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Foreword

The 2013 meeting of SEQS, organized under the auspices of the National Institute of Marine Geology and Geoecology – GeoEcoMar in Constanţa – Dobrogea County (Romania), represents a good opportunity to continue the rich agenda debated during the 2012 meeting in Sassari – Sardinia (Italy). The meeting will include 2 days of oral and poster presentations in Constanţa and a 3 days field trip in Dobrogea and Danube Delta.

The scientific program of Constanţa Meeting will bring together, once again, a large category of scientists, interested in Quaternary stratigraphy and sedimentation of continental and marine deposits, geochronology, relationships and correlation between fluvial, eolian, deltaic and marine sequences, land-sea interactions and climatic change records during Quaternary period.

The Constanta town, where the meeting will be held, is the 5th town of Romania (254 700 inhabitants), the most important port of the Black Sea and the 4th in Europe. Constanţa is an old town, founded by Greeks from Miletus in VII-V centuries B.C. as Tomis.

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The Campanian Ignimbrite as a Widespread Chronostratigraphic Marker for Late Quaternary Sedimentary Deposits in Romania: New Chronological Constraints

Valentina ANECHITEI-DEACU[1,2], Alida TIMAR-GABOR[1,2], Kathryn E. FITZSIMMONS[3], Daniela CONSTANTIN[1,2], Daniel VERES[1, 2, 4], Ulrich HAMBACH[5]

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Key words: ***loess, Lower Danube region, Campanian Ignimbrite, luminescence dating, Marine Isotope Stage 3***

Terrestrial sedimentary sequences, in particular loess and alluvial deposits, are instrumental in defining past environments in southeastern Europe (including Romania), as they are the most widespread Quaternary archives in this region. A wealth of sedimentological data, augmented by more recent applications of luminescence dating, tephrochronology, environmental magnetism and geochemical provenance studies, have opened new perspectives for elucidating the palaeoclimate information preserved within the sedimentary archives of this region.

In this contribution, we provide a synopsis of recently reported tephra occurrences within loess and loess-like deposits in southern Romania and Dobrogea, capitalizing on the value the Campanian Ignimbrite/Y5 tephra layer plays in providing a precise chronology for various Marine Isotope Stage (MIS) 3 deposits in this area. The eruption that produced the Campanian Ignimbrite/Y5 tephra approximately 40.000 years ago was one of the largest explosive events in Europe during Late Quaternary. The fine volcanic ash has been spread over very large distances, from the central Mediterranean to North Africa, and to the southern Russian Plain. Given its areal coverage, the close temporal association with the Laschamp geomagnetic excursion, and its occurrence within a period of extreme environmental (millennial-scale climate variability) and human cultural changes (Middle to Upper Paleolithic transition), it is one of the most important independently dated stratigraphic markers, that provide a strong basis for improving age-depth relationships and linking of records at regional scale, often surpassing site-specific chronological limitations.

We established the age and origin of these tephra layers through glass-shard chemical fingerprinting and by applying luminescence dating (OSL) on quartz aliquots from samples closely bracketing the tephra layers. Our observations suggest that the Campanian Ignimbrite/Y5 tephra layer is a widespread primary deposit in Romania that, at the time of deposition, may have blanketed the topography more thickly than numerical modelling of ash plumes and tephra fall-out suggest. We show that improved site-specific chronologies and palaeoclimatic reconstructions add to our understanding, yet, due to significant variability in loess characteristics and mineral composition (including various optical properties of OSL-dated loess quartz), a secure regional-scale correlation of records remains to be established. Thus, the Campanian Ignimbrite/Y5 tephra layer may act as a marker horizon for deposits of middle MIS 3 age with a crucial role in the assessment of regional environmental response within the terrestrial environments of central-eastern Europe.

The Use of Oxygen Isotope Geochemistry in Mollusk Shells as a Paleohydrological Proxy in Danube Delta (Romania)

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Mollusk shells, particularly bivalves, are extremely abundant in Danube Delta sediments. We evaluate whether the oxygen isotope geochemistry of their shell aragonite can provide any meaningful paleoclimatic or paleohydrological information as it has been suggested in other types of environments. The rationale for this study resides on the observation that in the present day the oxygen isotopic composition of the Danube river and Danube Delta lakes differs from that of adjacent coastal lagoons and of the Black Sea. Modern Danube River and Danube Delta lakes water have relatively low oxygen isotope values, between -9 to -11 per mil, and show small inter-annual changes. In contrast, the coastal lagoons, located south of the main delta, although fed by Danube waters via three main channels, have waters with higher $d^{18}O$ values ranging between -7 and -4 per mil, as a result of evaporation and longer residence times. The oxygen isotope composition of the Black Sea is also distinct, with values around -3 per mil. It is inferred that similar differences characterized the paleo Danube-Black Sea system, although the oxygen isotope composition of the water reservoirs might have changed.

Bulk measurements of shells from living bivalves and gastropods show that, in most cases, their shell aragonite grows in isotopic equilibrium with the water they live in, and their isotopic composition mirrors the isotopic signature of the different water masses in the Danube Delta-Black Sea system. In order to understand the controls of the oxygen isotopic composition of the shell aragonite, we examined the oxygen isotope schlerochronology of bivalve shells from the main Danube Delta lakes and from the largest coastal lagoon located south of the DanubeDelta, the Razelm Lake. Profiles of oxygen isotope ratios across growth bands show annual cycles with variable amplitudes ranging between 2 to 5 per mil. Based on existing climate records for the duration of the shell growth, we show that the temperature of the water is the main controller of the annual cycles. However, the significant relative differences of contiguous cycles are probably due to annual changes in the oxygen isotope composition of the Danube River water.

The analysis of bivalve shells present in short sediment cores from the Razelm Lake show vertical variations, although our limited number of data could not reveal clear, laterally traceable trends. However, the overall range of variation down core suggests that the isotope composition of Razelm Lake might have changed significantly over the last few hundred years, possibly as a result of fluctuating discharge of Danube river waters into the lake or as a result of episodic inflow of waters enriched in ^{18}O from the Black Sea.

Bivalves collected from the Caraorman beach ridge have relatively low oxygen isotope values, with a narrow range of variation (between -1 and -3 per mil) and no discernible stratigraphic trend. These low values are consistent with a marine origin of the bivalves. In contrast, bivalve and gastropod shells collected from two stratigraphic horizons from the Letea beach ridge show a range of variations of 10 per mil, suggesting a mixture of freshwater and marine faunas.

Holocene Palaeoenvironmental Changes in the NW Black Sea

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Key words: ***Ostracods; Foraminifera, Calcareous nannoplankton, sea-level fluctuation***

During Holocene times, the Black Sea basin suffered a major shift from a brackish water environment to a marine one. There are two main hypotheses regarding the Holocene Black Sea sea-level rising: catastrophic and gradual. The scenario concerning the catastrophic flooding of the Black Sea was advanced by Ryan *et al.* (1997), attracting the greatest attention and arousing a great deal of controversy and further research. Another scenario, agreed by many scientists (Panin, 1997; Görür *et al.*, 2001 and Yanko-Hombach *et al.*, 2007), indicates that no catastrophic flooding of the Black Sea has occurred, and the Neoeuxinian Lake gradually transformed into a marine basin. This work is focused on the fluctuation in composition and abundance of microfaunas (foraminifera and ostracoda) and nannofloras (calcareous nannoplankton), encountered in several drillings performed in the Romanian Black Sea shelf area.

In the Holocene deposits of the Black Sea, Ross and Degens (1974) recorded three stratigraphic units (from young to old): Unit I (the microlaminated coccolith ooze, deposited under marine conditions), Unit II (the sapropel mud, corresponding to a brackish, anoxic phase), and Unit III (the lacustrine lutite deposited during the freshwater or oligohaline stage).

Based on the lithological and sedimentological, as well as microfaunal and nannofloral changes, we identified in the deepest analysed core, situated at 200 m water depth, two lithological units, respectively the youngest Unit I (Coccolithic Mud) and the oldest Unit III (Lacustrine lutite). Between them there is an erosional surface and Unit II is missing. From a lithological point of view, the investigated cores are mainly characterized by the deposition of a grey mud, alternating with thin cm sands and coquina layers; mainly broken shells of molluscs, such as *Modiolus* and *Mytilus*, together with small gastropods, are present. A detailed lithology of the investigated cores was published by Oaie & Melinte-Dobrinescu (2010).

Based on the microfaunal and nannofloral assemblages, we identified two distinct assemblages:

(i) The base of the core is characterised by a brackish or even lacustrine ostracod assemblage, with a high diversity of taxa and by the absence of foraminifera and very scarce calcareous nannoplankton (the few occurrences, most probably are reworked). In this interval, the most abundant ostracod species are represented by taxa belonging to *Candonidae* and *Loxoconchidae*. In the lower part of the core, we assume that a lowering of temperature took place due to the occurrence of the ostracod *Fabaeformis candona*. This assemblage tolerates a salinity comprised between 3-8 ‰.

(ii) In the upper part of the core there is a shift from the lacustrine assemblage to a marine one, as indicated by the presence of ostracods with Mediterranean origin (i.e., *Hiltermannicythere rubra*) and by a bloom of the calcareous nannoplankton species *Emiliania huxleyi*. Notably, foraminiferal species occurs (i.e., *Ammonia* spp.), with a very high abundance, but showing a low diversity, The ostracods from this assemblage tolerate salinities comprised between 17-21 ‰ and characterise a sublitoral environment. The occurrence of this type of microfaunal association is indicative for the Late Holocene reconnection of the Black Sea with the Mediterranean.

Besides the above-described core of deeper part of NW Black Sea, several cores from a very shallow setting (water depth between 12 and 60 m) were analysed. Our investigations indicate that, above the fresh-water clays of Unit III (*sensu* Ross and Degens, 1974), which is the single lithological unit recognised both in shallow and deep marine environment of the Black Sea, a layer that contains fresh-water, brackish and marine molluscs was deposited. Above this level, blooms of the calcareous nannoplankton species *Braarudosphaera bigelowii*, followed by blooms of *Emiliania huxleyi*, were recorded. In the youngest deposits of marine Unit I of Ross & Degens (1974), as well as in its shallower correspondent (i.e., the Shallow Unit, *sensu* Giunta *et al*., 2007), the calcareous nannofloras contain almost exclusively (above 95 %) *Emiliania huxleyi* (Melinte-Dobrinescu & Briceag, 2011). The increasing abundance of *Emiliania huxleyi* (the dominant calcareous nannoplankton species in contemporaneous assemblages of the Black Sea) slightly preceded the occurrence of marine microfaunas on the Romanian Black Sea shelf.

The fluctuation in the composition of the microfaunal assemblages and calcareous nannoplankton suggests a progressive salinity increase in the Black Sea during Holocene times, from a brackish setting to a marine one. This observation is true, in our opinion, only for deeper parts of the Black Sea (with water depth below 200 m), while in a very shallow marine setting of the basin a rapid salinity increasing could be assumed. In Late Holocene times, stable marine conditions established, with salinity close to nowadays, allowing the proliferation of marine microfaunal and nannofloral assemblages, characterised by high abundance, but low diversity, a feature that is still present nowadays in the Romanian Black Sea shelf.

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Different Chronology Using Different Methods in Dating Aeolian Sediments in Sardinia and the Mediterranean: Is There a Bug in One of the Methods ?

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Key words: ***aeolianites, last glaciation, last Interglacial, geomorphological evolution, radiometric dating, Sardinia, Mediterranean***

Quaternary deposits of Sardinia include aeolian sediments that are widespread along the western side of the island where it can be many dozens of metres thick, whereas minor aeolian deposition occurred in the eastern side of the island. OSL dates point to aeolian deposition during MIS 5, including MIS 5e and MIS 4 (Andreucci *et al*., 2006, 2009, 2010, Thiel *et al.*, 2010). During MIS 3 and MIS 2, aeolian, slope, and fluvial deposition is usually missing. On the contrary, radiocarbon dating of humic horizons of buried soil interlayered with aeolian deposits or shells of continental mollusks indicate a late Pleistocene or even Early Holocene age (Melis *et al*., 2002, Coltorti *et al*., 2010, ISPRA a and b, in press). Therefore, there is an evident discrepancy between the results of the two methods. Aeolian sediments should be the best sediments to date with OSL, because the system gets closed when the granule is buried, and incomplete bleaching seems quite difficult to be invocated on a regional scale (Rhodes, 2011). However, the method also require a series of assumptions of the many variables at work, some of which could be critical, such as the water content of the sediment that is usually considered constant, while the sediment was loose during deposition. Furthermore, it is not well known when the cementation took place, reducing the porosity and increasing total moister. On the other hand, the organic horizons of palaeosoils, although buried, can be reached by rootlets of plants that could contaminate the mass resulting in younger ages.

In the rest of the Italian peninsula, thick aeolian deposits are common on the Tyrrhenian side and very limited on the Adriatic side (Cremaschi & Trombino, 1998, Cremaschi, 2000; Cremaschi & Ferrari, 2001). They are also common in other parts of the Mediterranean coast (Rose *et al*., 1999, Fornos *et al*., 2009) and in the rest of the world (Tamura *et al*., 2001; Bateman *et al*., 2011), where similar chronological problems are found (Brooke, 2001).

Fig. 1. Thick Late Pleistocene aeolian dunes at Porto Paglia (Iglesias, south west Sardinia)

In Sardinia there are unfortunately no Palaeolithic settlements associated with aeolian sediments that could provide an independent way for a gross chronological setting of a succession. In the Po valley and some other parts of the Adriatic side of the peninsula, loess sedimentation is associated with Musterian culture that has been attributed to MIS 4, also based on thermo-luminescence dating of burnt flint (Cremaschi, 1990; 2000). Renewed and thicker aeolian deposition is documented during MIS 2 and associated with Late Palaeolithic settlements (Cremaschi & Ferraro, 2001).

Radiocarbon dating of fluvial or slope succession in Sardinia indicates that alluvial fan sedimentation was active during MIS 2, with a strong reworking and down valley progradation during the latest part of the Pleistocene and Early Holocene. In most of the Italian Peninsula, alluvial deposition is also documented during MIS 3 and 2 (Giraudi & Frezzotti, 1995, Coltorti & Dramis, 1995), but very scarce or even absent during MIS 4.

