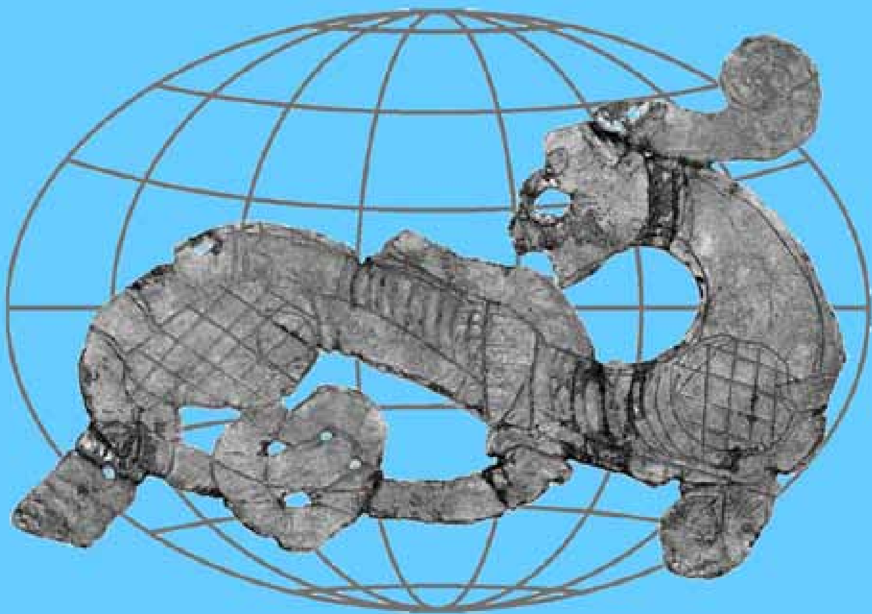
GEOMORPHIC PROCESSES AND GEOARCHAEOLOGY

From Landscape Archaeology to Archaeotourism

International conference
August 20-24, 2012
Moscow-Smolensk, Russia



EXTENDED ABSTRACTS

Administration of the Smolensk Region

Russian Association of Geomorphologists

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University of Moscow:
Faculty of Geography, Faculty of History

Smolensk University for Humanities

Russian Academy of Sciences:
Institute of Geography
Institute of Ethnology and Anthropology

Smolensk State Museum-reserve

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CONTENT

FOREWORD

International conference «Geomorphic Processes and Geoarchaeology: From Landscape Archaeology to Archaeotourism» was held in Moscow – Smolensk, Russia, on August 20-24, 2012. It was initiated by Russian Association of Geomorphologists (RuAG) together with Working Group on Geoarchaeology of the International Association of Geomorphologists (IAG) and supported by IAG Working Group on Geomorphosites, International Union for Quaternary Research (INQUA) – Terrestrial Process Commission (Hydrological Change and Climate Focus Area, Hazards and Humans Focus Area), Global Continental Palaeohydrology group (GLOCOPH). Conference was organized and hosted by the Smolensk University for Humanities (SHU) in cooperation with Moscow State Lomonosov University (MSU, Faculty of Geography and Faculty of History), State Historical Museum (SHM), Russian Academy of Sciences (RAS) – Institute of Geography and Institute of Ethnology and Anthropology, State Hermitage Museum.

The aim of the meeting was linking together different kinds of specialists interested in geomorphic and palaeoenvironmental aspects of archaeological studies, risk assessment and protection of archaeological sites and archaeological materials against environmental damaging processes of different nature (geomorphological, hydrological, pedological), and putting archaeological heritage into public domain.

Papers were presented at four oral / poster sessions:

1. Human dimensions of Quaternary palaeoenvironments.
2. Local palaeoenvironments of archaeological sites.
3. Alluvial geoarchaeology, palaeohydrology and paleopedology
4. Preservation of geoarchaeological monuments, geotourism and archaeotourism

In the abstract book all papers are put in alphabetical order in author's original versions.

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CLIMATE AND SEISMICITY AS FACTORS OF HUMAN EXISTENCE IN SOUTH-EAST ALTAI (RUSSIA) DURING THE LAST 3 THOUSAND YEARS

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Landscape, climate and such catastrophic geological processes as earthquakes, tsunamis, volcano eruptions are the main natural factors that always heavily influenced the existence of human beings as a biological species. These factors also determine natural (geographical) habitat, territorial organization of human society, the way of everyday life, ethnopsychology, religion, the dynamics of social processes, etc.

At present time, the issue of chronology of the archaeological cultures in Altai is still debated. From the beginning of the 1st millennium BC, these can be generally regarded as a single economic-cultural type – nomads of arid piedmonts and mountains of temperate zone [1]. However, both the names of cultures and the periods of their existence are debated [2]. Climatic reconstructions within Russian Altai in Holocene also vary considerably. This complicates the correlation between geological / geomorphological events and changing of archaeological cultures. By now, there are just single attempts to provide such correlation [3].

The paper focuses on studying of climate changes and estimating of paleoseismicity within south-eastern part of Russian Altai during the last 3 ka. This time period covers the life span of populations associated with archaeological sites discovered in the area at issue. Paleoclimatic and paleoglaciological reconstructions are based on absolute dating (including radiocarbon and dendrochronological methods) of archaeological sites, as well as landforms of glacial and seismic origin located within Kurai-Chuya system of intermountain depressions and framing ridges. A continuous 2367-years absolute tree-ring chronology «Mongun-Taiga» developed for the region adjacent to Tuva has enabled the use of dendrochronological analysis for absolute dating [5].

Absolute dating was carried out for wood remains washed up from modern glaciers and scattered over proglacial forefields, tree fragments buried in moraines and found on trough slopes above the upper tree limit, peat layers and lacustrine sediments that cover moraines, trees (both dead and living ones) located on the bodies of seismically triggered landslides, seismically deformed fossil soils, as well as wooden burial constructions from Scythian tombs associated with the Pazyryk culture in Chuya intermountain depression.

In order to provide absolute dates for paleoearthquakes, the age of tree injuries has also been analyzed. Simultaneity of these injuries sustained by several trees which grew on different earthquake-induced landslides was accepted as a criterion of their seismic origin. The accuracy of such an approach was supported by data obtained from analyzing injuries occurred on trees as a result of rockfalls triggered by the 2003 Chuya earthquake (M_S = 7.3), with its epicenter located within SE Altai.

Data provided by such archaeological sites as burials in Pazyryk barrows (kurgans) have been used for reconstruction of landscape prevailing at the time of these internments. Study of Scythian tombs of the Pazyryk culture within the Ulandryk, Justyd, Barburgazy, Sebistei river valleys argues for considerable timber usage (wooden blocks, poles, planks, massive larch logs up to 0.5-0.7 m in diameter, etc.) for burials chambers associated even with ordinary barrows of tribal burial grounds. It suggests a broad expansion of larch forests at now arid and desert areas of the Chuya intermountain depression and framing ridges [5]. The name of the Yustyd River, which means «a hundred larches» in the Altaic language, also supports this hypothesis.

Geomorphological study and absolute dating of landforms and archaeological sites enabled to distinguish two prolonged periods of cooling and moisture increasing during the last 3 ka. This climate deterioration caused glacier expansion in the mountain valleys. The glacial stages are separated by periods of warming and regeneration of forest vegetation in trough heads that indicates significant retreat or even complete glacier degradation during these interstage warming.

Previously unknown earthquake, which occurred in SE Altai during medieval times, has been dendrochronologically dated up to a year. This date lies within the time range determined by radiocarbon ages of seismically cut fossil soil overlapped by that undistorted. Thus, this seismic event was dated by two independent methods. It appears that the epicenter of this medieval earthquake was located in pleistoseismic zone of the 2003 Chuya earthquake (the number of injured trees in studied statistical sampling is comparable with that occurred in 2003).

In general, suggested chronology of the most important climatic events which caused glaciers expansion in mountain ridges of SE Altai, and seismically induced slope processes with disastrous effects may provide insights for pattern of changes in archaeological cultures and migrations of nomadic population inhabited the south-eastern part of the Altai Mountains during the last 3 ka.

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THE IMPACTS OF CLIMATE CHANGE ON GEOTOURISM IN MAHARLOU PLAYA, IRAN

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Introduction. Climate change influence the landforms that have some scenic appeals for geotourism. There are many geomorphic evidences of climate change in the interior areas of Iran as detrital and evaporative deposits from the past alternative arid and rainy climatic condition [1]. Maharlou Playa as a closed basin (centered on North 29° 28' East 52° 45') in Fars Province with a drainage area about 4266 km^2 has now an arid climate with evaporation more than precipitation. Maharlou Lake is located in a synclinal subsidence that might be generatedin late Pleistocene by the faultpassing now from inside the lake. In high water periods, the area of this lake surface covered in central parts by a layer of saltand as a function of annual precipitation is up to 280 km^2 and its average depth is 1.3 m.

Material and Method. Maharlou Basin was specified based on Digital Elevation Model (DEM) from radar data of ASTER Sensor, 30 m pixel size, and topographic map, at scale of 1 : 25000. The geologic data were obtained from geologic map at scale of 1 : 100000.

In order to study sedimentation changes around the lake in Quaternary, the topographic map has been coincided with DEM for the surface ranged in elevation from 1374 m to 1552 m, i.e., about 34 % of total area of the basin.Based on field observationsthe existence of alluvial fans states that above this elevation the lake might not be extended in Quaternary.

Proncipal component analysis (PCA) was carried out by correlation matrix to obtain the lake surface variations aimed at recognizing the surfaces resulted from mineral changes. For the analysis 6 bands of ETM+ Image, 30 m pixel size, were processed. Table represents the correlation coefficients between the brightness degrees of the bands. The greatest correlation is found to be between the bands 2 and 3 (0,989). Some correlation between adjacent bands was because of repetition of information. The six components from bands 1 to 7, except band 6, were calculated and the proportions of principal components (PC) of all the changes in percentage of variance were compared. The results indicate that the lower the PCs are in order, the less the information they contain. In the PCA1 two main surfaces were detectable that onewas coincident with the alluvial bed around the lake and the other with the area of evaporative minerals [2].

Discussion and Conclusion. Given that the glacial periods coincide with the humid ones in Iran, Maharlou Basin has more precipitation and less evaporation in glacial periods and as a rainy lake it has more development. This can be found from the first component as the greatest surface. The evidences show that the old alluvial fans are above the surface and it is accordant to the Quaternary alluvial bed on the geologic map. Therefore, in the last cold period (Wurm) the lake has its maximum expansion.

In addition to lime deposits, the field observations show the areas with gypsum and halite. To analyze these in details, another PCA was conducted on IRS image, with spatial and spectral resolution of 5,7 m and 4 bands, respectively. The first two components with 96,9 % of variance show different surfaces the greatest of which is coincident with calcite minerals. The surface is indicative of the last cold period when the precipitation was more or temperature was lower. There was no evidence implying that the lake was more extensive. A decrease in the calcite deposit and an increase in gypsum toward the lake indicate continuation of an arid climate. Climate changes as wet and dry years now on the lake can be observed as salty surfaces on the water as well as wet and dry surfaces of gypsum.

The lake is shallow and the difference between the deepest point and the highest surface is 148 m, but the contours are not consistent with the obtained surfaces. This is because the changes in the level of the lake are duo to higher temperature, lower rainfall and more evaporation. In the most humid condition the lake water,duo to the fault in the bottom, was in a certain level that is accordant to the greatest surface obtained. Therefore, it can be concluded that the statement of Krinsli about the absence of the lake before Pleistocene is debatable. However, the evolution of the lake as playa is consistent with the beginning of a climate with the evaporation more than precipitation because the Maharlou Basin that has a few streams is a closed drainage system into the lake .The results of PCA also indicated that there are reliefs on the bed of the lake that may be resulted from climate variations and a disparity in solution and deposition of salt; this can be accordant to the studies of Fayyazi et al (2007) about the bicarbonate waters from the springs in the bottom. This is evident that the more precipitation the lake received was not able to cease the evolving of the lake into playa. When more precipitation was received, the central part of salt would be expanded and in the dry condition the solved salts deposited.

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LANDSCAPE ECOLOGY AND THE END OF ANTIQUITY: THE ARCHAEOLOGY OF DEFORESTATION IN SOUTH COASTAL TURKEY

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Since 2000 the Rough Cilicia Archaeological Survey Project has incorporated research on landscape transformation as a component to its regional survey of ancient Rough Cilicia (south coastal Turkey opposite Cyprus). The goal of this project was to identify what combination of forces precipitated urban development in the ancient Mediterranean world, whether the remnants of such forces are identifiable in the archaeological record, and whether the geomorphic effects of such settlement changes have a lasting impact on the contemporary landscape. Specifically, we sought to document whether the natural resource of timber (*cedrus libani*) was the primary stimulus for urban and regional development as induced by the expansion of the distant Roman Empire.

The region of western Rough Cilicia was celebrated during antiquity for pristine cedar forests that stood between 1500 and 1800 m in altitude along the slopes of the Tauros Mts. Today along the front range of the Tauros Mts. this forest is completely denuded or otherwise replanted with recent growth (past 80 years). We employ paleoenvironmental analysis of relic cedar forests in the Taurus Mts. (ancient Rough Cilicia, south coastal Turkey) to construct a timeline of anthropogenic disturbances associated with population growth over time. To obtain this data the team recovers pollen and carbon samples from geomorphologic trenches excavated in the cedar zone (1500-1800 m asl), tree ring data from dendrochronological survey of the existing forest, and archaeological data from remains of ancient highland settlements. We use these data to reconstruct patterns of forestry activities in the Taurus highlands and spatial settlement patterns of human occupation in the coastal plain below.

OVERALL RATES

Excavation Location Dates	Timespan/years	Deposition/m	Rate/100 years
Sand Pit Kizilin Beach 654-274 BC	380	015	0.05/100yrs
Trench D Bickici River Terrace 532 BC-1007 AD	1538	0.75	0.48/100
Trench 5 Kizilin Cave19 BC - 417 AD	435	1.0	0.23/100
Trench D Bickici River Terrace 1007-2007 AD	1000	1.4	0.14/100
Trench 5 Kizilin Cave 417-2002AD	1685	2.0	0.12/100
Sand Pit Kizilin Beach 274 BC-2007AD	2281	3.35	0.146/100
Trench 2 Kuru Lagoon 532 BC-2007 AD	2533	4.0	0.157/100
Totals	**9852**	**12.65m**	**0.128/100 years**

PREMODERN RATES

Excavation Location Dates	Timespan/years	Deposition	Rate/100 years
Sand Pit Kizilin Beach 654-274 B	380	0.15	
Trench D Bickici River Terrace 532 BC-1007AD	1538	0.75	
Trench 5 Kizilin Cave 19 BC - 417 AD	435	1.0	
Totals	**2353**	**1.9m**	**0.08/100 years**

MODERN RATES

Excavation Location Dates	Timespan/years	Deposition	Rate/100 years
Trench D Bickici River Terrace 1007-2007 AD	1000	1.4	
Trench 5 Kizilin Cave 417-2002 AD	1685	2.0	
Sand Pit Kizilin Beach 274 BC-2007 AD	2281	3.35	
Totals	**4966**	**6.75**	**0.135/100years**

Figure 1. This table shows the rates of deposition at different canyons as they correlate with time periods. Premodern deposition rates are approximated at 0.08 m / 100 years, while the modern deposition rates are approximately 0.135 m / 100 years

The presentation will focus on three forms of anthropogenic disturbance likely to have influenced the ecology of this highland landscape: expansion and abatement of land clearance for agricultural purposes; demand for shipbuilding timber by Mediterranean maritime societies; and the likelihood that heavy reliance on wood-fueled firing technologies depleted regional forest cover during the Roman era (1-6th centuries AD). During the 2011 season of the Rough Cilicia Archaeological Survey Project, the team examined and collected soil samples at nine excavated pits and road cuts (Trenches 1-9). We also obtained carbon samples from an exposed pit of a large hill at Mühüler, where a deep layer of carbonized tree residue was visible at approximately 2.6 m depth. In addition, we conducted tree ring research in the same approximate area of the highland, obtaining 25 samples from cedar, juniper, and black pine trees.

Preliminarily, the available data points to the phenomenon of landscape abandonment following population decline ca. 600 CE, as the likely explanation for alluvial deposition in the region's river basins. According to this scenario, after having been cleared and converted into a well manicured agro-pastoral terrain, the artificially maintained landscape of Rough Cilicia gradually collapsed. This would have caused stored sediment to enter the bed load to become deposited in the river valleys, particularly during periodic flooding (fig. 1).

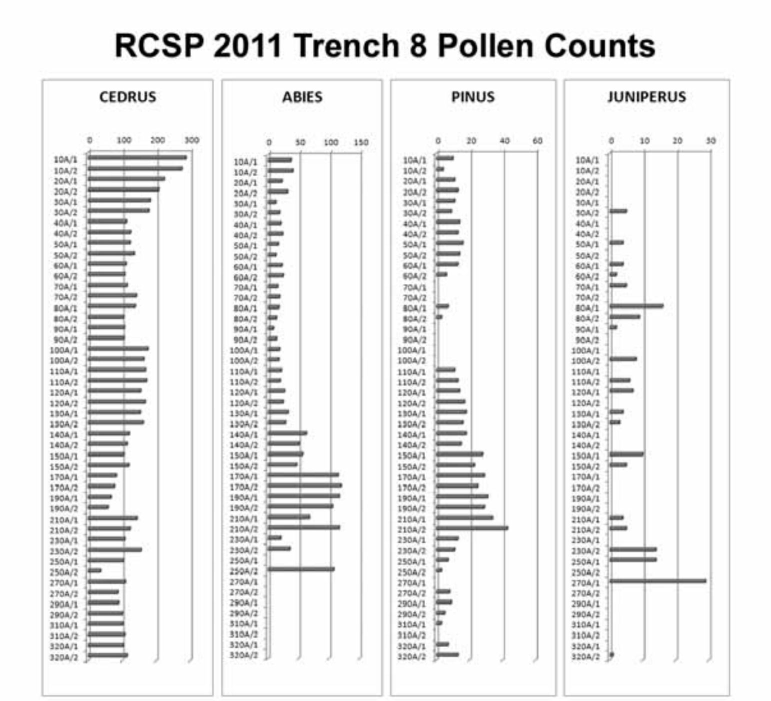

Figure 2. The pollen data from trench 8 at Maha Yayla shows a distinctive pattern. Periods of mature highland forest would have been dominated by cedar and fir pollens; whereas, pollens of the highland colonizers, juniper and black pine, would predominate at times when the natural forest cover of this altitude was depleted. As the table indicates, declines in cedar pollen counts at 60-90 cm depth, 190 cm depth, and 250 cm depth, appear to be matched by rising counts of juniper and black pine pollen, with a very significant spike of juniper pollen at 270 cm and a sustained count of black pine pollen between 110-210 cm depth

Eventually the landscape attained some level of equilibrium, albeit one that was highly eroded and deformed. The dendrochronological survey of relic cedar forests in the Taşeli plateau yielded similar results. The absence of relic forests older than 300-400 years of age and the lack of stochastic patterns in the surviving tree population indicate a) that the depletion of this highland forest occurred long before the advent of modern mechanically driven timbering operations, and b) that it was nonetheless systematic (clear cut) and likely to have been anthropogenic in form. This suggests that native reliance on regional forests for fuel and building materials was ultimately unsustainable. However, the resurgence of cedar pollen in the trench cut at Maha Yayla indicates that the forest regenerated more than once before modern times (fig. 2). In addition, the 50-year age difference between the relic forests at Gurcam Karatepe and the Biçkici highland (approx.

30 km apart) warns us that the timing of timbering events may have varied significantly from canyon to canyon. These results indicate that current perspectives about the timing of deforestation in this region are flawed and that the initial deforestation coincided with regional site abandonment and population decline at the end of antiquity.

Erosion associated with deforestation 2000 years ago appears to have left a measurable impact on the landscape, and one that has left a legacy landuse change on the landscape. This impact was governed by a combination of topography and the unique ecology of the Cedar of Lebanon (*cedrus libani*), the removal of which caused a cascading effect on the landscape, which was essentially a coupled human / environment threshold. The land use conversion persisted for the past two millennia. Once the landscape was developed, it was possible to introduce other forms of landuse that precluded the potential recovery of the landscape to pre-disturbance conditions. Summarizing the results of geoarchaeological field investigation, the presentation will explore the relationship between forest depletion in the Rough Cilician highlands and the «anthropogene process» over time.

FLOODPLAIN GEOARCHAEOLOGY

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Integrated research of floodplain archaeology and geoarchaeology began in our country on a large scale on the initiative of B. Folomejev and M. Glasko in the 1970-1980's. The complex structure of the floodplain, the presence of a series of differently aged cultural layers starting from the Neolith and the bedding of these cultural layers in buried soils were established through the research of the Oka River [1, 3; Glasko, Folomejev, 1981]. The cultural layers analyzed from the reference section of the multilayered Klementy site were discovered to belong to four main buried soils: soil 4 – Neolith; 3 – Bronze Age; 2 – early Iron Age and the early Middle Ages; soil 1 – the present. A special stratigraphic significance of soil 2 (gray forest soil, with a strong well-developed profile) was established in Klementy and many other sections of the Middle Oka-river floodplain.

Subsequent research of the Moskva River revealed that the floodplain there also contains the same four soils, and moreover, more ancient soils, down to the Allerød which belongs to the last glacial period, were discovered [2]. As a result, 7 main periods of soil formation were established. These soils often combine to form doubles or triples, and in some cases represent a single Holocene soil, which indicates that the conditions in the floodplain were maximally stable.

The analysis of soil-alluvial series makes it possible to obtain a detailed record of events in the development of the floodplain landscape in the Holocene. The chronology of the floodplain and the reconstruction of the palaeoenviroment are grounded on the methods of ^{14}C and OSL, used for dating geomorphological, paleosol, palynological, zoological and archaeological data.

The sequence of soils and alluvium layers reflect the periodicity of the processes of floodplain accumulation [5, 6]. The soils correspond to the intervals in the accumulation of alluvium. During these periods, the surface of the floodplain was covered with vegetation. Humus accumulated in the upper sediment, the structure changed, and matured soil profile was gradually formed. The high degree of development of the soils profiles shows that the length of rest periods was hundreds or several thousand years. Periods of alluvium accumulation were shorter. In times of soil formation the floodplain evolved as a terrace, and the landscapes were close to zonal. Thus, in the forest-steppe zone burred soils are often represented by such zonal types as Chernozem, Grey Wooded soil, and in the forest zone Albeluvisol encountered. Floods in these periods were rare and did not lead to an accumulation of alluvium.

Due to this, the conditions for human development of the floodplain were optimal, and long-term settlements could exist there, for example, on the Oka River (Folomeev et al, 1988). Settlements in the valley of the Moskva River have also been found. Research of the Zvenigorod Neolithic site that focuses on soil 4 which is buried in a layer of floodplain alluvium (excavations in 1958 by Yu. A. Krasnov and in 2010 by N. Krenke) showed that this layer pertains to a long-term settlement and contains materials of the developed and late stages of L’alovo culture. Radiocarbon dates indicate the interval 5300 – 4900 BP (uncalibrated age). Pollen analysis of samples from the buried soil showed that the lower levels of the valley were covered with wet meadows and floodplain oak forests, which were partially replaced with thickets of hazel, probably as a result of deforestation. It is significant that Cerealia-type pollen grains were found.

We can assume that the river "ousted" people from the floodplain in the Late Neolithic period, when rapid sedimentation on the surface of soil 4 began [4]. However, there were areas in the high valley of the Moskva River that apparently were almost never flooded. At sites Grigorovo 2, 4 (excavations in 1977, 2012) and Zar’ad’e in Moscow (excavations in 1949) Eneolithic finds were discovered in the floodplain, among other things, (Grigorovo) in a layer of alluvium formed through slow accumulation.

At the stage of the formation of soil 3 the type of vegetation in the valley of the Moskva River changed dramatically: the flood plain was overgrown with mixed coniferous-deciduous forests dominated by spruce. Intensive felling of the forests in the valley began with the arrival of the people of the Corded Ware culture, who already knew herding and farming. The traces of their activity are numerous finds of stone axes in the lower levels of the river valley. Apparently, the beginning of this new episode in the development of the valley coincided with a change in its flood regime. Alluvium deposits began to cover soil 3. However, seasonal settlements in the floodplain were preserved. Such is the settlement of ZBS-5. Typical Corded Ware pottery, which finds an analogy in the Baltic, was first discovered in the Moscow region on this site. Another object – ZBS-4, relating to Fatyanovo culture (a derivative of the Corded Ware culture), was found on the alluvial fan of a small creek. A broken pot was discovered there, along with charcoal which revealed the radiocarbon age of 4040 years. An arable horizon was recorded next to it; it contained an abundance of hemp (*Cannabis*) pollen. A series of similar dates were obtained for the settlement RANIS, located in the floodplain opposite to Nikolina Gora. Microstratigraphical observations on this site [4] clearly show that the settlement is deated to the period of rapid sedimentation of sandy alluvium on the surface of soil 3. Pollen analysis at this level indicates partial cutting of spruce-deciduous forest and grassland development in the floodplain. As well as on the ZBS, single Cerealia-type pollen grains were found there. However, it can not yet be interpreted as an unambiguous indication of the presence of agricultural land.

Little is known about human activity in the floodplain during the Iron Age. The basic Hill-forts were located at higher levels in the valley. The time of settlements is likely to coincide with a period of stabilization of the floodplain surface and the beginning of the formation of soil 2, characterized by a profile of the forest genesis. At the same time, the pollen spectra of cultural layers pertaining to the ancient settlements characterize the landscape of their neighborhoods as an open one, which was dominated by meadows and fields.

Floodplain lands were the first to be occupied at the initial stage of Slavic colonization of the Moskva River valley. There were long-term settlements in the valley, the forest was felled for arable land. We have the radiocarbon dating both for archaeological objects (buildings) and for the natural objects (inversion of a tree), indicating an age of about 900-1000 years.

Human activities, particularly in the last centuries, had a great impact on the landscape of the floodplain.The original forest landscape that was formed during the maximal stability of the floodplain (the formation of soil 2) ceased to exist. This was the result of deforestation and cultivation of large areas. The transformation of the flood regime from shallow to overflowing occurred during late 15 – early 16 centuries. The transition was not smooth, but "catastrophic": thick layers of sand brought by floods overlap soil 2. At a later stage of the Middle Ages the modern man-made landscape was formed. It is characterized by erosion of the slopes, filling of the bottom of the river valley with alluvium, the spread of grasslands in the floodplain. Some stabilization probably occurred in the 17-18 centuries (formation of the underdeveloped soils 1a). Then again, flooding increased in the late 18^{th} – early 19^{th} centuries, which led to the ousting of many settlements from the floodplains. These relatively recent developments may serve as a «model» of the dynamics of settlement systems in a floodplain. The most important task for future research is the correlation between the dynamics of river systems in the basins of the Upper Volga, Western Dvina, the Dnieper, Oka River.

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GEOMORPHOLOGICAL AND PEDO-STRATIGRAPHICAL APPROACH AS A TOOL FOR UNDERSTANDING THE ARCHAEOLOGICAL LANDSCAPES AND ENVIRONMENTS: THE CASE-STUDY OF THE ANCIENT LAOS TERRITORY (CALABRIA, SOUTHERN ITALY)

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The preliminary results of the «Landscape archaeology in the territory of ancient Laos» project, run by the Superintendency of Calabria, the University of Paris 1 Panthéon-Sorbonne, the Centre Jean Bérard in Naples (USR 3133 CNRS – École Française de Rome) and the Department of Heritage Science of University of Salerno, are discussed. The aims of the project, started in the 2009 and still in progress, are the understanding of the dynamics, the times and the forms of the landscape changes in relation to the ancient coastal territories of the northern Calabria (southern Italy), between the Scalea and Cirella promontories, and in particular the strip of territory comprising between the Lao river and the Abatemarco stream (fig. 1). The modern landscape was strongly modified by the last century man-induced activities, which shaped the persistence and the degradation of the landscape archaeology. In fact, if on one side the territory still presents several archaeological settlements (subject to the excavation and valorization, for detail see [1, 2, 3, 4]), on the other side is still unknown the localization of the Greek settlement of the Ancient Laos, cited from historical literature [5, 6] and still undiscovered. In order to define several sample areas constituting the base for plausible evaluation of the use and organization of the space in antiquity, a multidisciplinary approach was carried out. In detail, a geomorphological and pedo-stratigraphical approach was applied to the new archaeological surveys for understanding the formation processes of the archaeological records.

The study area is characterized by the presence of a wide alluvial-coastal plain, in which flows the Lao river and Abatemarco stream (fig. 1). The plain is landward bordered by hills, along which a stair of marine and fluvial terraces, stepping between 240 and 30 m a.s.l. and referred to a time interval falling between the Early Pleistocene and the Middle Pleistocene [7], is present. In the plain, behind the 20 km long and 0,5 km narrow modern sandy beach, one or more sandy dunal ridges and back-ridge depression are locally recognizable. These barrier-lagoon systems was formed during the second half of the Holocene, when a strong progradational trend interested the shoreline as result of the decrease of the sea level rise rate and of the increase of the fluvial sediment supplies caused by prehistorical and early historical man-induced impacts [8, 9]. Even more landward stretches of steep slopes, interpretable as palaeocliff relicts, are recognizable. These was probably modeled during the Early Holocene, when the rate of the sea level rise was particularly rapid [8, 9]. Some of it are recognizable into the fluvial valleys and in particular into the Lao river valley, where it go up to about some km from the modern shoreline. These were cut into sandy and gravelly deposits of the Pleistocene marine and fluvial terraces. The latter are represented by wide flat surfaces (i.e. Foresta S. Maria and Piano della Suvareta terraces, fig. 1) and by narrow ridge and small strips of lands because dissected by a dense river network, which reduced the original width. The valley flanks of the terraces are interested by several fluvio-gravitational processes (landslides, falls, creeps, rills and gullies erosion), particularly active along the borders of the terraces and in the high part of the slopes. At the base of the slopes, aggradational and colluvial

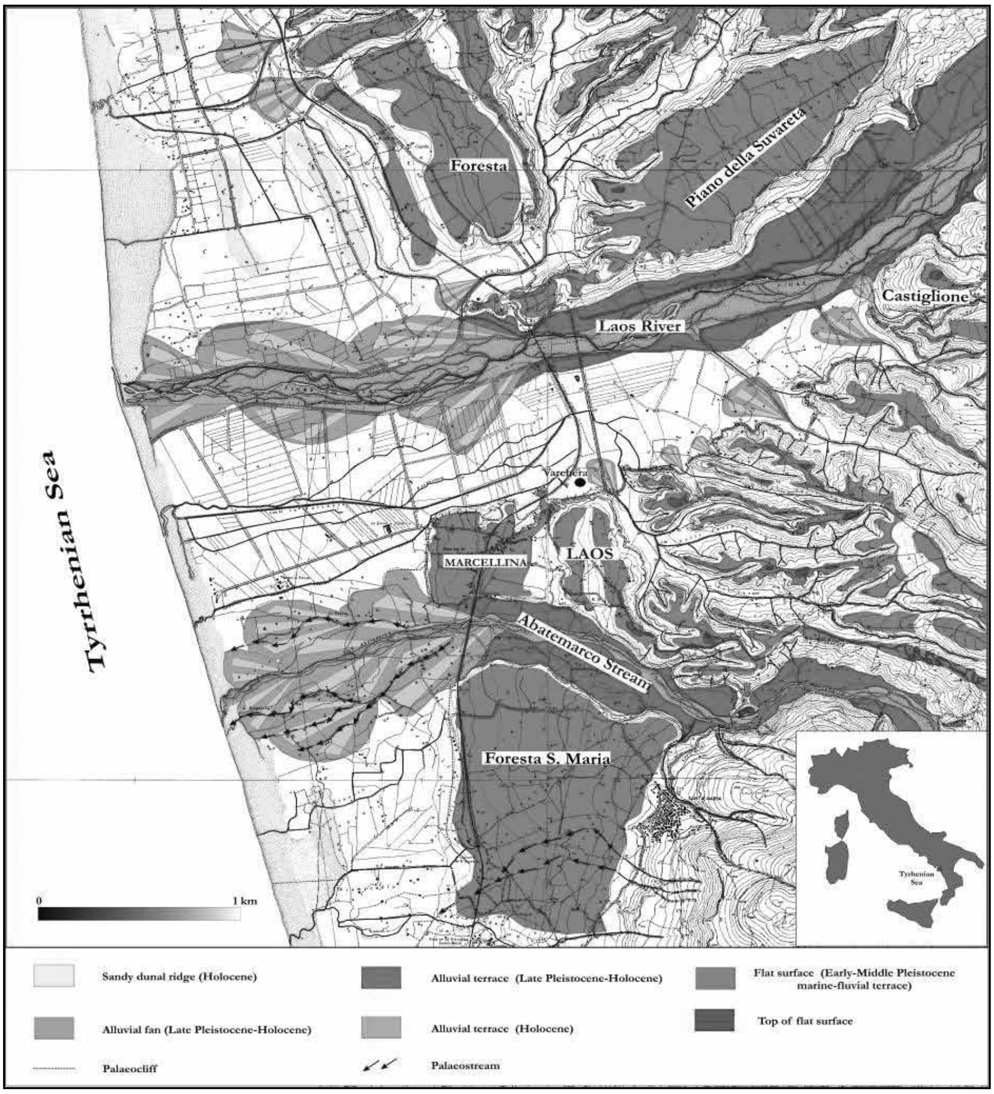

Figure 1. Schematic geomorphological map of the study area on 1 : 10.000 Regional Topographic Cartography (1962)

processes are active [3, 4]. The terraces of greater width preserve, on they top, thick soil covers (here namely «pedomarker»), interpretable as relic paleosoils [10], while in the terraces of smaller width, the soil covers are lack or small thickness and often the Pleistocene bedrock directly outcrops.

An intensive archeological survey, covered an area of about 45 hectares on the hills east of Ancient Laos and about 150 hectares on the Foresta S. Maria terrace, was carried out. During the 2010-2011 archeological surveys, the areas of distribution of the pottery fragments on the surface was GIS classified and GIS mapped. The choice of the recognized areas was established by preliminary geomorphological and archaeological considerations and the data of the surveys was related to other multidisciplinary data, as the degree of visibility to the ground, the land-use, the state and the characters of the soil covers and the main geomorphological processes. In this work we show only one of the matrix-profile of the recognized areas (fig. 2), while for the other profiles you can see [11]. The matrix-profile of figure 2 show as the presence on surface of potteries and tiles is related to the presence of the pedomarker and to the lack of the significant erosional or aggradational processes on surface. In particular in this area the pedomarker is constituted by the complete sequence of the pedogenetic horizons, as illustrated by [10]. In fact the best survey results are concentrated where the pedomarker is complete (Foresta S. Maria, Castiglione etc.), while where it is incomplete or lacking the potteries fragments on surface are scarce or absents.

Simultaneously to the geomorphological and archaeological survey, a morpho-stratigraphical approach to the alluvial-coastal plain between Lao and Abatemarco rivers was carried out. Several litho-stratigraphical cores, founded at local administration offices, was analyzed together to the archaeo-stratigraphical data known in the literature, in order to understand the paleogeographical evolution of the coastal sector.

