edmgri15@gmail.com
Grigoryan Taron	Institute of Geological Sciences, NAS, Armenia	grigoryantar@mail.ru
Hovakimyan Hayk	Institute of Geological Sciences, NAS, Armenia	hghovakimyan@gmail.com
Khokhlova Olga	Institute of Physical, Chemical and Biological Problems of Soil Science RAS, Russia	olga_004@rambler.ru
Khomutova Tatiana	Institute of Physicochemical and Biological Problems in Soil Science RAS, Russia	khomutova-t@rambler.ru
Khormali Farhad	University of Agricultural Sciences and Natural Resources, Gorgan, Iran	fkhormali@gmail.com
Lehmkuhl Frank	RWTH Aachen University, Germany	FLehmkuhl@geo.rwth-aachen.de
Ludmila Fominykh	Institute of Physical-Chemical and Biological Problems of Soil Science RAS, Russia	lfominyck@rambler.ru
Meenakshi G.	Department of Geology, University of Delhi, India	geology.meenakshi@gmail.com
Malinsky-Buller Ariel	Archaeological Research Centre and Museum for Human Behavioural Evolution, Neuwied, Germany	malinsky@rgzm.de
Meliksetian Khachatur	Institute of Geological Sciences, NAS, Armenia	km@geology.am

Petrosyan Hamlet	Institute of Archaeology and Ethnography, NAS, Armenia	hpetrosy@gmail.com
Pickarski Nadine	University of Bonn, Germany	pickarski@uni-bonn.de
Pötter Stephan	RWTH Aachen University, Germany	stephan.poetter@rwth-aachen.de
Raczyk Jerzy	University of Wrocław; Uniwersytecki, Poland	jerzy.raczyk@uwr.edu.pl
Rousseau Denis-Didier	Ecole Normale Supérieure, France	denis-didier.rousseau@lmd.ens.fr
Sahakyan Kristina	Institute of Geological Sciences, NAS, Armenia	sahakyankristina@gmail.com
Sahakyan Lilit	Institute of Geological Sciences, NAS, Armenia	lilitsahakyan@yahoo.com
Schmidt Christoph	University of Bayreuth, Germany	christoph.schmidt@uni-bayreuth.de
Skurzyński Jacek	University of Wrocław; Uniwersytecki, Poland	jacek.skurzynski@uwr.edu.pl
Shrivastava J.	Department of Geology, University of Delhi, India	jpshrivastava.du@gmail.com
Somayeh Ghandhari	Islamic Azad University, Tehran, Iran	ghandhari.s@yahoo.com
Stevens Thomas	Uppsala University, Sweden	thomas.stevens@geo.uu.se
Thiemeyer Heinrich	Goethe-Universität Frankfurt, Germany	thiemeyer@em.uni-frankfurt.de
Vandenberghe Jef	Vrije Universiteit, Amsterdam, The Netherlands	jef.vandenberghe@vu.nl
Wilkinson Keith	University of Winchester, UK	Keith.Wilkinson@winchester.ac.uk

Wolf Daniel	TU Dresden, Germany	daniel_wolf@tu-dresden.de
Wolpert Tilman	Justus-Liebig-Universität Gießen, Germany	urs.t.wolpert@geogr.uni-giessen.de
Zarikian Noushig	Institute of Archaeology and Ethnology, NAS, Armenia	noushigz@hotmail.com
Zdzisław Jary	University of Wrocław; Uniwersytecki, Poland	zdzislaw.jary@uwr.edu.pl
Zech Michael	TU Dresden, Germany	michael.zech@tu-dresden.de
Zech Roland	Friedrich-Schiller-Universität Jena, Germany	roland.zech@uni-jena.de
Zech Wolfgang	University of Bayreuth, Germany	w.zech@uni-bayreuth.de
Zeeden Christian	Leibniz Institute for Applied Geophysics, Hannover, Germany	christian.zeeden@obspm.fr

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