If we consider the question from a theoretical point of view, it appears very unlikely that aeolian sedimentation occurred during the last Interglacial, when the vegetation cover was dense, sea level at maximum and sediment supply by rivers at minimum. A source for aeolian sedimentation has classically to be found in proglacial areas, in alluvial fans or fluvial systems of very dry areas, in fan deltas and exposed clastic coastal plains. In the Mediterranean these conditions were very limited during MIS 4, but became widespread during MIS 2. All radiometric methods could be affected by errors, but apparently OSL is the least reliable. This fact generates serious problems for Quaternary chronology, because this method is one of the most used, for those periods for which cross checking of the results obtained with radiocarbon method is not possible.

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The Last Interglacial Palaeosoil/Pedocomplex as Stratigraphical Marker for Quaternary Stratigraphy of Europe

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Key words: *Palaeosoils, Pedostratigraphy, Last Interglacial, synthems, fluvial terraces, slope waste deposits, aeolian sediments; chronological setting*

Palaeosoils record the palaeoenvironmental and palaeoclimatic conditions at the time of their formation. For this reason, the palaeosoils can be used as stratigraphical or pedostratigraphical markers to unravel if they formed under long or short lasting soil forming conditions such as during Interglacials or Interstadials. The longer deep weathering occurs, such as during long lasting Interglacial, the better a soil develops a well expressed and easily recognizable feature. Under acid parent material (granites, gneiss, sandstones, etc) the processes are much faster than on calcareous parent material. In the case of the Last Interglacial (Eemian, MIS 5e), buried or relict palaeosoils are among the best stratigraphical markers due to their peculiar macro pedofeatures such as: a) thick and deep Bt horizons, with a poliedric to prismatic well expressed structure; b) complete carbonates leaching; c) thick Ck horizons, where the parent material is mostly limestone. Locally, where the buried palaeosoils are buried under fresh carbonate material, the buried Bt horizons are also characterized by secondary carbonate precipitation in form of nodules and concretions, sometimes very abundant, resulting in Btk horizons. These features imply long lasting soil forming conditions under dense vegetation cover and warm and wet climate, conditions which are typical for the Interglacial periods. The described macroscopic features are coupled with peculiar micromorphological pedofeatures, such as: a) groundmass made of clay minerals finely mixed with iron hydroxides; b) clay coatings, both massive, limpid or finely laminated; c) complete carbonates leaching and a coarse fraction mostly made of quartz and flints. In Mediterranean environments, most of the Last Interglacial palaeosoils have also dark red to reddish brown colors. Under particular geomorphological conditions, usually at the feet of the slopes, a pedocomplex made by three superimposed palaeosoil can be found. The MIS 5e is the lowermost and deeper palaeosoil, usually severely truncated, whereas the overlying palaeosoils are progressively less developed. Erosional surfaces, gravelly lenses and stone lines separate the three palaeosoils and can be attributed to the environmental degradation related to the MIS 5d, 5b and the beginning of MIS 4.

In Europe, during the cold stages of the penultimate and the Last Glaciation (MIS 6 and MIS 4-2), the river valley evolution have been dominated almost everywhere by fluvial deposition with the creation of paired terraces. Deeply weathered relict palaeosoils with pedofeatures similar to the described MIS5e palaeosoils are found on top of the MIS 6 aggradational terrace, but never on top of the MIS 4-2 terrace. At the transition from glacial to Interglacial conditions, the rivers assumed a meandering pattern and started to downcut the valley floors, creating unpaired terraces. The MIS 5e relict palaeosoil is therefore better expressed on top of the higher terraces that were stabilized earlier. Locally, it can also be found buried under late Pleistocene alluvial deposits. At the feet of the slope, this palaeosoil or pedocomplex separates the MIS 6 from MIS 4-2 slope waste deposits. It is also found on top of the amphitheatre moraine or the dune complexes of the MIS 6, but not on top of the MIS 2 moraines and aeolian deposits.

In long lasting previous Interglacials similar paleaosoils should have developed but in our experience they are very rarely preserved due to the following erosional phases. On the other hand, most of the Holocene palaeosoils do not show such strong expressed features due to shorter time and degradation of the forest cover following human impact. Therefore, working at a larger scale, glacial, fluvial, aeolian and slope deposits can be correlated using this pedostratigraphic marker. A detailed geological and geomorphological mapping will help to place these sediments and the relative synthem (UBSU, unconformity bounded stratigraphic units) in its overall stratigraphic context. This regional approach, although time consuming, is also helpful to provide a gross chronological setting and to check if the results provided by other radiometric methods such as U/Th and OSL are correct or have to be rejected. Too frequently, in recent years, stratigraphers delegate their work to the results of radiometric datings that should be always taken critically and with care.

Optically Stimulated Luminescence Dating of the Lunca Loess Section (Olt Valley, SW Romania) Using 63-90 µm Quartz

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Key words: *loess, SAR-OSL dating, last-interglacial cycle, Romania*

The luminescence dating methods exploit the dosimetric properties of mineral grains found in the geological sediments of interest. Quartz based optically stimulated luminescence dating using quartz is now considered a state of the art technique that plays a key role in providing absolute chronologies for Quaternary sediments. From this regard, loess deposits are considered the most suitable due to their aeolian origin and feature of continuous terrestrial records that extend over the entire Quaternary. The Lower Danube loess and loess-derivate deposits are considered to represent some of the thickest and complete European sedimentary paleoclimate archives. The imbedded loess-palaeosol alternations have the potential to provide information on climate and environmental changes for the last million years.

The loess in Romania (Dobrogea and Wallachian Plain) was mostly interpreted based on classic stratigraphy and pedostratigraphy. More recent studies document rock-magnetic susceptibility variations and luminescence dating, restricted only to the eastern loess deposits. For the more westerly loess deposits in the Wallachian Plain absolute chronologies are lacking.

In this paper we present preliminary results of on-going investigations based on OSL dating of coarse (63-90 µm) quartz using the single aliquot regenerative dose protocol. The present work reports a high-resolution chronology for the last L1 (Würm glacial), S1 (Riss-Würm interglacial), and L2 (Mindel glacial) loess-palaeosol units. Luminescence investigations confirm the reliability of the SAR-OSL dating protocol (preheat at 220°C for 10 s, cutheat to 180°C and elevated temperature OSL – ETOSL). The dose-response curve is best described by the sum of two saturating exponential functions and the natural signals are interpolated below the saturation region of the dose response growth curve. The equivalent doses are consistent with the stratigraphic order and span from 34 Gy to 156 Gy for the last glacial, from 155 to 259 Gy for the last interglacial, and 300 Gy for the penultimate glacial period. Coarse quartz in samples collected from the L1 yielded ages of ~11 ka to ~53 ka. For the upper part of S1 an age of approximately 80 ka was obtained, while a sample collected from L2 yielded an age of ~140 ka, in agreement with the expected geological ages.

The obtained chronology supports the findings of the previously reported ages on loess deposits in south-eastern Romania as with other studies on loess from Central-Eastern Europe. Thus, allowance is made for the correlation of similar sedimentary sections at a regional scale.

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Malacological Characteristic of The Middle and Upper Pleistocene Loesses of the Nantois Site (Northern Brittany, France)

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The site of Nantois is located in Brittany (48°35'50.57'' N and 2°31'51.46''W) at the westernmost end of Europe where the stratotype of the Nantois Formation was designed (Monnier and Bigot, 1987, Loyer *et al.*, 1995) (Fig. 1). The outcrop consists of loam, loess and slope (soliflucted) deposits, which are now continuously eroded by the sea. All the layers containing rock fragments and loam (soils) are completely decalcified. Only the loesses of the lower and upper parts of the outcrop, corresponding to the Nantois (Saalian) (section 1) and Sables d'Or les Pins (Weichselian) (section 2) formations, are well preserved and display some mollusc shells (Fig. 2).

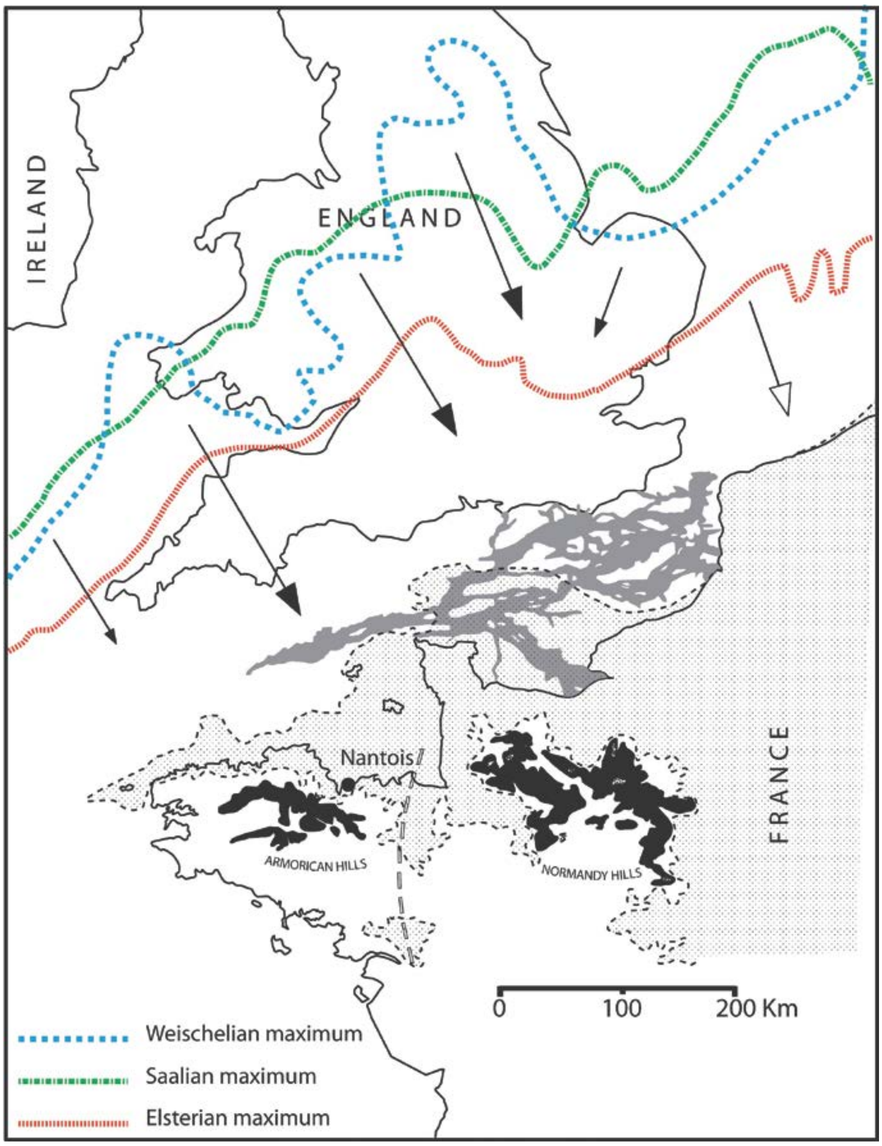

Fig. 1. General schematic map showing the location of the Nantois site and the ice sheet boundaries. Arrows show the wind direction. Black: main topography; grey: position of the braided rivers in the English Channel

Fig. 2. Panoramic view of the Nantois site showing the two excavated sections. Prs. J.L. Monnier and J.P. Lefort give the scale

The previous information regarding the first description of the site and its stratigraphy was given by Monnier (1973). This author took separate samples from the Nantois site and listed in his PhD thesis the mollusc species which were previously determined by Puisségur. Afterwards, this cliff mainly attracted the attention of sedimentologists (Monnier *et al.*, 2011, Laforge, 2012). It was also one of the selected sites used to show the Pleistocene stratigraphy to students. In 2008, Nantois cliff was shown to the participants of the field excursion of the INQUA SEQS meeting held in Rennes. A detailed study of the fauna was undertaken by the authors on both loesses in 2011-2012.

The sedimentary sections 1 and 2 were sampled at 10-15 cm intervals; each sample represented a mass of approximately 2.5 kg or a volume of one cubic decimeter. The methodology described by Sümegi and Krolopp (2002) was followed, save a closer spacing for our sampling.

A total of 422 mollusc shells of terrestrial species of 7 families (Succineidae, Cochlicopidae, Pupillidae, Valloniidae, Vertiginidae, Limacidae, Hydromiidae) and marine Gastropoda and Bivalvia were determined.

329 shells of terrestrial species were identified from the Saalian loess (MIS 6) – *Succinella oblonga* (Drap.), *Pupilla muscorum* (L.), *Cochlicopa lubrica* (Müll.), *Vertigo* cf. *alpestris* Alder, *Vallonia pulchella* (Müll.), *Trichia* sp. cf. *hispida* (L.), *Limax* sp., Gastropoda (marine) and shell detritus.

93 terrestrial mollusc shells from the Weichselian loess (MIS 2) – *Pupilla muscorum* (L.), *Pupilla* sp., Gastropoda, Bivalvia and shell detritus were recognized.

The mollusc shell distribution permitted to distinguish various species and to establish a preliminary list in the two loesses of the Nantois site.

1. The variations in thickness of the two loesses are as follow: Saalian – around 5 m; Weichselian – 3 m.
2. The lower part of the both loesses is poor in molluscs: they are absent or are represented by single finds and detritus.
3. The Upper part of both loesses is characterized by a complete absence of molluscs. This can be explained by the acidic nature of the soils which cover the Saalian and Weichselian loesses and rework their upper parts by soil processes.
4. Shell detritus are abundant in Saalian loess and are bigger when comparing with the Weichselian ones.
5. Saalian loess is characterized by a variety of species, which can indicate more moderate climatic conditions during Saalian than during Weichselian (last glaciation).

This last statement fits with the conclusion made by Loyer *et al*. (1995), which showed the existence of marked permafrost during the Pleniglacial Weichselian and its absence during Saalian.

The granulometric investigations, actually in process on both loesses, will bring additional data for the comparison of the Saalian and Weichselian loess and on the possible effect of their different relative distance respect with the British glaciations.

The position of the Nantois site and the maximal extension of the Saalian and Weichselian ice sheet cover are shown on Fig. 2.

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Contribution to the Knowledge of Quaternary Deposits in the Oltenia Plain

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Key words: ***Oltenia Plain, Danube Formation, Loess Formation***

The knowledge of the Geological Structure emphasizing the Stratigraphy of the Quaternary formations extended throughout the first 40 m deep in the Oltenia Plain is of major importance for a better understanding of the natural resources and of environmental hazards, too. In order to improve the existing conceptual model of the Oltenia Plain Quaternary stratigraphy, we processed columnar stratification data from 1,085 wells made in the following irrigation systems: Crivina-Vânju Mare (212 wells), Izvoarele-Cujmir (167 wells), Cetate-Galicea (101 wells), Calafat-Băileşti (214 wells), Nedeia-Măceşu (181 wells), Sadova-Corabia (124 wells) and Corabia terrace (85 wells). The entire surface analyzed is of 5,195 km², with an average density of one well to every 5 km².