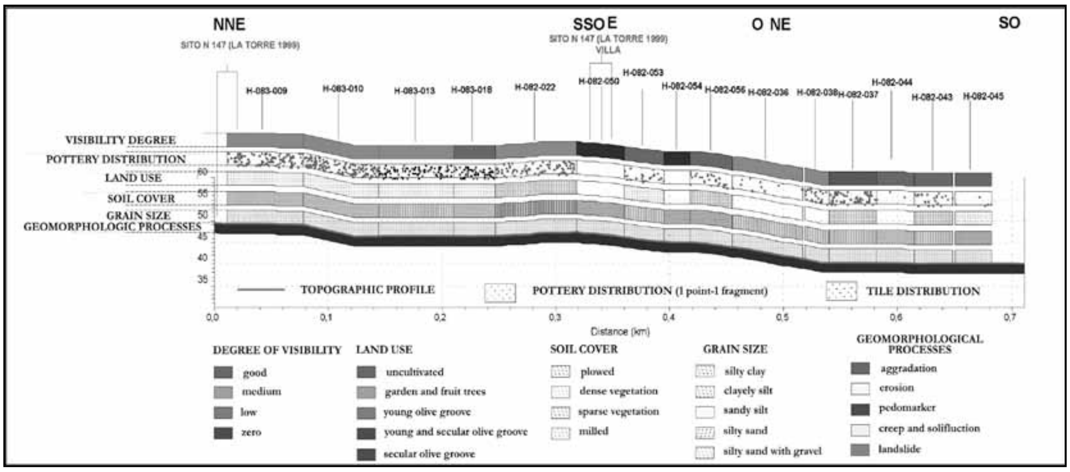

Figure 2. Matrix-profile of the Foresta S. Maria terrace (for location see Fig. 1)

The preliminary results allow to identify that during Greek and Roman Age the shoreline was more close to the foot of the flat terraces and only more recently it shifted seaward until to reach the modern position. During this period the coastal plain was interested by a barrier-lagoon system connected to the main rivers and to the secondary little streams, as the Varchera streams. The last one is now a reclaimed channel but in ancient times was connected to the Marcellina, Vitaliano and S.Barbato hills. In the 1990-1992, at the base of these hills and near the Varchera channel (fig. 1), an archaeological site, time-covering an interval spanning from Hellenistic period (III cen. BC) to Late Ancient Age-Early Middle Age (VI-VII cen. AC), was discovered and excavated [1, 4]. In order to define the palaeoenvironmental characters of the Varchera site, two samples of the archaeological layers were subject to paleoecological (ostracods and calcareous microfossils) and pollen analyses. The samples, preserved at the Laos Archeological Park warehouse, regard the layer of foundation of the more ancient structures of the site (III cen. BC) (US 49 / 53, at depth of about 3 m) and the layers of the its covering (Middle Age period) (US 26, at depth of about 1,50 m). The US 49 / 53 is constituted by silty sands with coarse sands and gravels while the US 26 is constituted by clayely silts and sandy silts, very rich in organic matter and plant remains. The palaeoecological data show that the US 49 / 53 is representative of floodplain environments and in particular could be represent a palaeosols, while the US 26 is a peat of marshy environments. The preliminary pollen data confirm the palaecological and litho-stratigraphical interpretations and allow to identify a cultivated landscape, mainly by olive trees, especially during the Middle Age.

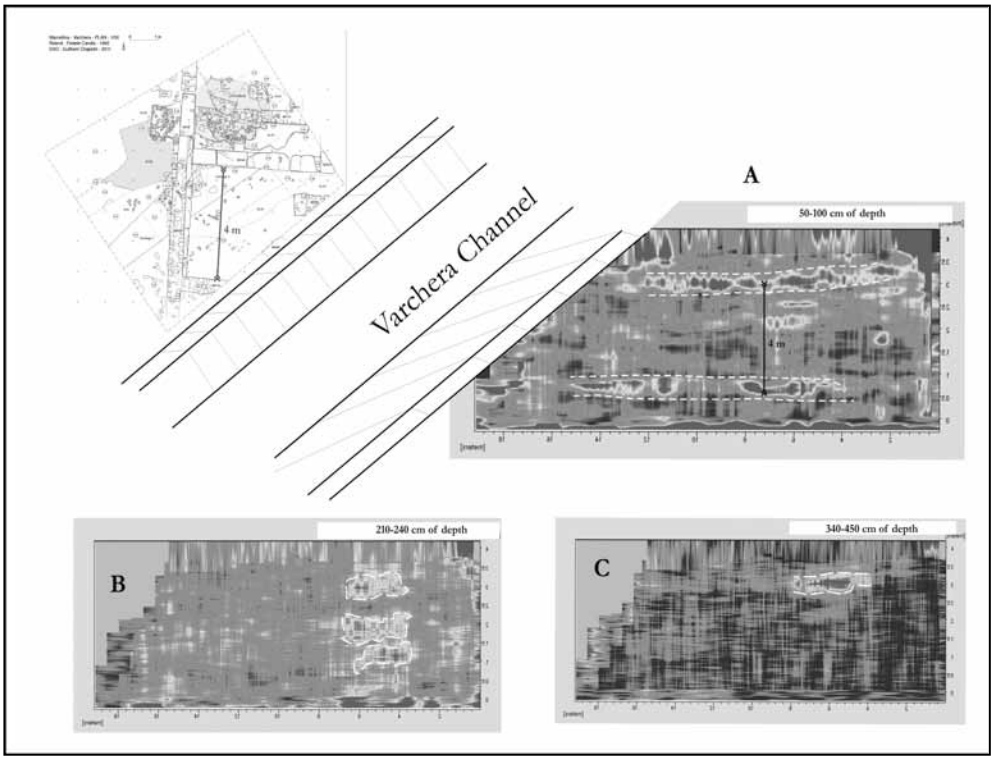

Figure 3. GPR at the Varchera Site: A) the structures (walls?) visible at 0,5-1 m of depth, probably connected to the structure excavated in the 1990-1992, B) the structure visible at 2,1-2,4 m of depth, C) the structure visible at 3,4-4 m of depth

These data show that the Varchera site was built in dry floodplain environments (paleosoil) and successively, after its abandonment, was subject to marshy environments. The causes of this environmental change can be related to the climatic changes that interested the Mediterranean valleys during the Late Ancient Age-Early Middle Age [12].

In order to understand the lateral continuity of the covered structures of the Varchera site, a Ground Penetrating Radar prospection was carried out. The results, showed in fig. 3, allow to identify three covered archaeological targets, at 0,5-1,0 m of depth, at 2,1-2,4 m of depth and at 3,40 m of depth. The first (fig. 3A) is constituted by two parallel lines, arranged to 4 m and oriented as the walls of the structures excavated in the 1990-1992, but more superficial than the latter. The second (fig. 3B) is constituted by a large rectangular anomaly (2 x 3 m) at the same depth of the structures excavated in the 1990-1992. The third (fig. 3C) is constituted by a linear anomaly oriented as the walls of the structures excavated in the 1990-1992, but deeper than the latter. These data shows that the area of Varchera site should be investigated with an extensive archaeological excavation in order to better understand the function and the rule of the structures excavated in the 1990-1992.

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GEOARCHAEOTOURISM ALONG THE COAST OF THE CAMPANIA REGION (SOUTHERN ITALY)

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The coastal sector of the Campania region have a large number of sites of high naturalistic, geologic, geomorphologic and, especially, archaeologic interest (i.e. Cuma, Puteoli, Naples, Hercolaneum, Pompei, Pontecagnano, Paestum and Velia), which, from many centuries, represent a strong attraction for tourists and travelers of each part of the world.

In these sites, the coexistence of geological and archaeological features allows to identify several educational and scientific paths, within which can be individuated and enhanced geosites and geoarchaeosites. In this way, the Associazione Italiana di Geologia e Turismo proposes several academic and socio-cultural actions, in order to highlights the geoarchaeological heritage in the qualified and sustainable tourism. In particular the Association organized several educational and scientific field-trips and congress: The field-trips, that we will present in this work, are the geoarchaeological paths of the Poseidonia-Paestum and Velia archaeological sites and the geo-archaeo-trekking of Naples. These paths provide short geotouristic walks, with several geoarchaeological stops, where it is possible to observe the more significant deposits and forms, representative of the palaeogeographical, morpho-stratigraphical and palaeo-environmental evolution of the Sele Plain, of the Alento Plain and of the Naples bay, which, respectively, including the archaeological areas of Poseidonia-Paestum, Elea-Velia and Parthenope-Neapolis.

The geotouristic path of Poseidonia-Paestum. The ancient town of Poseidonia was founded by Greek colonizers during the VI cent. BC, in the southern sector of the Sele river alluvial-coastal-plain.

The Greeks chose the travertine plateaux (Travertino di Fondazione) [1] located very close to the ancient shoreline. Then the city became a Roman town, namely Paestum, and from the IV-V cen AC was progressively abandoned, interested by swamping and covered by travertine deposits (Travertini di Seppellimento) [1, 2, 3] (fig. 1). The geoarchaeological path starts from the western door of the town (Porta Marina, STOP 1). Here, just outside the town walls, the travertine plateaux of the Travertini di Fondazione finish with a steep escarpment. The latter was referred to a palaeocliff (Porta Marina Palaeocliff) formed during the Holocene marine transgression, when the travertine plateaux was a promontory [3]. During the second half of the Holocene, the sea level rise rate decrease and the shoreline shifted seaward until to reach the modern position. In this period a barrier-lagoon system formed, generating the Laura and Sterpina sandy dunal ridges, respectively dated at 5.3 ky BP and 2.5-2.0 ky BP [3]. These palaeoridges, particularly the Sterpina palaeoridge, hosted in the back-barrier sectors lagoonal and swamp environments connected to the sea (as the Fossa Lupata back-ridge depression). The latter could be hosted the ancient harbour of the Greek town before of become a fluvial-marshy depression when the Pompei eruption distal products (79 AC) were deposited. Then the geoarchaeological path continues along the walls of the ancient town, where it is possible to observe the textural features of the Paestum travertine deposits, their polyphasic depositions, and their heteropic passages to coastal deposits and forms (STOPS 2 and 3). The path ends into the Poseidonia-Paestum archaeological area, where it is possible observe the materials used for temples, walls and houses buildings and the changes of the greek-roman town organization caused by socio-environmental crises (STOPS 4 and 5).

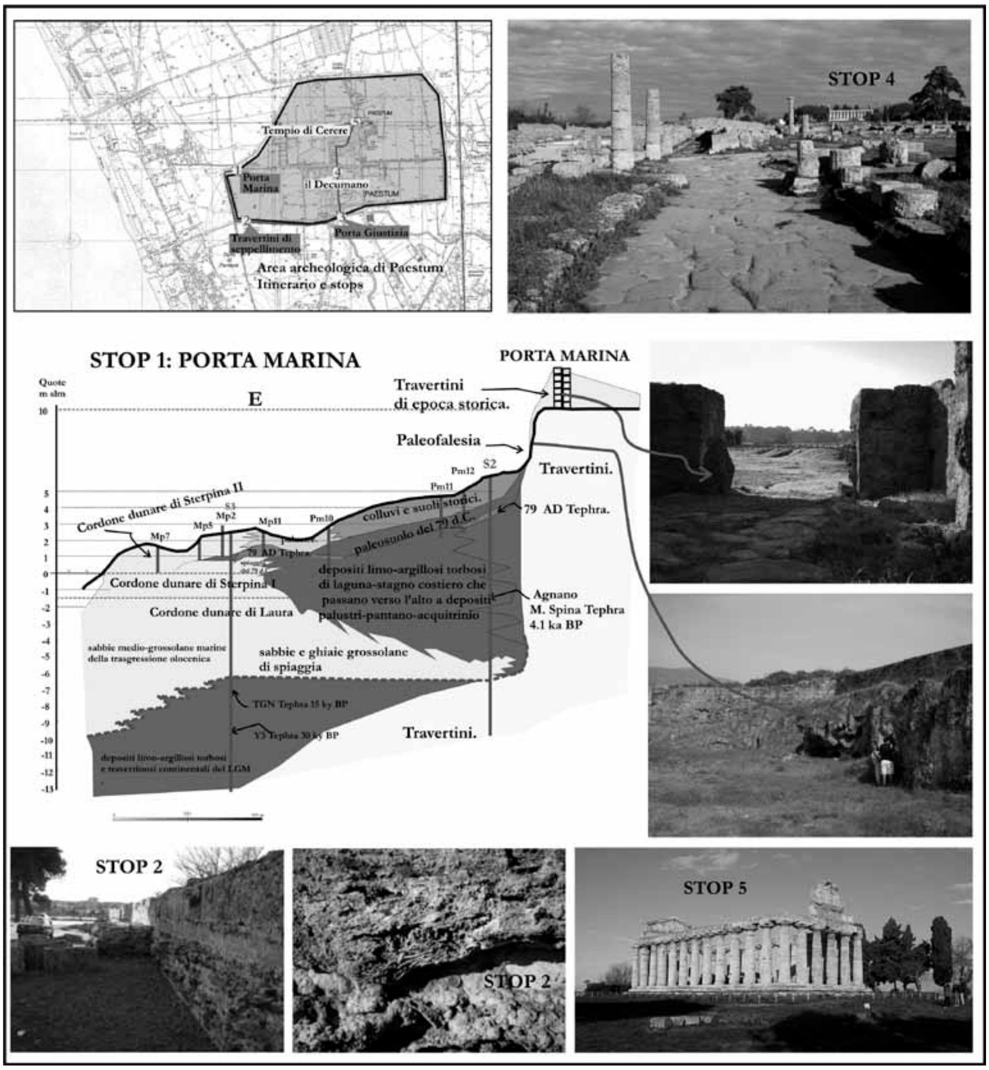

Figure 1. The geoarchaeological path of Poseidonia-Paestum and the main educational-scientific stops

The geotouristic path of Elea-Velia. The ancient town of Elea was founded in the 540 BC by Phocean colonizers in the southern Cilento, near the promontory dividing the Alento and Fiumarella rivers alluvial-coastal plains (fig. 2). During the Holocene, this relief represented a great attraction for the man and for their settlement choice. The Elea-Velia territory was interested by wide marine transgression during the first part of the Holocene, that generated cliffs near the reliefs and bays very marked into the rivers (fig. 2).

The main geoarchaeological feature of the Elea-Velia settlement is the strong interaction between the morpho-stratigraphical changes and the man-induced changes. Here the strong aggradation of the ground level and the marked progradational phases of the shoreline was strongly induced by man activities on land-use, when the phocean colonizers occupied the territory [4] (fig. 2, STOP 1). The path walks across the archaeological park. It starts from the exhibition halls (STOP 1), where some educational-scientific panels of the palaegeographical evolution of the area are hosted, and goes on the excavation path, where is possible to observe the flood events that interested the Southern Quarters of the ancient town (Necropolis areas, Via di Porta V e Triportico area, respectively STOPS 2, 3 and 4). In add, it is possible to note the urban changes of the town induced by floods events (STOPS 3 and 4), the construction techniques of the walls and buildings (STOP 5), and the Pompei eruption (79 A.C.) distal products (STOP 3). The path ends at the Acropolis hill, where it is possible to look a panoramic view on the archaeological area and on the coast (fig. 2).

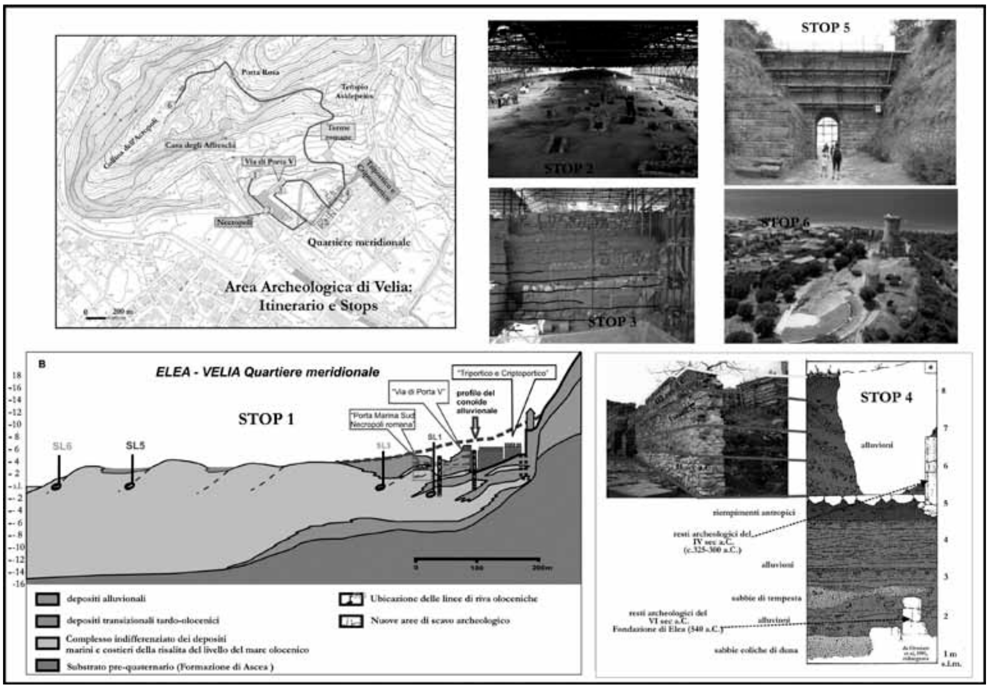

Figure 2. The geoarchaeological path of the Elea-velia and the main educational-scientific stops

The geotouristic path of Naples. The city of Naples, located in the NW sector of the Naples bay, found on Neapolitan Yellow Tuff hills and on their slopes very close to the coast. The modern urban structure of the Centro Antico is similar to the Greek-Roman and Renaissance urban structures. In fact in several streets it is possible to observe the overlap of the different building phases. In add to these features, which, from many centuries, highlight several tourists and travelers, the city shows some sites representative of its geological and geomorphological evolution. The latter was controlled mainly by Neapolitan Volcanoes eruptions, and, secondly, by bradisisms) [5], by Holocene climatic changes and by man induced changes. The path starts from the S. Elmo Castle and end to the S. Marcellino and Festo Cloister (fig. 3), passing through the main geological and archaeo-touristic sites of the city, as the Neapolitan Yellow Tuff outcrops (STOP 1), the Breccia Museo geosites (STOP 2), the Pedamentina and S. Antonio ai Monti streets (STOP 3), the Greek walls (STOP 4) and the S. Marcellino palaeocliff (STOP 5).

Figure 3. The geotouristic path of Naples and the main educational-scientific stops

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GEO-ARCHAEOTOURISM IN THE GALLURA REGION (NORTH-EASTERN SARDINIA, ITALY)

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Gallura region, located in the north-east of Sardinia island, is formed by a territory rich in complex and diversified geological events, forever impressed in the rocks, which gave rise to geo-morphological and geo-archaeological sites of exceptional scientific, cultural and tourist interest. The landscape is characterized by granite rocks and hard mountains that, even if not particularly high, have been a millenary barrier between this region and the near territories of Mont'Albo, in the region of Baronie. This hard and compact granite-type rock, in gray, pink and white shades, is the symbol of Sardinia. In fact, the most expressive and attractive aspects for the tourists in Gallura are the granite geomorphosites [1, 2]. Gallura granite massifs are of an average height and are distinguished by irregular and characteristic toothed edges, typical of the Aggius mountain range, rising above the Tempio basin. Their height grows gradually up to the Barbagia peaks, and the individual heights, which form the Sette Fratelli («Seven Brothers») granite group, plunge into the sea by sharply outlined ridges [3]. Limbara is a granite mountain massif (1,362 m), located in the center of Gallura. It is surrounded by Tempio basin to the north, by the Coghinas River valley to the south-west, and by the Monti Oschiri, Padrogiano and Olbia depressions on the south-east side.

This area also includes the region of «Costa Smeralda», with the most famous tourist spots in the whole Mediterranean Sea. The shore is cut by small and deep fiord-like gorges of intricate forms, which alternate with marvelous pebble and sand beaches. The town of Palau, located here on the coast, is famous for its inns, grand restaurants, ports for expensive private yachts, and other places of luxurious and elite relaxation, which attract thousands of people every year [3]. But the main point of interest in the town is a granite rock of unusual shape (fig. 1A).

The coasts are very jagged and continue along an uninterrupted series of small fiords, rock-cliffs and little islands forming the Archipelago of «La Maddalena», a natural bridge towards nearby Corsica. The large rocky promontory of Capo Testa is the Sardinia's extreme point. Capo Testa is considered one of the most interesting and notable capes, not only on the shore of Santa Teresa di Gallura, where it is located, but in the whole Sardinia. This cape, with its almost circular coastal outline, stands out for the diversity and the very special beauty of coastal forms, due to the influence of exogenic and abrasive processes upon the basement rocks (Late Paleozoic age).

Gallura region is also remarkable from an archaeological point of view. In fact, it is the heart of the culture of Megalithic circles, known as «circoli megalitici» or «circoli di Arzachena». This prehistoric testimony, dating back to the III millennium BC, presents characteristics which are unique in the various phases of Sardinian prehistory. In the territory surrounding the town of Arzachena there are the most important archaeological sites. The Albucciu Nuraghe is a typical «corridor» Nuraghe [4]; the Nuragic Temple of Malchittu is a rare example of a «megaron» Nuragic building; Giants Tomb of Li Lolghi (fig. 1B), is characterized by a majestic stele, or standing stone, composed of two overlapping granite slabs; Necropolis of Li Muri, Giants, is the only evidence in Sardinia of the culture of «Megalithic Circles of Arzachena»; Tomb of Coddu Echju is a particularly fascinating archaeological site, since it dates back to a number of different historical periods, starting from the middle of the II millennium BC.

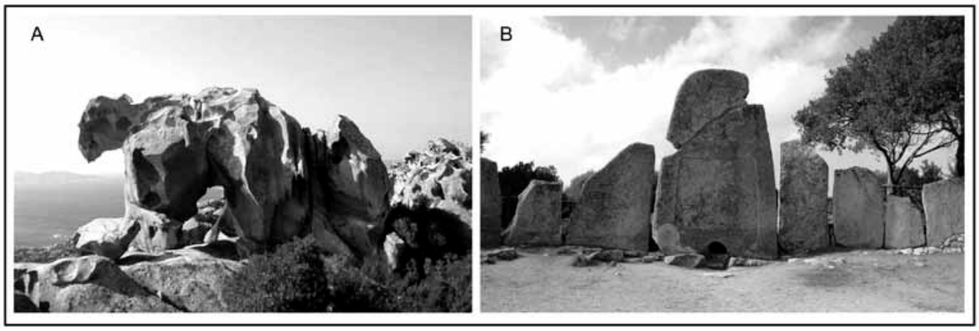

Figure 1. A. Palau's symbol – the «Bear's rock» (Capo d'Orso); B. Giants Tomb of Li Lolghi

Sardinia and Gallura coasts annually attract hundreds of thousands of visitors, thanks to the exceptional features of marine and coastal environment. Moreover, despite their quite inaccessible internal location, the archaeological sites of Gallura as well represent a remarkable attraction, due to their original archaeological characteristics related to the so called «nuragic period» [5]. The interest towards them is also shown by an increasing site management from private associations, and by the editing of several publications and archaeological tourist maps.

The geology of the region is well-known for the features related to the granite geologic environment, and particularly for some spectacular geomorphosites linked to past and recent morphogenesis phenomena concerning this peculiar kind of rock, so typical of the island.

Nevertheless, apart from some morphotypes really distinctive for their morphology that can reproduce natural shapes (mushrooms, bears, and so on) the geological tours are less known to the mass of tourists. With regard to this, a fundamental aspect for the promotion of geo-archaeological tourism is the diffusion, or better the capacity of doing geologic and archaeological divulgation, in an integrated view of the whole regional patrimony. The numerous publications and the panels positioned along the itineraries of the area are still mainly for insiders and geologic experts only; on the contrary, the capability of exchanging information suitable to communicate with people is missing. Therefore, it's necessary to implement a proper geo-archaeotourism through the correct management of the existing territorial patrimony, producing its largest knowledge in a simple way, clear to everybody, involving local populations too, which are delegated to conserve and pass on to future generations the geological and cultural original heritage belonging to their forefathers.

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GEO-ARCHAEOLOGICAL AND HISTORICAL SITES OF ETHIOPIA

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Ethiopia, located in north-eastern Africa, represents an exceptional country thanks to the beauty of its landscapes, characterized by significant prehistoric sites surrounded by spectacular natural environments, where it's possible to find a great number of geo-archaeological and historical places: ancient steles, tombs, old and historical rock-hewn churches, cultural cities with mysterious castles, some of which have been granted UNESCO World Heritage status. These sites, with scientific and aesthetic value, could become areas of significant touristic interest, and they were directly investigated in occasion of IAG / AIG Regional Conference – Addis Ababa, 2011 [1].

In the site «Adar» on the southern edge of the Afar Triangle, in the Awash River valley, the remains of an adult female, *Australopithecus afarensis*, were found, the most ancient human being on Earth, known as «Lucy». The human remains are 3.2 million years old and are preserved in the National Museum of Ethiopia in Addis Ababa. On the Ethiopian plateau, in the central part of Awash River at an altitude of about 2000 meters, there is a geo-archaeological park in which the remains of numerous Miocene and Pleistocene hominids have been found, together with some of the most ancient Olduwan stones, traces of baked clay and controversial evidences of the use of fire.

Melka Kunture is one of the most important Early and Middle Pleistocene prehistoric sites of the area, where the first inhabitants of the sites, represented by «*Homo erectus*», about 1.7 mln years ago reached the banks of the Awash, at Melka Kunture, and populated the surrounding savanna, the banks of the river and its tributaries. The site has also supplied several fragmentary remains of lithic industries and numerous mammals (*hippopotamus*, *elephant*, *antelope, horse*). The excavations and the research conducted show a stratigraphy included in the period from 1.7-1.4 Ma until 20,000 B.P. – 2,000 AD.

The site of Tiya Stele, declared part of the World Heritage since 1980, is one of the most important of the nearly 160 archaeological sites discovered until now in the region of Soddo, about 90 km north-west from the capital Addis Ababa. The site contains 36 monuments, including 32 carved steles covered with symbols, many of which are difficult to be deciphered. They are the remains of an ancient Ethiopian culture whose epoch has not yet been established with precision.

Axum is one of eight World Heritage sites in Ethiopia for the remains of an ancient Axumite civilization from the early modern era. The impressive ruins, dating back to the period between the 1st and 13th century AD, include monolithic obelisks, giant steles, tombs and remains of ancient castles. Axum is located at the entrance of a valley at

2300 meters above sea level, surrounded by trees and farmland. The Kingdom of Tigre River bordered with Arabia and Yemen to the east, with Sudan to the west and with Kenya and inner Africa to the south. The famous steles were carved out in ancient quarries at the foot of Gobo Dura hill, on a boulder-mantled bench. Axum is also important for the numerous tombs, which have been a source of precious information about the Axumite civilization. Among the most important ones, we should mention the Tomb of Nefas Mewcha, the Mausoleum, and Tomb of the False Door, located in the west side of the main steles and 65 meters away from the Mausoleum. These tombs were built on huge granitic blocks, which were partly carved *in situ*.

The area around Lalibela, where the famous rocky churches stand, is located north-west of the Ethiopian plateau, whose structure is the product of the Ethiopian Tertiary volcanism, as result of the basalt flow associated with ignimbrites and rhyolites. Nevertheless, only the Oligocene basalts (Aiba Formation) and the lower Miocene (Formation of Alaja) are observable in the area. Nowadays, Lalibela is a small and friendly town situated in central Ethiopia at 2700 meters above sea level. Thanks to its camouflaged location, far from prying eyes and predatory hands of uninvited guests, about 800 years ago a noble Christian king and the men of the Ethiopian Middle Ages, barricaded in the inexpugnable plateau and surrounded by Muslim nations, carried out the eighth world’s wonder: eleven rock-hewn churches built «inside out», that is not in the open air, pointing to the sky, but entirely carved deep into the volcanic pinkish tuff and connected one another by a web of underground passages, caves and tunnels. All the churches were decorated both outside: doors, windows and friezes; and inside: rooms, arches, columns, in a style that shows clear Axumite influences. Several churches have the roof at ground level and some are painted. Four churches are built directly in the rock, welded to the mountains from the floor, huge carved and sculpted blocks. The eleven monolithic churches of Lalibela (Bete Medhane, Alem, Bete Mariam, etc.) form a unique complex consisting in two main groups of five churches each, and in an isolated church. They represent, with the surrounding village, an evidence of exceptional historical and artistic value.

Not less significant in terms of geo-archaeological witness, are various historical monuments and castles in the major cities of Ethiopia. Gondar – Fasil Ghebbi, founded in the 17th century, was the capital of Ethiopia since its own establishment by Emperor Fasilides. It has been the Ethiopian political center for a long time. The remains of several palaces and many castles of the 17th and 18th centuries, built by different emperors, are a clear proof that Gondar was an important center of politics in the whole Africa. Gondar is about 750 km from the capital Addis Ababa. Another notable building is the church of Debre Birhan Selassie with numerous frescoes inside, including the ceiling entirely painted with angels’ faces. At Gondar – Fasilides Castle, beyond the city boundary, north-west of the Qaha River, there is another building associated with Fasilides, known as the «building of water». The two-floor construction was built up in a pond and was probably used for defense purposes. On the road that goes from Axum to Gondar there are the ruins of the Queen of Sheba’s Palace, a UNESCO listed Heritage Site: it was originally built in the 10th-century B.C. and in the past was one of the residences of the Queen of Sheba of Axum. An altar with two columns is claimed by some researchers to be the place where the Ark of the Covenant was kept before that the first temple was built in Axum. Excavations also revealed to the antiquaries Sirius symbols, the rest of sacrifices and the alignment of sacred buildings to the rising-point of Sirius, the brightest star in the sky. The palace was built with granitic stones coming from the near mountains.

Ethiopia can be considered a country of scientific and, sometime, didactic interest under the pure geo-archaeological aspect: in fact, it also is one of the few places in the world where historical manifestations of culture and religion are imprinted in the rocks (the stele of Axum, the rocky churches of Lalibela and central and eastern Tigray, etc.). The geo-archaeological monuments are relatively well preserved, even if sometime can be difficult to visit them because many of the main roads are in reconstruction. However, tourism is one of the major development sectors currently targeted by the government, and recently several studies [2] have been made, which have greatly contributed to the knowledge of the area as a whole.

The set of values supplied by the local natural scenery of geological and cultural history, and the religious events of Ethiopia, imprinted in the rocks, are primary factors that, for instance, in Europe should constitute the so-called «diffuse museum» on territory, but this is still difficult to be realized. Actually, to carry out this structure, it's necessary to create a «mechanism» applied to the territory, free from a logic based on inflexible bonds, and able to exploit, at the same time, all the values existing in the area (geological deposits, geotopes, biotopes, geo-archaeological, archaeological, and historical evidences, and so on). Besides, it can be achieved through a point of view able to integrate the two most important elements and phenomenology of the problem: *Nature and Culture* [3]. All the values of the territory must be subject to an absolute safeguard, and must be organized with the aim of allowing the collectivity to enjoy them.

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LATE HOLOCENE GEOMORPHOLOGICAL EVOLUTION OF THE RIBEIRA DE BENSAFRIM ESTUARY, LAGOS (PORTUGAL) – GEOARCHAEOLOGICAL APPROACH

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On the right bank of the estuary of the Ribeira de Bensafrim is located the present town of Lagos. This town in the SW area of Portugal was founded by Imperial Romans after they transfer their previous pre-Roman location from the left bank of the river to the opposite shore.

In this presentation we will try to understand the last millennia evolution of the human history in this location as well as the geomorphology of this asymmetric estuary. We will also try to understand why the Romans decided to switch their river bank establishment to continue to live in the same area. We will see that the geomorphological data as well as the geoarchaeological analysis brings us relevant information to the understanding of this subject multi-approach subject.

The main objective of this work lies in understanding of the reason why Romans changed their place from one river bank to the other. For this analysis will be used geoarchaeological methods that may help us understand what archeological science alone does not explain.

Through the sediment analysis gathered from the estuary, we will investigate if there was any estuarine paleoenvironmental changes that may have forced that establishment change. We will cross-examine that data with the archaeological sediments, malacological and mammalogical data of the pre-Roman archaeological site of Monte Molião (left river bank) attempting to find clearer answers. We will also add archaeoseismological data observed on the archaeological site.

This work will be presented with a chronological reading of the geomorphological evolution of the estuary in which we focus on the crucial role of alluvial sediments for the paleoenvironmental evolution of this unique and sheltered Atlantic estuary.

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GEOPHYSICAL PROSPECTING OF EARLY MEDIAEVAL SETTLEMENTS OF EURASIA

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Geoarchaeological investigation of the Semikarakory site on the Lower Don and the Jankent site on the Lower Syr-Darya was carried out in 2011 within the framework of the «Sinking Fortresses» project of the Russian Geographic Society and the «Marsh settlements of the Lower Syr-Darya» project of the Wenner Gren Foundation. Geophysical investigation of the Semikarakory site included both profile and area electric-tomographic survey, kappametry, magnetic prospection and high-accuracy relief measurements. Geophysical inquiries were aimed at the study of occupation deposit involving detection and description of anthropogenous anomalies enabling one to evaluate the structure of the object. The inquiries partially had to do with methodology: they were carried out on the basis of excavated archaeological structures in order to substantiate the hypothesis of the archaeological nature of geophysical anomalies. According to parametric observations carried out near excavation areas, bases of mud-brick walls are characterized by an anomalously low resistance. A hill in the eastern part of the area, presumably the donjon, and the outer circular structures situated outside the ramparts in the north part of the area are probably of artificial origin. Judging from magnetometry, there was another wall besides that of the citadel. A regular structure of the magnetic field on the site is indicative of ancient building over of a large part of the settlement. The analysis of the tacheometric survey has shown that, judging from the water level during spring freshets of the Don river prior to the construction of the Tsimlianskoe water storage, the enclosure of the Semikarakory site played the rôle of an anti-flood dam.

Complex geophysical explorations of the early medieval «marsh settlement» of Jankent in the eastern part of the Aral area in the delta of the Syr-Darya river included profile electrotomographic and area magnetometric observations. The electrotomographic data have shown that the site is situated about two metres above the mean level of the terrain owing to heaped up artificial platforms. The latter may be some 50-70 metres wide. It seems likely that the design of the enclosure of the fortress and the citadel wall followed the same pattern. Calculations show that the volume of the preliminary fill made up no less than 70000 m^3 of the moved earth. Minor streets of the lower settlement can be detected in the structure of the magnetic field as negative anomalies up to 7 nTl in amplitude. Judging from the structure of the magnetic field, the area between two streets was divided into ‘wards’, and each ward seemingly comprised several yards whose geometry is emphasized by local magnetic anomalies characteristic of stoves.

NATURAL CONDITIONS OF HUMANITY APPEARANCE IN KAZAKH STEPPE

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By the archaeological data today we know three hearths of humanity on the planet. One of the foci is known in Kazakhstan, the second – in eastern Africa, and the third – in Indo-China and the territory encompassing the islands of Sumatra and Java. The location of the cradle of humanity is not found in other parts of the world, namely in the three local areas have been presented with objective geological reasons [3].

For the smooth progress of the first people on the thorny path of life required an appropriate enabling environment in the natural environment. All the necessary conditions for this were all seasons’ warm weather and the availability of rivers and other water bodies in the habitats of primitive people. Warm weather conditions favored the development of evergreen vegetation, nutrient berry and fruits and rich wildlife.

Biological factor. It is known that the first signs of life on Earth appeared about 2 billion years ago in the form of simple organic compounds. Over time, simple one-celled moved into more complex and sophisticated forms, adapted to their environment, they were transformed into various kinds of complex organisms. There were apes – Driopithecus and Ramapithecus who ate the fruit trees and began to adapt to the hunt in the early Cenozoic era Neogene period, but the nature created Homo sapiens to the end. The ancient man's skeleton is about 3 million years old, according to the latest scientific data [2].

Geological and geographical conditions. Favorable natural conditions for human existence limited geological and geographical areas of the earth's surface. Natural conditions and processes at the earth's surface were associated with geological processes and energy states in its deep interior. To understand the essence of these relations, we can consider characteristics of individual periods of geological evolution of the planet.

Modern Mediterranean, Black and Caspian seas remained at the site of the former Tethys ocean basin about 5-10 million years ago. The northern part of Africa (present-day Sahara) and the south-western part of Eurasia (present-day Saudi Arabia) were turned into a vast coastal shelf area with a chain of islands. As the recovery of these areas the sea-shore began to retreat from the continent. Waves eroded rocks coast and deposited layers of sand. Mediterranean Sea had a modern look in Quaternary. The Sahara and Saudi Arabia as a result of drought were established in the sandy desert. Continent of Africa in period of closing between Gibraltar and Bosphorus was connected to the Eurasian continent.

In a collision Hindustan continent and Siberia, their edges were crushed and the resulting formed the highest in the world, Tibetan-Himalayan mountain-folded structures. This tectonic seam in the east began with a meridional Pacific seam, stretching sublatitudinally direction through mountain building and the bottom of the Mediterranean Sea, connecting the west with the meridional tectonic seam of Atlantic Ocean. Along this active tectonic seam earthquakes kept on functioning, and the Mediterranean islands volcanic eruptions occurred.

Uplift Tibetan-Himalayan mountain facilities already 3-5 million years ago began to close the path of the warm flow of air from the Indian Ocean. Eastern Steppe climate was cool, but the earth's surface due to coming from the interior of tectonic suture energy maintained its warm state.

Meanwhile, in the Kazakh steppe through unimpeded penetration of warm and moist air flow remained favorable climate. Coming from the bowels of the energy flows, in turn, contributed to the formation of eternal summer. Heat coming from these two trends had led to the establishment of the tropical and savannah climate. Vegetation, deciduous trees, high trees and wildlife's various species were developed.

On tectonic faults, located along the modern Tien Shan mountain ranges and Mangistau Karatau there were formed deep channels of heat flows. Under the influence of powerful tectonic energy along these faults began doming of the crust. Uplift of mountain ranges began with node Khan Tengri. Doming of the uplift and the mountain ranges began to flow a lot of streams.

In the mountainous center, which was connected via Khan Tengri Tien Shan mountain ranges with Pamirs, formed quite high mountain plants. They began to part off the way the warm southern air flow in the area where began a gradual cooling. Mountain River, coming out of the Tibetan mountains and the Pamirs, destroyed and eroded rocks. Ruined sandy material began to fill the Taklamakan desert. Here, because of the drought had strong winds that could move the sand mass and levitated the huge mass of dust. Adverse life conditions were formed in the natural environment.

On the northern slopes of the Tien Shan, especially along its western spurs, within the Kazakh steppe formed favorable to the emergence of human natural conditions. However, favorable conditions in the environment were not regular [1, 3, 4].

Ecological conditions. In the south of the Kazakh steppe favorable environmental conditions for life completely formed prior to Quaternary. On plain territory with uplift ridges formed river system with a permanent watercourse, rose wood and herbaceous vegetation with abundant fruits and nutritious berries, found the climate of eternal summer. In such favorable environmental conditions the first people lived without any worries.

Thus, in Anthropogenic in mountain valleys and the piedmont plains of the Kazakh steppe there were favorable climatic, biological and environmental conditions predetermined the emergence and development rights. The natural environment could not have kept such conditions all the time. The changes of natural conditions in the Kazakh steppe in the last 3 million years will be discussed below.

Settlement of the first people. Favorable conditions for the existence of hominids were fully formed in the Kazakh steppes to the late Neocene period. In the current ranges of Karatau herds of large animals lived in the forests and woods, where year-round were growing fruit trees and berries. Strong siliceous rocks deposited on the surface were required for the manufacture of tools. All these are a favorable factor for the life of ancient people.

Hominids inhabited the territory of the Kazakh steppe about 2.0 million years ago [4] and who had long and difficult path in life, enduring all the trials and overcoming all the difficulties of primitive society, came to our century. Archaeological studies have given the materials covering the long and complicated path of evolution of the first man.

In the Kazakh steppe early Paleolithic era samples were covered, known as Acheulean *and Arystandy* culture.

Arystandy culture. Found in the valley r. Arystandy (Alpysbaev H.A., Kostenko N.N., 1968) near Range of Big Karatau the primitive pebble stone tools are cultural monuments of the earliest people in the Kazakh steppe. Based on the comparison of these crop residues with well-known in the science culture Olduvai hominids in Africa, an archaeologist A. Medoyev [4] proved that they are coeval.

Age of the first people *Arystandy* cultural era, is the first page of ancient history, dated by geological methods more than 2 million years. The second finding, which indicates the existence of autochthonous hominid sites in the Kazakh steppe, was found on the shore of the Sarytas Gulf Caspian Sea in the Mangistau. Judging from the crop residues, referred to the archaeological culture Protolevallua-Acheulian, the lifetime of these hominids are also close to 2 million years [4].

The oldest stone tools were found (Alpysbaev H., 1959) in conglomerates in the valley of r. Arystandy Big Karatau and on the peninsula Mangyshlak, and allowed A. Medoyev [4] put forward the hypothesis that autochthonous way to having an ancient man in Kazakhstan.

In the area of the ridge B. Karatau most ancient instruments of men revealed in the area of the valley r. Arystandy on its left high bank among the preserved from erosion lower Anthropogenic conglomerates. Lower Anthropogenic conglomerates thickness are

9 m and more evident in a number of points as the left bank and right bank of r. Arystandy.

The presence of tools in human lower antropogenic conglomerates confirms that the camp of ancient men was uplifted areas of the range of Karatau. Detrital material that formed the valley r. Arystandy, shifting, transferred simultaneously and implemented human Lower Paleolithic.

In the conglomerates of fourth river's terrace there were founded archaic flakes with traces of weathering and roundness. Obviously, these products came here from older conglomerates. Quaternary Anthropogen conglomerates met near the former collective farm. Budyonny on the shore of r.Arystandy, they discovered deep in the flakes with a primitive treatment (fig. 1).

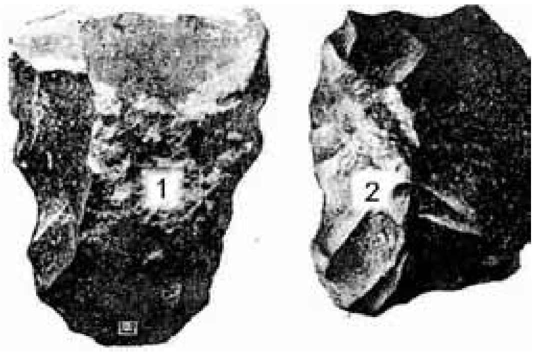

Figure 1. Stone wares were found in the bulk of lower anthropogenic conglomerates near r. Arystandy [1]: 1 – bilateral chopping tools, 2 – a massive archaic flake

About the time of formation lower anthropogenic conglomerates can be judged on the basis of archaeological, palynological and other data. Karatau ancient people lived in the era of the first anthropoids and anthropogenic faunal assemblage.

Spore-pollen analysis of samples of conglomerate strata in the river valleys of the Big Karatau indicated the existence of steppe conditions during deposition of these layers. Dominated by sagebrush (41,8 %), herbs (up to 22,5 %). In addition, there were pollen tree species: pine, alder, birch and willow. In various parts of conglomerate strata there were found 1,30 % of the pollen of trees and about 99 % of non-timber species. These data indicate the existence of steppe vegetation xerophytes habit. Flora recalled open savannah vegetation spaces.

Numerous monuments of culture Acheulian age (Akkol, Borykazgan, Tanirkazgan, Kemer, Kakish, Kazangap, etc.) have been found in the northern part of the ridge of Small Karatau. Proceedings of the locations represent a typical boulder industry [1].

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DEVELOPMENT OF KAMIENNA RIVER FLOOD PLAIN NEAR MARCINKÓW

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Studied part valley of Kamienna is located to the south-east of Skarżysko – Kamienna near Marcinków, in the świętokrzyski region, Poland.

Kamienna river is the main watercourse in the area and is left-bank tributary of the Vistula. The total length of the river is 138 km and the catchment area is 2007 km^2.

Older ground of valley Kamienna is derived from Trias sandstones with fragment clay, marl and iron store. Sandstones, claystones and mudstones represent Jura. The oldest Quaternary deposits in this area come from the Central Poland glaciation and it is a complex of sands and gravels. The valley in this part is filled with Quaternary deposits 20-30 m thick [1].

The longitudinal tectonic faults have a large effect on the channel stone [2]. There are two levels of terraces in the valley of Kamienna come into being in the Pleistocene. The valley bottom is a flood plain. Flood plain creates a morphological level resulted from lateral migration of the trough.

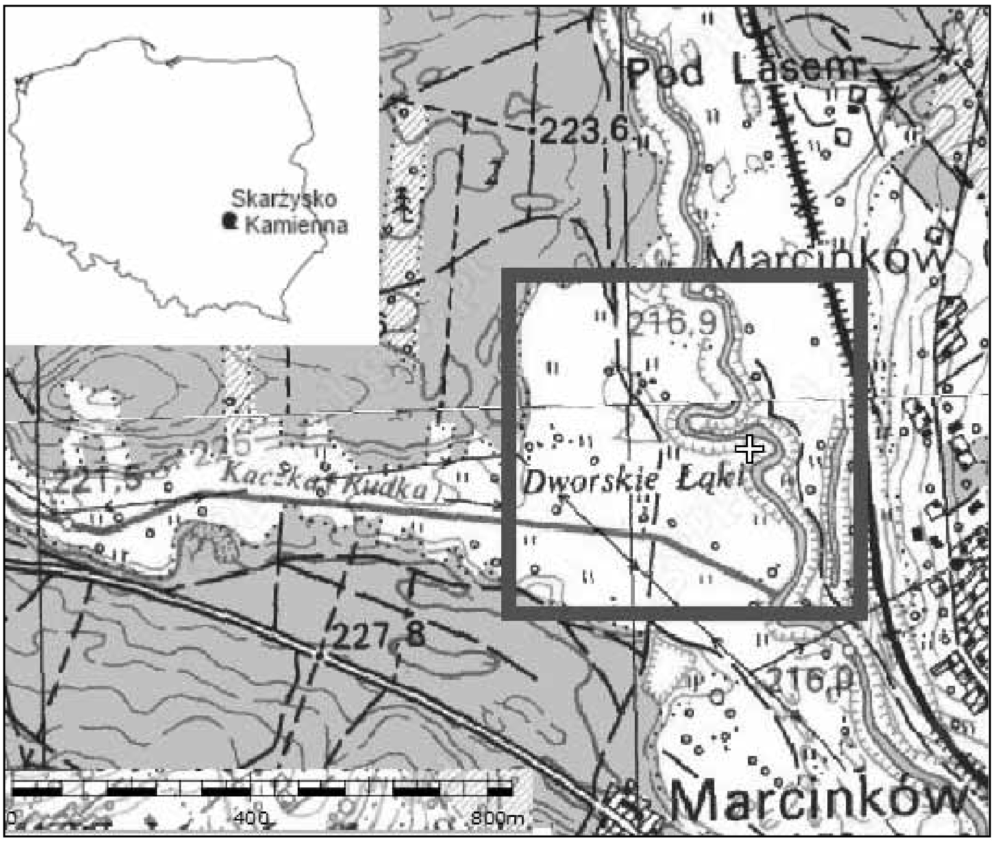

Figure 1. Location of the study area

Flood plain has a complicated structure because it builds various alluvia. Lateral migration of channel is the reason knockdown of trees which document the black oaks in the profiles. Floodplain has a diverse morphology to which the human was affected.

Archaeological studies show that in this fragment of late Paleolithic human changing the image of the valley. The biggest changes were in the Neolithic. The destruction of forests and development of the economy affected the size of floods and deposition of material on the flood plain. These changes are visible in the alluvia and in the form of hydro buildings.

On the floodplain, there are three mills, two of which are active and serve as a small hydro-electric power station. The activities of the mills disrupted balance between processes on the river bottom.

Research in this area indicate that an important influence on the morphology and the geological structure of the flood plain was human as seen in the profiles. Made profiles will be the basis for further research on this fragment of the valley.

Figure 2. Section of the flood plain of the Kamienna river

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UPPER PALAEOLITHIC ADAPTATION TO SURROUNDING LANDSCAPES IN DIVNOGOR'YE (MIDDLE DON, CENTRAL RUSSIA)

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The main problem for the reconstruction of Palaeolithic strategies of adaptation is the single sites separated one from other by long distances. Principal meaning for this purpose has accumulation of settlements, especially with sites of different functions (base camps, kill-sites, workshops for flint knapping, etc.). The best example of this accumulation of Palaeolithic sites is the Kostenki-Borshchevo group. New group of Late Upper Palaeolithic sites near Divnogor'ye in Middle Don, Voronezh region, was discovered and excavated during last decade. Remains of sites of distinct functional meaning allow us to reconstruct the human adaptation strategy to local environmental.

Divnogor'ye village is located on the right bank of the Tikhaya Sosna River, approximately 3 km from its confluence with the Don River. In the vicinity of the archaeological site the floodplain of the Tikhaya Sosna is 8 km wide. The right bank of the floodplain has two distinct topographic levels – central and high floodplain. High floodplain passes into the first terrace [1], which lies up to 12 m above the present-day elevation of the river channel. Cultural remains at the site Divnogor'ye 1 lie in loess-like deposits of this terrace (fig. 1). Rights slope of the Tikhaya Sosna valley and the Don River is 100 m high, while the slope angle exceeds 60 degrees. The slope is cut by gullies and ravines. Bone bed at the site Divnogor'ye 9 is connected with the filling of one of these ravines (fig. 1).

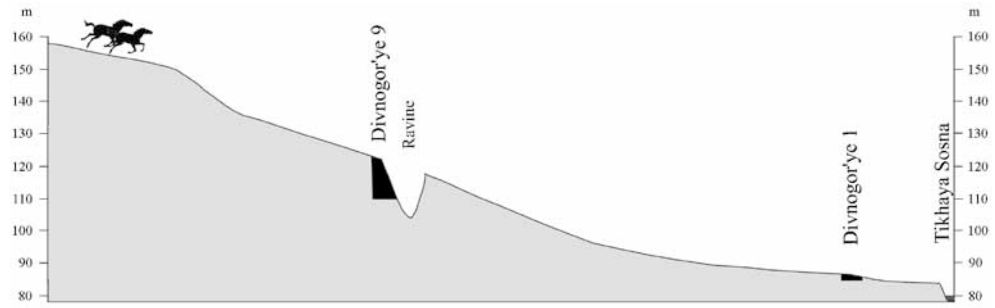

Figure 1. Topographic cross-section of the Tikhaya Sosna Valley in the area of the location of the Divnogor'ye Palaeolitic sites

There are two Palaeolithic sites and several localities of chipped stone concentrations near the Divnogor'ye village [2]. Divnogor'ye 1 is a shot-term occupation area, possibly a seasonal camp site. The site contains a thin cultural layer, with a dense concentration of lithic material (1500 items from a 53 m² excavation). The assemblage provides features of the Eastern Epigravettian techno-complex and contains truncated burins and points, end-scrapers and backed bladelets. Bones of various animals were also recovered at the site. Remains of wild horses (*Equus ferus)* are dominated in the faunal assemblage, while a small number of reindeer bones (*Rangifer tarandus)* were also recovered [3]. As a rule, mammal remains lie in chaotic position, but sometimes groups of bones in anatomical order are found. Elements of the axial skeleton are very rare. Two horse bones were submitted for radiocarbon dating. The resulting dates are 12 050 ± 170 (Le-8649) and 13 380 ± 220 (Le-8648). The second date seems to be more representative for the actual age of the settlement.

The bone bed at the site Divnogor'ye 9 (2.5 km to northeast from Divnogor'ye 1) is located in the middle part of an old ravine (fig. 2). The site contains six or seven levels separated by sterile layers of calcareous siltstones and contain horse bones. Radiocarbon dates acquired on a number of horse bones from the various cultural levels indicate that the human occupation of the site occurred between13 150 ± 200 (Le-8136; Level 1) and 14 430 ± 160 (AA-90655; Level 6). The relatively small age difference between the oldest and the youngest date suggests that the bones accumulated during a relatively short time span. An important geo-chronological marker is a paleosoil layer which caps the bones levels. This is the Alleröd soil, as confirmed by palynological data [4] and radiocarbon dates and formed during a warmer climatic episode during the Alleröd period.

The levels contain dense concentrations of horse bones in anatomical order. In some cases the bone beds yielded almost complete skeletons of individual horses. According to N.D. Burova (IHMC RAS), the minimum number of individual horses represented by the combined faunal material from all cultural levels is 59. The recovered material also contains a small assemblage of faunal remains of the polar fox (*Alopex lagopus)* and the wolverine (*Gulo gulo)*. More than 60 chipped stone artifacts from the various cultural levels were also recovered at the site. Single flint implements were found in each level, the highest concentrations occurred in levels 4, 5 and 6. Typologically the artifacts are similar to those recovered from the Divnogor'ye 1 site, although flakes from the Divnogor'ye 9 site were substantially more commonly retouched than at the Divnogor'ye 1 site (38 % and 10 % respectively). The chipped stone assemblage includes truncated burins and blades, retouched flakes and baked bladelets. Several horse ribs contained thin parallel cut-marks indicating that stone tools were used during the butchering process in level 6 at the site.

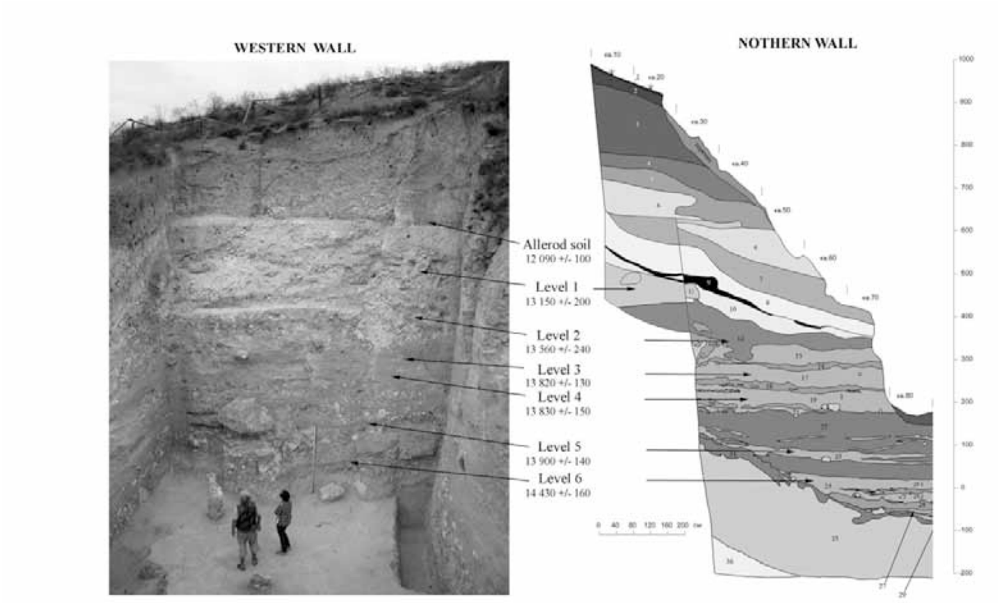

Figure 2. The stratigraphic profile and associated cultural levels at the Divnogor'ye 9 site (2011)

Both sites appear to be contemporaneous as indicated by the radiocarbon dates and were occupied by people who relayed on similar tool kits and foraging patterns. Both contain similar faunal assemblages (dominated by horse remains), raw-materials (high-quality chalk flint), knapping technology, and tool design. It seems to be very probable that sites represent different kinds of activities of the same group of people because of the close spatial, temporal and cultural association. With a high degree of confidence we could assume the synchronous existence of sites with functional difference [4].

In contrast to mammoth and bison bone beds, Paleolithic settlements near locations where horses died from non-human related causes are almost unknown. Using of animals meat from cemeteries is possible only in winter when bone bed becomes a kind of «refrigerator». While horse meat can be potentially scavenged from horse cemeteries, this can only be effectively done during the winter season. However, since the Divnogor'ye 9 site contains the remains of horses which died mostly during the spring and summer months [3], the scavenging hypothesis appears to be unsupported by the evidence. On the other hand, since horses tend to gain fat, and gather in large herds during the spring and summer month, it is this time of the year when hunting of these animals can result in substantial returns. This time of year is supposed to be the best for hunting on horses, when the mammals reach the highest fatness and gather in large herds. In Divnogor'ye 9 N.D. Burova state the absence of distal parts of horse limbs that could be carried away with the limbs to the habitation area. Faunal assemblage and characteristics of the cultural layer of Divnogor'ye 1 does not contradict this interpretation.

Geomorphological position of Divnogor'ye sites are of great importance. Divnogor'ye 1 is situated on a low terrace of 5-6 m above the modern river level. The location was probably selected for occupation because its position nears a water source and protection from the wind. Divnogor'ye 9, in contrast, is located in an exposed position in the middle of the ravine, cutting through the slope of the watershed, at an altitude of 35-40 meters. This location offers a good horse hunting ground. Natural cliffs and ravines were commonly used by humans in Europe and North America to trap and kill animals. The Divnogor'ye 9 site appears to be a hunting locality which utilized the natural topography of the area for ambushing and killing of horses.

Thus, there are more reasons to consider Divnogor'ye 9 as a systematically horse hunting site (kill-site) mainly in spring/summer periods. Divnogor'ye 1 may have been a short-term campsite which facilitated the nearby seasonal hunts, where, parts of horse body were transported for butchering and cooking from the Divnogor'ye 9 bone bed. Despite of some questions such as mechanism of the hunt, several bones levels indicate quite successful hunting strategy and its long-term use during 13–14 thousand years ago.

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ASSESSMENT OF GEOMORPHOLOGICAL SITES FOR RECREATIONAL PURPOSES

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The solution of scientific and applied problems of recreational activities, such as tourist product selection,optimal route search, creation of a new tourism cluster or expantion of natural recreation resources requires precise assessment of the territory.

Relief often determines technological peculiarities of land use (means of transport, location and territory zoning, safety for recreational system and people involved in recreational activity).

Attractiveness of relief, diversity and rareness were always the basic features of overall recreational attractiveness of a territory. Regions with high geomorphic diversity served as model for first recreation and tourism researches [2]. Unique relief forms are commonly referred to natural sites. They differ from the others in structure or have morphological and morphometric characteristics not found in other forms of the earth's surface. Such monuments form the main natural functional kernel for a recreation system which is created and exists around them.

Natural sites are particularly vulnerable to dangerous occurrence of endogenous and exogenous processes as guarantee of environmental stability is an essential condition for a proper system functioning. This requires a comprehensive study of relief dynamics, monitoring and forecasting its evolution in protected areas.

Currently, there are methods of assessing the recreational potential of the territory, including its location, climatic conditions, attractiveness and other factors which are valuable for recreational purposes [3, 4]. It is generally used to determine the cadastral value of land.

There are two general domains of relief and recreation mutual influence: recreational and geomorphic (RG) risk (treat) and RG attractiveness.

Estimation of attractiveness and danger value must be carried out by means of composite indexes which include particular rates of relief features (rareness, diversity, aesthetical attractiveness etc.) [1]. The value of relief capacity for having positive influence on a person (physical, psychological etc.) can be placed in it. This quantity which indicates a complex functional suitability of an area for recreational purposes should be called «recreational and geomorphic potential» (RGP).

Comparison of danger and attractiveness values for different feasible types of activities gives an average danger and attractiveness values for a certain area. Selecting the average value in the evaluation component of recreational and geomorphologic potential allows to unify the scale of assessments for various recreational systems and for different types of tourism activities within the system.

The impact of the various relief characteristics is determined by the objectives of holidaymakers. For example, in organization of recreational sports morphometric parameters are the most significant (absolute height, steepness, dismemberment). However, various types of recreation require different values of these parameters. For the attractiveness and risk assessment it is important to give a numerical score in each of the claimed relief properties taking into account the selected recreational activities. Therefore we assign several criteria and evaluate each of them on a scale of 1 to 4 points. Numerical approach allows to conduct the assessment procedure impartially and to establish the ranking based on final scores.

For all types of recreational use, the criteria are similar: for instance, quality of exposure, diversity or accessibility. In order to evaluate the potential more precisely, for the final assessment, these criteria have been given different weights (table 1, 2).

In the context of recreational and geomorphic research risk is a measure of the probability and severity of an adverse effect to life, health, property, or the environment. This effect could be caused by recreational use of a territory or natural geomorphological processes. It is particularly important to evaluate the risk of degradation for the management of recreational system.

Table 1.
Criteria used to evaluate potential recreational uses of a geomorphosite and corresponding weights (modified from Lima et al., 2010).

Criteria	Criteria weight for different functional types of recreational use		
	Educational	Sport	Medical
Representativeness	5	5	5
Quality of the exposure	10	5	5
Diversity at the state level	5	5	5
Educational potential	30	0	0
Logistics	15	10	15
Inhabitants around 25 km	10	0	5
Accessibility	10	10	10
Vulnerability caused by human activities	5	15	5
Association with other values	5	5	10
Monumentality	5	0	0
Recreational potential	0	0	0
Social setting	0	5	10
Proximity to recreational facilities	0	10	10
Morphological prerequisites	0	30	20
Total	100	100	100

Taking into account the obtained averages of RGP components the whole potential for organizing a particular type of recreational activity can be attributed to one of four types:

1 – Insufficient – characterized by high danger and low attractiveness
2 – Medium – characterized by low danger and low attractiveness
3 – Optimum – characterized by low danger and high attractiveness
4 – Extreme – characterized by high danger and high attractiveness.

Thereby a concrete system (or a geomorphosite) acquires some kind of «coordinates» in relation field of recreational and geomorphic potential of area.

Table 2.
Criteria used to evaluate the risk of degradation of a geomorphosite and corresponding weights (modified from Lima et al., 2010).

Criteria	Weight
Vulnerability caused by natural or human factors	35
Proximity to potential damaging areas	20
Present protection status	20
Accessibility	15
Inhabitants within 25 km	10
Total	100

After estimating recreational and geomorphic potential of a certain area we can analyse its structure, i.e. the set of presented or potentially possible recreational activities. Visually this classification could be represented as a pie chart (fig. 1).

The diagram consists of two parts: the inner circle, divided into 4 parts and the outer cells. The inner part of the diagram reflects different functional groups of recreational activities. Then, for each group there is a set of specific recreational activities, realized or potential within the touristic system. The latter are represented in the form of cells. Depending on the value of RGP for each of them, the cell can be painted in different shades of grey.

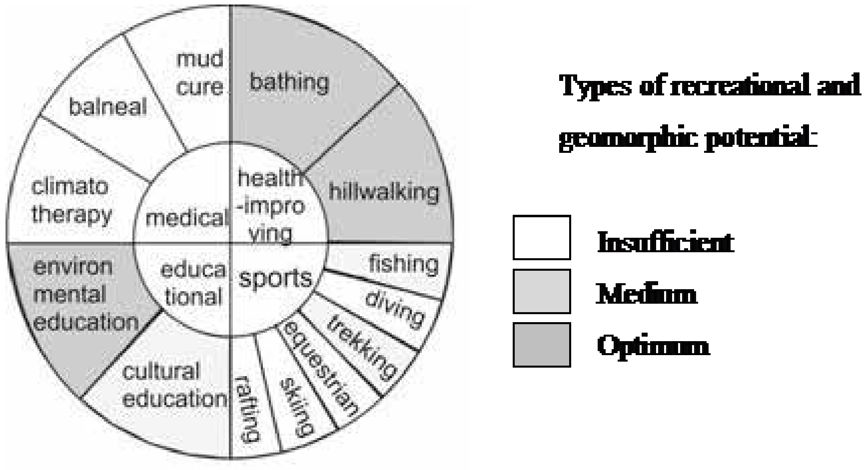

Figure 1. Scheme of recreational and geomorphic potential structure

Such assessment allow us to compare specializations and recreational and geomorphic potential of different territories. Thereby it is possible to optimize decisions on the proper tourist product choice, or on organization of recreational activity. The last confirms the necessity to assess the RGP for different parties of recreational system – the organizers and tourists. Estimation of recreation attractiveness and geomorphic risks is particularly important for prospective recreational regions. The decision-making concerning to creation a new tourist cluster depends basically on resource assessment. Various functional types of activity within a recreational and geomorphic system could have different potential. Taking into account the structure of recreational and geomorphic space is the information basis for effective functioning of existing systems and for creation new ones.

The approach to assessment of recreational and geomorphic potential introduced in this paper allows elaborating concrete recommendations in organizing recreational activities (for well-known touristic areas and also for areas of new recreational development).

Next phase in the development of prospective recreational system is to compare the results of recreation and geomorphological assessment with the economic potential of the area and use value.

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LATE QUATERNARY SPATIOTEMPORAL ANALYSIS OF PALAEOENVIRONMENT IN WESTERN EURASIA

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Over the past decades palaeoenvironmental events have increasingly been put forth by archaeologists as representing at least one major cause of changes in cultures over time in the East European Steppe over the last 8000 years. Methods used to acquire proxy data for palaeoenvironmental reconstruction vary and those selected by archaeologists often focus on one site or several sites within a single micro-region. However, interpretations of selective data of this nature are often framed much more broadly, with local findings used to explain global changes. The project reviews primary and secondary literature, and particularly reports of palynological, sedimentological, pedological and archaeological site findings, to assemble an inventory of all proxies used for the area stretching westward from the Urals and the Caspian Sea to the river Vistula and the Carpathian Mountains. Proxy data from more than 1 sites located in a wide range of landscapes have been collected. The initial analysis reveals several shifts in the palaeoclimate and palaeoenvironment during the Holocene that may have affected the way of life of the prehistoric population. Two of these major shifts will be discussed as a starting point for a critical review of Holocene palaeoenvironmental research in Western Eurasia.

HISTORY OF THE LATE HOLOCENE ALLUVIAL SEDIMENTATION, PEDOGENESIS AND COLONISATION OF RIVER FLOODPLAINS IN THE UPPER DNIEPER BASIN

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Pedosedimentary history of the late Holocene floodplain pedolithocomplexes in the upper Dnieper River basin is under consideration. Three floodplain key sites have been studied: (1) the Dnieper River, $54^{0}46'$ N, $31^{0}52'$ E; (2) the Vop' River, $55^{0}12'$ N, $32^{0}51'$ E; (3) The Khmost' River, $54^{0}53'$ N, $32^{0}28'$ E. Every of the key sites have archaeological evidences of early medieval (Viking Age) colonisation of floodplains. Several of key sections included buried habitation deposits transformed and buried remnants of original natural soils (fig. 1), other sections contain buried soils correlative to habitation deposits without signs of anthropogenic impact. Detailed soil morphological studies were conducted in key sections. Ones particularly included micromorphological diagnostic of pedogenic processes: soil structure formation, illuvial processes different in terms of illuviated material composition, and redoximorphic processes. Special attention was paid to time-and-space relations of pedogenic features and their correspondence to sedimentation stages. Pedological studies were combined with litho-facial analysis of key-sections supported by multi-fractional laser granulometry and general litho-geomorphological research of the key-sites (high-precision topographic surveying, litho-facial studies and ^{14}C dating of sediments in cores and transects). Dating of pedo-sedimentary events in pedolithocomplexes is based on archaeological and radiocarbon data, and litho-stratigraphic correlations with other dated sections at the key-sites. Following stages are defined in development of floodplain soil-sedimentary sequences within the last 2500-3000 years (fig. 2):

<u>Stage I</u> 2500 (3000) BP – 800 BP. Hiatus in floodplain sedimentation, progressive channel alluvium accumulation, gradual rising of groundwater. Zonal pedogenesis mostly in well drained, irregularly seasonally flooded or nonflooded conditions. Formation of Albeuvisols with numerous and morphologically variable textural pedofeatures. Albeluvisols of the same age were described earlier in floodplains of Moscow river, Oka river, Volga river, Tuskar' river [1, 2]. This time corresponds to a small climatic optimum of Holocene being well known both in natural and historical records all over the Europe as a dry, low-water epoch. Active colonization of floodplain occurred at the final stage of this epoch. Residential, handicraft and household zones of early medieval settlements extended to floodplain areas and left their habitation deposits there. Albeluvisols within the occupation zones of floodplains were transformed dependently on the local intensity of human impact into Technic Urbic Albeluvisols or Urbic Technosols.

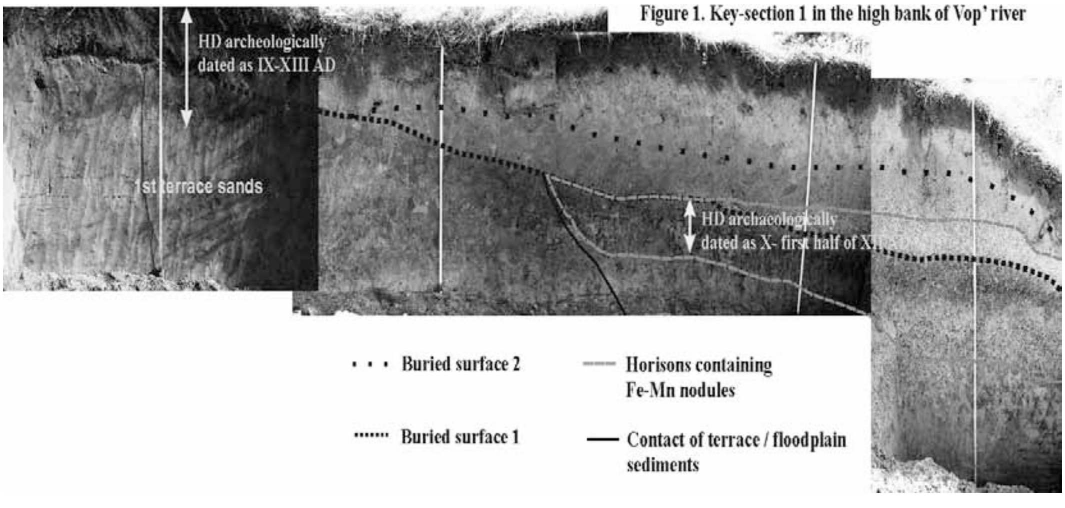

Figure 1. Key-section 1 in the high bank of Vop' river

<u>Stages II and III</u> are hardly dated separately. II+III 800 BP – 300-200 BP. Stage II corresponds to a high level of ground waters in floodplains, resumption of floodplain sedimentation, sinlithogenic alluvial pedogenesis, and formation of Fluvisols.

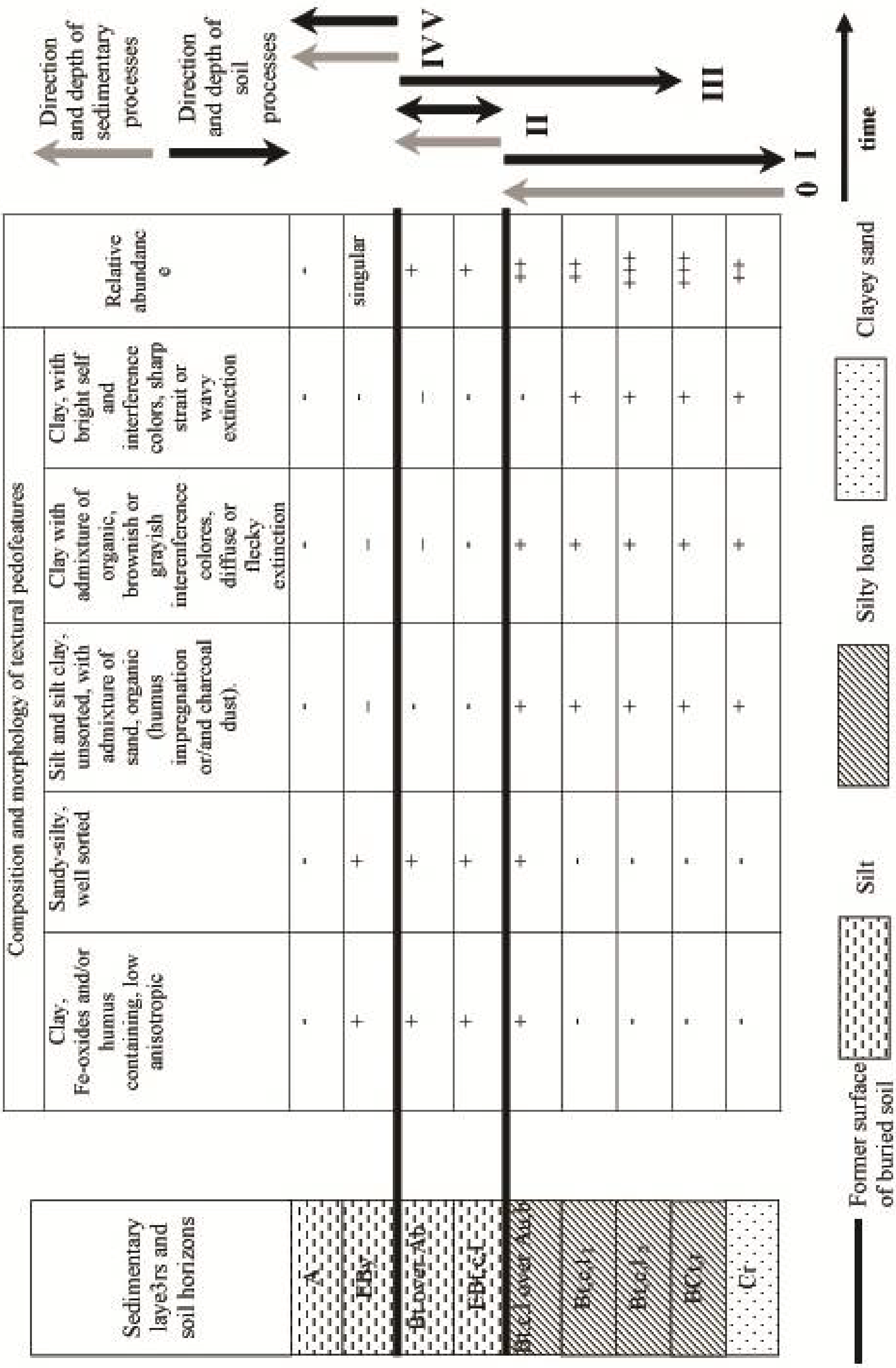

Figure 2. Floodplain soil-sedimentary sequences of the upper Dnieper river: stratigraphy, soil morphology, stages of development

Accumulation Renewed sedimentation resulted in a progressive rise of the floodplain surface and general improvement of the drainage. Stage III is a short (not more than 200 years) phase of ceased floodplain sedimentation and zonal pedogenesis characterized by weak manifestations of lessivage in conditions of seasonally impeded drainage.