Processing the data has led to the elaboration of: 1) the Map of pre-Quaternary formations found in the Oltenia Plain bedrock, 2) the Map of the Danube alluvium thickness deposited in the Middle Pleistocene- Lower Holocene interval and 3) the Map of the overlying Loess Formation thickness (Middle Pleistocene - Holocene).

With the exception of the Batoţi-Pristol sector, developed over the buried compartments of the South-Western Carpathians (ca 55 km long), the rest of the Oltenia Plain (210 km long on the W-E line) was moulded over the basement of the Moesian Platform. Within the Batoţi - Pristol sector, the Oltenia Plain background was affected by S-to-N differential movements along the strike-slip faults of the Timok Graben.

1. There, the Blahniţa Plain, a subunit of the Oltenia Plain, is built by five layers of the Danube terraces (ca 10-15 m thick of the up-fining sequence of the **Danube Formation Upper Member**). Due to the stacking of two alluvial Danube sequences, in some sectors (*i.e.*, Izvoru Frumos-Balta Ciorii), the thickness varies within the 15-20 m interval. The highest alluvium thickness values (20-25 m) are the result of the stacking of the two sequences built by: 1) the Danube and the Blahniţa rivers (Scăpau Sud, Vânju Mare – Hotărani - Patulele a.o.), and 2) the Danube and the Drincea rivers (Punghina East sector), respectively.

2. Downward of the Blahniţa Plain, in the Băileşti Plain (in the proximity of Golenţi, Basarabi and Calafat localities), the alluvium of the Danube terraces is overlying the Pontian marly-clayey Formation and has a thickness of 15-20 m.

3. Passing to the east, along the Poiana Mare and Desa strip, the bedrock is represented by the Lower Dacian sandy Formation. The thickness of the Danube Formation alluvium has the same value, 15-19 m.

4. On the W-E strip connecting Pisculeţ, Rast, Coveiu, Catanele and Bistreţu settlements, the bedrock is represented by the Upper Dacian-Romanian coaly-clayey Formation (30-20 m elevation). The Quaternary alluvium is < 5 m thick in the Pisculeţ - Tunarii Noi sector and 5-10 m thick in the eastern neighbourhood.

5. In the Danube Floodplain, situated between the Balasan Brook in the west and the Jiu River in east, the bedrock is represented by the same coaly-clayey Upper Dacian-Romanian Formation. The alluvium layer thickness is > 15 m.

6. The alluvium layer is the thinnest (< 5 m) in the strip connecting Dunăreni – Gighera – Zăval settlements that belong to the Danube terraces. The hanging wall elevation of the bedrock (Pliocene) is 35-40 m. The pre-Quaternary outcrops on the right-hand side of Jiu River (Comoşteni).

7. East of the Jiu River, over the Dăbuleni-Balş positive morphostructure, the thickness of the Quaternary alluvium varies within the 5-10 m interval in Ostroveni and Bechet villages. North of Dăbuleni commune, it is < 2.5 m thick. The bedrock is represented by the Lower Dacian sandy Formation (Jiu River mouth) and by sandstones and limestone (Sarmatian) in the east. Sarmatian hard rocks were found as alluvium bedrock in all the wells between Bechet, Călăraşi, Sărata, Dăbuleni and Ianca localities.

8. Between the localities of Ianca and Corabia, Quaternary alluvium thickness is steadily increasing, reaching maximum values (around 20-25 m) in Grojdibodu, Gura Padinii and Orlea Noua area. To the east, the thickest Danube Formation (>25 m) extends over the Corabia-Ghighen axis of negative morphostructure (possibly with a subsiding movement in the Quaternary).

In the easternmost part of the analyzed area, over the Nikopol-Turnu Măgurele positive morphostructure, alluvium thickness values of 5-10 m are prevailing. The higher value (15-20 m) corresponds to the alluvial fan of the Old Olt River. The bedrocks (chalky limestone) are reported to the Upper Cretaceous (around +11 m elevation).

All over the Oltenia Plain, the Danube Formation is overlain by the silty-sandy **Aeolian Formation**, thick of 0-35 m. Its main role is to protect the groundwater resources of Danube Formation against man-induced pollution. The grain-size, internal architecture and thickness of this youngest formation are very differently from W-to-E.

1. In the Stârmina and Castrele Traiane sectors, corresponding to oldest terraces, the Aeolian Formation thickness is 20-23 m thick. To the south, over younger terraces, the Aeolian Formation thickness, represented by clayey sandy silts a.o., is 10-15 m.

2. Over the lowermost terraces, t1, in the W-E elongated sector between the Danube River in the west and the Balasan Brook in the east, around Poiana Mare, Pisculeț, Piscu Nou and Piscu Vechi settlements, the Aeolian Formation (5-10 m thick) is dominating the fine-to-coarse yellow sands.

3. Going east, the Aeolian Formation grain-size changes progressively. In terms of petrography, a main difference between west (mainly sands in Ghidici area) and east (clayey silts between Catanele Vechi and Catanele Noi) does exist. Additionally, along the Băldau, Călata, and Ramolita WNW-ESE brooks (emerging north of Rast settlement), thickness reaches 0 m.

4. East of the Balasan River, on the flat surfaces of the lowermost terrace (t1), and especially over the Danube Floodplain surface (t0), Aeolian deposits are < 2.5 m thick or are missing altogether (reworked during major floods).

5. On large surfaces near the Bistrețu, Cârna, Nedeia and Potelu lakes, the overlying Aeolian Formation was rewashed during the main floods.

6. The thickness of the Aeolian Formation is radically changing east of the Jiu River. During the Middle Pleistocene-Holocene, the convergence of a few internal factors favoured the general dust generating process. On old terrace of Danube, the Aeolian Formation is > 25 m thick. It is exclusively composed of sand layers (20.0 m thick in the monitoring well Dăbuleni North) and of sands and silty clays (22 m thick in the monitoring well Ocolna).

7. In the easternmost part of the studied area, in the common Olt and Danube terraces, the Aeolian Formation thickness, consisting of primary loess, is 10-15 m.

8. The highest Aeolian Formation thickness values were accounted on the High Plain of Boian, in the eastern proximity of Oltenia Plain. Therefore in the northern part of Turnu Măgurele town, thickness exceeds 35 m.

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Some Considerations about Correlation in Alpine Quaternary Stratigraphy in the Frame of a Proposed ICDP-Project

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Key words: ***lithostratigraphy, morphostratigraphy, glacial overdeepening, International Continental Scientific Drilling Program (ICDP), lithofacies***

Johann Jacob Scheuchzer derived in the early 18th century "two episodes of the deluge" on the base of a compressed peat between two layers of clastic deposits (Schlüchter 1986). This was a very early lithostratigraphic interpretation of a single sediment profile obeying Steno'slaw of superposition.

In 1909 Penck & Brückner expressed a morphostratigraphical correlation between multiple melt-water-, ice-marginal- and subglacial profiles. They suggested that each temperate Pleistocene glacial advance into the European circum Alpine foreland produced a sediment accumulation in each of the morphological areas. Counting of accumulation impulses served as a key to correlate between sediment profiles and between areas. But, as discontinuities are quite common in the Alpine area and sometimes more, sometimes less difficult to recognize in the sediment successions, severe correlation problems arose. In a first attempt, they were addressed using relative time markers as a frame. *E.g.*, Schlüchter (1988-1989) and Ellwanger *et. al*. (1995) combined lithostratigraphy, morphostratigraphy and pollen investigations. Nowadays, more and more correlation depends on physical dating (*e.g*,. Schlüchter, 2004, Fiebig & Preusser, 2003). Therefore, development of dating tools has become one of the key issues to solve problems of correlation in the early 21th century.

Another important and still unsolved question concerns the unknown extent of several of the former glacier advances within the Alps and into the Alpine foreland.

In a lately proposed circumalpine scientific drilling project (Anselmetti *et al*. 2012), both dating and paleogeography will be focused. Drill holes are planned in the Eastern and in the Western Alps, as well as on the Northern and Southern side of the Alps. As result of the project, we hope to obtain comparable information about glacier advances from all important parts of the Alps. Scientists from most Alpine countries will work together and, hopefully, reach a new and better status of correlation in the Alpine Quaternary. Departure into a new chapter of Alpine Quaternary Stratigraphy seems perfect !

For the success of this great project it may be worthwhile to remember the fate of some other attempts to interpret and correlate Alpine Quaternary. As we know, it is still not an easy task to derive a reliable interpretation from a given "*clastic deposit*", be it a glacier advance, a periglacial feature, or even the biblical deluge (like Scheuchzer did). Just one example: Frenzel (1995) described from a small outcrop close to Krumbach (Baden-Württemberg, Northern Alpine foreland) a basal lodgement till on top of Eemian sediments while Schreiner (1992) considered the same layer to be a typical solifluction deposit. Although both authors kept investigating the site for more than a decade, and used all available methods, no agreement was reached. What went wrong ?

Sediment interpretation may become even more difficult, if, instead of outcrops, drill cores are to be considered (this difficulty was recently experienced again in a research project of the author, Fiebig *et al.*, submitted).

What can we learn from all this ? First, to correlate well dated strata is and will always be important. However, the difficulties highlighted here are not a matter of dating, nor of stratigraphic interpretations and schemes. They refer to the very basics, *i.e.* how to carefully recognize and investigate individual deposits, and how to compare them from one site to the next. We feel that modern markers and datings deserve to become embedded into a fully worked-out lithofacies architecture and into an up to date genetic interpretation of the sediments, to help to best improve the Alpine Quaternary Stratigraphy. This simple but important part of the techniques of Quaternary geology – the lithofacies interpretation – should return into the centre of all our efforts!

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The KapKøbenhavn Formation in North Greenland- and how to Date and Correlate the Early Pleistocene in the Arctic ?

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The KapKøbenhavn Formation is a 100 m thick sequence of sediments that piled up in an estuary close to Greenland's northern tip at the shore of The Arctic Ocean. The well preserved organic remains that were washed into the estuary have yielded a uniquely detailed picture of Arctic environments at the dawn of the Pleistocene.

Recently it was shown that the sediments also contain plant DNA. - probably the world's oldest. This discovery has emphasized the need for precise dating of the sediments, instigating in 2012 a field expedition to this remote and inaccessible area. The aim was to collect material for modern dating, which is performed partly by physico-chemical methods as palaeomagnetism, amino acid chronology and 10Be10/26Al dirt dating, but also by traditional biostratigraphy and correlation with the handful of Late Pliocene-Early Pleistocene sites scattered over Alaska, Canada, Greenland and Russia.

Combining these different lines of evidence, the KapKøbenhavn Formation was laid down within the the pre-Olduvai Matuyama Chron (2-2.6 Ma). Adding sedimentological and allostratigraphical evidence to this indicates that the deposition took place during a single deglacial-interglacial development, *i.e.* a half 40 ka cycle, possibly within isotope stages 91-100 (2.4 -2.5 Ma) or within stages 77-81 (2-2.1 Ma), correlatable with a warm period in the Tiglian of NW Europe.

Stratigraphy of The Serbian Pleistocene *Corbicula* Beds

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Key words: ***Pleistocene Corbicula beds, Lower and Middle Pleistocene, fluvial sediments, Serbia***

Clastic deposits of the polycyclic fluvial phase of sedimentation have significant distribution in the areas of the Serbian part of the Pannonian Basin System, especially in the riparian area of the Danube and Sava. These sediments are almost everywhere overlain by younger Pleistocene or Holocene deposits, and their thickness varies from 20-30 meters in the periphereal parts, to more than 100 meters in the depressions of Vojvodina's part of the Pannonian Plain. The names *Corbicula fluminalis* beds (slojevi sa *Corbicula fluminalis*) and Makiš Deposits (Makiški slojevi) come from the presence of molluscs identified for the first time by Laskarev (1926).

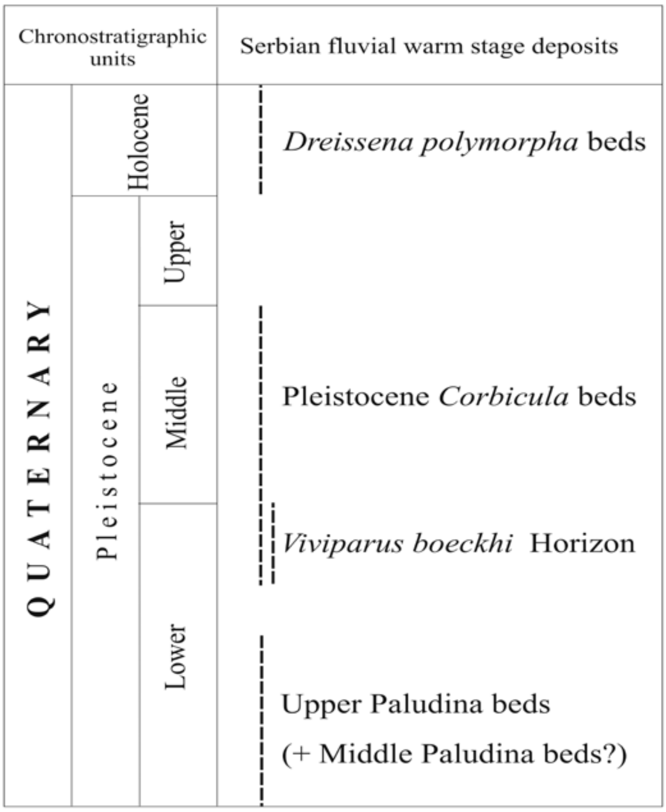

Fig. 1. The stratigraphical position of Pleistocene Corbicula beds in Serbia

Some of these deposits do not contain *Corbicula fluminalis*, although it is evident that they have the same lithological and other characteristics. Basically, the Pleistocene *Corbicula* was identified in three main areas: the area of the Sava and Danube riparian in the vicinity of Belgrade, Zrenjanin and between Brza Palanka and Golubac.