Stage IV 300-200 BP – 100 BP is a phase of intensive floodplain alluvium accumulation, fast channel migration and incision, descent of ground waters at low-water season.

Stage V not more than the last hundred years. Floodplain sedimentation weakening, development of relatively well drained Fluvisols, or sedimentation break and development of weakly manifested zonal pedogenic processes in small floodplains with lower intensity of morpholithogeniprocesses.

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GEOARCHAEOLOGICAL STUDIES OF HUMIC SOIL HORIZONS AND ANTHROPOGENIC INFILLINGS ON THE MULTICULTURAL ARCHAEOLOGICAL EXCAVATIONS IN THE WISŁOK AND STRVJAŽ VALLEYS, CARPATHIAN FORELAND

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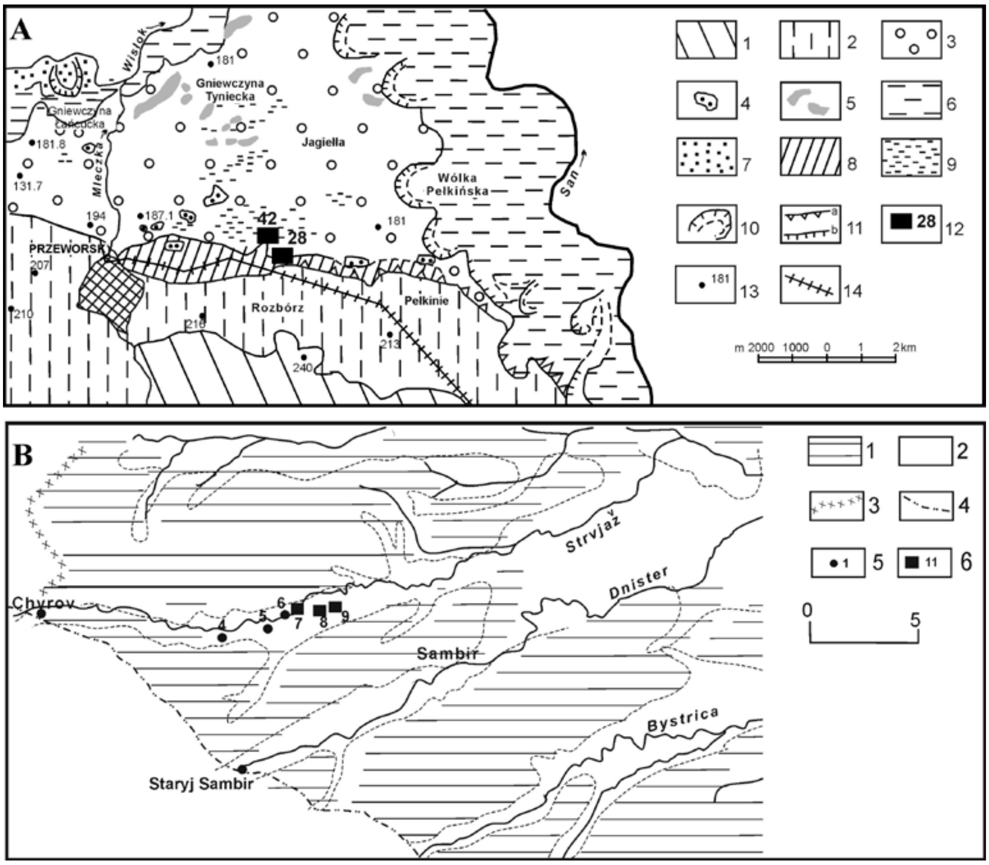
The research area are connected with the geoarchaeological investigation in the eastern part of Poland – site of Rozbórz and western Ukraine – Czaple, Jazy and Zasadki sites, in the Carpathian Foreland.

Rozbórz site is located about 5 km east of Przeworsk in the slope of the Kańczuga Uplands (Rzeszów Foreland). The loess slopes of the uplands descending to the floor of the Fore-Carpathian Trough, dissected in the Holocene by the meandering Wisłok river [1, 2]. The Ukrainian sites are located within the valley floor of the Strvjaž river, 1-2 km wide, dissected by the meandering river having its source in the lower part of the Bieszczady Mts in the Polish Eastern Carpathians.

The field work were carried out under two different projects, the first in Rozbórz as a rescue research preceding the construction of the A4 motorway and conducted by the Fundation For Archaeological Center in Rzeszów in the years 2005-2011 [3], and the second as grants of Polish Ministry of Science.

In Rozbórz, during the fieldwork four profiles were studied in laminated slope (delluvial) sediments and buried humic soil horizon in the north and east part of the site (Budek et al. in print). Delluvial deposits and humic soil horizon buried the burrows with artefacts dated at the Neolithic Funnel Beaker culture. In the southwest part of excavation the archaeological burrows dated at 6000 ^{14}C years BP occur on the sandy alluvial plain. In the western part of archaeological excavation the extensive and flat depression on the floodplain filled with organic silts dated at 4300-4100 years BP occur. In alluvial deposits developed Fluvisol and then, rising of ground water and/or flooding of the valley bottom caused formation of hydromorphic soils and finally developed Cambisol. The beginning of swamping the depressions in this area started in Subboreal wetter phase 4300-4000 years BP which is concurrence with flood phase 4400-4100 years BP, earlier distinguished in the upper Vistula river valley [4]. In the Early Medieval (about 1100 years BP) due to intensive cultivation and soil erosion the swampy soil were buried by delluvial sediments.



Location of the sites A. The Rozbórz sites in Poland. 1. Loess cover of Kańczucka Upland, 2. Loess plain terases, 3. Vistulian terases (8-12 m u.r.l.), 4. Outlier (residual hill), 5. Dunes, 6. Holocene terases (6-8 m u.r.l), 7. Floodplain (4-5 m u.r.l), 8. Base of slope with deluviat deposits, 9. Wet depresion, 10. Oxbow, 11. Erosional edge (a – > 5 m, b – < 5 m), 12. Archaeological sites, 13. Altitude point, 14. Railway. B. The Ukrainian sites in the Strvyaž river valley. 1. Uplands with Pleistocene terraces, 2. Holocene floodplains, 3. Main European watershed, 4. Carpathians Mts., 5. Describing sites: Čapli and Jazy profiles, 6. Another sites

In the plain and terraces of Strvjaž river were located three sites in Jazy, Čapli and Zarieče. The valley floor of the lower section of the river is formed of Holocene sediments underlain by Late Glacial sediments of the total thickness ranging 5–8 m. Radiocarbon datings, supplemented by dendrochrological data and palynological analyses enabled to distinguish several units and paleochannels of the Late Glacial, Atlantic Phase (clay series) and the next group of paleochannels dated at 3500–3000 cal ^{14}C BP, 2300–2500 BP as well as two- or/and three-partite series of the first millenium AD. In the sediments of the overbank facies numerous gley horizons and poorly developed paleosols have been recorded (Starkel et al. 2009).

On the west from the village of Čapli, in the left bank of the Strvyaž river a profile of 5 high meter terraces occur [5]. In the bottom, of the profile in gravel horizon were buried tree trunks. The radiocarbon datings of the trunks were 7730 ± 70 years BP and 6405 ± 100 years BP. Above of the gravel unit, on the depth of 3 m, the organic deposits of paleochannel occurs. The plant remains of the paleochannel organic clay were dated on to 3000 ± 110 years BP. The organic clays were covered by flood plain deposits. On the surface of terraces were founding the ceramics from the late Roman period [6]. Therefore, the flood plain of the Strvyaž River, was already inhabited and not flooded. In terraces were developed fluvial soils with traces of lessivage [7, 8]. The profiles below of the Čapli profile, mainly the sandy clay deposits with gley horizons were detailed studied. In Jazy profiles in overbank deposits tree dark horizons with organic remains occur. Two fragments of the tree trunks, situated on the bottom of Jazy profile were dated to na 11340 ± 140 lat BP oraz 9820 ± 350 lat BP. Therefore it possible that the profile of Jazy represented deposits developed during the Holocene.

The observations in the lower section of the Strvyaž river valley, although based on fewer sites than in the upper Vistula river valley, the Wisłoka river valley and Wisłok river valley [9, 4, 10, 11], indicate synchronicity of the phases of frequent floods, river avulsions and accelerated deposition in the valleys of the upper Vistula river and the upper Dnister river. The dated sites evidence the occurrence of separated cuts and fills and systems of paleochannels within the main level of the alluvial plain of the Strvyaž river valley. The terrace both of the Strvyaž and Wisłok valleys, was eroded in various segments in different times, so it is diachronic.

The distinct contrast is discernible between the granulometric composition of the overbank alluvia and the deposition rate of the alluvia accumulated during the phases which were controlled by climatic changes and those accumulated during the periods of human activity [4, 12]. This contrast of the sedimentation probably is reflected also in the formation of gley horizons as well as in fossilization of peat horizons and paleosols [7, 11].

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GEOARCHAEOLOGICAL INVESTIGATION OF ENVIRONMENTAL EVOLUTION AND SETTLEMENT CHANGES FROM NEOLITHIC PERIOD IN KUYAVIA LAKELAND (CENTRAL POLAND)

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The geoarcheological studies of the evolution and changes of the settlement since the Neolithic Age were conducted located in the eastern part of Kuyavia Lakeland on the border of the Plock Basin (Central Poland) (Kondracki, 2002).

The study area is located in the Smólsk village, near Wloclawek, in the east of the village buildings and west of the district Wloclawek town. The geological background of the site is morainic plateau, build with glacial tills of the Vistula glaciations [1, 2, 3, 4].

I the surface of the plateau near Smolsk a few glacial depressions and subglacial trough field with organic deposits occurs. Near the sites of Smolsk the morainic plateau rise up to 84-85 m above sea level. The archaeological sites (82 m a.s.l) is located on the small culmination of plateau closed to edge of Plocka Basin. A distinct morphological edge disjoint the morainic plateau and pradolina teraces. The relative height of the edge, at the area of the site reaches about 10 m.

During field work were collected samples to radiocarbon dating, paleobotanical, micromorphological and pedological studies.

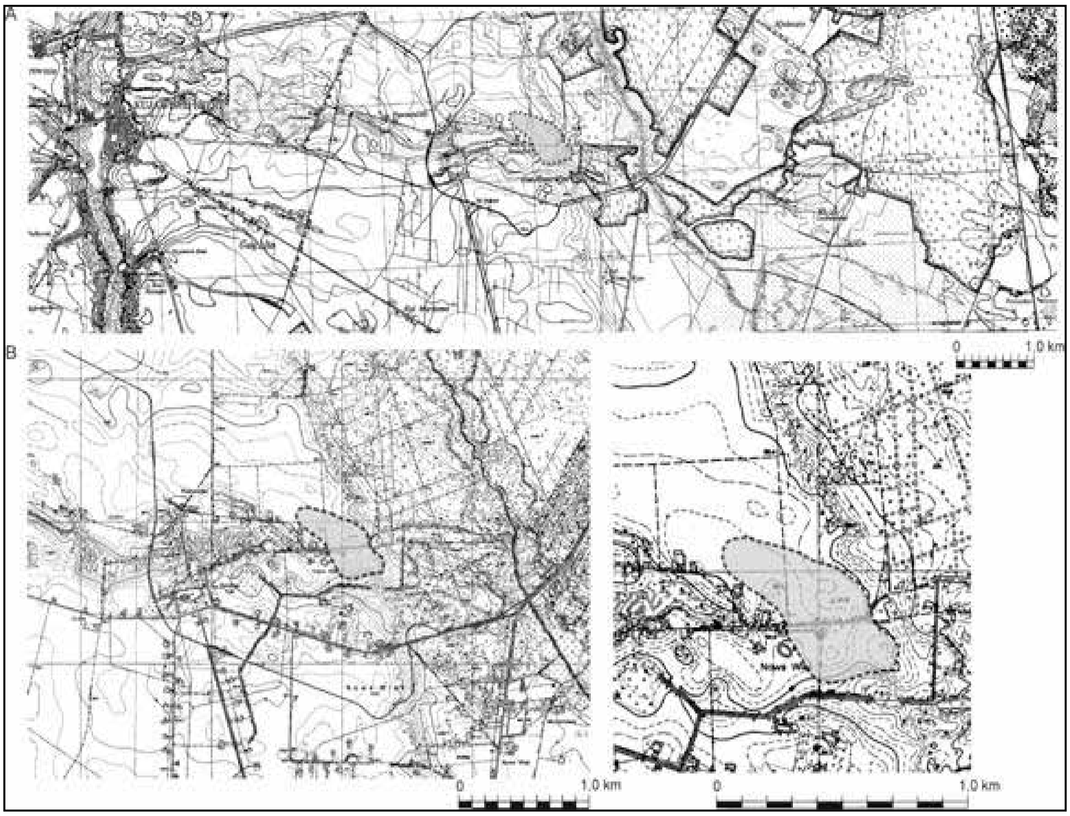

Figure. The archaeological site

Geomorphological investigation confirm of existence of numerous undrenage hollows, actually invisible in present-day relief of the plateau surface. At least, still in the early Neolithic that hollows were occupied by settlement of the linear culture. The surface of the hollows reached from 200 m^2 to 4 000 m^2, and the depth of the deepest of them reaching up to 180-200 cm. The hollows were field by morainic trill and in the upper part of them was humic horizon abort 25 cm thickness. According to microscopic observation in humic horizon were very well preserved traces of pedogenesis, but lack of the movement of coarse fraction (mainly quartz grains). Due to the recording processes of soil formation, characteristic pedofeatures there developed semihydrogenic soil Faeozems (by FAO / UNESCO). In soil horizon were found Linear Pottery culture artefacts. This proved that the soil was developed, at least, still in the early Neolithic. The soil was covered by fine sand and loamy sand with organic matter. In this deposits were developed lessivage processes. A shrinking cracks (up to 4-5 cm wide) were field by clay and loamy clay. The accumulation of that sediments set after deforestation of the area. Changing of environmental conditions led to periodic desiccation of the soil and the development of drying pedofeatures. On the southern slope of the plateau occupied by the archaeological site the thic deluvial cover occur. The thickness of the slope deposits with ploughing horizon is about 2.5 m. there are higher content of organic matter, mainly plant residue, bones fragments and shells.

The organic material from soil horizon was dated to 10130 ± 90 BP(LOD 1481), then this horizon was covered by delluvia about 5,0-4,0 ka BC. In this layer were found single Neolithic artefacts.

During the archaeological investigation discovered 11 chronological and cultural layers as: Paleolithic or early Mesolithic flint materials, early Neolithic settlement – Linear Pottery culture (early stage), relics of the settlements of Brest-Kujawy groups of Lengyel culture, early Funnelbeaker culture (Trichter becherkultur in north-central Europe), traces of settlement of Corded Ware culture, a few artefacts of Lusatian culture and traces of penetration of the area in medieval times and modern times.

The studies was carried out during rescue work in connection with the construction of the A1 motorway. Research conducted at the request of the General Directorate for National Roads and Motorways, the Foundation for Archaeological Research prof. Konrad Jażdżewski of Lodz.

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THE POTENTIAL IMPACT OF MERAPI VOLCANO LAHAR FOR PRAMBANAN HINDU TEMPLE AT YOGYAKARTA, INDONESIA

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Merapi Volcano was located 30 km north of Yogyakarta, Central Java. Being Indonesia's most active volcano, it erupts every four years on the average. Merapi

Volcano erupted on October 26, 2010, following weeks of increased seismic activity. Major and minor eruptions occurred in the following weeks. This was the volcano's largest eruption since 1872. The 2010 eruption had its main impacts towards south, whereas previous recent eruptions mostly affected areas to the west and southwest. Potentially, however, pyroclastic flows and lahar flows can occur all around the volcano. Prambanan temple is located about 25 kilometer southeast part of Merapi Volcano along of Opak River. This research was conducted by mapping of lahar flows from Merapi Volcano to Opak River in order to know how big the threat of lahars to Prambanan Temple. The observation found out that lahar sediments in consist of sand, gravels and rocks are situated in about 6 km away from the temple. Material sedimentation in the sabo dam in Ngaglik sub-district which is 2 km from Prambanan consists of sand material. The heavy rainy was predicted to be able sending the lahars to the temple location. The simulation of the threats of lahars against Prambanan Temple is urgently needed, however some data including the topography of the river, volume and speed of lahars and rain volume was required to quantify the risk.

GEOARCHAEOLOGY OF THE EARLIEST PALEOLITHIC SITES (OLDOWAN) IN THE NORTH CAUCASUS AND THE EAST EUROPE

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Early Paleolithic cultural layers with tools of oldovan type was discovered in N. Caucasus (Dagestan) by Kh. Amirkhanov (2006) [1] and Dniester valley by N. Anisjutkin (2010). During last years these Paleolithic sites was studied by complex methods leading by A.L. Chepalyga, including geology, geomorphology, paleontology, palinology, sedimentology, mineralogy, paleomagnetism etc. [2].

In Dagestan Akusha region group of Early Paleolithic sites settled in upstream of Sulak (Akusha-Usisha rivers) was studied. Numerous cultural layers with tools and bones included into layered clastic sediments.

Akusha formation. Geological background of Akusha geological formation (by the name of Akusha river).

Spatial distribution of tools-containing sediments studied along interfluvial ridge Akusha-Usisha river, where it followed on 4 km long (fig. 1a, 1b). Total area of Akusha formation is 0,78 km^2 (78 ha). Cover sediments are absent and younger Pleistocene sediments are represented by river terraces alluvium. Surface of the sediments reach to 1650 m asl. (possible more) and lowered northwards to 1500 m. asl. Basement (Mesozoic limestone and sandstone) lowered northwards from 1570 to 1499 m asl. Contact with basement with discordance, erosion and basal conglomerates.

Table 1. Spatial characteristics of Akusha formation clusters along the Akusha-Usisha interfluves ridge

Clusters		Area of sediment (km^2 (ha))	Perimeter length (km) along the basement	Heights (asl. m); surface / basement	Thickness of sediments (m)	Oldovan sites
N	Name					
1	Muhkay – Gegalashur	0.5 (50)	3.50	1620; 1541	80	Muhkay-1,2; Gegalashur
2	Ainikab-2	0.16 (16)	1.60	1555; 1515	40	Ainikab-1
3	Ainikab-1	0.01 (1)	0.43	1539; 1515	24	Ainikab-2
4	Sunduk	0.1 (10)	2.00	1533; 1509	24	Tools
5	Yantsara	0.01 (1)	0.50	1500; 1499	1	Tools

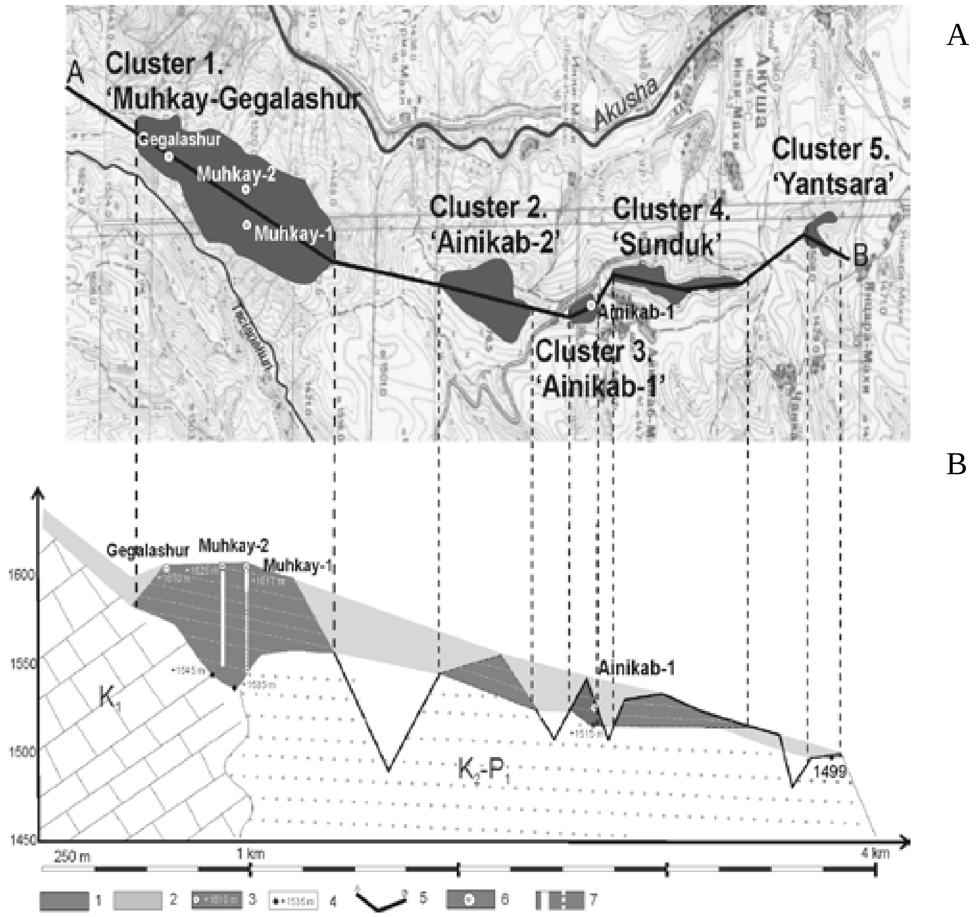

Figure 1. A. Akusha formation clusters distribution in Akusha-Usisha interflew. 1. Akusha formation sediments area, 2. Akusha formation eroded sediments, 3. High asl. of Akusha formation surface, 4. High asl. of Akusha formation basement, 5. Transversal profile along Akusha-Usisha interflew, 6. Paleolithic sites (oldovan). 7. Digged tranche and Not yet digged tranche. B. Transversal section of Akusha formation sediments along the Akusha-Usisha interflew ridge.

Space of Akusha formation divided by postsedimental erosion on 5 separate clasters (table 1). Stratotypes. Holostratotype of Akusha formation proposed section of site Mukhkay-2 with layered sediment 75 m thickness excavated from level 1620 to 1545 m asl. (basement). Parastratotypes proposed are in digged trenches of sites Ainikab-1,2, Mukhkay-1,2, Gegalashur, Sunduk. Inclination of layers to the North is hear 1-2º.

Geological age of Akusha formation was established in section Mukhkay-2 (fig. 3-4) by several methods (paleontology, palinology, paleomagnetism) as Eopleistocene = Early Lower Pleistocene (0.8–1.8 million years). According to paleomagnetic studies (fig. 2, 3) this section is characterized by reverse magnetization of Matuyama epoch (0.8–2.6 myr). Event of normal magnetization Garamillo (0.99–1.07 myr) recorded in upper part of section on depth interval 9-16 m. Another normal magnetization event founded some higher on the depth 3.5 m possible Kamicatsura event (0.85 myr). Some short of intervals of anomalous magnetization founded below and above of Garamillo event (transition zones).

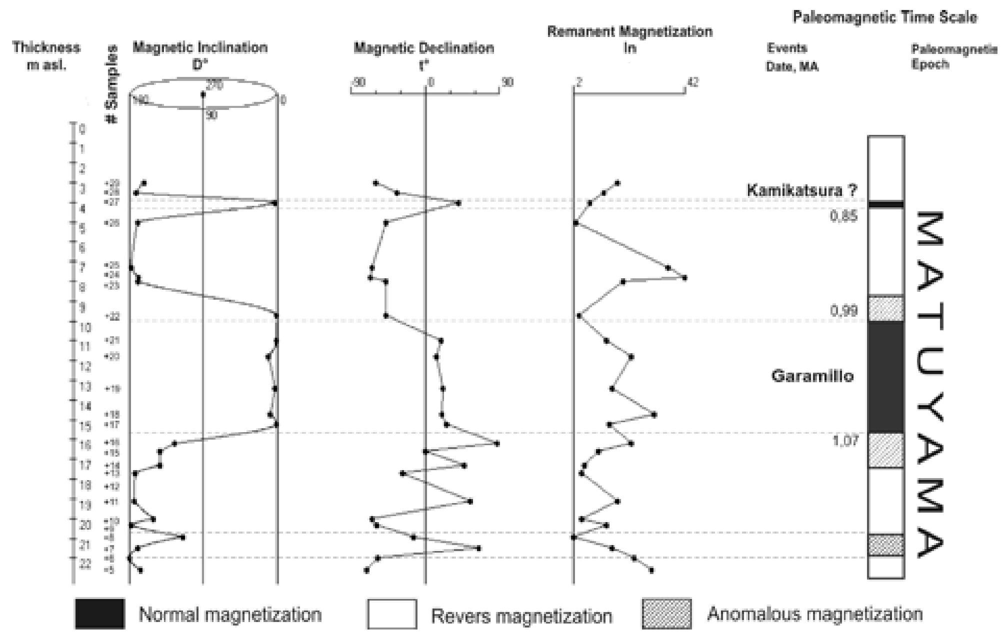

Figure 2. Paleomagnetic characteristics of Akusha formation (Mukhkay-2 site)

These data allow us to determine of isochrones of some absolute age: 0.85 myr (3.5 m depth), 0.99 (9.5 m depth), 1.07 (15 m depth). Estimated age of main cultural layer calculated by rate sedimentations 1.4–1.5 million years. These dating are confirmed by paleontology (Psekupsean = Odessa mammal complex).

Akusha formation represents by intercalation of coarse grain (sand, gravel, pebble, bolders) and fine sediments (clay, aulleuroclay, loam mainly carbonated). Coarse sediments have lagoonal, nearshore, proluvial, alluvial, origin and accompanied by mammal bones, tools and land mollusk shells. Fine clay sediments up to 10 m thickness reflect water basin environment relatively deep and contain nannoplankton (*Spiniferites ramosus, Spiniferites sp. Panonean type*) typical for brackish water Caspian type isolated brackish basins (Apsheronean, Akchagylean).

Clay packages contain mineral authigene glauconit which formed during sedimentations time. This suggest of isolated marine basin nearshore environment. This time in the Caspian depression (30 km from Akusha sites) was Apsheronean brackish water basin. Possible, Akusha formation sediments deposited in lagoons of this basin.

Palinological studies of upper 35 m thickness sediments recovered vegetation changes with 13 palinocomplexes and reflects alteration of climatic oscillations (aridisation – humidisation, cooling – warming). During cooling stages parvifoliate (*Betula*) and dark coniferous (*Picea*, *Tsuga*) are predominate; warming stages accompanied by thermophile timber (*Magnolia*, *Ostrya*, *Pterocaria*, *Cryptomeria*) and just absence of dark coniferous and parvifoliate.

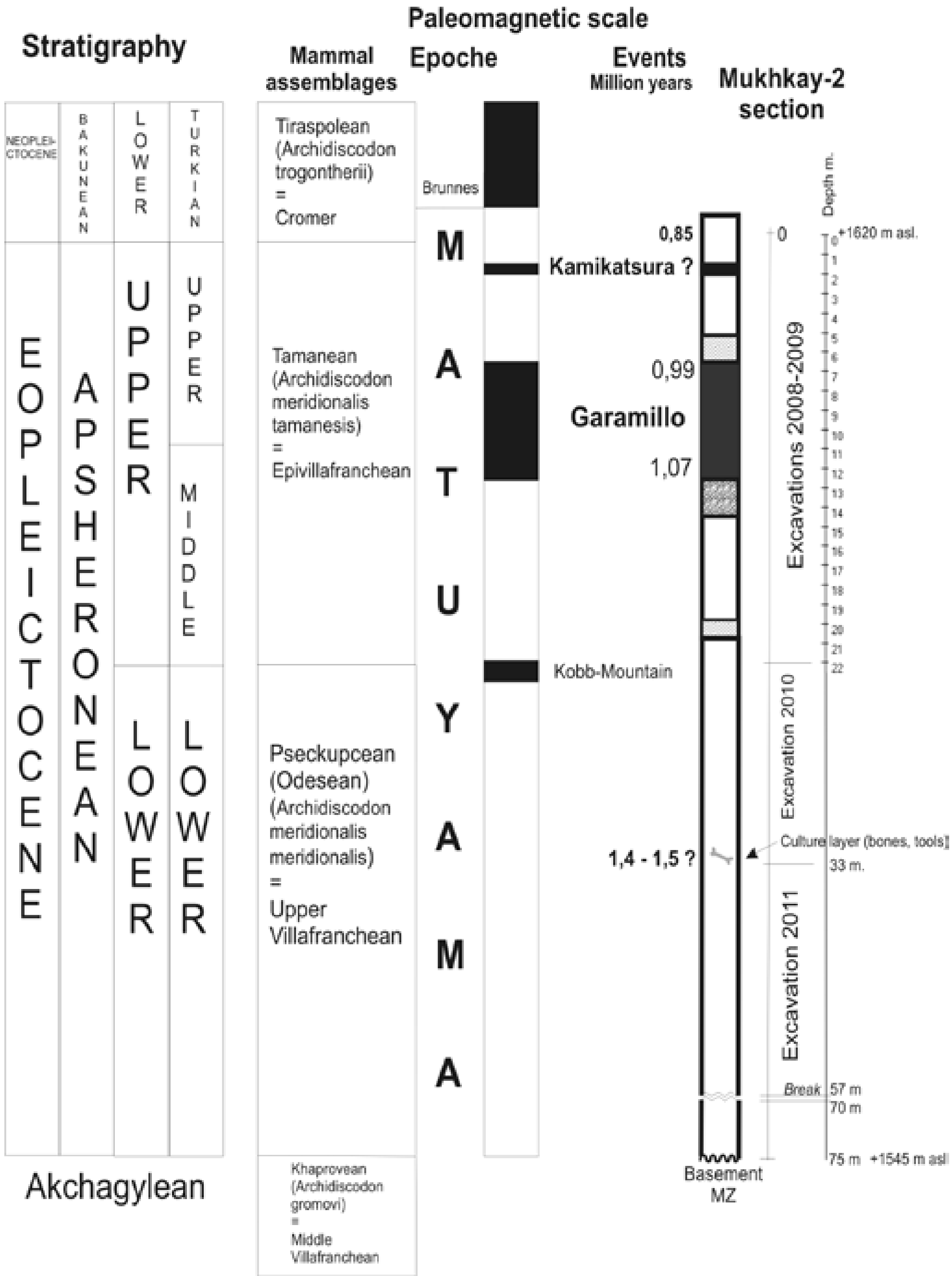

Figure 3. Stratigraphic position and age of Akusha formationLithology and sediment genesis.

Environment reconstruction. First human settlements appeared on low hights of Caucasus foothills and nearshore environment possible faced to Apsheronean basin subjected by sea level oscillations. Coarse sediment accumulation is indicator of regressive stages of the basin territory studied was covered by terrestrial landscape with broad live vegetation contained thermophil elements and settled by Psekupsean mammal complex and archantrops using oldovan type tools.

Fine clayey sediments accumulation reflected transgressive stages and sea level rise, water basin deeped and flooded previously terrestrial landscape with human population. During next 1.0-1.5 ma this territory was rised on 1-1.5 km by tectonic uplift and reached resent mountain level.

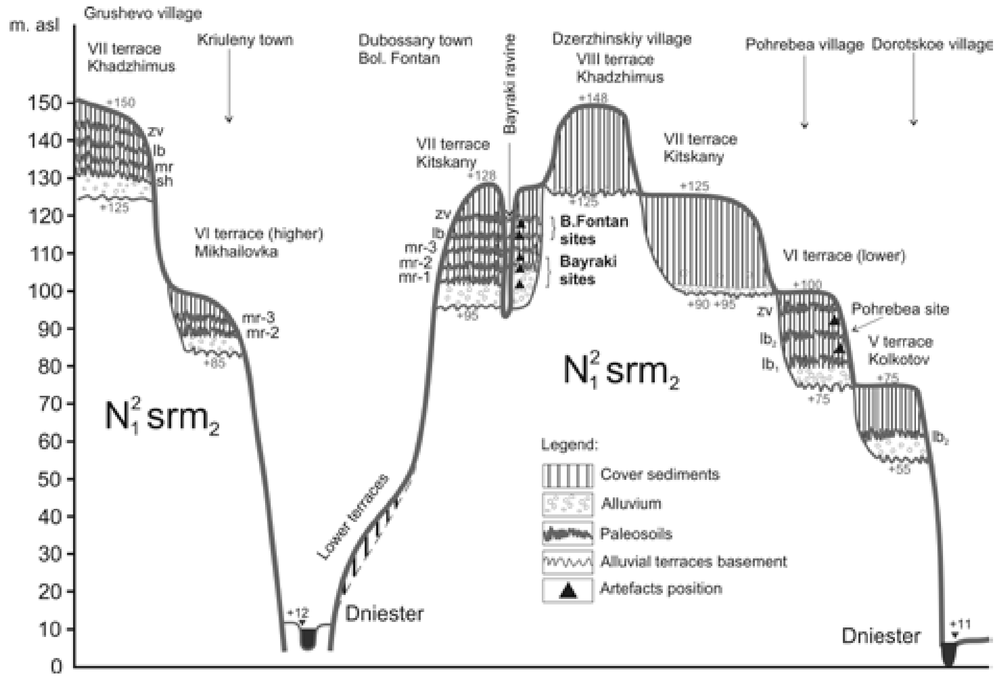

Figure 4. Terrace profile of Dniester valley near Dubossary town and stratigraphic position of Early Paleolithic sites

Dniester valley (Dubossary town). Early Paleolithic site Bayraki discovered by N.K. Anisjutkin in 2010, settled in alluvial and cover beds of VII Dniester terrace (Lower Eopleistocene) [3]. The same time it was studied by A.L. Chepalyga for age and environmental reconstruction determination [4]. River Dniester alluvial terraces system near Dubossary town is studied and corrected. 5 high terraces system (fig. 4) represented by: three terraces – VIII, VII, VI (Eopleictocene age) with artefacts and 3 terraces – VI high, VI low, V (Early Neopleictocene) were investigated. Paleomagnetic event Jaramillo (0.98-1.07 mln. years) was found in stratotype section Chitskany terrace in upper alluvium of VII terrace. This date supported by RTL dates 1.1 mln. ± 0,25 and 0.940 ± 0,2 mln. years and Tamanean complex of mammals (Epivilafranchean). The age of the oldest oldovanean tools from alluvial pebble is 0.8–1.2 mln years. This is one of the oldest Early Paleolithic site in the Europe [5]. Fossil soils and pedosediments are studied: 3 fossil soils were identified. Palinologycal analysis recovered some palinozones with forest (oak, beech, hornbeam, elm, linden, hazel, etc.) and steppe vegetation. Climatic environment is reconstructed.

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FLUVIAL GEOARCHEOLOGY OF EAST EUROPEAN VALLEYS (DNIESTER, KOGYLNIK, DON) DURING EXTREME INUNDATION EPOCH

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The latest Paleolithic sites (Epipaleolithic) in the SE European river valleys related to events of Extreme Inundation Epoch (EIE) 17-11 ky: marine, river, slope and interfluvial floods [1]. These events influenced of ancient population and remaied footprints in topography, geomorphology, geology and lead to substantially changement of environment.

In Boudjak valleys (Kogylnic, Sarata) these events and their consequences was studied in 2011 together with odessa archaeologists (Kiosak D., Pistruil I., Glavenchuk A.) and marine geologists S. Kadurin and I. Losev.

These investigation in Paleolithic provided near site Belolesie (Sarata district of Odessa region) followed by trench, handle coring and sampling of lower terraces of Sarata river.

1. *Anormal wide* river valleys of small rivers (balkas) – some kilometers width similar to *misfit valleys* of Dury (1984). Dry valleys in arid step zone: Kogolnik, Sarata, Yalpug, etc.

2. *Macromeander**s*** – wide river paleochanels of the North Black Sea region, flooded now by marine transgression and transformed to marine lagoons (liman): Koujalnik, Tiligul, Jngul, South Bug.

3. *Proterrace* (new term of A.L. Chepalyga) – intermediate lowermost terrace level between alluvial terraces and flood plain, formed during terminal Pleistocene age (EIE) after LGM cooling (17-10 ka). In Kogilnic and Sarata valleys Proterrace occupied just all valley bottom and have 3-4 km wide and have 2-3 hypsometric levels (3-4, 9-16, 14-17 m) terrace body by fine (clay sand, loam, fine sand) alluvial sediment below Holocene soil. In the top of alluvial loam Upper Paleolithic culture level Belolesie site was excavated and dated by radiocarbon 9-10 ka BP. According palinological data obtained cooling Dryas-3 Lycopodium arcticum Final Pleistocene.

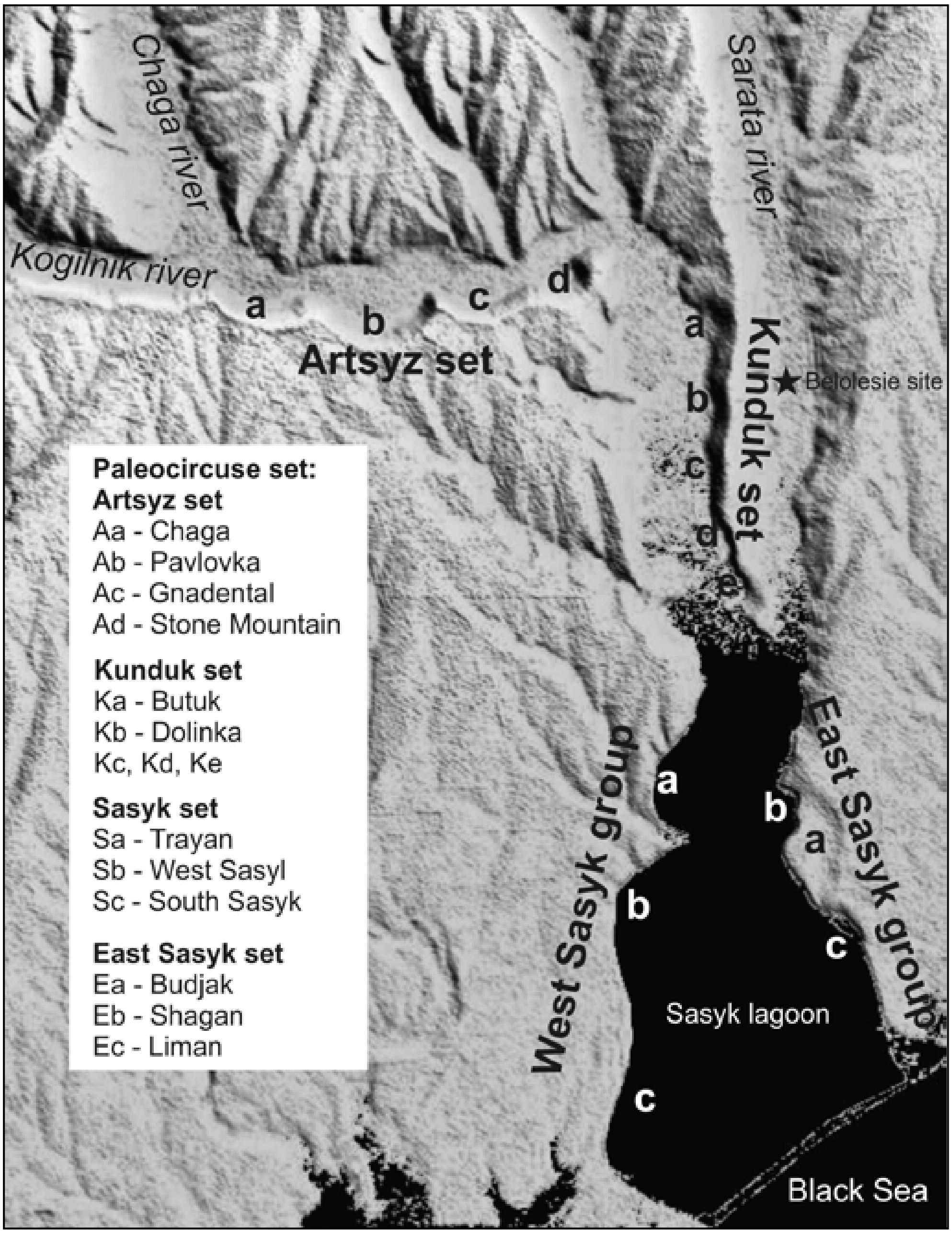

Figure 1. Evidences of Extreme Inunadation Epoch (17-11 ky). Great Flood events in Budjak valleys: Kogilnik, Sarata, Sasyk, Liman

4. *Relict cryogenic microtopography* on the Proterrace surface, especially on the youngest hypsometric level. It represented by alternation of small mouds and

microdepressions with rate of 3-4 metres high and 200-400 m units dimension. In a nearshore area this microdepressions are flooded and transformed to small lakes, lake system and golves. Age of relict criogene microrelief is Drias-3 cooling on the base of radiocarbon and palinologic data.

5. *Erosional paleocircuses* related to *macromeander paleochannels* activity. In Kogylnic valley some paleocircus groups of different size and age exist (fig. 1). Artsyz paleocircus set represent by 4 units on right slope of valley with mean size of 3-4 km long: Chaga, Pavlovka, Gnadental, Stone Mountain. This is the youngest generation, very good morphologically preserved, because these arcs incised in Neogen layers, armed by hard pontean limestone. Another weaker represented Kunduk paleocircus set of 5 units can be recognize on left valley board: Kunduk 1-5 (Butuk, Dolinka, etc) paleocircuces. The oldest and biggest paleocircuses are recognized on Sasyk liman – West and South Sasyk one with size more 10-15 km. East Sasyk paleocircuses have intermediate size (7-8 km long) and age. This arc complicated by two smaller (3-4 km long) and younger ones insized: Shagan and Liman paleocircuses.

Another one type of slope flooding event was recognized in Don valley near Divnogorie upper Paleolithic site. Paleocircus of Tikhaya Sosna river and Divnogorie paleolake (12-14 ky) was here recovered and studied (fig. 2).

Described objects and processes was environmental phone for ancient people tribes and must take in attention for paleoreconstructions.

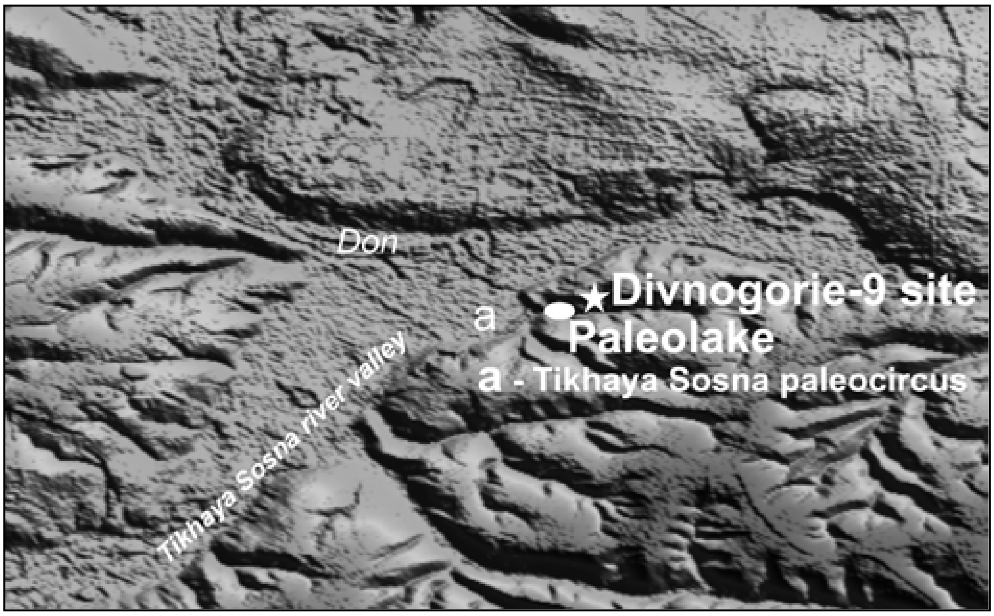

Figure 2. Extreme Inundation Epoch. Great Flood events in Don and Tikhaya Sosna valleys: misfit valleys, erosion paleocircus of paleomeanders, slope Divnogorie paleolake

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LANDSCAPE ARCHAEOLOGICAL RESEARCH ON THE LINEAR POTTERY CULTURE IN POLAND AND UKRAINE

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The aim of the collaborative research is comparative investigation of the settlement structure of several Linear Pottery Culture sites at the same general scale throughout the eastern branch of the European early Neolithic. The Linear Pottery Culture settlement of Zwięczyca 3, Poland is part of a group of Early Neolithic sites in the loess-covered foreland of the Carpathians in southeastern Poland (fig. 1, no. 1) [1]. The investigated settlement, which has also produced Earliest Linear Pottery Culture material, lies south of Rzeszów, on the high west bank of the River Wisłok. It covers approximately 15 ha. Its western part is threatened by a rapidly growing development area. In terms of extent it ranks among the major settlements of the loess area of the northern foreland of the East Beskids.

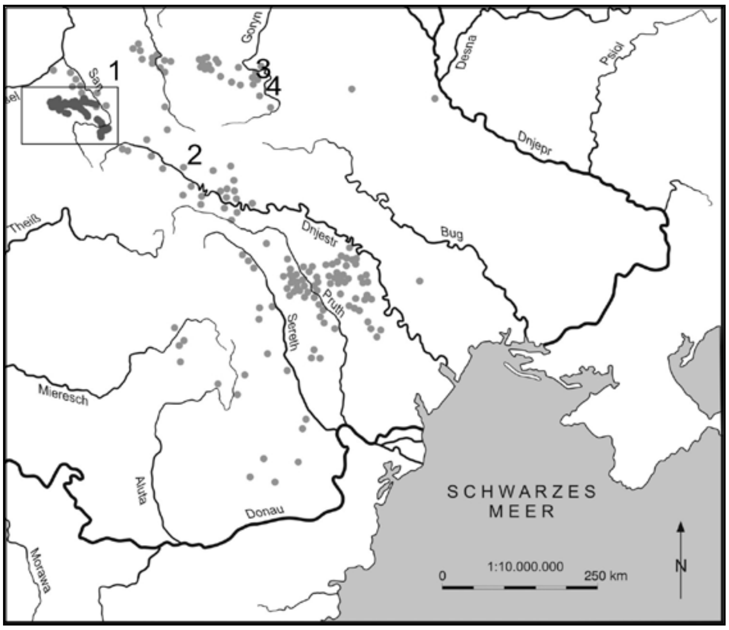

Figure 1. The eastern area of distribution of the Linear Pottery Culture. 1. Linear Pottery Culture settlements in the River San catchment area, 2. Bilshivtsy, 3. Rivne Pljaz, 4. Mezhyrich

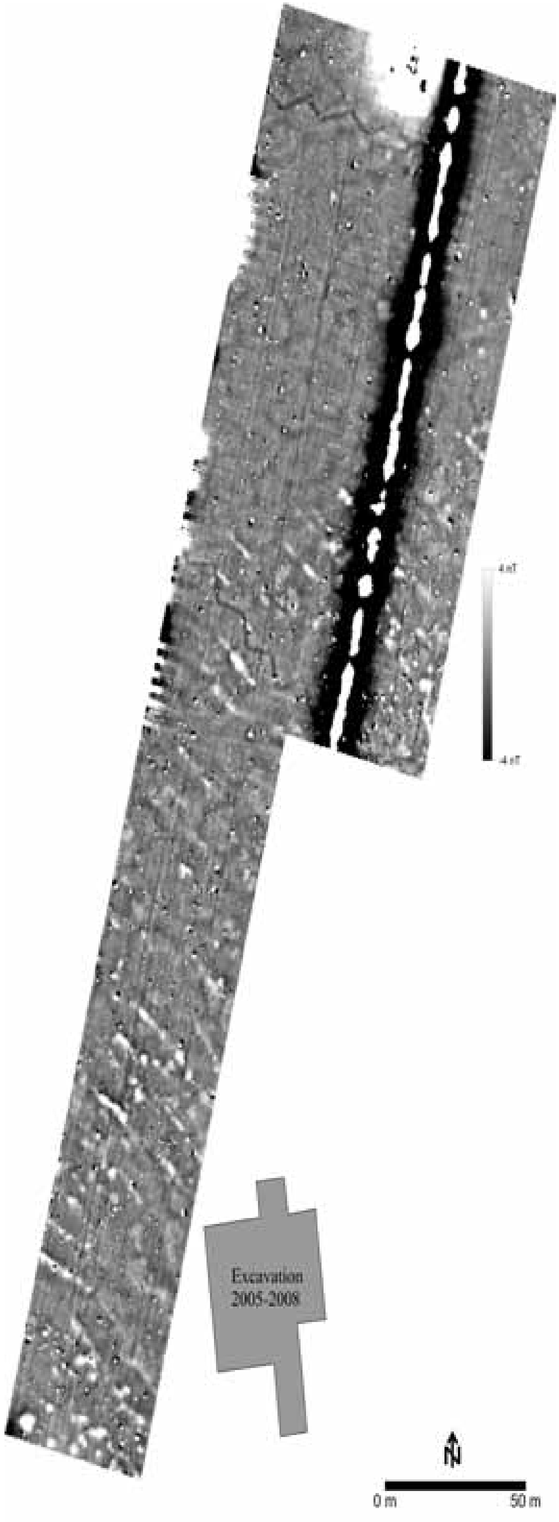

Figure 2. Zwięczyca 3. Grey-scale image. Vertical gradient map of the magnetic field at the earth's surface (256 greyscale values (linear black / white), four-channel Fluxgate Gradiometer Ferex 4.032 (separation 0.65 m, sensitivity 0.1 nT), raster 0.2 m / 0.5 m, amplitude -4/+4 nT).

Excavation was undertaken in the years 2003 (S. Czopek) and 2005–2008 (M. Dębiec, A. Dzbyński) [2]. Altogether, an area of 2300 m^2 was excavated, in the course of which more than 600 finds were recorded, the majority relating to the Linear Pottery Culture. Four ^{14}C dates on wood charcoal support the dating of the ceramics to the Notenknopf and Želiezovce Horizons. Among the most important finds are three double-bladed tools, as well as idol fragments. The remains of 6–7 Linear Pottery Culture houses have been identified (three-post bars, double posts and pits connected with houses).

In September 2009 magnetometer prospection was undertaken in the central part of the settlement (fig. 2). The magnetogram shows an area of about 3 ha, of which about 1.7 ha belongs to the former Linear Pottery Culture settlement, permitting its northern limit to be determined. Remains of at least 16 buildings can be identified. Linear anomalies predominate, interpreted as elongated pits along the walls. Their orientation varies around northwest-southeast. In terms of dimensions and alignment, the house remains visible in the magnetogram correspond to those discovered in the course of excavation. In no cases could the magnetogram reveal remains of posts, whereas in the excavated area they are present in considerable numbers, albeit poorly preserved.

As a continuation of the cooperation, fieldwork was undertaken in the Linear Pottery Culture settlement area in the upper reaches of the Dniester. So far, an area of 3.75 ha has been magnetically prospected in

Bilshivtsy, Iwano-Frankiwsk oblast, Ukraine (fig. 1, no. 2), a Linear Pottery Culture site not far from Halych. In spite of the numerous Linear Pottery Culture finds, predominant especially in the northern part of the magnetogram are structures indicating burned buildings of the Tripolye Culture. In the southern part the grey-scale image shows the disturbance caused by earlier excavation, which also produced Linear Pottery Culture material. The planned continuation of the prospection should document Linear Pottery Culture settlement areas that are not overlain by Tripolye structures.

Further fieldwork (magnetometer survey and excavations) are planned for a 2012 campaign at early Neolithic sites at Riwne, Pljaz (fig. 1, no. 3) as well as Mezhyrich near Ostrok, Riwne oblast, Ukraine (fig. 1, no. 4), the latter one having yielded the easternmost specimen of Earliest Linear Pottery Culture material lately.

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COMBINATION OF THE TANGIBLE AND INTANGIBLE IN CULTURAL EVENTS ORGANIZATION

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A study conducted by the author aims to investigate the resource base for organization of event tourism. The intermediate results of the study, obtained within the analysis of secondary sources are presented below.

Cultural heritage is divided into the tangible (works of art and monuments) and the intangible (traditions, customs, folklore, etc.). Traditionally, tangible cultural heritage objects are more closely examined, protected, and as a result, are more accessible to the public.

In turn, the task of preserving intangible cultural heritage is often laid on the shoulders of particular culture carriers and, hence, is more localized. Nevertheless, preservation of intangible culture is one of the most important tasks of cultural policy and its maintenance receives considerable attention. For example, in 2008, Russia adopted a Concept of conservation and development of intangible cultural heritage of the peoples of the Russian Federation for 2009-2015.

One of the problems identified in the concept is lack of promotion of intangible cultural heritage. In our view, this problem can be partially solved through the organization of special events: contests, festivals, fairs, etc. [1]. Much of intangible cultural heritage can be performed, and, therefore, transferred only through personal contact of culture carrier and receptive side. Especially this is relevant for such objects as language, folklore, some forms of performing art, as well as rites and rituals. The need for personal presence of the culture carriers and nature of non-material objects themselves cause the necessity for special places to display cultural heritage for many viewers or listeners.

On the one hand, archaeological monuments are objects of tangible cultural heritage, but, on the other hand, they are naturally associated with the intangible culture [2]. The example of excavations of sites of rites and rituals, as well as artifacts related to any form of folk art like musical instruments can be set here.

That is why development of cultural tourism at archaeological sites in order to acquaint a visitor with elements of both tangible and intangible culture seems very promising direction. However, in the context of widespread dissemination of innovations in all spheres of human activity, habitual contemplation of cultural objects in the form of excursions becoming less popular as a tourist product. Distribution of post-modern approach to perception of cultural goods and services increases the value of symbolic capital, where real artifacts provide just a stimulus for attractiveness, while created experience gain the value [3].

Organization of a certain event, based on traditions and customs of the ancestors who inhabited this area many centuries ago and restored by archaeological finds, in the present conditions will likely be in demand among the tourists. High-tech computer gadgets allow you to fully «complete» picture of the past on the basis of artifacts, but even they are not strictly necessary. Thanks to the discoveries of archaeologists visitors gain an opportunity to express their own imagination and to «invent» the reality of the past.

One of distinguished features of the event tourism is a high degree of visitor's involvement in events' activities, whether it's folk dance performance, creation of a traditional household item or reenactment of historical events that actually took place in the area [4]. Another feature is relatively low cost of creating such a tourist product, especially in co-operation of interested groups: local communities, administration, government and public non-profit organizations, businesses, tour operators, etc. An issue of the search for mutual understanding between all stakeholders requires particular consideration. Here we consider such a stage when development of tourist activities on a given territory is conformed by all interest groups.

Within the analysis of literature we have identified main features of event tourism development at archaeological sites (current and preserved):

- Location of archaeological sites in the sparsely populated areas causes the interest of local communities in development of infrastructure and tourism;
- The need for more thorough protection of tangible cultural heritage;
- Development of this type of event tourism is expedient to combine with eco-tourism, where it is possible;
- Opportunities for cooperation with local or nearby schools, institutions of secondary vocational and higher education, children's and youth institutions of additional education in order to foster interest in and respect for the native territory and to improve the quality of knowledge;
- The need for the development and organization in each year or the original and «serial» events (initiating repetitive participation, such as historical reenactments) to ensure the flow of «returning tourists».

This experience of archaeological sites as stimulus for attractiveness for the organization of events have been accumulated in our country (the archaeological park

«Arkaim» in the Chelyabinsk region, «Tomsk Pisanitsa» in the Kemerovo region [5], «Slavic Village» in the village Lubytino Novgorod region) as well as abroad (archaeological parks «Moundville» in Alabama, United States, «Xanten» in Germany, «Month of Archaeology» in Scotland and the others). The analysis of this experience suggests the desirability of its distribution and adaptation to local conditions of other historically significant areas.

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THE DYNAMICS OF CLIMATE HUMIDITY IN SOUTHERN RUSSIA STEPPES WITHIN THE HISTORICAL TIME (IV MIL. BC – AD XIV) (BY THE DATA OF SOIL-ARCHEOLOGICAL STUDIES)

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Essential progress in solution the problem of the development of natural environment and climate in Eurasian steppes within second half of the Holocene first of all was achieved due to wide-scale soil-archeological investigations of ground monuments dated back to the Bronze, Early Iron epochs and Middle Ages (IV mil. BC – AD XIV). Paleosoils buried beneath cultural layers of settlements, kurgan embankments, defending lines, etc, preserve till today numerous signs and properties, which in a varying degree characterize climatic, lithological, geomorphologic, geochemical, biological, hydrological conditions of soil formation during past epochs.

The territory of southern Russia steppes studied includes Srednerusskaya, Privolzhskaya, Yergeninskaya uplands and Cis-Caspian Lowland within the area of Volgogradskaya, Rostovskaya oblasts and Kalmykia republic. Climate of the region is moderately continental. From north-west to south-east the rates of atmospheric precipitations decrease from 400 to 250-300 mm per year, mean annual temperature increase from 5.1 to 8.1^{o}C. The region lies in the zone of dry and desert steppes with dark-chestnut and chestnut, light-chestnut and brown semi-desert soils respectively.

Objects of studies were paleosoils of archeological monuments (kurgans) dated back to the Eneolith (IV mil. BC), Bronze (the end IV-II mil. BC), Early Iron (V BC – AD IV) epochs and Middle Ages (AD XIII-XIV). Using soil-archeological methodology about 350 monuments from about 30 burial sets, each including from 3-5 to several tens kurgans dated back to different cultural-historical steps of the development of ancient and Middle Age societies were studied.

Studies of under-kurgan pedochronosequences allowed us to elucidate main diagnostic paleosoil signs, which reflect the state and centennial dynamics of the level of climate humidity in the steppe zone of southern Russia within the historical time. These signs are the content and profile distribution of carbonates, gypsum, and readily-soluble salts; forms and amounts of mineral new-formations; the expression of solonetzes process; various microbiological parameters, in particular, active biomass of microorganisms and its share in the total microbial biomass, ecological-trophic structure of microbial communities, index of oligotrophy, etc. Comparative analysis of quantitative and qualitative parameters of morphological-chemical, magnetic, microbial properties of paleosoils of under-kurgan pedochronosequences gives an opportunity to reconstruct the direction and the scale of centennial variability of atmospheric humidity, to determine chronological position of humid and arid periods on the historical scale of the development of climate.

The data obtained point that in IV mil. BC paleosoils were developed under elevated atmospheric humidity with amounts of precipitation over 400 mm per year in dry steppes of Volga-Don interfluve and 350 mm per year in desert-steppe zone of trans-Volga area (table 1). Climatic situation most similar to the modern one took place in the end IV-first half of III mil. BC. About 5000 years ago a stepwise aridization of climate had started, lasted for millennium and reached its maximum on the boundary of III-II mil. BC. During that period mean annual amounts of precipitations decreased at least by 100-150 mm and reached the level of 200-250 and less mm per year. Finally about 4000 years ago in the steppes of Lower-Volga region a largest scale paleoecological crisis within past 6000 years took place. It conditioned desertification of landscapes and convergence of soil cover with transformation of zonal chestnut soils and solonetzes into chestnut-like eroded carbonate salted soils, which within 4300-3800 years ago dominated in the region.

We believe that sharp aridization of climate in the end of III mil. BC had a global scale. It was fixed by other researchers in the Northern Africa, Middle-East, Upper Thrace, Northern Cis-Black Sea region and Cis Azov sea regions, Middle Asia. In XVIII-XVII BC a softening of climatic conditions had started with elevation of atmospheric precipitations to 350-400 mm per year. The peak of that humidization fell seemingly to the middle of II mil. BC and resulted in important evolutionary transformations of soils with the shift of landscape boundaries toward the south. In II mil. BC climate humidization had conditioned the divergence of soil cover with secondary formation of complexes of chestnut soils and solonetzes. Next arid step took place in the end of II – first third of I mil. BC.

Paleosoil studies of kurgans dated back to the Early Iron ages showed that during VI BC – AD IV cyclic changes of morphological, chemical, microbial, magnetic properties took place. The scale of the changes revealed, as a rule, did not lead to evolutionary transformations of soils on a type (sybtype) taxonomic level. However, they

Table 1. Reconstruction of climate humidity in Volga-Don steppes within the Eneolith, Bronze, Early Iron, and Middle Ages (IV mil. BC – AD XIV).

Archeological cultures	Time	Volga-Don interfluve, dry-steppe zone	Trans-Volga region, desert-steppe zone
		Rate of atmospheric precipitations, mm/year	
Eneolith			
Novodanilovskaya	End of V – 1st half of IV mill. BC	> 400	> 300
Bronze			
Yamnaya	XXXI-XXVIII cc. BC	350–370	280–300
Early Catacomb	XXV-XXIII cc. BC	300–350	250–300
Late Catacomb and post Catacomb	XXII-XIX cc. BC	200–250	< 200
Pokrovskaya, Srubnaya	XVIII-XIII cc. BC	300–400	250–350
Early Iron			
Savromathian	VI-V cc. BC	~ 400	330–350
Early Sarmathian	2nd half IV-III cc. BC	300–350	250–280
	2nd half II-I cc. BC	~ 400	330–350
Middle Sarmathian	I c. AD	380–400	300–330
	1st half II c. AD	350–380	~ 300
Late Sarmathian	2nd half II – first half of III cc. AD	330–350	250–280
	2nd half of III c. AD	350–380	~ 300
	End of III-IV cc. AD	380–400	300–330
Middle Age			
Khazars, pechenegs, polovtsy, etc.	VIII-XI cc. AD	300–350	250–280
Gold Orda	XIII-XIV cc. AD	420–450	350–400
Modern		350–370	280–300

point to certain dynamics of mean annual amounts of atmospheric precipitations within ± 30-50 mm. From climatic point of view the time of existence of Savromatian-Sarmatian cultural societies may be considered as a period of alternation of micro-pluvial and micro-arid periods of 100-200 years (table 1). In particular, both in dry (Volga-Don interfluve) and desert (Trans-Volga) steppes relatively humid conditions fell to VI-V and I BC, AD I and IV, and most arid ones – to IV-III BC and AD second half II – first half III. Intermediate and similar situation of humidity level was in AD first half II and second half III. The established periodization and chronology of climatic dynamics in the lower Volga steppes within Sarmatian time in general agrees with regularities of the development of natural processes in other steppe and desert regions of Eurasia. In particular, from paleogeographic and soil-archeological studies a number of authors fixed micro-pluvials in AD I-II and / or end II-IV on the Middle East, Cis-Azov, southern Urals and Trans-Ural regions. In the Aral Sea basin in AD II-III the climatic aridization had considerably increased.

The peculiarity of paleosoils dated back to Middle Ages AD XIII-XIV observed on all objects studied in southern Russia steppes was an essential difference of their properties both from those of recent soils and modern background ones. During that period the processes of humus formation, desalinization, destruction of solonetzes had activated, the carbonate profiles were transformed, and sharp transformations were fixed in microbial communities. These data allow us to consider that within period of developed Middle Ages essential changes of climate took place toward its humidization. From main soil properties we may consider that the amounts of atmospheric precipitations exceeded modern one by 70-100 mm and were 420-450 mm per year in the Volga-Don interfluve, and in the Trans-Volga region – 350-400 mm per year (table 1). The increase of atmospheric humidity had resulted in the shifts of natural boundaries toward the south, in particular, in the expansion of dry-steppe landscapes toward desert-steppe ones. Basing on paleosoil data we may state the existence of «Middle Ages climatic optimum» in the steppes of southern Russia. Its peak fell to AD XIII. The favorable soil-landscape and climatic situation, which was registered in the Golden Orda time in a certain part, favored the ethno-political change in the region, the rising of numerous settlements, and the transition of Middle Age nomads to the semi-settled style of life. Recently we supposed a considerable humidization of climate on the whole Eurasian steppe area during the time of Tatarian-Mongol invasion and the period of the Golden Orda existence. Besides, the results of palinological and paleosoil studies of archeological monuments carried out by other authors demonstrate that the rate of atmospheric precipitations increased within the historical period mentioned in the northern Cis-Black Sea region and Ciscaucasia.

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MICROBIOLOGICAL STUDIES OF PALEOSOILS OF ARCHEOLOGICAL MONUMENTS IN THE STEPPE ZONE OF RUSSIA

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Problems of the development and functioning of microorganisms in the course of evolution of soils and environment within the historical time are practically unstudied in modern soil microbiology. Characterization of microbial community in paleosols is one of important diagnostic parameters that reflect environmental conditions of any geological or historical period. In this connection, new important for soil microbiology questions arise. Are microorganisms present in the preserved paleosols of archeological monuments viable and what radiocarbon ages do they have? What is the present status of microbial communities in the soils of different ages under burial mounds? How adequately does this state reflect the paleoenvironmental conditions of the historical time?

What are the peculiarities of biodiversity of microbial communities of the paleosols of the archeological monuments?

The aim of this work was to consider main problems of microbiological investigations of paleosols related to archeological monuments in the Lower Volga steppe on the basis of various parameters characterizing the status of microbial communities in soils of different ages (pedochronoseries) and the regularities of their spatial-temporal changes related to soil evolution and centennial dynamics of climate in the Late Holocene.

The microbiological investigations of paleosols beneath burial mounds in dry and desert steppe of the Lower Volga River basin showed that, in these soils, the microbial communities that existed at the time of burial mounds' construction have been preserved until now. This fact is confirmed by the regularities revealed in the distribution of different microorganisms in the mound substrates and in the buried and present-day soils and by the data on determination of the age of microbial fraction using ^{14}C atomic mass spectrometry method [1, 2]. The adaptation mechanisms for microbial communities' survival (anabiosis, transfer of bacteria to nanoforms, etc.) under unfavorable conditions provided their preservation. Using electronic microscopy, it was found that, in A1 horizon of chestnut soil under the burial mound, 77 % of the cells referred nanoforms (their volume did not exceed 0.09 μm^3); in the present-day chestnut soil, that amount is 63 %. Cytological investigations of artificially formed nanocells allow supposing that their formation is a response of organisms to unfavorable conditions and stress factors [3].

In paleosols buried beneath burial mounds hundreds and thousands of years ago, a considerable part of microbial community exists in a resting state. Therefore, in studying these objects, the determination of total microbial biomass, including the cells at different stages of their life cycle and dead ones, becomes topical. The method of determining total microbial biomass elaborated by the authors and based on isolation of microbial fraction from the soil with the assessment of its completeness was used in soil-archeological studies for the first time [4].

Total biomass of microbial communities in the soils beneath the mounds, including the cells at different stages of their life cycle and the nonviable ones, amounted to 20–105 % of microbial biomass in recent soils. In all soils, a pool of viable microorganisms (estimated from the phospholipids content) was present; it was comparable with that in the reference soil (48-142 % of the present pool). In microbial community of the paleosols, the biomass of active microorganisms responding to glucose application varied from 0.3 to 19–41 % of the biomass in the reference soil.

As a result of burial of the soils, their microbial communities turned out to exist under conditions that are not common for them. At the same time, a considerable part of microorganisms is transformed into resting state to overcome stressful environmental conditions (unfavorable hydrothermal regime, absence of falloff, etc.). The issue of preserving mycelium of microscopic fungi in these conditions and its structure remains open. Dark-colored mycelium is known to occur in extreme conditions. The pigments of melanin type determine stability of fungal mycelium against lysis and drying and weaken the effect of unfavorable temperature conditions; in addition, they provide the safety of cellular structures in the course of long-term carbon starvation. The content of mycelium of microscopic fungi in paleosols decreased down to 43–50 %. The share of dark-colored mycelium increased to 98–100 % due to its high resistance to unfavorable environmental conditions.

The data on conservation of microbial communities in paleosols under burial mounds allow using different microbiological parameters as indicators of the dynamics of paleoclimate, in particular, its humidity. Soil microorganisms are an integral part of soil. Practically all processes in the soil are important diagnostic indices reflecting the soil-forming conditions. The centennial dynamics of microbial communities was studied using the example of several chronological series of paleosols (beneath burial mounds) in different regions of the Lower Volga River basin. The variability of microbial communities in some historical periods (for the northern Ergeni area, 4000–3000 BC, 1800–1600 BC, AD 100–300, and the fourth century; for the northern Caspian Lowland, from the third to the second millennium BC, from the 16th to the 15th century, from the third to the fourth century, from the 13th to the 14th century, etc.) was shown to be significant. In other periods (for the second terrace of the Volga–Akhtuba floodplain: the early first century, the first to third centuries), it was relatively low. The microbiological data evidence the specific features of the dynamics of environmental conditions in the regions studied that caused the changes in microbial communities of the soils in different historical periods. Microbiological parameters characterizing the paleosols' microbial communities in arid and humid climatic periods were revealed. Among them are active biomass of microorganisms and its share in the total microbial biomass and organic matter (Corg) of the soil; the ecological–trophic structure of microbial community characterized by the ratio between microorganisms grown on soil agar and using dispersed nutrients, on nitrite agar and using humus, on rich organic substrate and decomposing plant residues; the ratio between the number of microorganisms consuming readily available (plant residues) and difficultly available (humus) organic matter; and the index of oligotrophy.

The changes in paleoenvironmental conditions in the past historical periods caused changes in e biodiversity of microbial communities. Since, in the soils of arid regions, a considerable part of microbial communities is in a resting state, their diversity was assessed using genetic methods. Experiments were performed at the Center of Microbial Ecology of Michigan University supervised by Prof. Tidji and Dr. Marsh. The microbial communities were studied in three paleosols (the A1, B1, and B2 horizons) buried under mounds of different ages and in the reference light chestnut soil (the southern Ergeni Upland). The total microbial DNA was isolated, the areas of the 16S RNA gene were amplified, and the polymorphism of this gene’s fragments was analyzed (using the T-RFLP method). The diversity of microbial communities was estimated using conventional units (the ribotypes of the microorganisms, i.e., the definite sequence of the gene area analyzed). The bacterial diversity of communities in the profiles (A1, B1, and B2 horizons) of paleosols and light chestnut soils was compared. The number and character of ribotypes (general and specific) were analyzed, since the microbial communities were characterized by high diversity. The total number of ribotypes in the reference soil reached 118; in paleosols, their number varied from 70 to 108. In each present-day soil, 36 to 68 ribotypes were preserved; their diversity amounted to 46–63 % of the diversity of microbial communities in the paleosols. One can suppose that some changes in paleoecological conditions in the former times caused a definite reconstruction in soil microbial communities; in this case, some part of initial diversity was preserved and supplemented by new groups of microorganisms [5]. Based on the database of known microorganisms (the database of Michigan University), the bacterial ribotypes were identified in A1 horizon of the recent light chestnut soils and the paleosol buried 5100 years ago. In spite of the fact that the majority of fragments obtained differed from those in the database, a number of organisms that were genetically close to those registered in the reference soil and in the paleosols (the differences were not more than by a pair of nucleotides) were revealed. Usually, the microorganisms identified were halophilic or halotolerant and need not be sporeforming ones. In common for both soils were the *Rhodobacter*, *Erythrobacter*, *Leptotrix*, *Arthrobacter*, and *Bacillus* genera. Specific for the recent soil were the *Aurantiaca*, *Paenobacillus*, and *Acholeplasma* genera; for the paleosol, they were *Azoarcus*, *Xanthomonas* and *Serratia Ficaria*.

The alternation of arid and humid climatic periods was shown to be reflected in the structure of microbial communities of paleosols at the ecological–trophic, metabolic, and genetic levels.

Thus, the paleosols of archeological monuments of different ages in the steppe zone are a unique object, somewhat of a natural archive preserving information concerning the status of soil microbial communities in former historical time and concerning their centennial dynamics related to the changes in soil forming factors.

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LATE PLEISTOCENE-HOLOCENE SEDIMENTATION AND VALLEY FLOOR DEVELOPMENT OF THE DICLE RIVER, SOUTHEASTERN TURKEY: IMPLICATIONS FROM GEOARCHAEOLOGICAL DATA

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This study is a re-assessment of our previous data concerning the Late Pleistocene-Holocene sedimentation and valley floor development of the Dicle (Tigris) River which crosses between Bismil and Batman settlements in southeastern Turkey. We discuss geoarchaeological data newly collected from the ancient settlements or mounds on the Holocene terrace of the river. A GIS-based geomorphologic map of the study area was drawn using satellite images. The Dicle River terraces lying at 4 and 2 m above the present river channel are of Holocene age. According to geoarchaeological data collected from three mounds, i.e. Körtik, Hakemi Use and Aşağı Salat, floodplains of the 4 m terrace formed as a result of floods which took place at four different cycles. The first floodplain formed during the Late Pleistocene-Holocene, coinciding with Bølling / Allerød interstadial. The first settlement, Late Epipalaeolithic-Aceramic Neolithic Körtik Tepe, established on the floodplain during the Younger Dryas and Early Holocene (between 10170 and 9280 cal yr BC).

GEOARCHAEOLOGICAL INVESTIGATIONS OF NEOLITHIC-BRONZE AGE SETTLEMENTS ON LAKE NERO (CENTRAL RUSSIA)

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Lake Nero is located about 200 km north-east of Moscow (fig. 1). The initial vegetation of this area has been transformed under anthropogenic impacts. The depression of Lake Nero is located in the transitional zone between the southern taiga and the zone of mixed coniferous–broadleaved forests. The environmental conditions of the Bronze Age and the entire Middle Holocene in this area differed from the modern conditions. The relict features preserved in the soils of the region suggest that these differences were considerable.