Lithologically, polycyclic fluvial sediment are made of cyclical alternation of typical riverbed deposits (sands, gravels) with sediments of flood phase (silts and clays) that could be observed in many places. In some cycles flood deposits are missing and regular multi-phase gradation of material has been formed, with coarser material in the lower, and finer in the upper parts. Beside *Corbicula fluminalis* (MÜLLER) the commonest fossil mollusks in these deposits are: *Fagotia acicularis* (FÉRRUSAC), *Fagotia esperi* (FÉRRUSAC), *Lithoglyphus naticoides* (PFEIFFER), *L. fuscus* (PFEIFFER), *Amphimelania holandri* (FÉRRUSAC), *Theodoxus transversalis* (PFEIFFER), *T. danubialis* (PFEIFFER), *Bithynia tentaculata* (LINNAEUS), *Viviparus boeckhi* (HALAVATS), *Unio crassus* (PHILIPSSON), *Pisidium amnicum* (MÜLLER), etc.

Earlier authors used the presence of the fossil assemblage of molluscs *Corbicula fluminalis* (MÜLLER) and *Viviparus diluvianus* (KUNTH.) to determine the age as Middle Pleistocene - Mindel, Mindel/Riss (after the Pleistocene morphostratigraphical subdivision for the Alps).

The results concerning on the stratigraphy from core analysis in the 1990-s and comparison of the other European records, the malacological revision suggests that the taxonomy of the Pleistocene *Corbicula* species is not solved the *Viviparus diluvianus* from Serbia should be identified as *Viviparus boeckhi* (HALAVATS). The Serbian Pleistocene *Corbicula* beds belongs to the temperate stages (equivalent to the interglacials) of Early and Middle Pleistocene age (Fig. 1). The results also support the conclusions of the analysis of the Hungarian sites by Krolopp (*e.g.* Krolopp 2003).

The results of the investigations shows that the Pleistocene *Corbicula* beds basically represents the litho-climatostratigraphical unit(s) which were identified according the index fossils of fluvial shells *Corbicula* gastropods and it corresponds to the Pleistocene warm/temperate stages of the upper part of Lower Pleistocene and Middle Pleistocene. The lowermost subunit of the Pleistocene *Corbicula* beds was identified as *Viviparus boechki* Horizon (after Halaváts, 1888) (Gaudenyi *et al*., 2013).

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High Resolution Climatic Change Records from the Upper Pleistocene Sequences of the Eastern Ukraine

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Multiple environmental changes during the Late Pleistocene are recorded in the loess-soil sections and deposits of archaeological sites located in the Dnieper and Donetsk Area, and in Crimea (Muzychi, Novi Petrivtsi, Stari Bezradychi, Stayky, Vyazivok, Lamane, Stari Kaydaky, Kryva Luka, Novorayske, Novotroitske, Amvrosievka, Kabazi II, Buran-Kaya III and Rockshelter Skalisty). The stratigraphy applied is based on the Quaternary Framework of Ukraine (Veklitch *et al*., 1993). Some changes in chronostratigraphic position of the units are connected, first of all, with discrepancies in TL-dates obtained with different methodologies from Dnieper unit (OIS 6 or OIS 8).

Pollen succession of the last interglacial has been found in pedocomplex of ***Kaydaky unit (kd)*** which overlies Dnieper unit. The latter is represented by glacial and glaciofluvial deposits in northern Ukraine and by the thickest loess in southern Ukraine. From bottom to the top, the Kaydaky pedocomplex consists of incipient soil, luvisol, grey forest soil and mollisol, in places separated by erosional breaks and seasonal frost features. The *Carpinus* phase is represented in the whole studied area, despite presently *Carpinus* does not grow in the steppe belt. The *Picea* phases are represented only in the north. During the last interglacial (with exception of its final phase), the climate was wetter than nowadays. During the climatic optima, steppe zone does not exist in Ukraine being replaced by forest-steppe. The base of the unit yielded TL date 132.5±5 kyr BP, and the top soil has been dated 110±8 kyr BP. The first Mousterian artifacts are found in the upper Kaydaky soil (Chabai, 2005).

Tyasmyn unit (ts) represented by thin loess or by hillwash deposits corresponds to the first Late Glacial stadial. It has been correlated with Marker 1 of Czech sections (Rousseau et al., 2001). At this time, steppe spread north up to the border of modern forest belt. The latter was occupied by sparse tree stands (*Pinus* and *Betula*) with arcto-boreal *Betula* sect. Nanae et Fruticosae. Few refugia of broad-leaved trees existed in the strongly dissected Donetsk Upland and the Crimean Mountains. Dry steppe (Poaceae, *Artemisia*, Chenopodiaceae) covered the south of Ukraine, and strong cryogenisis developed in the north. The TL age of the unit in some sections is possibly underestimated (90±7 kyr BP).

Pryluky unit (pl) consists of two soil subunits (pl_1 and pl_3) separated by thin loess (pl_2). In the north and centre of Ukraine, the soil succession of ***'pl_1' subunit*** includes grey forest soil and two chernozems, while in the south, only chernozems are represented. Broad-leaved trees (including *Carpinus*) existed in the forest during the greyzem soil formation, but *Betula* was also rather abundant. Pollen succession of an interglacial is not traced in this soil: pollen of broad-leaved trees appeared all together as it is typical for 'warm' interstadial (Zagwijn, 1992). During formation of the 'pl_1' chernozems, forest-steppe occupied the north of Ukraine, while its central and southern parts were covered by meadow steppe and grassland, respectively. Few broad-leaved trees occurred in valleys. The phases of forest and steppe pedogenesis are separated by short cool and dry phase. During the 'pl_1' time, succession of climatic events recorded in vegetation changes resembles that of the first Early Glacial interstadial at Grand Pile (Woillard, 1978). This fits its TL-date 95±8 BP. During deposition of non-soil ***'pl_2' subunit***, steppe dominated, but it was less xeric than during the Tyasmyn time. Spread of shrub birches and cryogenic features indicate subperiglacial climate, but refugia of broad-leaved trees existed in dissected plains. The date 82±10 kyr BP confirms the correlation with the second Early Glacial stadial. Soil succession of ***'pl_3' subunit*** consists of the lower mollisol, cambisol and the upper mollisol. The latter is separated from the cambisol by cryoturbations. By pollen data, the lower mollisols were formed under rather dry steppe, but climate was warmer than that of 'pl_2' subunit. The cambisol developed under boreal and south-boreal forest and forest-steppe with a few broad-leaved trees, whereas the upper mollisol was formed under boreal forest-steppe and steppe. At the end of 'pl_3' subunit, the climate became cooler and drier, particularly in the south where kashtanozems existed under dry steppe. The older mollisol and cambisol are correlated with the second interstadial of the Early Glacial, whereas the younger mollisol (in places two thin mollisols) might correspond to the Ognon interstadials at transition to the Early Pleniglacial. This soil is separated from the cambisol by cryoturbations (or by thin loess). The Mousterian cultural layers are found in Pryluky unit in the whole area studied.

Uday unit (ud) is relatively thick (up to 2 m) loess, TL-dated (75±4, 70±4,5 kyr BP) to the Early Pleniglacial. In the north, it is more clayey than other loesses. This is possibly controlled by relatively wet climate during its formation. Mesophytic steppe dominated, whereas spread of shrub birches and strong cryogenic features indicate periglacial environments. Boreal forest-steppe existed only in the foothills of Crimean Mountains, where Mousterian sites existed, as well as in the Donetsk area.

Vytachiv unit (vt) consists of 3-5 short-profile soils which are separated by loess or loess-like beds. In the north, the lowermost soil (TL 57,5±3, 58±7) is rather enriched in humus and leached of carbonates. In the south, it is replaced by carbonate soil of dry steppe. The two middle soils are cambisols. In the north, they were formed under tree stands (*Pinus* dominated, spruce and few broad-leaved trees occurred), and in the south, they were steppe soils. The ages of the lower soil (TL 47,5±4,4, 48±6, ^{14}C >46 kyr BP) enables its correlation with Moershoofd interstadial, whereas the upper soil yielded TL and ESR dates 36,4±3,4, 36,0±3, 41,2±3,6 and might correspond to Hengelo interstadial. The loess between these soils was formed under subperiglacial environments with arcto-boreal plants, and it can be compared with Hosselo stadial. The incipient soil at the top of subunit (^{14}C dates 35-38 kyr BP, Huneborg I interstadial) developed under boreal forest. The pedocomplex described above belongs to ***'vt_1' subunit***. The ***'vt_2' subunit*** (^{14}C AMS and ESR dates 35-30 kyr BP, Huneborg stadial) is thin but well expressed loess which was formed under periglacial steppe. In the north, steppe was mesophytic, and shrub birches occurred frequently. In the Crimean Mountains, boreal steppe firstly appeared at this time. The ***'vt_3' subunit*** consists of eutric leptosol (AMS and ESR dates 28-30 kyr BP) overlain by incipient soil (AMS 26-27 BP). The leptosol is enriched in humus in the whole area studied. In the north, it was leached of carbonates and formed under mesophytic steppe, while in the south it contains carbonates and developed under grassland. In the Crimean Mountains, the leptosol was formed under sparse tree stands with broad-leaved species. The soil is related to Denekamp interstadial. During the formation of the uppermost incipient soil, arcto-boreal plants appeared in the north, and broad-leaved trees did not grow even in the south. Up to the very end of Vytachiv time in Crimea, the Mousterian culture coexisted with the Upper Paleolithic, while the plain area of Ukraine was a realm of the latter.

Bug unit (bg) is the thickest loess (up to 10 m in the north) with the highest proportion of 0.01-0.05 mm particles. In the lower part, loess alters with leached incipient soils (0.15-0.30 cm thick) which are characterized either by weak humus accumulation, or by enrichment in iron and gleying. By pollen data, the incipient soils were formed under wetter and somewhat warmer climate (subperiglacial or boreal) than periglacial climate of loess accumulation. A role of xerophytes, particularly *Artemisia,* increased at the end of Bug time. The Bug loess yielded TL-dates between 27 and 17 kyr BP and it corresponds to the first half of Upper Pleniglacial. The Upper Paleolithic sites occur rarely in the area.

The Dofinivka unit (df) is a pedocomplex from 2-3 incipient soils which are better developed than the Bug soils (an individual soil is 0.5-0.6 m thick). By pedomorphological features, they were compared with the modern soils of Yakutia (Sirenko, 1972) or Chukotka. In the north, they formed under specific vegetation consisted both from xeric *Artemisia* associations and mesophytic herbal coenoses. Shrub birch dominated arboreal vegetation even in central Ukraine (though it did not grow in the south), but *Corylus* occurred in protected loci. Such a mosaic vegetational type indicates 'cool' interstadials. In the south, dry steppe covered plataeux but mesophytic coenoses survived in gullies. In the Crimean Mountains, broad-leaved trees appeared. Dofinivka unit has been ^{14}C-dated 18-15 kyr BP and TL-dated 17.5±1.6, 17±3, 15.5±3 BP. It was a time of Epi-Gravettian cultures existance.

In the north, ***Prychernomorsk unit (pc)*** is rather thick loess, but its thickness and content of 0.01-0.05 mm particles decreases to the south. Pedocomplex from two short-profile soils ('pc_2') subdivides the loess into two parts (the lower 'pc_1', TL >13±2 BP, DR-I, and the upper 'pc_3', AMS 10.9±65, 10.6±60, DR-III). The 'pc' loesses were formed under periglacial and subperiglacial steppe (the north and south differed by a role of arcto-boreal vegetation elements). By pollen data, the 'pc_1' time was colder and drier than the 'pc_3'. The Bug – Lower Prychermorosk loess-soil succession has been correlated with Dansgaard-Oeschger cycles (Antoine *et al*., 2011). Even in the south, the 'pc_2' soils were formed under forest-steppe: the lower soil under boreal climate and the upper soil (^{14}C 11,4±140, AMS 11,7±110) under south-boreal climate (few broad-leaved trees). Broad-leaved species started to dominate in the Crimean Mountains at this time. The 'pc_2' soils are correlated with Bölling-Alleröd, respectively. The Prychernomorsk time corresponds to spread of Final Paleolithic cultures in Ukraine.

The Alluvial Sediment Transport – Important Factor of the Lower Danube Loess Accumulation

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The Lower Danube area accommodates one of the main European loess zones. In view of evidencing primary genetic features of the Lower Danube loess, the author focused on large-scale aspects of this loess accumulation. The areal basin-wide distribution of the loess lithology/grain-size and thickness were the primary points of interest of this study.

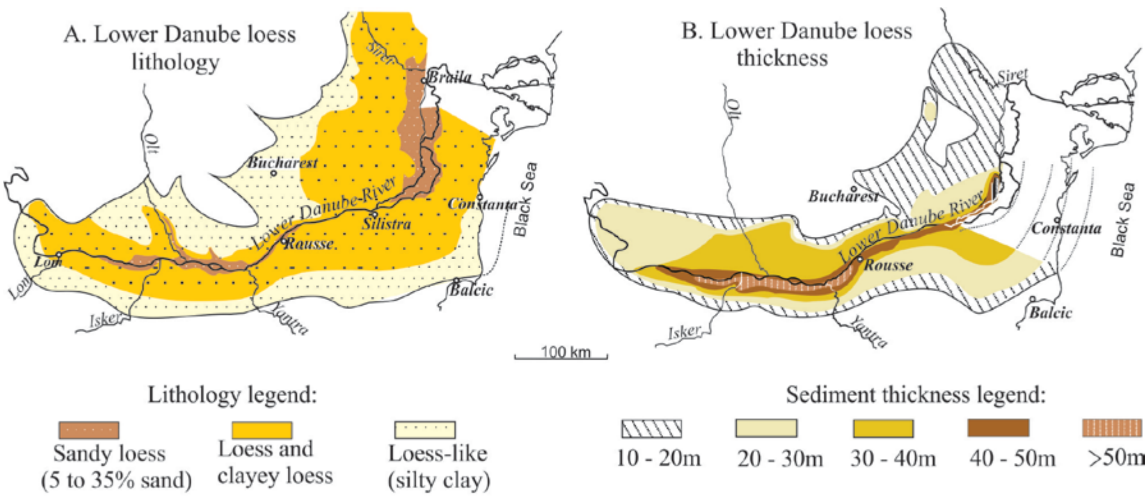

Fig. 1. Integrated maps of the Lower Danube loess lithology (A) and sediment thickness (B). Lithology/grain-size data from Fotakieva and Minkov (1966), Conea (1970a) and Conea (1970b). Sediment thickness data from Fotakieva and Minkov (in Haase and al., 2007), Codarcea and Bandrabur (1976) and Ghenea et al. (1980). Modified after Jipa (in press).

The goal of the first stage the investigation was to put together the different Lower Danube loess maps, built up in different areas of the Lower Danube basin. The main loess lithology maps were published by Fotakieva and Minkov (1966) from the Bulgarian Plain and by Conea (1970a; 1970b) from the Romanian Plain and Dobrogea. Fotakieva and Mincov (in Haase, 2007), Codarcea and Bandrabur (1977) and Ghenea et al. (1980) provided isopach map data from the Bulgarian Plain and the Romanian Plain. No Dobrogea loess isopach maps exist. Both lithology and thickness maps are also absent from the Northern Dobrogea and Danube Delta. In spate of this data failure, the existing maps cover most of the Lower Danube loess area, offering integrated images of this basin.

The integrated Lower Danube loess lithology/grain-size and isopach maps (Fig 1 A and B) are the main data generated by the present study. These maps reveal two important features pertaining to the entire Lower Danube loess basin:

1. the coarsest-grained (sandy loess) and the thickest (mostly 40-50 m, but reaching 100 m) loess deposits are located along the Lower Danube, strictly following the river course;
2. away from the Lower Danube River, especially southward to the southern Bulgarian Plain, and to the north toward the periphery of the Romanian Plain, the loess deposits turn finer-grained and thinner. At the northern and southern basin periphery the deposits become dominantly silty-clay (loess-like).

The axial position of the river within the sedimentary model of the entire basin (Fig. 2), makes evident the dominant role played by the Lower Danube River in the transport and sedimentation of the loess clastic material. The lateral transition to finer-grained and thinner loess deposits away from the Lower Danube course, suggests the flood plain sedimentary environment, developed by overbank alluvial sedimentation. The coarse-grained material of the sandy loess may represent levee or crevasse splay deposits, accumulated close to the Lower Danube river channel. The typical loess and the clayey loess can be regarded as flood plain sediments, which became finer-grained and thinner-bedded as transported farther from the Danubian river channel. The loess-like, silty-clayey deposits stand for the overbank sediments which suffered the longest transport from the alluvial channel, and accumulated at the periphery of the flood plain area. The alluvial stage of the Lower Danube Basin preceded the main, eolian loess phase.

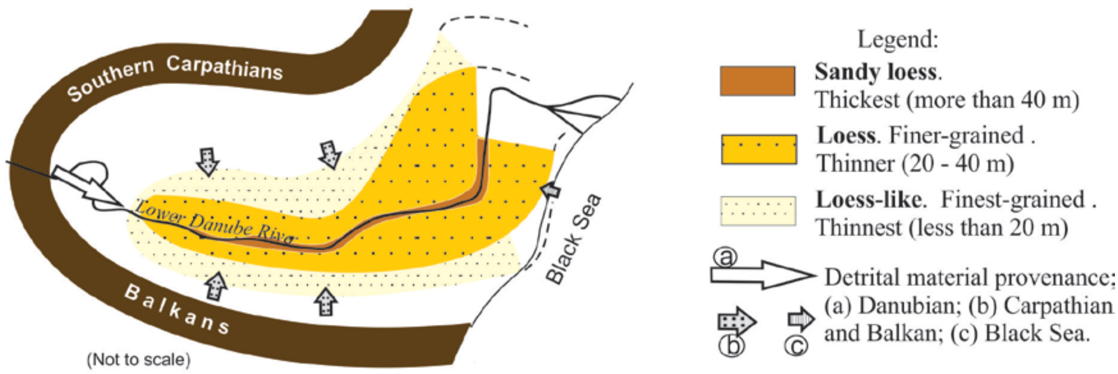

Fig. 2. Conceptual sedimentary model of the Lower Danube loess accumulation, during the initial, alluvial stage. Modified after Jipa (in press)

The idea of the alluvial transport of the loess clastics is not new. Smalley and Leach (1978) have been the first to consider that a part of the Pannonian loess sediments could have been transported farther downstream by the Danube River, to the Lower Danube loess basin.

The basinal picture of the Lower Danube loess points out to the multiple provenance of the loess detrital material. As a prominent genetic factor, Lower Danube River supplied a large part of the detrital material. The Danube tributary rivers also played an important role, bringing Carpathian and Balkan clastic material in the Danube River channel, or on their own flood plain. The Black Sea source area was active for the loess area from the eastern Dobrogea.

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Pulsed OSL vs OSL – Preliminary Results from the Aeolian Sediments of Estonia

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Key words: ***OSL, pulsed-OSL, feldspar contamination, aeolian sediments, Estonia***

The windblown characteristic of aeolian deposits is considered to ensure reset of the luminescence timer prior to final deposition of sediments. Thus, the luminescence techniques find a wide and successful application in the aeolian sequences and has been successfully applied to determine the age and chronology of aeolian deposits in different parts of the world (*i.e.*, Cohen *et al.*, 2010, Derese *et.al.*, 2009, Thamó-Bozsó *et.al.*, 2010, Tolksdorf *et al.*, 2010, Vandenberghe *et al.*, 2013, Yu and Lai, 2012, Zieliński *et al.*, 2011), but also raise some critical questions about their reliability (*i.e.*, Kolstrup, 2007).

The aeolian deposits forming up to 20 m high dunes from the north-eastern Estonia (Iisaku 1 and 2 profiles in Ida-Virumaa county) were studied. All investigated deposits lie directly on the glaciolacustrine sediments of the glacial lake Peipsi, correlated with the Pandivereice marginal zone of the Late Weichselian glaciation (Hang, 2003, Kalm *et al*., 2011). The minimum age of the Pandivere belt is indirectly supported by the AMS C^{14} dates: 14,450±240 (Kihno *et al.*, 2011) and 13,900±80 calyr BP (Amon *et al.*, 2012). Varve chronology investigations point on the stagnation of the ice margin at Pandivere–Neva line to ca. 13.9 to 13.7 ka BP in the western Estonia (Hang *et al*., 2011), and ca. 13.5 to 13.1 ka BP in the north-eastern Estonia and Lake Ladoga vicinity (Hang, 2003, Saarnisto and Saarinen, 2001). The new reassess of data point to the development of the A_1 phase of the Baltic Ice Lake in the front of the Pandivere ice margin during 13,800 to 14,000 calyr BP (Vassiljev and Saarse, 2013). The aeolian deposition of sand could start only after the lowering or/and drainage of ice-dammed lake. The established chronological framework of the aeolian sequence in Iisaku indicates aeolian activity from 3.0 to 7.1 ka (Raukas and Hüüt, 1988). Those dates are relatively young and point on the multiple redeposition of the glaciolacustrine and aeolian sediments (Raukas, 2011). To this day, no organic matter suitable for radiocarbon dating within Iisaku area aeolian sediments has been found, hence no independent age control is available.

Five of aeolian sand samples were dated with the standard OSL SAR protocol in the Gliwice Absolute Dating Methods Centre, Poland and seven samples with the pulsed-irradiation OSL in the Nordic Laboratory for Luminescence Dating, Risø, Denmark.

For the luminescence analysis performed in the Risø laboratory, quartz grains from the 180–250 µm grain-size fraction were extracted from the inner part of the opaque plastic tubes. The conventional preparation of 7 aeolian samples included wet sieving, treating by HCl, H_2O_2 and HF, as well as using the heavy liquids for quartz separation. Three aliquots of each OSL sample were stimulated with infrared light to identify possible feldspar contamination. According to Duller (2003), the sensitivity of infrared stimulation is significant if the IR OSL depletion ratio deviated more than 10% from unity. Among all 27 aliquots the average value of depletion ratio reached 19.86% and only for 7 of them passed the purity check criteria. To discriminate against the feldspar contamination, the pulsed OSL (POSL) was used, where the stimulation light is delivered in discrete pulses and the emitted luminescence is measured between those pulses (Thomsen *et al*., 2008). The equivalent dose (D_e) estimates derived for 7 pulsed samples showed the results in the range between 25.3±1.5 to 29.97±1.8 Gy. Simultaneously, the results obtained for the blue continuous wave stimulation (Gliwice) revealed ca. twice smaller values between 11.46(87) to 14.32(74) Gy. Thus, it resulted into the significant age differences: between 11.06±0.85 to 14.94±1.18 ka (Risø), and 5.56±0.48 to 7.23±0.34 ka (Gliwice). To test the reliability of blue pulsed stimulation, two "pure" samples from the Lithuanian aeolian sediments were chosen. Both of them indicated a good agreement between the derived doses using POSL and standard methods. According to the palaeogeographical background of Iisaku sites, as well as a significant improvement in the accuracy of dose estimation offered by POSL, the older obtained group of dates should be applied.

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Quaternary Stratigraphy of Makran Region Southeast Iran

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Key words: ***Iran, Makran region, Southeast Iran, Quaternary stratigraphy, alluvium deposits***

The Makran region consists of the west – eastern Mountains, which are extended from Omansea shores to Jazmurian depression zone. Western boundary of these mountains is separated from contact zone of Zagros by Oman line (Minab fault), and to the east, after passing through Baluchistan – Pakistan, extends further into Las Bela axis. The Quaternary deposits can be conveniently grouped under the following headings:

- *Minab Formation (Minab Conglomerate).* Minab Conglomerate, with thickness of 1300 m, is formed of marl and conglomerate intercalations in the inferior part, and of only conglomerate in the upper part. Upper part of Minab Conglomerate is representative for the Lower Pleistocene.
- *Sadich Alluvium*: the thickness of this unit in the type section is 24 m and is divided into two parts: the inferior part is composed of sands and, sometimes, with boulders layers, while the superior part is formed of conglomerate with feeble texture. This deposit is lacking of fossils and human tools. The age of Sadich Alluvium is Upper Pleistocene.
- *Minab Alluvium*: it is composed of 5 m of grey fine silts and sands, well stratified. Remains of turbo and coal have been found in the interior of this alluvium. C^{14} dating indicated a mean age of sedimentation of 1250 years. It is Holocene in age.

Beginning of Quaternary in the Makran region was contemporaneous with the tectonic phase of Late Walachian and Upper Pleistocene corresponding to the tectonic phase of Pasadenian, which has contemporaneous influence on Iranian basin. These events produced many alluvial types of sediments, filling up mountains and covering valleys. In the Pliocene and Quaternary periods, the orogeny has changed morphologically Iranian platform and has been developed Makran ranges. The sedimentary process has been effective in the formation of these alluviums, which were created by alluvial, colluvial and proluvial actions.

Quaternary Stratigraphy Correlation between Alborz and Zagros Basins-Iran

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Key words: ***Quaternary stratigraphy, Sediments, Alluvium deposits, Alborz and Zagros basins, Iran***

In the geology of Iran, generally, rocks and deposits related to after Pliocene – Pleistocene conglomeratic formations (Hezar Dare and Bakhtiari) have been attributed to Quaternary period, which have covered older rocks (except to southern beaches of Caspian sea) unconformably; alluvial – alluvial fan, eolian and desert – wilderness deposits are more represented among them. That is why there is this belief that after late Alpine tectonic event, Iranian plate has been emerged from water and it has formed its current morphology. One of its results is the beginning of erosional cycles which have been imposed on Iran ares since that time to recent. In the Alborz and Zagros basins, the Quaternary alluvial deposits are composed of thick sediments, which are formed by conglomerates, coarse gravels, boulders, pebbles, sand, silt and marls. Intervals of different stages are distinct by sedimentation changes.

On the basis of the stratigraphical and sedimentological development of the Quaternary deposits, the Alborz basin can be divided into the following formations: Hezar Dare Formation, Kahrizak Formation, Tehran alluvial Formation and Holocene alluvium (Recent alluvium) with a total thickness of ~1115 meters. At the Zagros basin, the Quaternary sediments belong to four main horizons: Bakhtiari Formation, Old alluvial deposits, Young alluvial deposits and Holocene Alluvial with a thickness of ~540 meters.

In the two typically different areas of Iranian platform, Quaternary deposits have similar characters, which indicate the influence of above mentioned factors in the contemporaneous Alborz and Zagroz geological zones.

Deflation and Transportation of the Upper Pleistocene Loess Particles by Katabatic Winds During the Lowstands of the English Channel: New Data and New Constrains. Contribution of the Heavy Minerals

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Study of the submerged Pleistocene conglomerates sampled in the English Channel shows that they correspond to successive beach deposits, which were cemented under a loess cover (Danukalova and Lefort, 2009). Although those loess were latter washed out by the different transgressions, the Northern limit of the conglomerates can be taken as the past offshore extension of the loess cover (Lefort *et al.*, 2011). Onshore, most of the loess are confined to the shoreline and are never found south of the Brittany and Normandy hills, save in a large gully corresponding to a linear topographic depression. Compilation of the offshore and onshore altitudes of the loess deposits shows that the loess particles were deposited by “slices” of winds not thicker than 200 metres. A peculiar attention has been given to the upper and lower limits of these deposits to be sure that their altitudes could be used in our model. The most recent studies confirm that these limits do not represent erosional limits and are very close to the original loess boundaries. This physical characteristic, the proximity of the British Ice Sheet (BIS) and the North or Northwest orientation of the winds suggest that, like in Alaska, loess particles were transported by strong katabatic winds (Thorson and Bender, 1985).

Various granulometric studies show that, south of the English Channel, these particles are always coating the north facing basement cliffs and never deposited on the south facing slope of the relieves. On the contrary, north of this area and in the Channel islands, most of the loess were deposited on flat surfaces. This discrepancy suggests a different depositional process probably related with a northward decreasing strengh of the winds before the last warming episode.

Study of a long sectiont, 700 Km in length (Fig. 1), running between the Weischelian British ice sheet and Vendée in France evidences a clear succession of deflation and accumulation zones. The deflation zones correspond to large flat surfaces, to river terraces or to the outwash of the ice sheet. South of the Channel the accumulation zones are usually coating the basement cliffs.