Several Neolithic-Bronze settlements (Lipovka-1, Pesochnoe-1, Varos) were investigated on the shore of Lake Nero. Habitation deposits and soils of settlement Lipovka-1 contain the archaeological remains of Bronze Age cultures (Fatjanovo-Balanovo, Chirkovo and culture Textile Ceramics (or Netted Ceramics, Netter Ware, or Fabric Impresed Ware) in thin modern humus horizon (10 cm). Several cultural epochs on settlements Pesochnoe-1 and Varos are distinguished in the cultural layer (30-40 cm) consisting of more or less homogeneous habitation deposits colored with humic susbstances. The artifacts of the Ljalovo culture (local variety of the culture of Pit-Comb Ware in the Upper Volga region) are found in the lower part of the cultural layer; above them, the artifacts of the Volosovo culture (Kama-Volga variety of Late Pit-Comb Ware) are present, and the upper part of the cultural layer corresponds to the culture of Textile

Ceramics. Dominated by materials of culture Textile Ceramics.

Radiocarbon dating was performed by the standard LSC method in Kiev (Institute of Environmental Geochemistry of the National Academy of Sciences of Ukraine). The calibration of the dates was made with IntCal04 dataset [1]. The content of organic matter, carbonates, and phosphorus was determined in buried soils and cultural layer by routine methods. The humus content was determined by the wet combustion method (Tyurin's procedure). Analysis of the microelement composition of cultural layer was carried out by the X-ray fluorescence method whereby the object under study was kept intact.

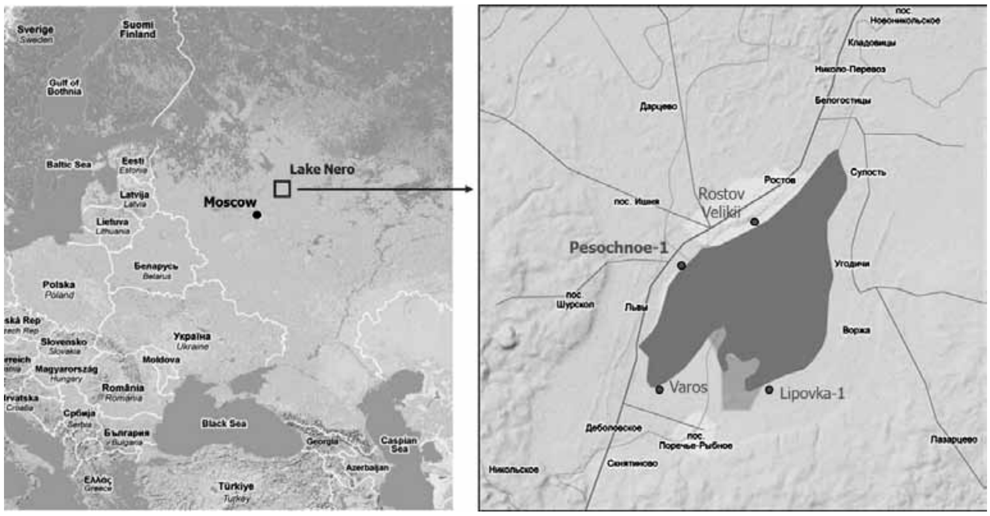


Figure 1. Location of the site

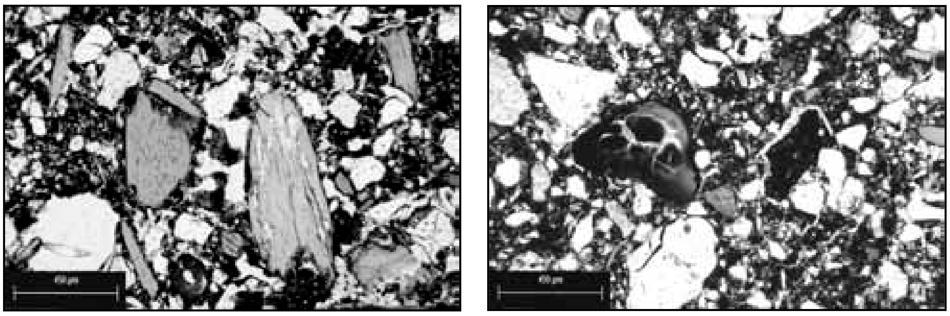
At the same time habitation deposits of Pesocnoe-1 are characterized by relatively small thickness (30-40 cm), very high content of humus, calcium, phosphorus, copper and zinc [2]. There are numerous passages of soil fauna, as well as burnt bone. Charcoal is almost no longer exists, so radiocarbon dating was performed on total organic matter, which is based on humified organic material of the cultural layer, and soil humus, particulate carbon, and probably bone charcoal. The same habitation deposits are characterized for settlement Varos but there are some differences in concentrations of trace elements (low content of cooper, medium content of zinc).

Micromorphological observations in thin sections from Pesochnoe demonstrated abundance of bone fragments of different sizes which comprise more than 10 % of the groundmass (fig. 2). Some of the bone fragments have intense heterogeneous brown pigmentation that is supposed to be result of burning. Charcoal particles are much less frequent, most of them show signs of fragmentation and destruction. We suppose that the major part of charcoal is already finely fragmented and incorporated in fine organic material (humus sensu lato).

The results of dating (80 radiocarbon dates) showed the high stability of organic matter in the cultural layer of ancient settlements Pesochnoe-1 and Varos. The reasons for that are related to the high concentrations of calcium and phosphorus in the cultural layer, especially in its parts enriched in calcined bones. The radiocarbon dates for humic substances in the corresponding layers display a good chronological stratification and correspond to the existing data on the ages of these cultural stages [3-5].

Different results have been obtained for the cultural layer from the nearby settlement of the Bronze Age Lipovka-1. At this site, the humus content in the cultural layer is much smaller. From the surface, typical Albeluvisols are formed. They contain relatively small amounts of humus, calcium, and phosphorus. The age of humus in the upper part of the cultural layer is significantly younger. Low content of trace elements are defined for cultural layer of Lipovka-1 and Bronze Age cultural layer of Rostov Velikii.

A



B

Figure 2. Micromorphology of cultural layer in Pesochnoe; A) abundant bone fragments; B) charcoal fragment (right) and burned bone (left). Plain Polarized Light

Unusual extremely high concentrations of calcium, phosphorus and zinc are characterized for habitation deposits of Pesochnoe-1 and Varos, cooper – only for Pesochnoe-1. On the content of these elements revealed stratigraphic and planigrafic heterogeneity of the cultural layer of the settlements, made assumptions about the stages of revenue items and changes in the nature of prehistoric man. With the non-ferrous metallurgy (during culture Textile Ceramics) due to the accumulation of copper in the collection of residues of fish (and / or shellfish) – zinc. Intensive intake of soda bone (apatite) – source of calcium and phosphorus, which led to high concentrations of sorption (binding) of copper and zinc.

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INFLUENCE OF THE ROUTE «FROM VARANGIANS TO GREEKS» ON THE FORMATION OF THE ECONOMY ON THE UPPER BANK OF THE RIVER DNIEPER

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The strongest influence on the economical development of any territory in the Middle Ages was made by transnational trade routes. There were both water and land routes. In the forest part of the temperate climate water ways prevail significantly, especially in spring at high tide and in winter on ice. The need to ensure supervision over portage caused setting up a chain of settlements and defense installations on its way. Only three great trade routes of that period are known in the history of mankind: «from Varangians to Greeks», «the Great Silk Way», «the Tea Way». The analysis carried out on this issue shows that in spite of their collective character they all impressed people at that period by three factors. First, by a large scale of transportation of goods, second, by the high level of the servicing facilities (storehouses, ports, caravanserais etc.), third, by the longevity of their existence at that historical period. All three routes were connected with a certain kind of goods (amber, silk, tea) which were sold at huge profit regardless the duration of the journey (more than a year), gigantic length of the route for the transport available at that historical epoch and risks to lose not only all the goods, but also life or freedom.

The routes themselves had in fact only the starting point (a place where the caravan was formed) and the destination point (the place of sale and purchase of the goods for the way back) and some intermediate places where it was possible to store goods, to have a rest, to change guards and transport and in case of emergency to have major repairs. The routes could meander depending on weather conditions of a particular year and on political situation in the region. Not having the stability of contemporary transport arteries, they just showed general direction of the goods transportation. For that reason it is actually impossible to reconstruct all the routes precisely. It is possible to reconstruct only separate typical parts and the most important basic elements.

Being the earliest of all known routes (it was formed in the first part of the IX century), the route «from Varangians to Greeks» doesn’t have any known authentic infrastructure proved by archaeological findings.

However, the fact that this route crossed absolutely different natural zones, governmental and pre-governmental political establishments of different kinds indicates that there were specially arranged reinforced places to stay at which could guarantee safe transportation of goods. As there was no unified money equivalent at that historical period, the merchants had to reduce the amount of goods significantly on their way back upstream and that, in turn, increased their value. Although many rivers pretend to be a part of the route, it is beyond doubt that only the Dnieper in the Smolensk region could serve as the main transshipment point for that time.

The Gnesdovsky archaeological complex is one of the most well-known main bases on this part of the route. It emerged in the Dnieper valley on the shortest and, consequently, the safest watershed between the rivers of the Baltic and the Black Sea basins. Unfortunately, no basic constructions such as moorings, places for the winter stay for ships, houses for accommodation of guards, storehouses, heathen temples etc. have been found so far. Meandering of rivers, landslides and other both natural and anthropogenic causes led to a significant change of the existing landscape, though there are still some preserved places of habitation and some burial places of that period. Consequently, today we can't reconstruct how this place looked like in the IX or X century.

The economic life in the period of VIII-X centuries from Podvinie (the territory along the Dvina) to Podneprovie (the territory along the Dnieper) was focused on servicing the water route and portage on it. This area was formed into a unified space with its own identity. The main krivitch population of the region differed from all other Slavic tribes significantly in clothing, types of burial places, kinds of moulded ceramics. Implementation of slash-and-burn agriculture entailed domination of settled life and dependence of the population on rivers and lakes. Unlike more northern regions, hunting didn't play a leading role in the economy, though furs made up a part of the tribute or of the exported goods. The main kind of collecting tribute was poljudje, i. e. when the amount of tribute was the same for each house regardless the economic conditions of its inhabitants. Servicing the route and handicrafts were profitable for the population. Apart from that, Smolensk was occupied by Prince Oleg only in 882.

There are some data about the handicrafts and the agricultural activity in the Gnezdovsky settlement at that historical period. First of all, there was production of iron and iron goods, melting of bronze, making of ceramics, processing of bones, and making boats of a single tree trunk. Agriculture was characterized by livestock farming. Being a place of collecting tribute and of winter stay for merchants before the high water that enabled passing rapids of the Dnieper, Gnezdovo turned into a centre of international trade on the rout «from Varangians to Greeks» till the middle of X century. This fact is proved by some findings in the Gnezdovsky barrows.

The overall catering infrastructure (storehouses, boatyard for the winter stay of ships, animal-drawn and water transportation means, handicraft production, stocks of raw materials and goods that could be kept for a long time) made that settlement not only duly reinforced, but also ensured its significance and diverse international population. All the tribute was brought there. It was mainly grain that could be kept for a long time, fur skins (the Okoevsky forest occupied about 95 per cent of the territory), honey (one of the two preservatives existing at that time) and wax.

Objects which were found during the excavation in the Gnezdovsky barrows shed light on imported goods at that time. This was silver (treasure troves) in the form of Arabic dirhems, spices (mustard), copper and bronze, Norman swords, glass, women's jewelry and other luxuries. Part of the local objects was manufactured from the imported raw materials. Salt was brought from the northern regions at that time.

A special archaeological open-air museum was built in order to use the Gnezdovsky complex for tourist purposes. New objects of tourist attraction are to be created for the development of the overall infrastructure, because there are only few objects left and, moreover, their attractiveness is not high enough. There are also no objects of economic complex of that time left at all. Consequently, there is a need for modern remakes on the basis of visual imitation of similar objects in other places both in our country and abroad in order to continue efficient development of the museum complex. Typical archaeological findings are to be exhibited in the museum with a proper explanation of their implementation process. It would be beneficial to reconstruct the basic manufacturing processes of that time (smelting of the ball iron, producing ceramics and glass jewellery, smithcraft and leathercraft, making log canoes, willow weaving etc.). The majority of newly manufactured items can be sold as souvenirs. It would be interesting for foreign tourists to see remakes of non-typical objects of attraction such as a heathen temple and a military settlement of the Vikings.

Principles of the event-based tourism can be applied in order to increase the promotion. It means that some theatrical performances and sports competitions should be held on definite calendar dates. Apart from that, festivals, conferences and symposiums can be arranged on a regular basis. One of the strong motivating factors for tourists to come can be their involvement in the production and transport activities imitating the ancient technologies.

The third factor contributing to the development of the Gnezdovsky open-air museum must be implementation of such new technologies as multimedia presentations, table and computer games, promotional animated cartoons, short historical films, music videos etc. in addition to the traditional printed promotional materials. There still has not been any film shot about the route «from Varangians to Greeks» where the Gnezdovsky settlement is featured as the largest international trade centre.

SEA LEVEL CHANGES IN EASTERN ATTICA (GREECE) THROUGH THE USE OF GEOARCHAEOLOGICAL INDICATORS

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The aim of this study is to correlate the coastal and submarine antiquities in Eastern Attica with geomorphological indicators of sea level change (e.g. beachrocks), in order to trace the palaeoshorelines of the Late Holocene.

The study area is located on the eastern coasts of the Attica Peninsula (eastern Greece), extending from the bay of Porto Rafti to the Marathon bay. The archaeological remains that bear witness to past sea levels have been studied and correlated with submerged geomorphological indicators. Seven sites with coastal and submarine beachrocks have been investigated. Their height in relation to sea level varies per site; however the deepest beachrocks are traced at approximately -1.8 m.

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THE HUMAN SETTLEMENT ON THE PERIPHERY OF THE LOWER SAALIAN'S ICE-SHEET (ODRA STAGE, OIS-8) IN THE UPPER SILESIAN (POLAND)

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This paper focuses on the presence of humans in Upper Silesia in Poland at the cold time of the Middle Pleistocene, called the Odra Stage (OIS-8). At present, within the so-called Middle Polish Complex, more complex stratygraphic division is proposed. If it is accepted, some of the sites should be moved to the beginning of OIS-6. However, it does not change the context of human presence in similar climatic conditions in Upper Silesia.

In the period 1997-2003, the Authors paid particular attention to the presence of artifacts in deposits of the so-called cold stages of the Pleistocene. Also prof. J.K. Kozłowski confirmed that he had made similar observation in the years 1963-1964. The discovery of Early Middle Palaeolithic sites in Upper Silesia in the fluvio-glacial and fluvio-extraglacial sediments of the Odra Stage confirms the penetration of the extraglacial foreland by Pre- or Neanderthals. During warm oscillations, the neighborhood of the melting ice sheet did not constitute a major territorial and climatic barrier for them.

We think, that during those short climate warmings, particularly in the final parts of glaciations and also before pesimum of glaciations, hunters following the animals went through the Moravian Gate to north pastures. These were probably tundra pastures, woolly mammoth steppes or open forest-tundra – possibly with some forest formations in the river valleys. Climate was much colder than it is today but this area was populated by humans at late spring, summer and early autumn time. The degree of human adaptation to periglacial landscapes in the middle Paleolithic of northern Moravia and southern Poland was quite good. Humans could use numerous herds of ruminants and other herbivorous animals wandering along the ice sheet front to summer pastures. As hunters they could take advantage of open landscape, river traps and swamps. They could also use rich resources of salmonids and birds breeding and feeding in tundra and braided rivers. Another trumps of such type of «oscillatory» settlement with short-term transit hunting camps which probably occurred in an annual cycle, were convenient natural routes running across the outwash plains with abundance of stone resources especially flint. This way humans could quite freely and even wastefully use the resources. Humans coped with colder than today environmental conditions using suitable technology, artificial shelters and megafaunal excreta or bones as fuel.

In terms of taxonomy the sites belong to two different cultural traditions: microflake of Bilzingsleben type and Jungacheuleen of the Markkleeberg type. Three sites can evidence the existence of another traditions: Micoquian (Tychy 45, Samborowice 50), Proto-Charentian (Rybnik-Orzepowice 4). Although numerous sites of microflake tradition are known in the northern part of Central Europe (Lower Silesia, Saxony, Thuringia and Bohemia), so far they were related to warmer episodes of the end of the Middle Pleistocene. At Rozumice 3 we are dealing, for the first time, with this tradition in cold conditions, directly at the front of the retreating Odra Stage ice-sheet. The OSL dating of Rozumice 3 in the range from 253 to 279 ka BP. places the culture levels IV–V–VI–VII at isotope stage 8, that is in the period of the Odra Stage. In Rozumice site 3 clusters of artifacts appear *in situ* in the context of hearths and habitation structures in fluvio-glacial sediments in primary position.

During the Odra glaciations – just like in cold climatic zones today – people could walk on the outwash cones choosing easier routes over a fairly stable ground and using shallow places in braided rivers. The shallow beds of braided rivers built mainly of gravels lithotypes P4 were stable in that area, the water level in river channels was low – no more than up to knees – so that wading was possible.

The classic lithotypes P4 are the sediments in the top part of the profile at Rozumice abounding in traces of man’s sojourn. In that region and in those conditions people not only crossed the shallow beds of braided rivers but also used the gravel-sand shoals, that emerged above the water level in summer and were easily drained, as grounds for setting up camps or even building ephemeral habitation or ceremonial structures. At the site of Orzesze-Gardawice lithic artifacts occur near the heart.

In the investigated area, a man chose the route that ran along the edge of the ice-sheet as he had to bypass flood waters or even lakes and boggy shoals and the large river formed in that period near contemporary Ostrava and Bohumin. It seems, that people must have simply followed the trails of game – which they hunted – migrating to grazing areas of the unglaciated plateaux of Central Poland or even contemporary Ukraine.

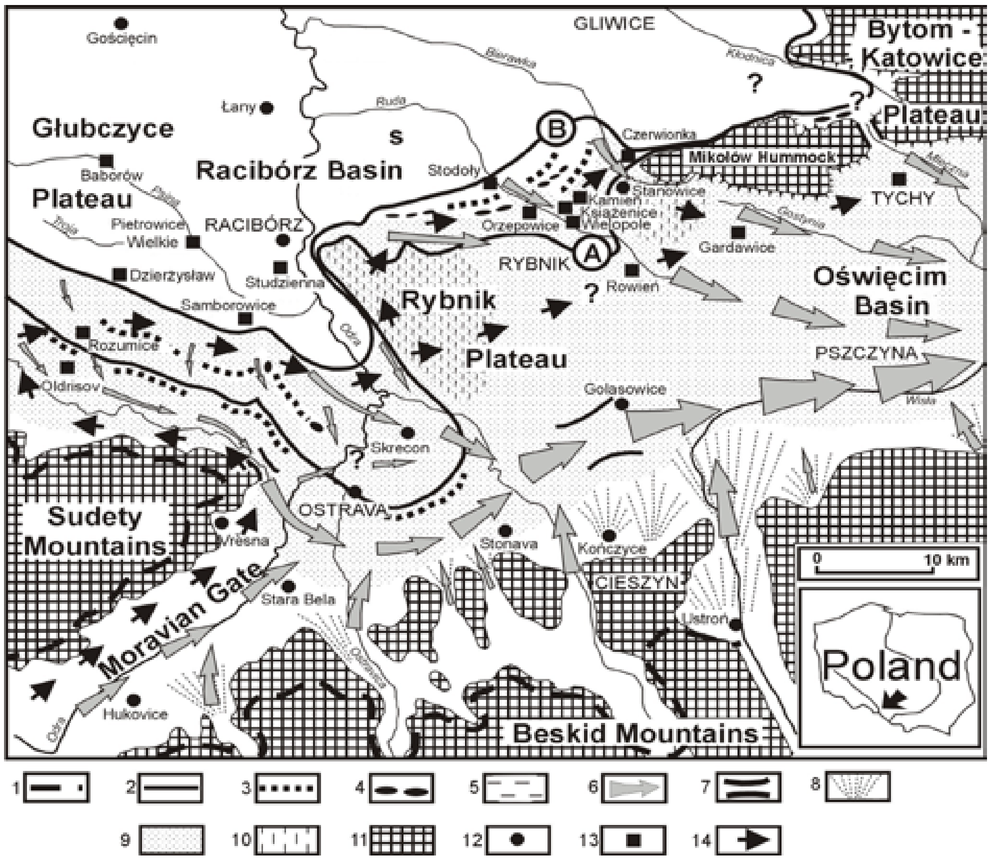

Figure 1. Map of palaeomorphology of the southern part of Upper Silesia during the Odra Stage, (by J.M. Waga). 1. San (Southern Polish) stage ice-sheet range, 2. Maximum Odra ice-sheet range, 3. Glacitectonic ridges axis, 4. Marginal moraines of the Odra stage, 5. Main sedimentary basins of stagnation stage during Odra ice-sheet transgression, 6. Directions of proglacial water flow (outwash), 7. Morphological gates, 8. Premontane extraglacial cones, 9. Outwash fields (added by J.M. Waga), 10. Palynological sites and main lithostratigraphical profiles, 11. Pre-Quaternatery upland and montane areas, 12. Uplands covered by a thin mantle of Quaternary formations, 13. Archaeological sites, 14. Possible routes of human migrations, A. Maximum Odra ice-sheet range, B. One of recession phases of the Odra Stage ice sheet

The range of migrations of these Pre-Neanderthal groups is demarcated by lithic raw materials circulation. Upper Silesian sites are dominated by «northern (erratic) flint» from fluvio-glacial deposits accompanied by mesolocal raw materials from the south (Moravia, Slovakia and Hungary) and from the north (Kielce Plateau and Lublin Upland in Central Poland). The Middle Palaeolithic hunters visited the site at Rozumice several times and were able to identify it very precisely in the morphology of the terrain.

The location of Middle Palaeolithic sites in the front of the retreating ice-sheet was determined by environmental conditions (fig. 1): the landscape relief, the presence of streams and rivers. An important role belonged to the south-north corridor, i.e. to the Moravian Gate. North of the Moravian Gate the main pre-Odra bed and the flood waters forming lakes in front of the outwash plains had to be avoided. Better conditions for communication along the front of the ice-sheet existed in the central part of outwash plains, possibly in some sections of dry beds of older braided rivers where well drained sediments not only made mobility easier but also provided areas suitable for building camps. At the same time clusters of vegetation at the edge of the outwash zones provided food for animals which, probably crossed these terrains in transit to grazing areas.

The settlement situation, documented by archaeological finds, in the foreland of the retreating Odra ice-sheet differs from the situation that can be seen in the Upper Palaeolithic during the ice-sheet recession at the Brandenburg or Pomeranian morains. The Upper Palaeolithic man abandoned the northern part of central Europe already before the maximum glaciation, migrating to refuges in the region of the Middle Danube basin and the Russian Lowland. The Pre-Neanderthals had never wholly abandoned the European Lowland territories (which is documented by the discoveries in northern France, Belgium, Holland and Germany), even immediately before the isotope stage 8 or during stage 6. This phenomenon was probably caused by the climate becoming more oceanic in the cold episodes of the Odra Stage in comparison with the Last Glaciation. Nevertheless, to explain this apparent paradox between the abilities of the Pre-Neanderthal man to adapt to the conditions of the subglacial zone and these of the *Homo sapiens* population in the same conditions, further studies are required.

GEOARCHAEOLOGICAL ASPECTS OF NEW EXCAVATIONS AT THE PALAEOLITHIC SITE OF KULBULAK (UZBEKISTAN)

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Introduction. Kulbulak is an open-air site (41°00′31″ N – 70°00′22″ E), *c.* 1040 m asl, at the foot of the Chatkal range, on the western edge of the Tian-Shan mountains, a few kilometres from the town of Angren (Akhangaran valley, Tashkent region, Uzbekistan; fig. 1).

From 1962 until the 1990s, several excavation campaigns have been carried out in Kulbulak [1, 2, 3]. An area of around 600 m^2 in total has been excavated and one of the trenches reached a maximum depth of 19 m below ground surface (on 3 m^2). According to Kasymov & Grechkina [2] the stratigraphy of Kulbulak corresponds to a long sequence that spans the Lower to Upper Pleistocene; it contains 49 archaeological horizons corresponding (from bottom to top) to 22 «Acheulean» levels, 24 Mousterian levels and three Upper Palaeolithic levels. During these excavations, more than 70,000 artefacts (without systematic sieving) were recovered.

Figure 1. Map of Uzbekistan showing Kulbulak

While several scholars have pointed out the importance of Kulbulak (e.g. [4, 5]), they also stressed the weaknesses and poor quality of the available information, making it difficult to verify the chronological and cultural interpretations proposed by the excavators. In 2007, an international collaboration was established to undertake new excavations at Kulbulak. At present, four campaigns have been successfully carried out. This paper reports on the preliminary results and geoarchaeological aspects of these new excavations.

Results of recent excavations. The excavation surface corresponds to 36 m^2, in three different areas, and two stratigraphic profiles have been cleaned on the sides of Kasymov's former trench. The current stratigraphy is 20 m deep and consists of 24 geological layers (fig. 2), some of which contain archaeological material (layers 2.1, 2.2, 3,12–18 & 23).

At present, the chronostratigraphy is based on two absolute dates only: optically stimulated luminescence (OSL) dating of sedimentary quartz from the base of layer 7b, and the top of layer 8 yielded results of 53 ± 10 ka (GLL-070304) and 50 ± 5 ka (GLL-070305), respectively. Although the luminescence characteristics of the quartz samples require further investigation, these initial results are consistent with the stratigraphic position of the samples and with the geological and archaeological expectation. Further luminescence investigations, including the dating of additional samples, are in progress.

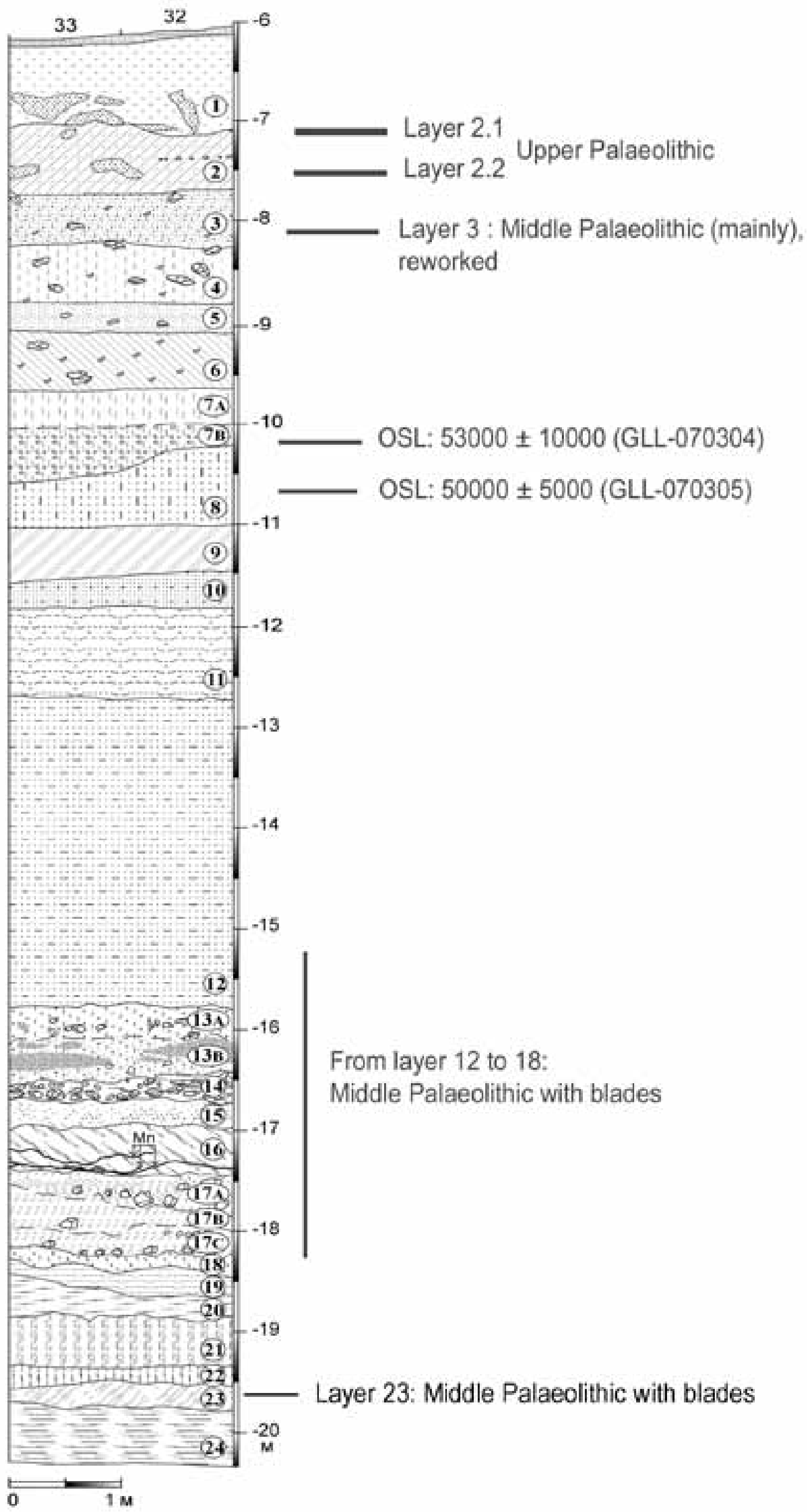

Figure 2. Kulbulak stratigraphy (after the 2010 excavations)

Upper Palaeolithic. A very large assemblage was found in layers 2.1 and 2.2 (more than 40,000 artefacts, including those recovered by sieving), in a greenish clayey proluvial deposit related to a spring. Most of the finds come from a concentrated archaeological horizon within layer 2.1. A second (much less abundant) horizon is present in underlying layer 2.2. The main part of the assemblage corresponds to knapping activities made on local raw material (flint outcrops and river pebbles available within a 2 km range). Blank production corresponds mainly to blades (from volumetric cores) and abundant bladelet and microblade production using different methods. Among these methods, the most striking is microblade debitage from carinated or nosed «endscrapers» (fig. 3). Some of these microblades were retouched (lateral direct retouch on one or two edges, one partially backed by abrupt retouch, one with inverse retouch). Two geometric triangles were also found, but one of them out of context. Apart from these retouched bladelets, the tool-kit is dominated by endscrapers (on blades) and splintered pieces.

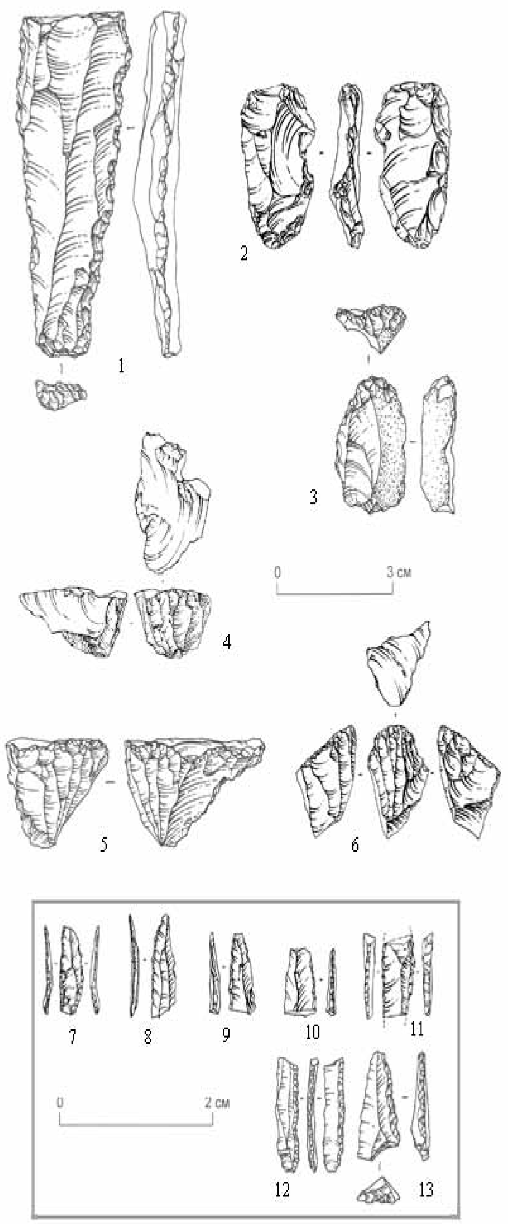

Figure 3. Lithic artefacts from layer 2.1. 1) Retouched blade; 2) splintered piece; 3) endscraper; 4–6) bladelets cores (carinated endscrapers); 7–13) (double scale) retouched bladelets (7–11 with direct retouch; 12 with direct and inverse retouch; 13 is a triangle)

Several arguments support the attribution of these assemblages to the Upper Palaeolithic. They show similarities (bladelet production from carinated «endscrapers», kinds of retouched bladelets, presence of geometric triangles, importance of endscrapers and splintered pieces) with a recently excavated Uzbek open-air site, Dodekatym II, where one of the levels has been ^{14}C dated to around 23 ka BP [6]. Bladelet production from 'carinated endcrapers' is also present in the Kara Kamar Cave sequence (northern Afghanistan, [7, 8]), dated between 35 ka and 25 ka BP.

Middle Palaeolithic. In layer 3, a strongly reworked industry has been discovered, probably corresponding to a heterogenous assemblage catched in colluvium deposited under high-energy circumstances. This industry shows a mixed Upper and Middle Palaeolithic technology (flake production from discoidal cores and bladelet carinated cores) and a tool-kit containing some side-scrapers. The assemblage also includes many pseudo-tools (denticulate-like) due to edge damage during colluvial reworking processes; this observation contradicts the cultural interpretations («Mousterian with denticulates», «Tayacian», and a long tradition of denticulates in the Kulbulak sequence) made by Kasymov [2]. Layers 4 to 11 appear to be archaeologically sterile (based on observations while cleaning Kasymov's trench), but underlying layers (12–18) once again contain artefacts. At least one clear archaeological horizon has been observed in this part of the stratification (layer 16), which contains a small concentration of debitage products with some refitting. All other excavated deposits in this part contain isolated artefacts (fig. 4). Deeper, a more important concentration (around 4,000 artefacts on 6 m²) have been found in layer 23. This lowermost industry is also marked by the presence of blade production (blades showing thick, sometimes facetted, platforms) and bladelets (fig. 5). This kind of early blade production may be compared with Obi-Rakhmat rockshelter (Uzbekistan, several layers estimated between 100 ka BP and 40 ka BP [9]). Our excavations show that there is no trace of a Lower Palaeolithic or «Acheulean» industry as originally proposed by Kasymov [1, 2].

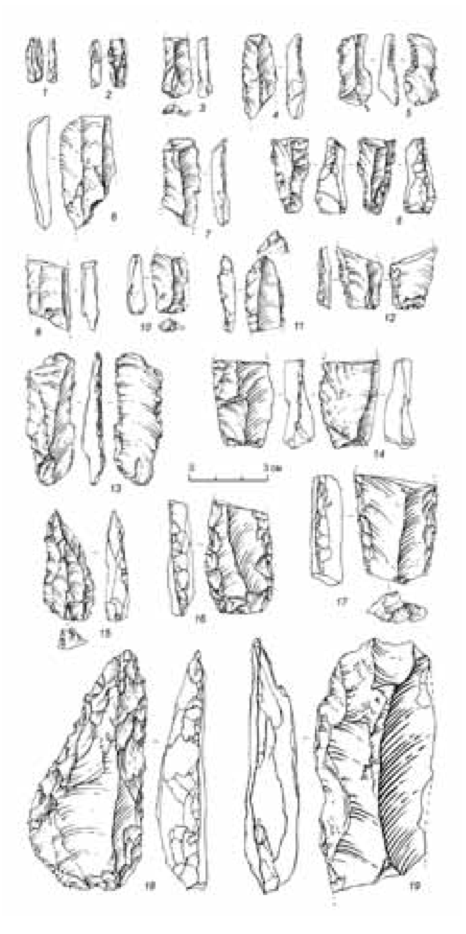

Figure 4. Lithic artefacts from layers 12–18: 1–4) retouched blades; 5) blade; 6) burin-core; 7) core

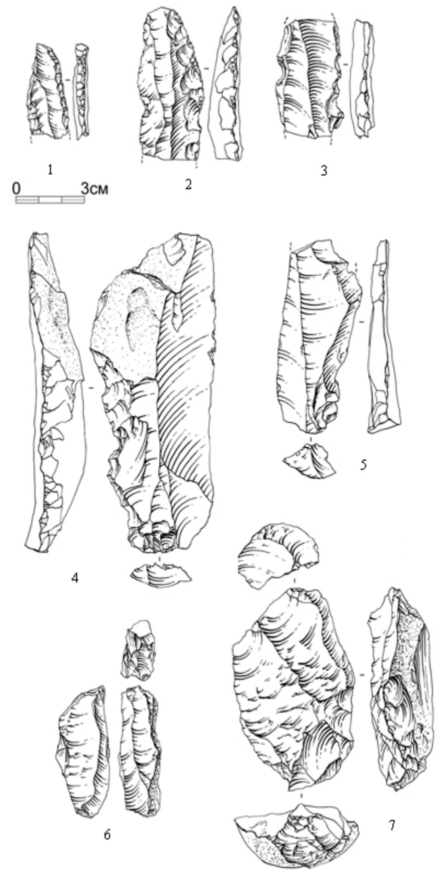

Figure 5. Lithic artefacts from layer 23. 1-5) bladelets; 6-7, 9-11, 13-14, 19) blades; 8) sidescraper; 12, 16-17) retouched blades; 15) point; 18)Mousterian point

Conclusion. The new excavations at Kulbulak have provided new data enabling us to re-evaluate this site and its place in the Palaeolithic of central Asia. The presence of a Lower Palaeolithic industry is not demonstrated and with respect to the Mousterian artefacts, the importance of the «denticulates» seems to be taphonomic, related to colluvial reworking processes. Moreover, the interpretation of the Upper Palaeolithic assemblages at Kulbulak has been deeply altered by the recognition of the importance of microblade production. This new project has also provided the first absolute dates. These results now make it possible to include the Kulbulak industries in the discussion of Middle Palaeolithic blade assemblages and Upper Palaeolithic industries with microblade carinated cores in central Asia. The site will be playing a role in addressing several related issues: the early blades and bladelets productions in Central Asia, the Middle to Upper Palaeolithic transition and hypotheses about the Aurignacian complex in these regions [8, 10, 11].

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PALAEOGEOGRAPHICAL RECONSTRUCTION AND MANAGEMENT CHALLENGES OF AN ARCHAEOLOGICAL SITE LISTED BY UNESCO: THE CASE OF THE LETOONSHRINE IN THE XANTHOS PLAIN (TURKEY)

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During the Hellenisticperiod, Xanthos and Letoonused to berespectively a large city and an important shrine in Lycia. Huge question marks stillremain about the geography of the EşenÇayı delta thatused to surround the Letoonshrineat the Lycian and Hellenisticperiods, thatisduring the first millennium BC: whatwere the features of the landscapesurrounding the Letoonshrine? Wheredid the riverbed lie? Startingwithsuch questions, ourreasoningisbased on a reconstruction of the geomorphologicaldynamicsatworkduring the Holocene. The papermakes use of resultsobtainedfromanalysis of cores and geophysicalprofiling. These are then broughtinto contact withhistorical, archaeological and literary sources. So sedimentarysampling shows that a marine baywasgraduallyclosedduring the formation of a coastlinespit, whichled to the development of a lagoon system. Lagoons and marshesremainedpredominantcharacteristics of the plain oveer a long period. A branch or a former channel of of the EşenÇayıwasdiscovered close to the Letoonshrine and thiscouldperhaps have provided a direct link via the river between the shrine and theseadownstream, and upstream to the city of Xanthos, whileat the same time contributing to the slow engulfment of the shrine in alluvium. In recentdecades, there have been a growingnumber of palaeoenvironmental and palaeogeographical reconstructions carried out around the main archaelogical sites of the Mediterranean areas, and at the same time the authorities, as well as UNESCO, are nowmaking an effort to put theseresults to good use in their promotion of the touristpotential of thesearchaeological sites. The presentpaperis the management project for the Letoon site, shortly to besubmitted to the Turkishauthorities.

THE DYNAMIC LANDSCAPE. METHODS, RESULTS AND PERSPECTIVES OF THE INTERACTION BETWEEN ARCHAEOLOGY, GEOMORPHOLOGY AND ARCHAEOBOTANY IN THE EXPERIENCE OF EGIALEA SURVEY PROJECT (GREECE)

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This paper describes the project of survey in Egialea (Greece) – a collaboration among the VI Eforia to the Prehistoric and Classical Antiquities of Patrasso, the Italian

Archeological School of Athens, the KERA, and the Department of Cultural Heritage of the University of Salerno - issued from the demand to contribute to the knowledge of Oriental Acaia territory. It focus on survey's method based on advanced technological tools, integrated with traditional examination techniques. In detail, it deals about the issue of the formulation of an intervention coherent with territory's reality, research's goals and human and instrumental resources available. The goal of Egialea survey project was to contribute to the knowledge of Eastern Acaia, the first establishment of Western Greek colonies [1].

The survey's area was taken from the river basin of the Krios. The river drains into a wide basin of about 100 km^2, to the east is the massive, inaccessible Mount Evrostina (about 2000 meters high.). The valley is filled with numerous crossing streams and brooks flowing into the Krios creating deep trenches within the valley. In the innermost part of the Krios the landscape changes into the open Arcadia (fig. 1).

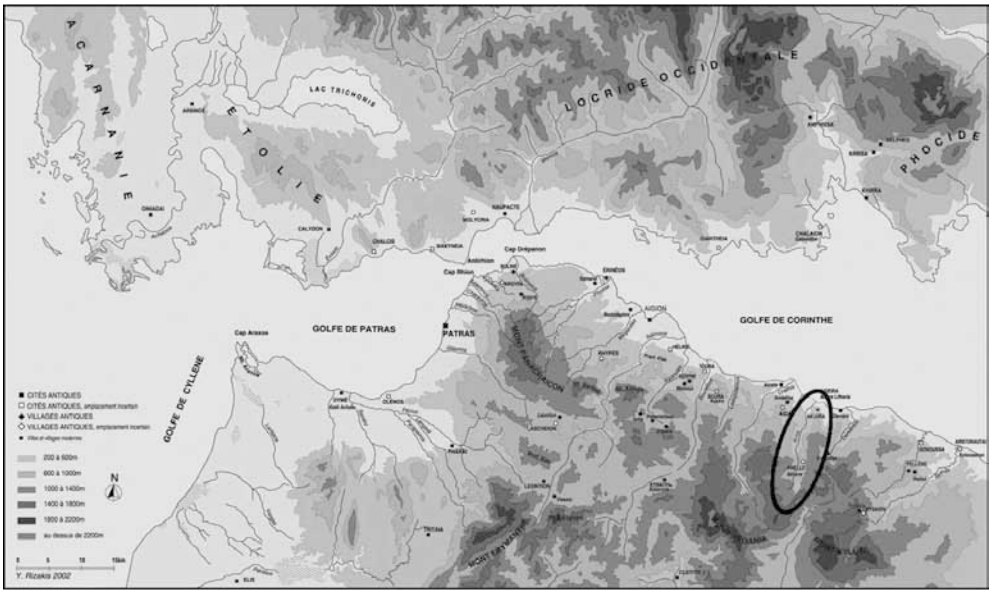

Figure 1. The Krios valley in the Eastern region of Acaia (Greece)

As for the whole north side of the Peloponnese, this region is made up of geological formations belonging to the Plio-Quaternary delta. The latter, due to the constant lifting of the south rim of the Gulf of Corinth, are now arranged in altitude and are subject to intense erosion, from the time of emplacement. It is particularly effective in terrigenous rocks as the Plio-Calabrian marls, covering most of the area under review; marls are submitted to more resistant Plio-Calabrian conglomerates.

The constant lifting and lithology, favorable to the development of forms of erosion, explain the importance of the incision and erosion of the valleys, linear regression, the tributaries of the Krios. The incision is continued in talwegs. Nowhere alluvial terraces are observed. On the slopes are concentrated in a particular way large landslides, formed by actions of runoff water.

The survey methods employed were based upon systematic and asystematic strategies with extensive and intensive character. The aim of the asystematic survey was to acquire wider knowledge of territory along both sides of the Krios, while at the same time to georeference archaeological evidence noted in bibliography and also known spoken about in traditional stories around the area. The systematic survey was used in a sample area (fig. 2).

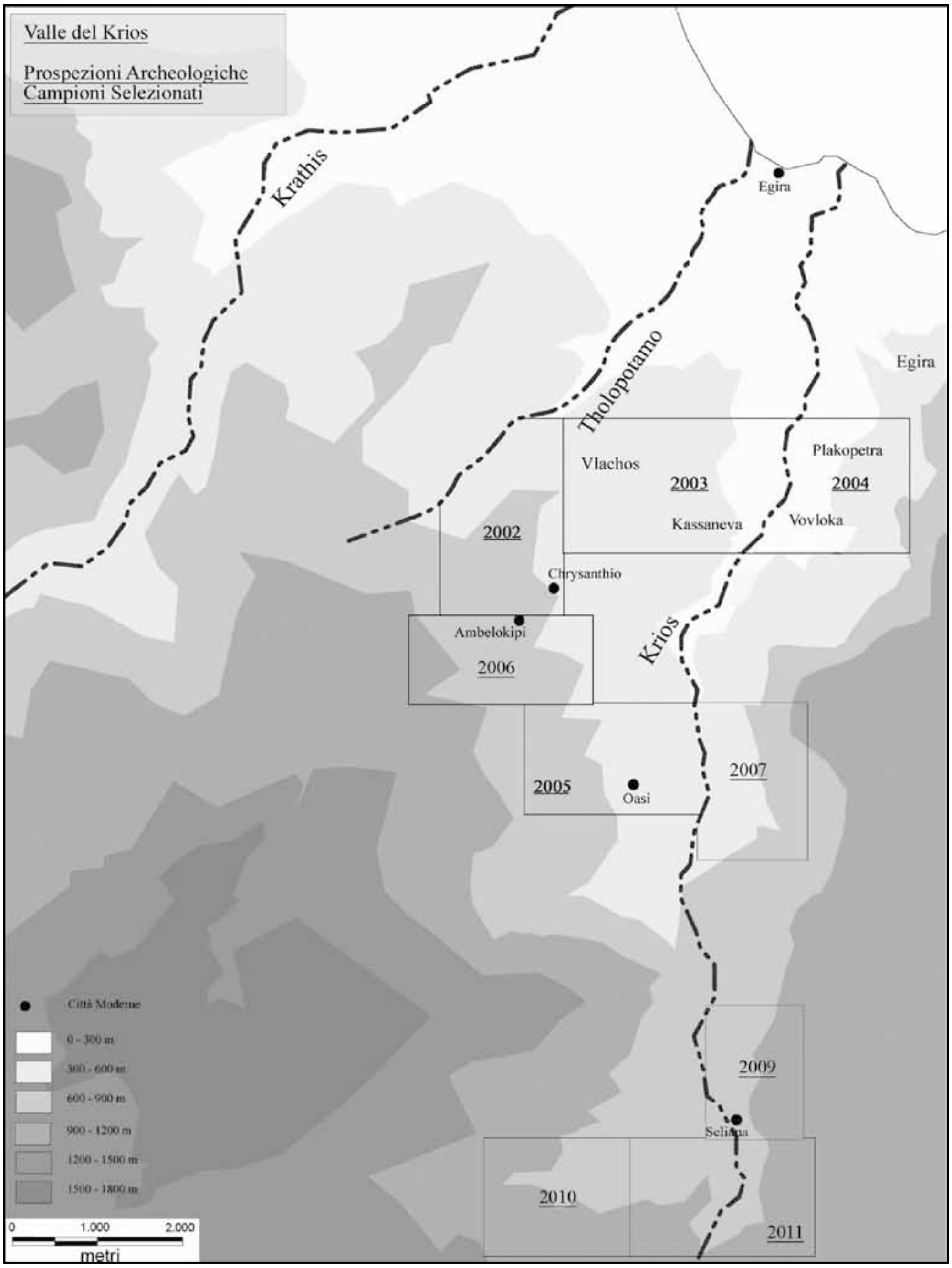

Figure 2. The Krios valley, systematic survey area samples

The general aim is to create a stratigraphical scheme of natural and anthropic activities, that through the course of time determined different landscapes [2].

The awareness that landscapes are a dynamic realization, that move over time with different rates of transformation, has led us to plan an intensive survey program of geo-environmental investigations. The connection between environmental and anthropogenic aspects survive, even now, in specific physical realities. They offer themselves to our analysis, as a stratified elements of broad and diversified value.

Discover and assign one or more historical significance means giving value to the constituent elements of the landscape.

In this sense, the research goes to a development project, where the object of scientific inquiry turns into an attractive cultural dimension.

From a conceptual point of view, the reality of the landscapes is considered as a system with many variables, each of them carries its own syntax in time and participates with its own degree of conditioning to the construction of the other.

The dynamic landscape is the result of a gradual process of layering. It is not locked in an instant of time, being in constant change due to the contribution of human activities in conjunction with natural processes. It may not have an evolution of linear type. This implies the need to define transformations and overlaps in topological terms: the relationships of the shapes of the landscape is a continuous function of the changes.

In this framework we have set up a multidisciplinary research which brings together archaeological analysis, vegetation and geomorphology.

The study of vegetation in a given area provides a useful opportunity to interpret the dynamics of transformation of the surrounding environment.

The purpose of this study, in the valley of the Krios, lies not in the mere enumeration of the species present, but aims at understanding the relationship man-environment over the centuries.

The analysis of the vegetal component, as a function of the understanding of landscape features, was carried out in order to grasp the relationship between populated areas and uncultivated spaces, the potential supply basins, the vegetational associations in relation to geomorphology, hydrology and distribution of settlements, the changes in the structure of soils.

Essential step of the research has involved the mapping of taxa, working not only a medium-scale phytogeographical distribution, but by relating the survey areas with the processing structures of plant products, such as mills and barns. This enabled us to trace the mode of exploitation of the land cover, shrub and tree.

The geomorphological analysis was conducted to determine the evolution, over the past few thousand years, of physical and morphological characteristics of the territory. Were sought the reasons could be more favorable to the population.

The main objective assigned to this survey was to map areas of low surface dynamics, where archaeological facilities had a high probability of being found in place, and areas of unstable slopes where it was unlikely.

In general, there are three major sets topographic. Two are favorable to the arrangement in situ of archaeological sites and are interested only by surface runoff and colluvial that can reach two meters in thickness.

The secondary objective was to attempt to determine, with the archaeologists, the geological nature of some anthropic locations e some topographic and geological anomalies (benches, stone lines, rock outcrops etc.), identified during the survey.

We, therefore, agreed, from a field survey, an observation of topographic maps at 1 / 5000 and aerial photographs to draw a thematic map that summarizes the information sought by archaeologists. We therefore distinguish geomorphological units very stable throughout the Holocene, and sectors with high instability. Finally we produced a simplified document which distinguishes at once the most favorable areas for prospecting, based on geomorphological evidence.

The different levels of information and the assumption of a conceptual object of investigation, extremely dynamic, have imposed the adoption of a GIS system, fitted with appropriate logical and functional modifications to the registration, management and data analysis.

The result is a tool, and a documentary base, able to integrate and to propose multitemporal frameworks [3].

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REMOTE SENSING IN THE STUDY OF IRRIGATION OF THE DARGOM AREA

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1. The Samarkand Region of Uzbekistan is situated in the middle reaches of the Zeravshan on the left bank of its southern branch, the Karadarya. Its geomorphology is characterized by a combination of wide flood-lands and terraces of the Zeravshan river, the foothill loess valleys and *adyr*'s. It is one of the oldest Central Asian regions with the buried anthropogenous landscape formed by agro-irrigation and occupation deposits.

Favourable physical-geographical conditions and a mild climate, river valleys with fertile soils and the abundance of natural resources were conducive to human occupation of the region from time immemorial and the development of irrigational farming.

2. Intensive farming hampers the search for ancient irrigation networks. Aerial photography, however, offers much scope for the study of historic landscape. While reconstructing the evolution of irrigation in the Dargom area we have used the photographs taken in (M 1 : 12000, M 1 : 36000; M 1 : 39 000) as well as maps published in the late 19th – early 20th century and in the 1950s – 1970s (M 1 : 100 000).

Varieties of standard photographs of both visible and invisible parts of natural and irrigational systems were systematised in the course of deciphering and divided into two blocks: Б.1 and Б.2.

Block Б.1 is represented by natural land and water arteries.

Block Б.2 is constituted by irrigating mains (Б.2а); drains (Б.2б); lasting meandering channels with considerable flood-lands (Б.2в); channels with high banks and eroding ravines (Б.2г); dammed courses and embankments of channels (Б.2д); distributive water developments (Б.2е); and small-scale nets of irrigation channels (Б.2ж).

Methods of relative dating developed in aerial archaeology and involving complex archaeological-geographical research, namely the study of morphology and hydrography of channels and river-beds, multi-layer intersections of irrigation systems and roads were used to date the lifetime of the recorded natural and artificial arteries [1, 2, 3].

Meridional courses of the Agalyksai, Kapakqulsai, Tepaqulsai and Sazangasai drying-up rivulets (Б.Ia) cross large valleys in the southern part of the Pastdargom area. The majority of photographs show old riverbeds (Б.1б) and irrigation systems pertaining to them (Б.2а, б, е) on the left banks of these rivulets.

The analysis of the archaeological record and photographs enabled us to trace the evolution of irrigation in the Tepaqulsai and Sazagansai interfluve during three periods: I the 5^{th} – 4^{th} century BC; II the 3^{rd} – 1^{st} century BC; and III the 1^{st} – 5^{th} century AD.

The first period saw the functioning of the Теп.2а, б / 1,2 irrigation system. The latter was possibly enlarged in the 4^{th} century BC by means of extending the main canal with a series of meridional diversion channels in westerly direction (Теп.2а, б / 2,2). An irrigation system whereby water was diverted from a Sazagansai branch (Саз.1а/2) functioned in the west part of the area at that time. It included south-east oriented canals with a latitudinal canal approaching the Tepaqulsai irrigation net (Теп.2а / 2) in the east (fig. 1).

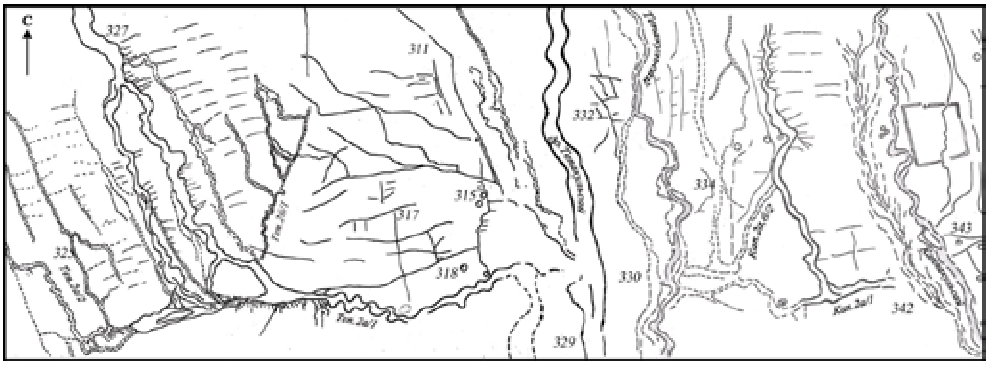

Figure 1. Irrigation systems in the Tepaqulsai and Sazagansai interfluve

The hydrographic pattern and morphological characteristics of the canals, the difference of the dimensions within the Tepaqulsai irrigation system (Теп.2 а,б / 1), channels diverted from the irrigation main at right angle, fork-shaped hydro-schemes and analogies in irrigation networks in other parts of Central Asia enable us to date them to the ancient period.

During the second period (the 3^{rd} – 1^{st} century BC) canals became narrower and longer yet meridional channels were still diverted from the latitudinal irrigation main at right angle as in Саз.2б / 1. Ancient and Hellenistic irrigation networks were renovated and widened, the straightened-out channel beds became meandering and by the Early Middle Ages (the third period) long narrow canals with a sophisticated irrigation network had prevailed in the region.

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EVALUATION OF LARGE RESERVOIRS AND RIVER SYSTEMS ACTIVITY AS A FACTOR OF ARCHAEOLOGICAL MONUMENTS DESTRUCTION WITH REMOTE SENSING DATA USAGE (VOLGA-KAMA REGION)

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The problem of conservation of archaeological heritage is highly relevant For the Republic of Tatarstan (RT), because in its territory identified, studied and registered around 4,300 archaeological sites [1]. Most of archeological sites from the Mesolithic to the late Middle Ages, situated in the coastal zone, which is due to the nature of human life in the past [2]. According to the 2011 approximately 2905 monuments of archeology are destroyed each year in the Republic of Tatarstan, including the area of the Kuibyshev and Nizhnekamsk reservoirs 942 objects are identified. Monuments placed on the slopes of river valleys, also can be destroyed as a result of various slope processes and river erosion, but the targeted study of their condition not have been performed. Approximately 75 % of the Kuibyshev reservoir shores and more than 290 km of small rivers shores in RT affected by dangerous exogenous processes [3, 4].

Today is necessary to provide security and conduct large-scale rescue operations at the destructible objects to preserve the historical heritage in Tatarstan. It is necessary to use modern technologies in field identification of monuments destruction processes. Thus, when the cultural object in closely located to the abrasive ledge or brow, tacheometry or GPS-survey is necessary for exact object location binding. Obtained results comparison with topographical maps and remotely sensed data using GIS technology will allow to estimate the rate of hazardous processes and, thus, to determine the risk of destruction of the monument.

As a result of remote sensing data processing and monitoring data we have identified areas in the zone of Kuibyshev reservoir influence and along the banks of small and medium-sized rivers, with lots of archaeological sites and intensive destruction processes.

Thus, nearby Comintern settlement and Izmery village of the Spassky district, «Devitchiy gorodok» hillfort was placed (1.06 hectares square), now completely destroyed by Kuibyshev reservoir waters. As a result of analysis on the basis of remote sensing data (1958–1980–2011) de-encryption, the monument exact location determined, its form restored, and dynamics of coastline retreat at its placement evaluated. Coastline retreated here in the period from 1958 to 2011 to a maximum distance 318 m, large area was washed away (10.3 ha).

Another complex of monuments – Ostolopovskoe hillfort, Ostolopovsky burial and Ostolopovskie Settlements I and II – located on the shore of the Kuibyshev reservoir at the mouth of Shentala river (Alexeevsky District RT). The displacement of coastline (1958-2005) studied with the help of multi-temporal remote sensing data. The distance of coastal retreat varies from 0.75 to 1.4 m per year. Archaeological site Ostolopovskoe Settelement I, is mostly destroyed by permanent abrasion processes. During the study period the area of 2.74 hectares washed away, cultural layers were destroyed, maximum displacement speed is 1.4 m per year.

Burakovsky hillfort surveying also showed a slope edge retreat (20-30 m) as a result of landslide processes provoked by washing away the river floodplain terraces. Thus, the rate of destruction is 1-1.5 m per year. Also we have fixed the destruction of Lukovskoe (Yapanchinskoe) hillfort and Tankeevsky cemetery, located in the area of washing away slopes of the Kubnya and Utka Rivers.

Cultural heritage sites monitoring, with information about the chronology, cultural layer value, settlement specifics, etc., taking into account the methods used in landscape ecology and field archaeological survey, allows to evaluate damage and the intensity of archaeological sites destruction through the dangerous exogenous processes estimation. Exogenous processes data and archaeological GIS integration will form unified system of archaeological rescue works, will provide analysis of large amount data in a short time, to update and enter new data, etc.

This approach will help to determine the most problematic areas, in their funding valuation and archeological excavations planning and broaden knowledge about the past of the peoples living in the modern Tatarstan Republic territory.

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GEOARCHAEOLOGICAL DATA ON RAPID ENVIRONMENTAL CHANGES AND CATASTROPHES IN KARELIAN ISTHMUS, NW RUSSIA

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Karelian Isthmus is situated between the Gulf of Finland and the Ladoga Lake. During the Holocene time this territory was many times affected by water level oscillations of the Baltic, as well as of the Ladoga lake, which is the largest fresh aquatic body in Europe. Moreover, during the whole Holocene time the Karelian Isthmus relief has been affecting by the isostatic uplift of the Earth core, with a gradient growing from the South-East to the North-West. Surface spots, which had an equal elevation above the sea level at the certain moment of time, now are at different elevations - higher to the

North-West and lower to the South-East. The tilt gradient was at its maximum in the beginning of the Holocene, and then was getting lower towards the present time. The isostatic uplift caused several significant rearrangements of the hydrological system in the region [1].

Ancient shorelines displacement studies were always in a focus of the regional palaeogeographical studies. Lake and bog sediments are usually supposed as the main sources for reconstructing of ancient shores using so-called «cascade» method. During the regression phase small lakes become separated from the main water body, and this change the sedimentation process; during the transgression phase small lakes can join the main water body again, which also caused changes in sedimentation. Studying of lake / bog sediment cores by a set of natural science methods (lithology, palynology, diatom and geochemical analyses), allows to define margins between the sediments of a large aquatic body and the sediments of small lakes and bogs. These margins can be dated by radiocarbon method. The threshold of the small lake or bog shows the lowest possible water level of the main aquatic body at the time when this small lake or bog was a part of it.

Elevation measuring of ancient terraces, which were formed during the periods of water level stabilization, also gives the possibility to define the water level at the certain period of the past. But it is rather difficult to define the terrace that was formed during the period of accumulation of the certain layer in the lake / bog sediment sequence. Several continuing transgression and regression phases produce overlaying of similar geomorphological objects of different age. For this case costal archaeological sites provide very important information for shoreline displacement study. Sites location changed following the shoreline displacement. Synchronous sites, which situated at the shores of the same aquatic body, mark the maximum of the water level for the time of those sites functioning. Location of those sites at different elevation allows calculating an isostatic tilt gradient for the certain period of time. Transgression phases are marked by the archaeologically «clean» layers in profiles of multilayer sites. Specific of Karelian Isthmus geographical position and geological history determined formation of archaeological sites, where archaeological contexts of different periods (from Mesolithic to the Roman Age) are presented in stratigraphic order; and separated or overlapped by sediments of water transgression phases. Well-studied palaeogeography of the region and possibility to date those contexts within rather narrow chronological intervals allow using such sites for geochronology studies in Karelian Isthmus as well as in the neighboring regions.

The Gulf of Finland region was mainly deglaciated between 10 800–10 300 BC (10 800–10 300 bp – here and further in the article the dates are presented in calibrated calendar years in BC format, with the original radiocarbon dates or the respective radiocarbon age in the brackets). After deglaciation Karelian Isthmus was mainly covered by the ice-dammed Baltic Ice Lake (BIL). According to the paleographic data the level of the BIL at the south coast of the Gulf of Finland was between the present 30 m and 70 m elevations above sea level, and reached the present 150 m elevation above sea level at the northern coast [2].

About 9 600 BC (10 000 bp) the water breakthrough near Billingen mounting, Central Sweden, resulted in catastrophic drop of the BIL to the ocean level, which at that period was lower than today. Apparently the water level in the Baltic region dropped by approximately 25 m during a relatively short period of time [3]. After the alignment of the BIL and the ocean levels a short-term stage of the Yoldia Sea with rather high salinity occurred. Relatively soon a threshold appeared in the strait in Central Sweden because of continuing of isostatic uplift. About 9 000 BC (9 500 bp) the aquatic system of the region was again separated from the ocean.

That was the beginning of a fresh-water Ancylus Lake stage. Continuation of the threshold uplift caused the rise of the water level known as the Ancylus transgression. The shorelines of the Ancylus Lake were registered at various levels in different parts of the region – from 10 m to 35 m above the present sea level in the southern part of the Gulf of Finland, at the 25 m–30 m elevations above sea level in the northern part of the Karelian Isthmus, and up to 112 m above sea level in central Finland [1].

The first archeological evidence of human penetration to this territory was related to the period of the spreading of boreal forests (the transition from the Preboreal to the Boreal period according to the palynological periodization), coinciding with the maximum of the Ancylus transgression, which culminated not later than 8 200 cal. BC. The earliest archeological sites in Karelian Isthmus are presented by Antrea Korpilahti, Borovskoye 1 and 2.

After 8 200 BC (9 000 bp) the overflowing Ancylus Lake reservoir found a new drainage through the newly formed Danish Straits. Radiocarbon dates obtained for those layers demonstrate smooth and long-term decreasing of the water level, which continued till approximately 7 200 BC (8 200 bp). Within the interval 7 200–6 800 BC (about 8 000 bp) the level of the Ancylus Lake became equal to the ocean. That was the beginning of the new brackish water phase of the Baltic Sea – the Lithorina Sea stage. The destruction of the Ice Shields in the North of Eurasia and North America caused eustatic rise of the ocean level. In the Baltic region this water rise is known as Lithorina transgression and dated within the interval 6 400–3 100 BC (7 500–4 500 bp). The transgression maximum is dated about 5 500–4 800 BC (6 500–6 000 bp). This and some other factors provoked an increase of the average annual temperatures and a significant climate warming [2, 3].

Environmental changes about 7 200 BC (8 200 bp) marked the beginning of the Atlantic period according to the climatic periodization – the time of the so called Holocene optimum. Broad-leaved tree species became common in the Gulf of Finland region. As a result of the rise of sea level numerous shallow water areas with islands and deep bays formed near the coast.

A specific cultural phenomenon appeared in the Karelian Isthmus and the Lake Saimaa area. Two large fresh-water basins existed within this territory – the Ladoga lake, which is for now the largest in Europe, and the Great Saimaa Lake, which prior to the formation of the Vuoksi river about 3 700 BC (5 000 bp) was several times larger than now. Subspecies of ringed seal were formed in both of those two huge fresh water basins. Numerous Stone Age settlements (several thousand of them are known) were located along the shores of the Ladoga Lake and the Great Saimaa Lake. The settlements, including the settlements of year-round occupation with the remains of dwelling depressions were mainly concentrated at the shores of former sounds, bays, islands, and also channels which connected the Great Saimaa Lake and the Ladoga Lake to the Gulf of Finland. Such location of settlements allows exploitation of forest resources and seal hunting in the settlement neighborhood with no lack of fresh water.

A significant amount of the late Mesolithic and the Neolithic sites were located close to the shorelines of the Littorina Sea. However it should be noted that the number of the discovered Late Mesolithic complexes in the eastern part of the Gulf of Finland region was several times lower than the number of the known Neolithic complexes. Many of the Late Mesolithic sites were covered by the sediments of the Littorina. Lithorina transgression affected the whole Baltic catchment. Not only coastal sites were flooded, but also the sites situated at channels, like Ozernoye 3, Bolshoje Zavetnoje 4, Veschevo 1. Many Late Mesolithic complexes which were not covered by Lithorina sediments have been discovered along the shorelines of the Littorina Sea on the northern coast of the Gulf of Finland in Finland, as well as on the southern coast – in the northern and the north-western part of Estonia, where the speed of isostatic uplift exceeded the rate of eustatic rise of the water level [4].

Continuing isostatic uplift closed the drainage of the Great Saimaa Lake, previously flowed to the Gulf of Bothnia, and about 3700 BC (5000 bp) a new drainage appeared – the Vuoksi river flowed to the Ladoga Lake. The Vuoksi breakthrough was a rapid catastrophic event. There were no signs of it defined in Karelian Isthmus lake and bog sediments, but it is well-recorded in stratigraphy of several archaeological sites – Kurkijoki 33, 35, Silino, Komsomolskoye 3, Veschevo 1 and 2. Rather soon after the Vuoksi breakthrough people came back to the original settlement places.

The isostatic uplift also caused a long-time Ladoga transgression. The threshold of the Hejnijoki strait in the northern part of the isthmus, which connected the Ladoga Lake to the Gulf of Finland during the Stone Age time, gradually raised up, and the lake bath gradually tilted to the south-east direction. Large territories in the southern part of the Ladoga coast were flooded, and Neolithic archaeological sites were covered by water sediments. This was first mentioned by A.A. Inostrantsev in his famous work of 1882. Some archaeological sites in Karelian Isthmus, such as Komsomolskoye 3, were also covered by Ladoga transgression sediments.

Ladoga transgression culminated with the Neva river breakthrough about 1200 BC (3000 bp). After that water level in Ladoga felt down up to 10 m. That abrupt change caused a new rearrangement of settlement pattern in the isthmus.

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DAMAGING EFFECTS OF CLIMATE CHANGE ON PLAYA GEOTOURISM, GAVKHOUNI

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Introduction. Gavkhouni as a closed basin is a playa at the end of Zayandehroud River in the southeast of Isfahan (located on North from 31°37' to 31°47' and on East from 52°12' to 53°35'). The playa was introduced as a global wetland whose special geographic, natural and environmental characteristics made it a wetland that scarcely can be found in the world [1]. Gavkhouni has an especial place for desert geotourism because of the beautiful micro-geomorphological landforms of evaporative minerals, particularly sodium chloro, and of its proximity to the historical city of Isfahan. During the recent years the closure of Zayandehroud River flow into Gavkhouni caused a decline in ground water level and an extreme dryness and consequent wind erosion for saline landforms. The research was carried out for the purpose that the desert landforms were evolved through a long period of climatic variations and their conservation will be possible just by conserving the desert ecosystem of the area.

Material and Method. The area of Gavkhouni Watershed has been drawn based on topographic map, at scale of 1 : 25000, and on digital elevation model (DEM). The DEM has been extracted from ASTER Sensor that has pixel size of 30 m.

Geomorphological data were bought about from topographic map, DEM, ETM+ Image in panchromatic band and using visual interpretation method and field observations. As illustrated in Figure 1, there are a variety of special geomorphological units in the area but it is mostly consisted of flat and smooth surfaces. During the field observations many micro landforms can be seen over the surfaces (fig. 2).

From a terrace selected near the entrance of the wetland, up to 10 samples have been collected for morphoscopic and granulometric analysis.

Results. The analysis of geomorphological units map revealed an arid and semiarid climatic condition over the area. The results of granulometric analysis on the 10 samples from the selected terrace indicated that the particles with diameters ranged from -1 to 4 Phi, i.e., the remaining sediments on 230-mesh screen, have the highest frequency of all. This means that the fluvial erosion had the most influence and the sediments were resulted from the fluvial transport. The morphoscopic analysis shows that the trend of abrasion coefficient variations diminishes from the floor upward to the top. It means that the older the sediments, the more rounded they are. This is typical of a gradual reduction in the influence of fluvial erosion toward the recent periods.