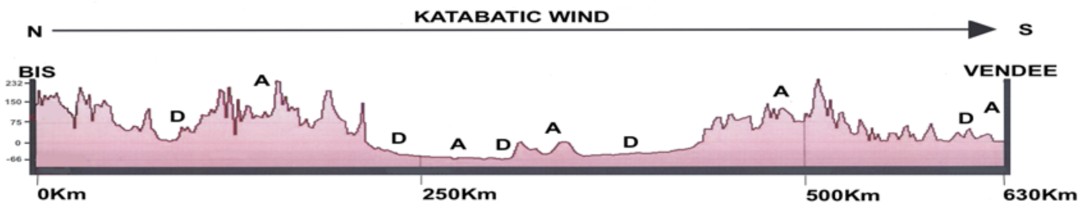

Fig. 1. Location of the deflation (D) and accumulation (A) zones between England and Vendée

A systematic comparison between the heavy minerals characterizing all the accumulation and deflation zones shows that it exists two types of heavy mineral associations. The first stock corresponds with a background of heavy minerals which is common to all the accumulation zones. This stock of heavy minerals is made of Epidotes (d=3.12 to 3.52), Amphiboles (d=3.02 to 3.50), Tourmalines (d=3.03 to 3.10) and sometimes Andalusites (d=3.13 to 3.16). The second stock corresponds with a local flux of foreign minerals. It can be observed that all the heavy minerals which constitute the background stock show a lighter density. On the contrary, the heavy minerals which contribute to the local flux correspond to heavy minerals showing a higher density such as Augites (d=3.40 to 3.60) , Olivines (d=3.22 to 4.39) Anatases (d=3.82 to 3.97), Zircons (d=4.60 to 4.70) or Garnets (d=3.59 to 4.32). It is clear the heavy minerals showing a higher density were always transported over shorter distances. The minerals showing a lower density were apparently transported from one deflation zone to an other. Study of the heavy minerals of the preferential zones of accumulation located between the BIS area and Brittany or Normandy consequently shows that, contrary to the katabatic winds which were propagating over distances of hundreds of kilometres, the distance of transportation of the heavyest part of the dust was limited.

The physical behaviour of the loess particles during their transportation by katabatic winds was very similar to the sorting process of the heavy minerals flowing across a sluice box (Fig. 2).

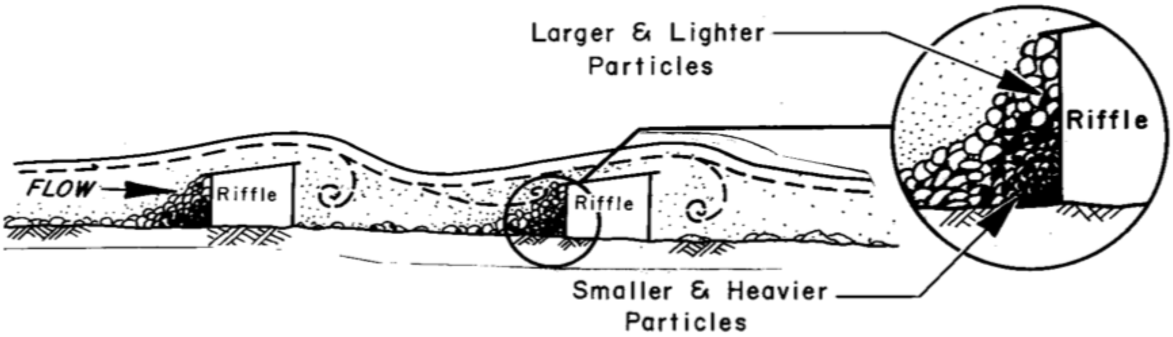

Fig. 2. Longitudinal section of a sluice box

A close look at the age of the loess dated north and south of the English Channel shows that they did not deposited at he same time. In Britanny the younger loess deposited between 22.5 and 18.2 ka. On the contrary south of England their ages ranges between 18.8 and 14.6 ka . Since we know that the deposition of the loess transported by the katabatic winds was only possible when the strengh of the wind was decreasing (Thorson and G. Bender, 1985), our data strongly suggest that the weakening of the katabatic wind affected first the southernmost parts of the section. This diachronic deposition was almost certainly related with the beginning of the regression of the ice sheet.

In Western Europe, some authors have suggested that the transportation of the loess particles was closely related with typical Eastward drifting storms or by West-East blowing winds. None of these hypotheses fit with our data. It is actually accepted that high altitude winds already existed during the Weischelian and we know that the approach of a low-pressure centre towards a glacial plateau may accelerate the katabatic velocities and generate particularly strong and gusty winds, but they cannot be at the origin of the loess deposited in the studied area for the reasons given above.

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Stratigraphy of Pleistocene 'Mixed Gravels' in the Northern Foreland of the Carpathians in Poland and Ukraine

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Key words: ***Scandinavian erratics, fluvial deposits, Middle Pleistocene, Carpathians foreland, Ukraine and Poland***

Accumulations of pebbles in the northern foreland of the Carpathians in Poland and Ukraine are composed of Carpathian sandstones mostly, but with a small admixture of Scandinavian rocks (5-10%). These deposits have been known for many years as the 'mixed gravels' (cf. Lindner & Marks, 2013) and have been generally identified either southwards of the extensive till area of the Sanian 2/Okanian (Elsterian) Glaciation or beneath/above this till. The occurrence of the mixed gravels beneath the till seems obvious, because of the erosion of them by the younger Carpathian rivers. However, their location beyond the extent of the till is more problematic. The latter is even more interesting if a possible advance of the Scandinavian ice sheet during the Middle Pleistocene glaciations, either Nidanian or Sanian 1 (equivalent to Don Glaciation) or both is considered.

Present knowledge of the origin of the mixed gravels indicates that they can be treated either as glacial, redeposited glacial, dam-lake or fluvial deposits. Divergent opinions are close to the view that deposition of the mixed gravels occurred in various flowing waters, either of fluvial, glaciofluvial or fluvio-periglacial origin. Therefore, the gravels mentioned could be channel deposits of lateral rivers, supplied with both Carpathian waters and glacial meltwaters. The deposition of these gravels could occur not only during ice sheet advance, but also during its time of maximum extent and the deglaciation that followed.

The data presented suggest most convincingly that the mixed gravels are mostly of fluvial, partly fluvio-periglacial and partly interglacial origin. Deposition of these gravels occurred usually to the north of the areas with *in situ* occurrences of rocks of the Carpathian flysch, that is, to the north of the Carpathian nappes. Predominance of Carpathian over Scandinavian material in these gravels proves unequivocally the prevailing role of the Carpathian rivers. When flowing from the south northwards, they first eroded flysch rocks and then the accumulations of freshly deposited glacial deposits. In the interfluves of the Vistula and the Odra, these rivers shaped the valley bottoms, inclined from 350-340 m a.s.l. near Ustroń and Skoczów to about 270-260 m a.s.l. near Kończyce in the west. Also in the case of the interfluves of the San and the Dnistr Rivers in the east, the valley bottoms occurred from 350-337 m a.s.l. near Dubrivka and Susidovichi to 280-275 m a.s.l. near Przemyśl and about 260 m a.s.l. near Krukienichi. These facts probably support the idea of the occurrence of buried valley systems that are sloping northwards in both interfluves. Therefore, they are the evidence for a fluvial origin for the gravels described.

The deposition of the mixed gravels in the interfluves of the Vistula and the Odra followed the incision of a till that was older than the Brunhes/Matuyama boundary (~780 kyrs BP) as proved at Kończyce (Lindner *et al.*, 2013). This glaciation was named firstly the Olza Glaciation or the Carpathian Glaciation and was correlated with the Narevian Glaciation in the Polish Lowland (Wójcik *et al.*, 2004). The present state of knowledge (Gozhik *et al.*, 2012) and the material presented suggest that the area of the interfluves of the Vistula and the Odra, which was more open northwards, was occupied by the Scandinavian ice sheet already during the Nidanian Glaciation (MIS 22). In the remaining part of the northern foreland of the Carpathians, including the interfluves of the San and the Dnistr, the ice sheet was at its most extensive limit later, during the Sanian 1 Glaciation (MIS 16). The extent of the ice sheet during the younger Sanian 2 Glaciation (MIS 12) was smaller (Fig. 1). It reached the Lower Nida drainage basin and the northern part of the Sandomierz Basin in Poland and the San-Dnistr interfluves in Ukraine (Gozhik *et al.*, 2012).

Recent re-examination of the Polish stratigraphy (Lindner *et al.*, 2013) proved that the warming, corresponding to the activity of rivers that eroded glacial deposits of this glaciation, should be referred to the terminal part of the younger, tri-optimal Podlasian Interglacial. This interglacial comprises the overlapping warm periods, represented by the Augustovian and the Domuratovian pollen successions, the latter being an age equivalent of the Kozi Grzbiet Interglacial (Fig. 1).

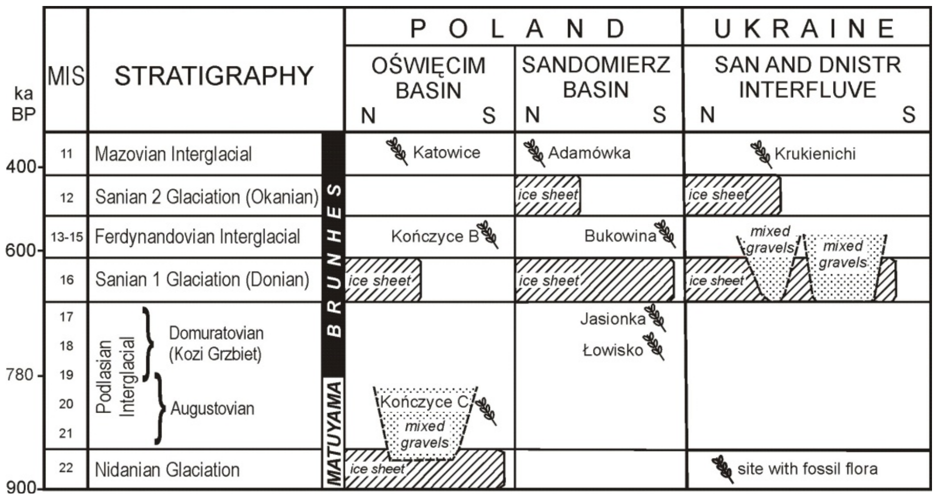

Fig. 1. Schematic diagram with age and extents of Scandinavian ice sheets against interglacial sites with fossil flora and location of the mixed gravels in the northern foreland of the Carpathians in Poland and Ukraine (after Lindner & Marks, 2013, slightly modified); MIS – marine isotope stages.

In the case of the San and Dnistr interfluves, the mixed gravels to the south of the Dnistr-Stryvihor valley system quite commonly occur beneath aeolian deposits. Therefore, they seem to be a relic of the eroded deposits of the older glaciation, considered either to represent the older Sambor Phase of the Sanian 2 Glaciation or the Sanian 1 Glaciation. The evidence presented indicates that these gravels are younger than the Sanian 1 Glaciation and correspond mainly with the Ferdynandovian Interglacial (Lubny).

The occurrence of the mixed gravels in the San-Dnistr and Vistula-Odra interfluves proves that they are of fluvial origin and were deposited by rivers that flowed northwards during the Podlasian (Martonosha and Shirokino) and Ferdynandovian (Lubny) Interglacials. The Scandinavian material was derived from eroded glacial deposits of Nidanian (Turskian) and Sanian 1 (Vyzhivskian, equivalent to Donian) Glaciations (Fig. 1). Deposition of the mixed gravels as a fluvial accumulation, resulting from the erosion of the glacial series of the Nidanian and Sanian 1 Glaciations by the Carpathian rivers, occurred in the whole northern foreland of the Carpathians. These gravels are best preserved within the Vistula-Odra and the San-Dnistr interfluves, owing to their watershed location and related minor post-depositional erosion. Such gravel accumulations must have occurred also at the mouths of most Carpathian rivers. During the Podlasian and Ferdynandovian Interglacials Vistula, Soła and Skawa Rivers flowed north-westwards to the Odra valley. The waters of the Raba, Dunajec, Wisłoka, Wisłok and San entered the Fore-Carpathian channel in Poland and flowed eastwards to the valley of the Dnistr River.

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Savyntsy Site: Faunistical and Geological Data to the History of the Psiol River Flood-Plain (Left Bank of the Dnieper River, Ukraine)

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Key words: ***flood plain terrace, Psiol river, Holocene, small mammals, Teleost fishes***

The Holocene history of the fluvial systems is an important subject of the investigation; both due to different aspects of human activity that were being developed in a connection with river systems, and due to rivers are being rapidly changed under a human influence, which occurs beneath our eyes. There must have been the facts in the fluvial systems history, which enable us to estimate such essential properties as a resistance, a flexibility and trends of the future development of these systems.

Of course, the Holocene history of fluvial systems has been documented, but by the only one geological document, which is the recent alluvium on the flood plain terraces. All information concerning repeated base level oscillations, changes of humidity, vegetation, vertebrate and invertebrate fauna of rivers and their surroundings over the last ten thousand years was piled up and was mixed in the flood-plain deposits.

Have all time intervals of the Holocene really been mixed in alluvium of the flood-plain terrace ? Is there any way to extract mentioned data differentially ? In some cases, it seems that to solve this task it would be problematic. For example, a mixture of the Late Quaternary and Holocene fauna is contained in the recent channel alluvium of the Dnieper River. Whole entirety of the remains corresponds to not less than last 100 Ky BP, because the river rewashed its own terraces. Some data about the Holocene mammal fauna of the Dnieper area were managed to obtain on the basis of that material (Popova, 2004), but it is clear that an in-depth information in such a case is inaccessible. The mentioned material from the recent Dnieper channel alluvium had been collected on the beaches. If sections of river flood-plains are studied, it may provide more opportunities to obtain pure Holocene material characterizing strict time intervals.

Such a case is presented by the Savyntsy site that is situated at a distance of 2 km downstream of the same named village on the right bank of the Psiol River, left tributary of the Dnieper (Poltava region, Ukraine). A hemilenslike body of fine-to-medium grained sands has been exposed there. It has been covered by sandy clays of flood-plain alluvium, with soddy-alluvial buried soil above them. The soil is overlapped by a loam, likely to have formed as a result of the newest ploughing up of slopes and relief depressions. This exposure is a section of buried sandy spit. A downstream flank of the hemilenslike body is steeper. Lenses of purely sorted, fine-, medium- and coarse-grained ferruginous clayey sands are exposed there near water edge. Fossil remains of small mammals and fishes were obtained from these lenses.

Savyntsy fauna contains remains of the following Teleost fishes and mammals (with number of diagnostic remains in brackets):

Teleost fishes – *Rutilus rutilus* (1), *Abramis* cf. *brama* (1), *Silurus glanis* (3), *Esox lucius* (12) and *Perca fluviatilis* (2), Cyprinidae gen. (4), Percidae gen. (4). **Mammals, Rodents** – *Apodemus silvaticus* (1), *Spermophilus pygmaeus* (2); *L. lagurus* (2); *Microtus gregalis* (3); *M. oeconomus* (8).

All presented fish specimens are characterized by relatively small sizes (reconstructed body length for *Rutilus rutilus* is 18.5 cm, for *Abramis* cf. *brama* – 15.0 cm). All recently identified fish species are common and numerous in the Dnieper River basin (Movchan, 2011). Fossil remnants of them are known from the Pleistocene sediments of the Middle Dnieper (Poltava region) and Upper Dnieper (Kyiv region) (Tarashchuk, 1962).

Diversity of the fish fauna indicates various habitats. *Rutilus* and *Perca* prefer flowing waters with a sandy to gravelly bottom. *Abramis* and *Esox* prefer standing to slowly flowing waters. *Silurus* lives in the deep sloughs and backwaters. According to the fish fauna, three freshwater habitats can be assumed: a high-energy habitat with flowing water and a coarse-grained bottom, a habitat with slowly flowing to standing water and, probably, a muddy bottom and a mainly standing-water habitat with seasonally stagnant conditions. It can be assumed that the river had strongly meandered and generally had looked like a modern Psiol. Piscivorous species (*Silurus*, *Esox*, *Perca*) are qualitatively and quantitatively dominating among identified fish forms, while herbivorous species (*Rutilus*, *Abramis*) are in the minority. It may indicate a relatively weak development of higher aquatic vegetation.

Mammals are represented by the recent species only and even the evolutionary level estimation (on the basis of relative anteroconid length of the arvicolids first lower molar), yields too broad possible chronological interval for the fauna (Fig. 1). Matveevka site, dated by the Saalian time (Rekovets, 1994), fully corresponds to the Savyntsy fauna by the evolutionary level of the available arvicolids species, as well as to the recent population of these species. Nevertheless, all that it was said above, the Holocene age of the fauna is beyond a doubt. There are two groups of evidences which affirm that: molar size of Savyntsy arvicolids and matching of the species composition of Savyntsy fauna with data concerning natural habitats changes from the Pleistocene to the Holocene.

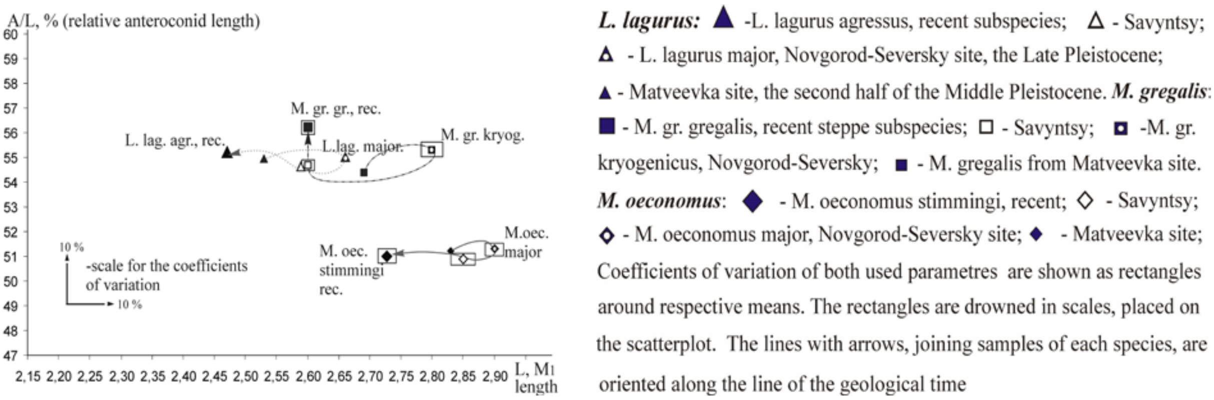

Fig. 1. The first lower molar dimensions of Savyntsy arvicolids in comparison with some recent and the Middle-Late Pleistocene samples (the latter data from Rekovets, 1985, 1994)

As regards the molar size, it is well known that rodents body size, including molar sizes, were the subject of Bergman's rule during the Pleistocene. The Pleistocene *L. lagurus* and *M. gregalis* even demonstrate coincidence between the molar size changes and the paleotemperature curve (Strukova, 2002). Thereafter, reduced size differing Savyntsy arvicolids from the large subspecies, described for the Ukrainian Late Pleistocene (*L. lagurus major*, *M. gregalis kryogenicus*, *M. oeconomus major*) (Rekovets, 1985), could mean the only one thing that Savyntsy fauna is of the Holocene age.

As regards the natural habitat dynamics, bare *Apodemus* appearance so far eastward is an evidence of the Holocene age of the fauna because representatives of the genus are virtually unknown for the Dnieper Left Bank during all the Pleistocene. Among other rodents of Savyntsy fauna only *Microtus oeconomus* persists on the considered area, while other representatives have disappeared. Disappearance of *L. lagurus* is the most recent, in the twentieth century. The northern boundary of *Spermophilus pygmaeus* natural habitat had been pointed out on the Vorskla river right bank (not so far from Savyntsy), but this species has never been observed in this area. Finding of *Microtus gregalis* is the most significant; as *Microtus gregalis* has never been known from the Holocene of Ukraine.

Coefficients of variation have been counted for Savyntsy arvicolids to exclude the possibility of redeposition of more ancient remains in the taphocenosis. All obtained coefficients do not exceed such measures in the recent populations of respective species, and are lower than that of the samples from the above-mentioned Pleistocene sites (Matveevka, Novgorod-Seversky). So, Savyntsy fauna is highly homogenous related to the chronological aspect.

Taking into account the presence of *M. gregalis*, it is likely that Savyntsy site can be dated as the Early Holocene. However, as it is known, mainly, thanks to works of I. Pidoplichko, extinction of typical representatives of the tundro-steppe Pleistocene fauna during the Holocene was gradual in the Ukrainian area; meanwhile, certain extinction events here have not been linked to the stratigrafic scale. Thus, comparative data are absent for the precise dating of Savyntsy site.

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Is the Romanian Loess Older than 0.8 Ma ? A Dating Overview and an Up-to-Date Reply Based on Magnetic Multy-Proxy Signatures correlated to the Geomagnetic Polarity and Marine Isotope Stage Time Scales

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Key words: ***Romanian Plain, Dobrogea, Chinese Loess Plateau, loess-palaeosol sequences, Matuyama/Brunhes boundary, Magnetic Susceptibility Stratigraphy, Magnetostratigraphy***

The paper is dealing with a composite magnetic approach of the loess – palaeosol sequences in the south-southeastern Romania. At the beginning, it is performed a tentative synopsis which mainly focusses on the aspects of dating the Pleistocene loess – palaeosol sequences from the Romanian Plain and Dobrogea. The first part is a short review of important achievements concerning the estimation or evaluation of the loess age, starting ca. 120 years ago, with a tentative to systematising the significant contributions of the last half-century (Rădan, 2012). Implicitly, it is remarked the way passed through time in order to know the loess age, *i.e.* from the classic stratigraphy/pedostratigraphy to magnetostratigraphy, astronomically tuned ciclostratigraphy, magnetoclimatology, and up to the multi-proxy methods, and optical/luminescence dating. In all the sections, ages up to 781 ka are determined [the loess – palaeosol horizons are assigned to the Brunhes Chron of the ATNTS-2004 (Lourens *et al*., 2004)/ATNTS-2012 (Hilgen *et al*., 2012)], but the synopsis includes a section from Dobrogea (analysed by the Infrared Stimulated Luminescence/*IRSL* dating method; Bălescu *et al*., 2003), wherefore the "estimated geological age" of 800 ka and the *Marine Isotope Stage 20* are mentioned. In the second part of the paper, there are presented some informative data regarding several (palaeo)magnetic signatures (related to the vertical distribution of the declination and inclination of the Characteristic Remanent Magnetisation, Natural Remanent Magnetisation intensity and initial magnetic susceptibility), recovered from some loess – palaeosol sections in Dobrogea. Finally, a special attention is given to the results of a composite approach ["magnetic susceptibility (MS) stratigraphy" integrated with "magnetic polarity stratigraphy"] relating to a loess – palaeosol borehole profile (ca. 39 m thick), located in the Romanian Plain. The up-to-date interpretation of these data (Fig. 1) points out the possible identification of the Matuyama/Brunhes boundary (*MBB*; 0.781 Ma) (Rădan, 2012). The subject has generally given rise to a dispute in the scientific literature on both the Chinese and the European loess. The correlation of our results with the MS records for two loess – palaeosol sequences from the *Chinese Loess Plateau*, one of them being calibrated (Spassov, 2002) to the "*marine oxygen isotope stages*" (*MIS*) of the *benthic* $\delta^{18}O$ *record* at ODP site 677 (Shackleton *et al*., 1990), is presented, as well. The "*observed*" *MBB* location within the loess *L8*, and of the "*corrected*" *MBB* within the palaeosol *S7* of the borehole profile from the Romanian Plain (Fig. 1), as well as the calibration to *MIS Time Scale* (*i.e*., location within the *MIS 20* and the *MIS 19*, respectively) are commented. Moreover, in the context of a positive reply given to the paper's title question, a possible palaeosol *S8* (?), located towards the borehole profile base, could be calibrated to *MIS 21*, which means an age within the interval 0.801 – 0.861 Ma (Spassov, 2002).

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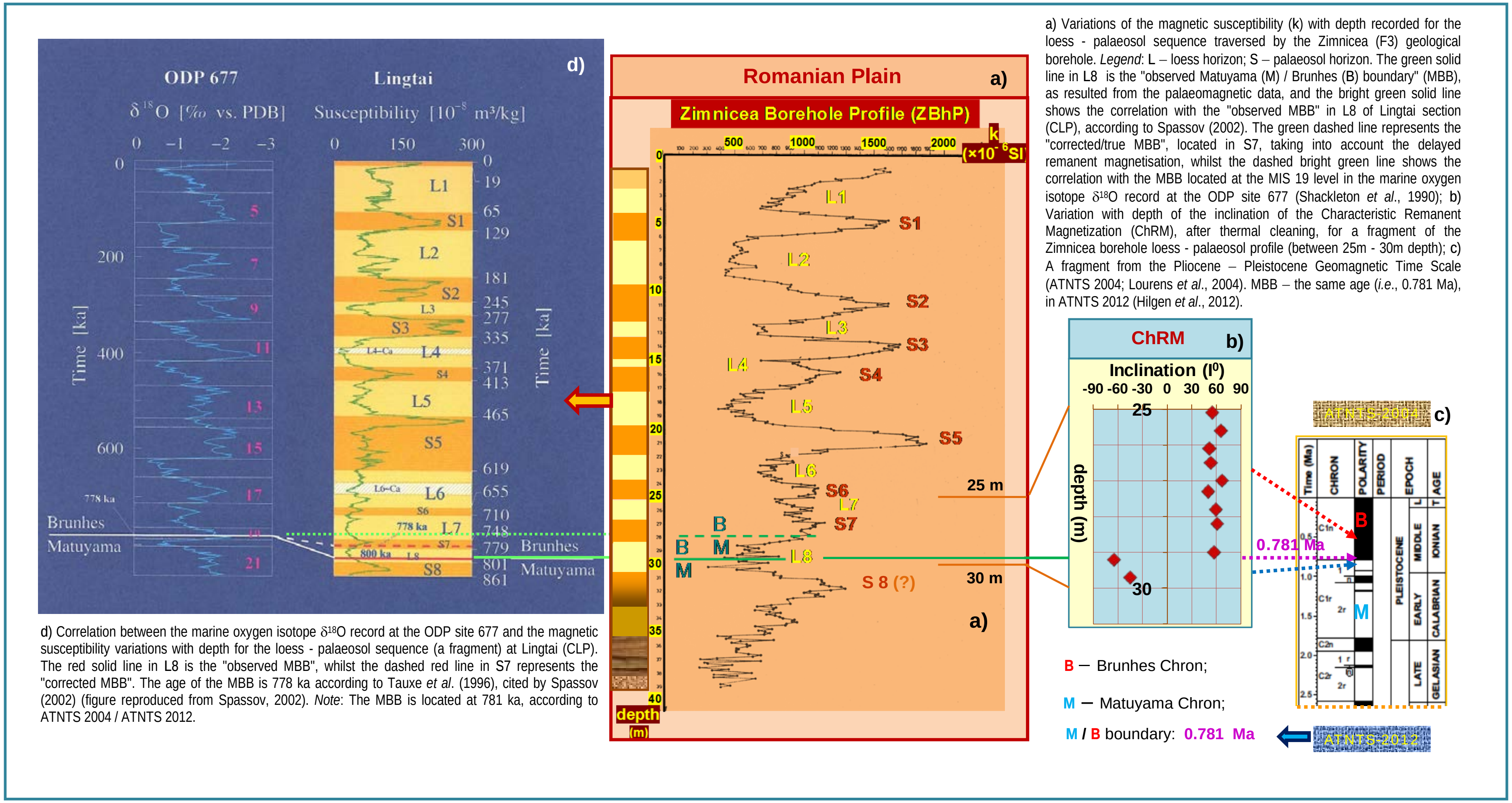

d) Correlation between the marine oxygen isotope δ18O record at the ODP site 677 and the magnetic susceptibility variations with depth for the loess - palaeosol sequence (a fragment) at Lingtai (CLP). The red solid line in L8 is the "observed MBB", whilst the dashed red line in S7 represents the "corrected MBB". The age of the MBB is 778 ka according to Tauxe *et al.* (1996), cited by Spassov (2002) (figure reproduced from Spassov, 2002). *Note*: The MBB is located at 781 ka, according to ATNTS 2004 / ATNTS 2012.

a) Variations of the magnetic susceptibility (k) with depth recorded for the loess - palaeosol sequence traversed by the Zimnicea (F3) geological borehole. *Legend*: L – loess horizon; S – palaeosol horizon. The green solid line in L8 is the "observed Matuyama (M) / Brunhes (B) boundary" (MBB), as resulted from the palaeomagnetic data, and the bright green solid line shows the correlation with the "observed MBB" in L8 of Lingtai section (CLP), according to Spassov (2002). The green dashed line represents the "corrected/true MBB", located in S7, taking into account the delayed remanent magnetisation, whilst the dashed bright green line shows the correlation with the MBB located at the MIS 19 level in the marine oxygen isotope δ18O record at the ODP site 677 (Shackleton *et al.*, 1990); **b)** Variation with depth of the inclination of the Characteristic Remanent Magnetization (ChRM), after thermal cleaning, for a fragment of the Zimnicea borehole loess - palaeosol profile (between 25m - 30m depth); **c)** A fragment from the Pliocene – Pleistocene Geomagnetic Time Scale (ATNTS 2004; Lourens *et al.*, 2004). MBB – the same age (*i.e.*, 0.781 Ma), in ATNTS 2012 (Hilgen *et al.*, 2012).

Fig. 1. Composite model showing a tentative correlation of the integrated magnetic susceptibility and palaeomagnetic signatures recovered from the Zimnicea borehole profile* (Romanian Plain) with the Lingtai section from the Chinese Loess Plateau (CLP) (Spassov, 2002), the marine oxygen isotope δ^{18}O record at the ODP site 677 (Shackleton *et al.*, 1990), and a fragment from the Pliocene – Pleistocene Geomagnetic Time Scale (ATNTS 2004; Lourens *et al.*, 2004).

**Note*: The powder samples and the semi-oriented (up/down) cubic specimens were collected by dr. Petru Enciu and provided to theLaboratory of Rock-, Palaeo-, and Environmental Magnetism of the Geological Institute of Romania [Enciu, P., Berindei, F., Rădan S.C., Wanek, F.W. (2000) – Analysis of the deep aquiferous systems from Romania, Phase Report, *Archives of the Geological Institute of Romania*, Bucharest (unpublished scientific report; *in Romanian*)].

Early-Middle Pleistocene Sedimentary Environment Changes in Lithuania

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Key words: ***Early-Middle Pleistocene: stratigraphy; Brunhes/Matuyama inversion; pollen; plant macrofossils; Lithuania;***

The Early-Middle Pleistocene in Lithuania is represented by a series of stratified sediments of lacustrine and alluvial-type origin distributed in the two key areas of eastern part of Lithuania - Anykščiai and Vilnius districts. Investigations of the sediments started from the first half of the last century and are still attracting researches because the Neogene-Quaternary boundary is thought to be present within them. Nevertheless, the stratigraphical interpretation and its correlation with the western European stratigraphical divisions remain problematic. The recent stratigraphic scheme of Lithuanian Quaternary places mentioned sediments to the Anykščiai Formation of the Upper Pliocene and Daumantai Formation of the Early Pleistocene (Guobytė and Satkūnas, 2011). More precise stratigraphical subdivision of the sediments is complicated because of sedimentation brakes, low content of pollen in some intervals and absence of geochronological data.

Recently, new complex proxies of geochemical, palaeomagnetic, magnetic susceptibility, plant macrofossil, pollen and diatom investigations were applied to 3 sections from Daumantai Formation (Daumantai-1, Daumantai-3, Šlavė-2), one section from Lower Pleistocene Vindžiūnai (Augustovian?, Malopolanian) Interglacial, and one section from Middle Pleistocene Turgeliai (Cromerian IV, Ferdynandovian) Interglacial. The preliminary results of the investigations enable to establish the character of environmental changes and to specify the stratigraphy of the sediments.

The boundary of the Brunhes/Matuyama reversal in three sections (Daumantai-1, Daumantai-3 and Šlavė-2) and Jaramilo subchron in the Daumantai-3 and Šlavė-2 sections were detected by palaeomagnetic studies. It suggests to specify the stratigraphic position of these sediments and to attribute them to the Early Pleistocene (Baltrūnas et al., 2013).

The palaeobotanical data from the sediments below the Brunhes/Matuyama reversal contain large amount of the species characteristic for Tertiary, such as *Taxodium*, *Sciadopitys* and *Pinus* s/g *Haploxylon* and single grains of *Tsuga*, *Juglandaceae*, *Nyssa, Celtis, Ostrya* were present as well. The extinct species *Azolla pseudopinnata* Nikit., *Salvinia glabra* Nikit., *S. intermedia* Dorof., *Pilularia pliocenica* Dorof., *Sparganium nuduliferum* C. et E. M. Reid., *Dulichium vespiforme* C. et E. M. Reid., *Ranunculus sceleratoides* Nikit., *Hypericum tertiaerum* Nikit. and *Naumburgia subthyrsiflora* Nikit. etc. were fixed among plant macrofossil flora.

The Early Pleistocene pollen composition has some features characteristic for interglacials: coniferous (pine and spruce) are prevailing in the lowermost and uppermost parts of the sections and the higher pollen content of broad-leaved is present. The single pollen grains of exotic plants, such as *Taxodium, Celtis, Zelkowa, Ostrya* and *Pinus* s/g *Haploxylon* are detected sporadically as well. The status of the exotic pollen is not clear and the rewashing from older deposits is rather probable. Plant macrofossil flora could be characterized by the presence of fossil Pliocene species (*Pilularia pliocenica* Dorof., *Typha* e gr. *pliocenica* Dorof., *Ranunculus sceleratoides* N. et D., *Hypericum* cf. *tertiaerum* Nikit.) and by species only characteristic of the West European Early Pleistocene flora (*Salvinia aphtosa* Wieliczk., *Selaginella tetraedra* Wieliczk., *Potamogeton perforatus* Wieliczk., *Myriophyllum subspicatum* Wieliczk.).

Most complicated is ascertaining of the right stratigraphical position of Middle Pleistocene interglacials - Vindžiūnai and Turgeliai. Mixed coniferous-deciduous forests, with a high presence of *Quercus* are characteristic of Vindžiūnai interglacial. The forests were not thick, and there were some woodless areas as well. This is evident by pollen of such plants as *Larix*, *Rhododendron*, *Ephedra*. A number of exotic and extinct species are found in the composition of flora. Plant macrofossil flora compouded of the extinct species (44 %), such as *Azolla interglacialis, Potamogeton trichoides* Cham. et Schlecht., *Potamogeton perforatus*, *Potamogeton* cf. *parvulus* Dorof., *Eleocheris praemaximowiczii* Dorof., *Ranunculus sceleratoides*, *Elatine hydropiperoides*. The species *Potamogeton trichoides* is characteristic to the warm climate and is common only in the sediments of interglacials during their optimum (Velichkevich *et al*, 1998). Because of fragmentary character of the complex, no tree macrofossils were obtained, except for one finding of *Larix* sp.

Much more information has been accumulated on the deposits of the Turgeliai interglacial. Mixed conifer and broad-leaved forests with *Corylus* underwoods are typical of this period. The broad-leaved including the hornbeam and nut-tree spread in the forest almost simultaneously. Conifers dominated. A marked spread of alder trees is typical of the first half of glaciation, while the spread of fir trees appeared in the second half. *Ilex,* *Buxus and Ligustrum* has been growing under favourable conditions. Diatom complex of the Turgeliai interglacial has some distinctive features: frustules of some species of *Aulacoseira* (Thw.) genus have coarse pores, dots, their contours of irregular form; an extinct species *Cyclotella radiosa* var. *lichvinensis* (Jouse) Log. was found; forms of *Aulacoseira granulata* f. curvata Grun. and *A. italica* f. *curvata* (Pant.) Hust. curved along the vertical axis are abundant.

Geochemical analysis revealed distinct differences between the sections. The concentration of Ca and total inorganic carbon (TIC) in Turgeliai Interglacial sediments is significantly higher than in Vindžiūnai Interglacial and Daumantai Formation sections indicating much higher content of carbonates in this section. The obvious difference according to the content of $CaCO_3$ might have been predetermined by:

– higher concentration of carbonates in the glacial sediments of Dzūkija ice age preceeding the Turgeliai interglacial than in the glacial sediments formed during the Kalviai glacial and than in pre-Pleistocene sediments;

– different sedimentation conditions, *i.e.* dominance of authigenic sedimentation during the Turgeliai interglacial.

The presumption was done in this research that the second reason plays important role and the climate is one of the most important among many factors determining the proportion of authigenic and allogenic fractions in lake sediments. The section representing the Vindžiūnai interglacial was predominated by terrigenic or biogenic sedimentation whereas authigenic sedimentation was weak. During the Turgeliai interglacial palaeolake was predominated by authigenic sedimentation.

Recent investigations indicate Vindžiūnai Interglacial sediments those were thought to be contemporaneous with the Šlavė-2 section sediments are younger than latter and deposited during the Middle Pleistocene. The detection of the Brunhes/Matuyama inversion and Jaramilo subchron in the sections enables correlation of the sediments with the European stratigraphic subdivisions.

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The Evolution of the Southern Danube Delta and its Impact on Histria Ancient City Development

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Key words: *coastal settlement, shoreline evolution, OSL dating, beach ridge plains*

This study proposes a new hypothesis concerning the southern Danube Delta evolution focusing on the morphological changes occurred in the proximity of Histria ancient city. Histria (Istros) is a Milesian colony founded on the Black Sea coast during the 7th c. BC. Nowadays, the remains of the city are located 8 km inland from the Black Sea coast, on the continental edge of the Sinoe lagoon, representing the southernmost part of the Danube Delta. Significant environmental changes occurred during and after the ancient city's lifetime, particularly related to dramatic shoreline displacement.

A new chronology of the paleo-shorelines was obtained through OSL (Optically Stimulated Luminiscence) beach ridge age determination, with stratigraphic records obtained by auger cores and GPR (Ground Penetrating Radar) scanning of the beach ridges and lagoons.

Our results indicate that in the last 4000 years the coastline evolved from a moderate in-dented rocky shore to a sandy low-lying coast with the present-day barriers and lagoon system, due to coastal progradation. The most significant shoreline advance took place in the last 2000 years and corresponds to the formation of a new deltaic lobe (Dunavăţ, 2000 – 1400 BP), followed by its abandonment which allowed to the longshore currents to redistribute southward its sediments and to create a new beach ridge plain (Saele – Chituc) in front of the city. The city decoupling from the sea temporally coincides with its final decline (7th c. AD). Discontinuous chronology and discordant stratigraphy obtained by OSL dating and GPR scanning of successive ridges document intense neotectonic movements which affected Saele-Chituc beach ridge plain. The seismic activity led to the recent drowning of its central part and the formation of the Sinoe lagoon; the same processes acted at the downdrift part of the Dunavăţ lobe and also in the areas presently occupied by Histria and Nuntasi Lakes. Several areas containing archeological remains are currently below sea-level due to local neotectonics.

The new sea-level curve obtained for the last 5000 years within the Histria region shows a relative stability (oscillations smaller than 2m), which contradicts the concept of a marine regression (called Phanagorian), which was supposed to occur in the Black Sea basin at the middle of the first millennium BC.

Insights Gained from Optically Stimulated Luminescence Dating of Romanian Loess

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Key words: OSL dating, SAR protocol, loess, Campanian Ignimbrite/Y5 tephra, Romania

Given favorable circumstances, loess can be used to reconstruct synoptic-scale paleoclimatology over millennial timescales.

Luminescence dating is considered the most suitable method for obtaining absolute chronologies for loess palaeosol sequences. Here, an overview of our five years research in establishing a reliable chronological framework of some of the most important loess-palaeosol sequences in SE Europe is presented.

Optically stimulated luminescence (OSL) ages obtained for three representative sites in Romania (Mircea Vodă, Mostiştea, Costineşti) and one site in Serbia (Orlovat) using different grain-size fractions of quartz are discussed from chronological and methodological perspectives. The potential of luminescence as a dating tool is examined through a comparison of ages obtained between quartz OSL and feldspar (polymineral fine grain post-IR IRSL) at Mircea Vodă. As well, the results obtained at Caciulatesti site (SW Romania) and Rasova (SE Romania), where independent age control is available through the existence of a tephra layer assigned to Campanian Ignimbrite Y5 eruption, support the reliability of luminescence dating using quartz for young samples of loess (*i.e.* up to about 40 ka).

While our studies support a revision of the formerly established chronology for the representative sections in SE Romania, intriguing evidence is presented showing that OSL dating different grain-size fractions of quartz can lead to discrepant depositional ages for samples older than about 40 ka. Thus, our studies are challenging the assumption that loess is an ideal material for luminescence dating.

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Towards a European Quaternary stratigraphy: Dream or challenge?

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Background and objectives

The Quaternary stratigraphy in Europe has been developed over the last 150 years. Initially, the deposits were differentiated based mainly on rock properties and geomorphological characteristics. Already soon, biogeological evidence from plant macro remains and the fossil remains of small and large mammals were added. Halfway the last century detailed pollen-based subdivisions in stages and substages came into existence. Applications of the ^{14}C method and luminescence dating have added absolute ages for the last 40 Ka and respectively 150 Ka. Paleomagnetic ages are locally available but due to the fragmentary character of Quaternary continental deposits a well-constrained sequence that spans the full Quaternary is lacking. Furthermore, European Quaternary sequences are not evenly distributed throughout the continent. There are marked regional differences. In brief: the Early Quaternary is relatively well-recorded in and around the North Sea. Mid-Pleistocene sequences seem to be best developed in the Russian plains and southward of the maximum land ice advances. The Alpine glaciation history is traditionally best-studied in the Alpine Foreland while the northern ice sheets left major deposits on the North European Lowlands. Loess covers are widely spread in Central and Eastern Europe and have registered mainly Mid to Late Pleistocene developments. In addition several parts of the Quaternary geological history are recorded in fluvial systems either by the infill of sedimentary basins or in regionally developed stair cases of fluvial terraces. So, Quaternary stratigraphy in Europe deals with regional and local different stratigraphical schemes derived from a variety of depositional systems. Nevertheless, the available European records provide a huge source of information on climate change and its impact on Earth surface processes.

Subividing the continental Quaternary in Europe?

Over the last decennia, the much new information became available on the stratigraphy of many continental Quaternary deposits and sequences. Careful analysis has also shown that stratigraphical schemes dating back to the mid-half of the last century need to be revised. Within the SEQS community, much knowledge and information on new sites has been presented and published. So, the question arises if we are able to establish a cross-continent solid stratigraphical framework for the continental Quaternary deposits of Europe? Should we strive for a single framework covering the whole continent from the Atlantic to the Urals ? Or, is it preferable to work with regional stratigraphical schemes and should we improve the inter-regional correlation? In the marine sequences from the Mediterranean we have nowadays more or less well-defined stages. However, the correlation with the continental deposits and sequences is not always clear. In part this is hampered by the lack of absolute dating techniques covering all Quaternary time . But the innate fragmentary composition of the continental records doesn't help to find a simple and straightforward solution.

In the presentation it will be discussed how we can proceed, and which questions have to be answered before a cross-European Quaternary stratigraphical framework is established.

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