Discussion and Conclusion. The results of the studies believe in the geomorphological evolution of Gavkhouni through humid and arid formation periods. As the sampling location is in the terminal part of the Zayandehroud where it was rarely possible for existence of a high discharge and high velocity river flow, it seems that the fluvial sediments had been deposited in a flooding condition. The grain roundness duo to the erosion by running water also indicates fluvial transport of the sediments. Some

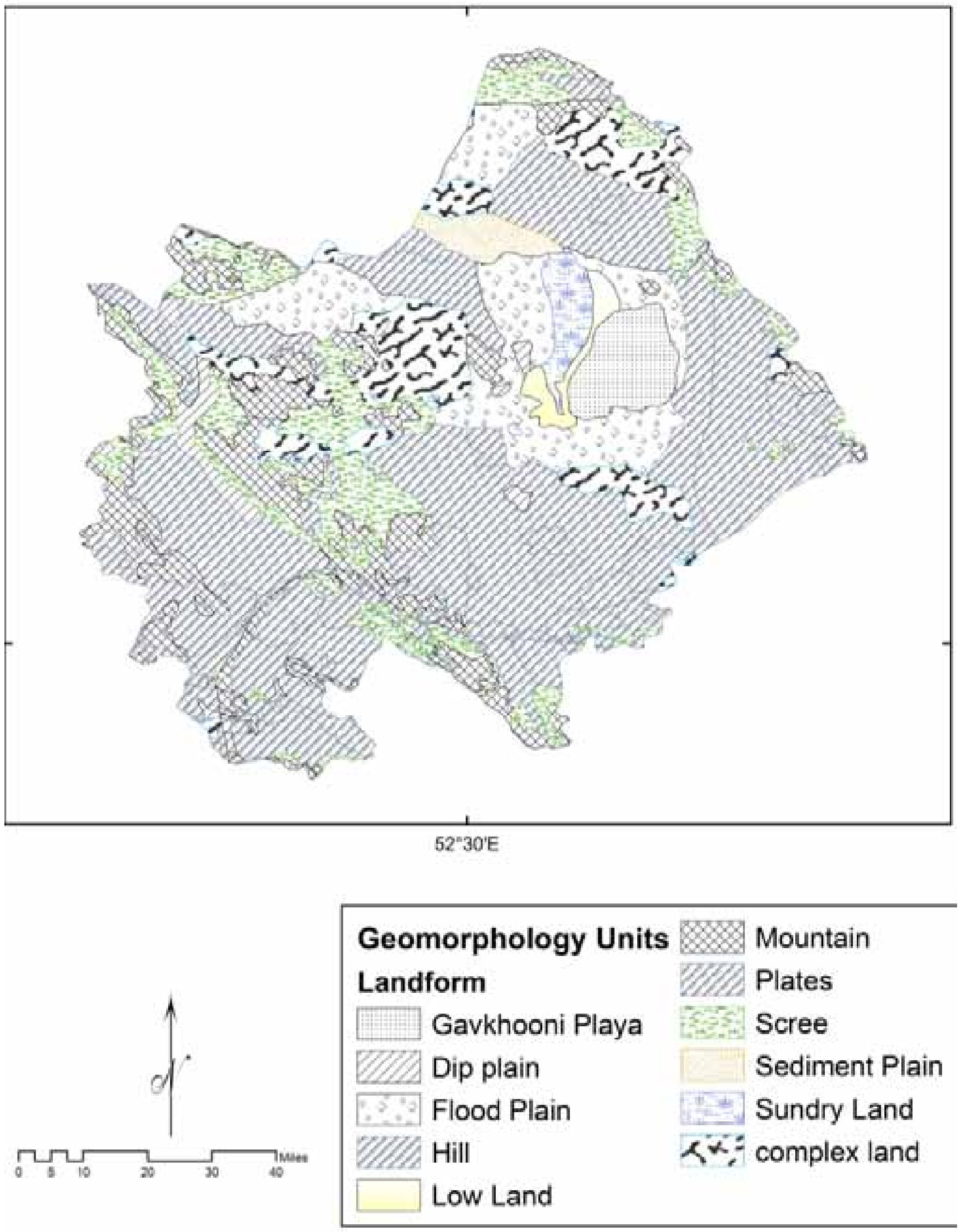

Figure 1. Geomorphology Units in Gavkhouni Basin

samples with coarser grains may represent more discharge and stream power for transport in their corresponding erosion and deposition periods. These results can be accordant with the last glacial period when the central Iran was receiving more precipitation [2]. From the results of morphoscopy and exploring the opaqueness of the grains it can be revealed that the older sediments are more rounded in that, as mentioned earlier, there is a general trend in abrasion coefficients from top to the bottom. This is indicative of a gradual decrease in the influence of fluvial erosion over time to the present or perhaps a relative fall in the precipitation over the area. What is considerable in examining the sand sediments is the existence of the relatively cohesive clay films on the grains that may be resulted from a climate change from more humid condition to arid. Indeed, these films can imply the more humid situations in which a cease in the moisture front could be a cause for particles to adhere on the grains. From the above discussion it can be concluded that the micro landforms of evaporative minerals in the playa were resulted from the long term climate evolution from humid to arid condition and that Zayandehroud River was flowing into the playa because there are wind deposits in the alluvial terrace. Now the human interference as the closure of flow from Zayandehroud River can change the geomorphological system of the playa and may completely desiccate it and destroy desert geotourism in the area.

Figure 2. Salty Micromorphology in Gavkhouni Basin

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LAKE DWELLING RECONSTRUCTIONS AND PUBLIC PRESENTATION: FROM SCIENCE TO TOURISM

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From the beginning of the 20th century, archaeologists have reconstructed many prehistoric lake dwelling houses and other features. Some of them have been made with close links to archaeological research, others have been made for public presentation purpose. One of the oldest in the Pfahlbau Unteruhldingen in Germany (created in 1922).

The UNESCO recognition for 111 prehistoric lake dwelling perialpine settlements in June 2011 should raise the public frequentation [1].

Such reconstitutions are also connected to the important development of popular architectural museums or ecomuseum in central and eastern Europe especially [2].

Ethical questions are involved with archaeological [3].

Some examples taken in France, Switzerland or Germany can illustrate the difficulties to conciliate research, sites preservation and public presentation (fig. 1).

It took place on a site, after the excavation and was used for research purpose and public presentation. The whole archaeological area is protected as historical building since 1911.

Figure 1. House reconstruction at the neolithic lake dwelling settlement in Chalain(France)

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NEW DATA FROM THE PLEISTOCENE OF SARDINIA: THE PALEOLITHIC LANDSCAPE

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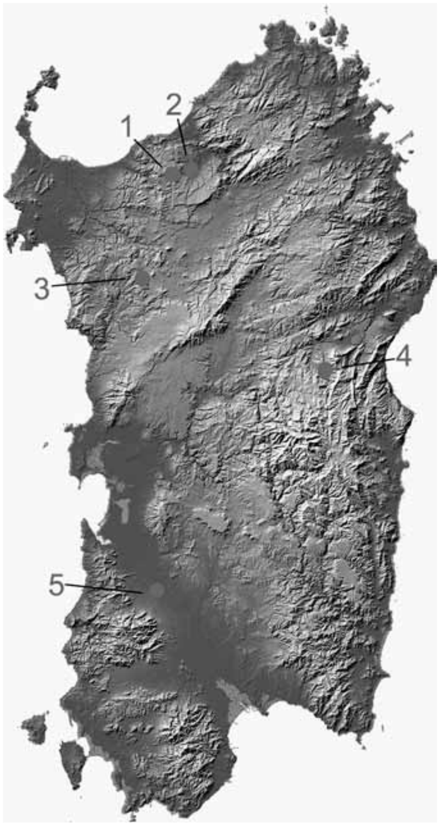

Figure 1. Distribution of palaeolithic sites in the island: 1. Perfugas, 2. Perfugas second gisment, 3. Nurighe cave, 4. Corbeddu cave, 5. S. Maria Is Acquas terrace

The particular condition of the Sardinia's landscape, produced by the prevailing erosive morphogenetic activity during all the Pleistocene, imposes the search of the pre-protohistoric landscape a particular survey. Most geoarchaeological researches uses mainly land surface prospecting in order to identify archaeological features existing in a chosen area. These investigations will serve «natural» subjects as the territorial geography and geomorphology in attempt to reconstruct the paleo environment thought the study of supply basins (two to five kilometers to the agricultural areas, and 10 kilometers to hunting and gathering areas; [1, 2]). This geographic approach can be applied starting from the Neolithic into account the wide variation in the coastline that affected the whole Mediterranean sea, producing a great variation in Sardinia where the continental shelf is more extensive. The reconstruction of the paleo landscape becomes more difficult when you consider the study of the Paleolithic Age, particularly in the lower levels. It appears evident by the geomorphological reconstructions performed in the northern Sardinia where the territory has changed faster, to become unrecognizable today. In the island five sites attributed to the Lower Paleolithic are known, these are located in different spatial contexts (fig. 1). Among these, one has uncertain origin (4 in picture), another place has a precise radiometric dating (3 in picture) and the other ones are dated thought the artefacts (1 and 2 in picture). The sites are located in abandoned river terraces, in the region Anglona (in northern Sardinia) as shown by the morphological reconstructions [3] in this area where the river network still proceeds on the same Paleolithic system, although much more affected (fig. 2). The in southern Sardinia site is located in a low terrace of the wide tectonic plain of Campidano [4]; an important graben which has been affected by a subsidence (more than 100 meters?) during all the Pleistocene [5].

Figure 2. Perfugas site. The creeks round the excavation show the recent cuts of the ancient alluvial sufaces

Figure 3. The 0.4 M.y.b.p. surface near the Nurighe cave (locality 3) like an «Island» in a lower ground. The skyline show the oldier surfaces referable to the early Pleistocene and the end of Pliocene

Two other sites are located in caves, the first (4 in picture, [6]), in which the presence of man is uncertain, is located in a mountain area in the inner island; the second one (3 in picture) documents the presence of man (archaic Neanderthal man?) by the presence of a bone (phalanx) and evidences of scarification in animal bones (Megaceros *cazioti*, Cordy & al., 2001).

The geographical and geomorphological reconstruction has allowed us to recognize, within these areas, the lower and middle Paleolithic surface referable to a period between 300,000 and 500,000 years BP ([7]; fig. 3). These paleo fossils erosional surfaces can be dated with stratigraphic precision thanks to the basic volcanic activities that affected some areas of northern and central eastern Sardinia starting from the end of Pliocene (3 Mybp; [8]).

The geographical and geomorphological method applied to the reconstruction of the background, surfaces and erosional terraces, in an area like Sardinia, allows to «follow» the traces of early human presence in the island's history through the archaeological prospecting targeted still preserved remains of the Paleolithic landscape.

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TRANSFORMATION OF CULTURAL LAYERS BY PEDOGENESIS IN DIFFERENT CLIMATIC ZONES OF RUSSIA

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The specificity of cultural layers (CLs) transformation by the soil forming processes was examined in humid (Moscow region) and arid (Kalmykia) regions. Table 1 shows that the investigated objects are united by two common features: sandy parent material and leading role of the anthropogenic factor in the past.

Humid region is represented by the settlement of the Early Iron Age «Dunino» (archeologist A.A. Alekseev), arid region – by settlement of the Bronze Age «Ar-Dolong» (archeologist P.M. Kol'tzov). Archaeological methods revealed in both regions the presence of ancient settlements: ancient artifacts occur in situ up to the depth 35 cm in the first site, and up to 66 cm in the second site.

Morphological investigation was supplemented by the determination of chemical properties (organic and inorganic, total phosphorus, pH). Radiocarbon dating was performed for humic acids from the organic matter of the ancient cultural layer in arid site. Simultaneously the background soils were used as a reference.

Table 1. Geographical and historical characteristics of study sites.

Characteristics	Ar-Dolong	Dunino
Location	47°42‘50" N; 44°48‘24" E	55°43'20,7" N; 36°55'35,1" E
MAT, ºC	11,1	3,4
MAP, mm yr^{-1}	150–200	550–600
Nature zone	Semi desert	South taiga
Vegetation	Sparse dry steppe	Coniferous and Broad-leaves forest
Parent material	Sand	Sand
Age of the site	Bronze Age	Early Iron Age
Age of modern soil, years	3000–3500	1500–2000

Both ancient settlements were abandoned for a long time. The ancient cultural layers formed in both settlements were not recovered by any sediments i.e. they have been exposed and transformed by processes of soil formation. The duration of soil forming processes was different, not exceeding 2 kyrs in the humid zone, and about 3.0-3.5 kyrs in the arid zone. Post-Urbanozems have been formed in both sites in a course of pedogenesis, with the morphology similar to the zonal soils.

Chemical analyses of the CLs have shown the following (fig. 1). *Post-Urbanozem of the arid zone* is characterized by the formation of horizon of carbonate accumulation, low humus content and its gradual decreasing with depth, which is absolutely similar to the background brown semidesert soil. The only important difference was the character of total phosphorus distribution. Phosphorus is a biophile element and its accumulation in any sediments indicates the input of the organic matter. The concentration of total phosphorus in soils decreases with depth. Its maximal concentration in surface horizons of natural soils of the region does not exceed 0.17 %. The total phosphorus content in the upper 10-cm layer of the post-Urbanozem corresponds to the natural values. This apparently is explained by the vegetation cover, which has re-worked the stores of this element in the root layer. But below 10 cm, the elevated concentration of total phosphorus was preserved permitting to identify the ancient cultural layer. Meanwhile the *post-Urbanozem of the humid zone* became absolutely similar by its chemical properties to zonal Rzhavozem soil. All features and characteristics of the ancient cultural layer have been changed including the concentration and vertical distribution of the total phosphorus.

The lower part of the cultural layer in Ar-Dolong has been sampled for morphological and chemical analyses, and radiocarbon dating of the humic acids. The aim of this investigation was to compare the radiocarbon dating of the organic matter with the archaeological dating based on the artifacts analysis. The obtained data (table 2) confirmed our assumptions about the transformation of the initially uniform CL by the processes of modern soil formation. The radiocarbon dates of humic acids from the CL of the Bronze Age were significantly rejuvenated at a considerable depth.

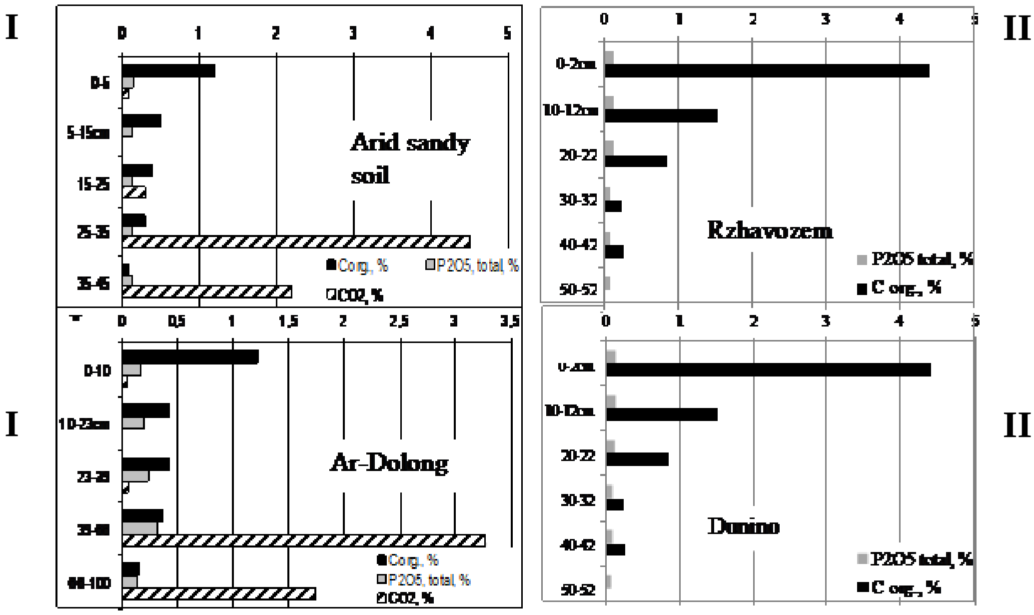

Figure 1. Organic carbon and total phosphorous distribution in modern soils and study sites in arid (I) and humid (II) climate zones (%)

Thus the CLs of the ancient settlements transform with time into zonal soils despite the geographical location of the region. But at the same time the transformation rates of separate soil features and whole soils profiles are variable. According to our radiocarbon data the rejuvenation of the organic matter is relatively fast process: the «young» humus incorporates at a depth about 0.5 m even in semidesert zone with small amount of precipitation and sparse vegetation cover. The «normal» type of the organic profile has been formed in both post-Urbanozems. The typical carbonate profile has been recovered in soil of arid zone.

Table 2. Comparison of archaeological age and radiocarbon dating of organic matter from CL, Ar-Dolong site.

Index IGAN	Sample, depth (cm)	Archaeological age (approximately)	Conventional radiocarbon date, humic acids	1σ confidence interval: [start : end] relative area
2807	Ar-Dolong, 39-66 cm	Bronze Age	1600 $\pm$ 160 yrs BP	Cal AD 256 (439) 635 Cal BP 1694 (1511) 1315

The content and profile distribution of total phosphorus became the main difference between the sites. The «older» post-Urbanozem Ar-Dolong with the duration of pedogenesis 3.0-3.5 kyrs shows the elevated content and the increasing of total phosphorus below the depth of 10 cm, which is absolutely different comparing to its distribution in a zonal soil. At the same time the concentration of total phosphorus does not exceed the reference values all along the former CL in «younger» post-Urbanozem Dunino (the duration of soil formation 1.5-2.0 kyrs). The only explanation to this fact is the difference in mean annual precipitation between these regions. In other words the rate of transformation of ancient non-buried cultural layers in humid environment is higher than in arid environment. In the last one only 10 cm upper layer corresponds to all parameters of the zonal soil.

The obtained knowledge is necessary for the correct interpretation of the stages of the settlement functioning. The attempts to explain typical soil peculiarities from the archaeological positions only resulted in the erroneous conclusions, and the valuable differences between the archaeological and radiocarbon age, in some cases, lead to the unreasonable skeptical position towards the radiocarbon dating.

NATURAL AND ANTHROPOGENIC FACTORS OF SIKLIUK SETTLEMENT FORMATION – «WHALE BONE ALLEY» (NORTH-EAST BERINGIA, SENYAVINSKY STRAITS)

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Historical and cultural site «Sikliuk – Whale Bone Alley» was discovered by M.A. Chlenov in 1976 and was investigated by a group of scientists under supervision of M.A. Chlenov in 1977, 1979 and 1981 [1]. Investigations led by Bering Archaeological Expedition in 1993, 2006 and 2010 (archaeological research, tacheometry and geomorphology investigation of the site and profile research of mellow sediments) made possible to define unbiased time when whale bone construction complex originated as well as history of Yttygran island occupation, history and character of paleoenvironment development.

The site represents a unique hunting and sacred complex, created by numerous sea hunters of Bering Strait, which reflects history of centuries-old adaptation to severe conditions of Arctic Pacific. The site is situated at the north cost of Yttygran island in Senyavinsky straits near Chaplin cape, 1.5-6.5 m high above sea level (tide time), and the site is stretched from south-west to north-east. Constructions made of dig-in skulls and jaws of Greenland whales, meat-pits, pebble pavements («Whale Bone Alley») spread for 560 m distance along the spit. The distance between east most group of constructions and the main group is 153 m. Rows of jaws in the central part stay 10-30 m apart from the row of skulls. Skulls of Greenland whales, dug in by nose-part into spit are stretched mainly along the shore, some of them are located in wave zone nowadays. They were put to contour meat-pits. Groups of jaws are stretched almost in one line. Vertically put Greenland whales' jaws are more than 4 m high. Some jaws are sawn and they are 0.6-1 m high. M.A. Chlenov, S.A. Arutiunov, I.I. Krupnik [1] confirm that whale jaws were sawn by Sikliuk village inhabitants for recent constructions.

Hills with dwelling and household constructions left by Sikliuk village inhabitants in the middle of the XX[th] century are located at the same spit to the east of the complex. Inhabitants of the village were resettled to Chaplino and later to New Chaplino. The researchers confirmed that historical memory of Chaplino Eskimo didn't fix information about origin of «Whale Bone Alley» (this name was given by M.A. Chlenov). Eskimo name for «Sikliuk» is «place for meat store». Anthropogenous Sikliuk hills stretched for 320 m. There are traced at least 4 dwelling pits at these hills. The dwelling is related to paleolagoon which is now separated from the sea by distal part of spit. There are 4 anthropogenous hills.

The longest part of the site is 960 m. The widest part is ab. 150 m.

Excavations of test pit # 2 (on one of the hills at Sikliuk settlement) gave material of different times: old-Eskimo tools and ceramics (at least Birnirk culture of VI-IX centuries AD); stone and obsidian tools (1[st] century BC). Radiocarbon dates received do not contradict chronological characteristics of artefacts in test pit. At the very bottom of test pit (-210 cm) the date from organic material is 2540 ± 70 years ago (Ле-7740), date from organic material (-190 cm) is 2760 ± 160 years ago, date from wood (-60 cm) is 820 ± 25 years ago (Ле-7746).

Dates for «Whale Bone Alley» received from Greenland whale bones (picked up and useful samples) are: 7743–860 ± 80;7752-770 ± 60; 7744-640 ± 50; 7745-1000 ± 100; 7749-130 ± 320; 7748-2160 ± 380; 7741-690 ± 40; 7742-240 ± 30. Leaving apart data which don't fit main complex, we receive the interval 640-1000 years ago. Thus absolute dates are XIV-XV – XVI-XVII centuries AD [2].

The complex is located at the spit which originated as a result of along-shore stream discharge from inwashes (direction: south-west – north-east) in the zone of intersection of regional north-north-east fracture and east-north-east rupture disturbance which control position of north shore of the island. Relief and sediments' structure show traces of contemporary tectonic activity. At the main branch of regional break traverse (test pit # 2) there are fixed abnormal width of seasonal melting layer for the region – 238 cm, when medium data is 40-45 cm. Sea hunters from New Chaplino village confirm that in hunting house near test pit # 2 it was warm «from the ground» while temperature outside was -20° C. Streams and «bochags» infected with hydrogen sulphide related to fledging disturbance are detected at the base of the spit.

Spit is formed by two shore ramparts separated from root slopes by base declines. Root parts of the ramparts border on carry-out cone of stream. In distal part of the spit base declines are occupied by shallow lagoon and lagoon terraces, separated from the sea by sea shore rampart only. Height of rampart crests in areas unoccupied with anthropogenous hills is about 2 m above sea level and is only 0.1-0.2 m higher than base joint height of contemporary beach. Ramparts and base decline (profiles It1, It3, It4) are formed by pebbles and small boulders. Filling material (sand, sandy loam) rate is not more than 5-10 %. Changes in dimension and rolling of fragments as well as filling composition allow to estimate intensity of hydrodynamic processes during ramparts' formation. Shore rampart height at Sikliuk site increases because of cultural layer sediments up to 4 m.

In base decline profile (It2) which borders on root slope we distinguish contact of slope sediments and seashore ones. Radiocarbon date 1800 ± 100 years ago (Ле-9427) received from peat contact level fixes the end of seashore accumulation in the base of the spit.

We'd like to mention that anthropogenous hills with the most ancient dates of cultural level come from interior shore rampart, when whale bones construction (XIV-XVII centuries AD), sacred place and graves are located on all relief elements except for contemporary beach and lagoon terraces.

The following stages of spit formation and inhabitation are distinguished.

The most ancient spit element is interior shore rampart formed during subboreal transgression 3200-2500 years ago as a result of along-shore stream of inwashes. One of inwashes source was carry-out stream cone. In the distal part of the spit (which stretched up to north-east shore of island but didn't border on it) a narrow open gulf with asymmetric transverse profile was formed. East cost (related to rupture disturbance) was crucially steeper than the west one. Ice rate was higher during this time and hydrodynamic activity was lower than the present one, what is confirmed by thinner composition of sediments (in comparison with present beach inwashes).

In the end of transgression period when sea level decreased and storm waves couldn't influence the shore regularly, the inhabitance of the spit started. During this time an open lagoon could remain in the base of the spit; its root part was overflowed by storm waves. During the periods of minimum shallowness of sea spit base and partly its underwater slope were drained. Base depressing in spit root was drained ab. 1800 years ago. Extremely rough composition of slope sediments (fragments of local rock practically lack filling) which accumulated just after drainage, permit to suppose that at this very time movement along regional fracture activated. Spore-pollen analysis from It2 profile (made by MSU researcher I.A. Karevskaya, Faculty of Geography) shows that landscape conditions during this time were close to contemporary ones. Despite cold climatic conditions warm exits in main branch zone of the regional fracture, where the site is located, didn't permit to store meat near dwellings. That's why meat pits were dug at some distance. Later meat pits were dug on anthropogenous hills also but this happened after cultural layer's growth up to 2 m and more [2].

During transatlantic transgression the inner-cost rampart was partly destroyed. Later a marine shore rampart joined it, thus separating lagoon filled with water. Distal turn of exterior shore rampart could be connected with decrease of ice rate in the sea what defined heaving activity from the Bering Strait. Nevertheless traces of significant warming are not defined in spore-pollen specters from It2 profile. In the beginning of this period lagoon was partially separated. A narrow strait existed at its deep east shore, its position is reconstructed by lagoon terraces outline. Rolled pebbles' oblique position in It2 profile above slope sediments signifies that storm overpressure during this period reached base part of the spit.

Regression of subboreal time end witnessed decrease of fully separated lagoon and formation of lagoon terraces. During this time constructions of «Whale Bone Alley» were created at marine shore rampart which suffered from extreme storms only during sea level decrease.

Wash-out of the cost activated during subatlantic – contemporary transgression, contemporary beach with relatively rougher deposits' composition was created. Shore destroy occurred under waves' pressure, and ice exaration is significant in «Whale Bone

Alley» area. Shore receding speed is the first dozen centimeters per year. Shore receding is the factor which threaten preservation of «Whale Bone Alley».

We consider that this complex was created as householding and sacred one. Sea hunters executed here rituals before hunting season on whales and walruses. «Whale Bone Alley» is located at whale migration route.

Important factors for complex formation were settlement location at active fractures and climatic rhythmicity which defined wave activity and ice impact.

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GEOCHRONOLOGY OF OLD WHALING CULTURE SITE «UN'EN'EN» AND PALEOLANDSCAPE CONDITIONS OF SURROUNDINGS (NORTH-WEST BERINGIA)

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In the 50th of the XXth century J.Giddings and D.Anderson investigated a series of dwellings at Kotzebue cape, Alaska, and assigned «Old Whaling Culture» [1], what caused fierce discussion about beginning of whaling in the Arctic. Since 1997 Bering Archaeological Expedition from Institute of Heritage realizes investigation of old whalers' settlements in Chukotka. In 2007 field work was realized in cooperation with Alaska University (Fairbanks) and Kunstkamera (Peter the Great Museum of Anthropology and Ethnography). The settlement is located at the seaside in southern part of Nunligran town, at the 3rd terrace near pebble-sandy beach. The western part of the settlement borders with steep mountain slope. Total area of the settlement is more than 15000 sq.m. There can be distinguished several zones with intensively coloured and higher vegetation.

Stone tools are represented by knife-scrapers on blades and blade flakes with marginal retouch and both-side flat retouch, knives, arrowheads, javelin points, harpoon points on blades, borers, burins, scrapers, inserts of projectile tools. Percussive platforms are grinded. More than 95 % of all artefacts are made of grey jasper. Obsidian and chalcedony were also used. A unique artifact is an engraved walrus tusk. The tusk (49 cm long) is shaped in a seal-form with head and flippers at the ends. On both sides there are engraved human figures, sea animals and birds, constructions, boats. Constructions are represented by sheds on three supports. Genre scenes are represented by scenes of whale and walrus hunting from many-placed undecked boats («umiak»), bow shooting, sacred actions. Hunting technique and boat construction are related to Proto-Eskimo tradition.

Figurative representations reveal exterior and interior world of sea hunters who left a message for XXI century in the form of graffiti on a walrus tusk.

Radiocarbon dates (non-calibrated) indicate the time of dwellings' life between the end of the 2nd – beginning of the 1st millennium BC.

Paleolandscape conditions of the settlements' environment are reconstructed on the basis of relief morphology analysis, tacheometrical shaping of the terraces (Alyautdinov V.A.), study of 22 profiles of mellow sediments, palynological analysis and radiocarbon dating. According to the results received, the main stages of relief development are close to regional paleolandscape scheme set for the south of the Far East [2].

Morphological structure shows that the site is located at periphery of decline, which sustains a relatively slow lifting against the background of intensively rising blocks of surrounding hills. During transgressive phases of Late Neopleistocene – Holocene there existed shallow-water open gulfs within the decline. Filling of bank concavity occurred in conditions of sediments' shortage what caused mainly abrasive, rarely abrasive-accumulate nature of sea terraces. Such profiles' type makes it difficult to define terrace age. During regressive periods the bottom of the gulf revealed and was covering with erosion net. Nevertheless due to significant depth near the shore, Un'en'en site retained maritime position during low-water periods.

The bottom of the decline is occupied by a series of terraces surrounding the lagoon which is separated from the sea by sandy hill up to 7.5 m high.

The surface of the third abrasive sea terrace (22-30 m high) which was inhabited by ancient whalers in the end of the 2nd – beginning of the 1st millennium BC. [3], originated more than 60000 years ago [4]. Later it represented an elevated oblique area above the sea which was slowly covered by slope clays with fragmental rock material.

The oldest gulf in neighborhood environment (its shore line position is reconstructed trough base juncture of the second sea terrace, 8-13 m high) continued inside decline for more than 500 m in comparison with present-day lagoon. According to regional data the gulf existed during Amguem transgression (34000-31000 years ago) [4].

During sediments originating of the first sea terrace (5-7 m high) shore line of the gulf was located 50-250 m to the north of contemporary lagoon. Palynological specters from all the levels of terrace profile witnessed climatic conditions far warmer than contemporary ones. Thus we can date terrace age 6500-5000 years ago (climatic optimum). Grass-moss and lichen tundra was combined in site surroundings with dwarf birch and alder which were related to protected southern slopes. River valleys could contain deciduous-birch open woodland mari complex. On the shores of the gulf (in conditions of shallow permafrost soil) there existed swamp territories. According to heterogeneous grain size analysis and mainly bad sorting of sediments, the gulf was covered with ice main part of the year. In the terrace profile there could be tracked indications of 2 stages of sea raising, divided by regression phase (when on the terrace surface a net of erosion hollows was formed). At the foot ledge of high terrace (where site is located) the profile of the 1st terrace witnessed undercutting. The upper stack of seashore sediments is represented by badly-washed sands laying on detritus paving. The date 2130 ± 30 (Ле-9426) was received from the base of covering slope boot, it fixes the stage when (as a result of sea level shallowing) abrasion didn't impeded already accumulation of slipping clay peat. With contemporary sea level storm waves influence terrace edge. During subboreal periods of transgression it could be destroyed quicker.

Shore lines position during transgressive subboreal periods is reconstructed through base juncture of abrasive-accumulating terrace 2.5-3.5 m high. In the base of lagoon (in profile) 2 ancient shore lines were detected. The lower one (3.1-3.2 m high) witnesses the stage of abrasive terrace base generation in slope clay. Slope sediments contain ancient microfossils (redeposited from the first sea terrace sediments) as well as more recent pollen grains and spores which witnessed phytocenosis close to contemporary one (typical grass-moss and lichen Arctic tundra). Sublevels of this terrace are not determined. We can suppose that the height of sea level raising during the first and the second subboreal transgression were close.

Sandy hill (separating the lagoon) formation is correlated with subboreal transgressions also. The shore line of sandy hill often moved because of replacing regressive stack of seashore sediments in profile by lagoon sediments, then by transgressive stack of seashore sediments, then by regressive one. At the final stage of lagoon separation, the hill was located far inside to the sea then in present time. According to morphological characteristics the development of accumulative form started at the eastern end of the gulf. During transgression (end of subboreal: 3200-2500 years ago) there could exist a strait at east end of the hill which connected lagoon with sea.

Thus by the beginning of inhabitation at Un'en'en site (regression, end subboreal) there existed narrow surface of the first sea terrace under ledge of the high terrace where the site originated. With sea level a bit lower than the present one [2] this surface was not touched by the waves. Lagoon was drained or represented a swamp-like depression which assumed streams at the north-east and the east. Landscape conditions were close to contemporary ones.

During settlement-time landscape conditions changed. During transgression (3200-2500 years ago) storm waves started to overflow the surface on the first sea terrace, lagoon was filled with water and was separated by the hill by maximum of transgression. As transgression occurred at the background of relatively low annual temperatures [2] we can suppose that main part of the year lagoon was covered with ice. In the site surroundings there rested tundra landscapes. Main stock of dates (15) mark the cultural layer as following: 2800-3200 years ago [5].

The end of settlement function was caused by an earthquake (5-7 grades) which occurred 3000 years ago at Achchen lagoon [6-we corrected geological date on the base of dates from cultural layer], which caused downfall&talus processes which, in their turn, forced huge stone blocks (weight up to 2.5 tons and more) and smaller stones to cover cultural layer what is well-fixed by stratigraphy.

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ADVANTAGES OF MYCOLOGICAL INDICATION FOR THE ARCHAEOLOGICAL RESEARCH (ON THE EXAMPLE OF MEDIEVAL CULTURAL LAYERS IN DIFFERENT CLIMATIC ZONES)

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We propose the soil mycological properties can be used for information about ancient human-landscapes interactions, because the fungal communities could be informative bioindication marker about human activity and exploitation types of ancient settlement`s territories in the past. It is well known a spore-pollen and fitolite analyses for bioindication in paleo-ecological reconstructions [1]. The assessment of total and living microbial biomass, the ratio of different microbial trophic groups successfully used in determination of biotic properties and age of paleosoils buried under mounds [2, 3, 4]. We recommend to investigate the changes of microfungal species composition and fungal biomass structure in antropogenically transformed soils on archeological objects in comparison with zonal fungal communities. The properties of the fungal communities in culture layers can be considered as a type of «soil mycological memory» about environmental situations and human impacts in the past (Marfenina, 2008).

Why it is exactly the fungi? There are a number of reasons to use this group of organisms for bioindication of culture layers of excavated ancient settlements.

Fungi are the ubiquitous organisms in terrestrial environments, soil being regarded as their most typical habitat [5]. In nature fungi exist as mycelium and spores. The fungal mycelium could decompose different organic materials, plant and animal debris; such polymers as lignin, keratin, cellulose, etc. Fungi successfully colonizes the solid surfaces of such materials as wood, stone, plaster, cement, some building construction, rocks [6]. Fungal spreading and conservation in nature is realized by spores. The fungal spores can survive for a long time (up to thousands years) even under extreme conditions, for example, during fire [7] or long-term permafrost [8].

It is known a zonal soil properties and specific features of the vegetation cover affect the features of soil mycobiota, namely, the diversity and species composition, the occurrence of dominating species, the biomass structure [9]. In result of nowadays human impacts, including urbanization, some typical mycological characteristics are changing [10]. These reasons underlie our beliefs about the usefulness and success of mycological analysis to assess human-induced changes in the soils of ancient settlements.

Our investigations were held in the 1999-2011 years. Some of obtained data were published [11, 12, 13, 14]. We investigated the mycobiota of antropogenically transformed soils of medieval settlements (the 7th-11th centuries AD.) at different climate zones in Russia and Kazakhstan. There were: the Gnezdovo archaeological complex (the 9th-11th centuries AD, Smolensk region), the slavonic settlement Chul-Gun (the 10th-11th centuries AD, Komi Republic, Syktyvkar area), the unnamed settlement (the 10th-11th centuries AD, the Prioksko-Terrasny State Biosphere Reserve, Moscow region), the Alan settlement Gornoe Ekho (the 7th-11th centuries AD, Kislovodsk, Stavropolsky region, North Caucasus), the fortress Por-Bagin (the 9th-10th centuries AD, Tuva Republic, Tere-Hol-lake depression of Eastern Sayan), the 'marsh town' Dzhankent (9th-10th centuries AD, Kazakhstan, Kazalinsk area, eastern Aral Sea region).

A total fungal biomass and biomass structure in soils were evaluated using luminescent microscopy with Calcofluor white stain, which linked polysaccarid (chitin) in the fungal cell wall [15]. The isolation and enumeration of cultivated microfungi were done with method of serial dilutions of soil samples and plating them out on the selective solid media with different organic and nitrogen source (Czapek agar, Getchinson agar, Sabouro arag, Water agar, Alkaline agar, Cristensen agar). Also we used the isolation of functional trophic group of keratinolytic microfungi by hear-bite technique. The isolation of koprophylic fungi was made by incubation of soil lumps into moist camera.

In result it was revealed a significant redistribution of the fungal biomass in the profiles of anthropogenically transformed soils of all investigated medieval settlements. It was reflected in the increase of total fungal biomass in the cultural layers in comparison with the enclosing mineral horizons. As the other important difference between the cultural layer and undisturbed surrounding soil`s horizons was detected the mycelium biomass reduction and an increase in fungal spores biomass in culture layers. The third distinctive feature of the fungal biomass in the cultural layer was the change in structure of the pool of spores in comparison with the background soil. As a rule, the high diversity of different morphological types of fungal spores was determined both in the upper humus soil horizons and in the cultural layers, not in surrounding mineral horizons. The increased spore biomass in the cultural layer was due to the increased content of large (> 6 µm in diameter) spores. Among these spores many ascospores and, maybe, yeasts (one-celled fungi) were found. The presence of morphological diversity of fungal spores and an increase of its quantity may be due to the accumulation of various organic substrates (vegetative and woody debris, building materials, wool and feathers, bones, food and household waste), which were introduced by human during the existence of settlements. One part of the fungal spores can survive from the time of settlement, another part formed by the succession of fungi in the cultural layer and it is also a result of human impact in the past.

The isolation of cultivated microfungi on the selective solid media confirmed the fact that usually the medieval cultural layers are characterized by high (sometimes the highest) fungal species diversity compared to the surrounding soils and also by the presence of fungal groups not typical of zonal soils. The fungal communities in the cultural layers of the settlement are differentiated in dependence on the particular character of the land use in the past. The some areas of the cultural layers with extreme anthropogenic impacts are characterized by a decreased species diversity of microfungi and simplification of their population structure mainly due to the decrease of rare species richness. For example, the burred places and fire pits in the culture layers of settlement Chul-Gun.

At the same time other areas of the cultural layer (or other deposits of a different time old) could contain higher total microfungal species richness due to increase the presence of fungi of different trophic groups. This situation was found in case of intensive human influence, for example, in floors of living rooms of the settlements Gornoye Echo. In these and similar places we established the transformation of the composition and species structure of the fungal communities and the replacement of dominant species typical of the background zonal soils by eurytopic species Another example is the some household pits of unknown purpose of the settlement Gnezdovo. In one of that pits it was determined the prevalence of phytopatogenic microfungi (genera *Fusarium, Phoma*), usually growing on cereals or grass debris. From the other pit there were isolated microfungi, which can grow on skin, wool, features and peptone-content substrates (genera *Chrysosporium*). As a typical feature of the cultural layers in contrast to the surrounding soils it was revealed the increase in the presence of fungi of the genus *Aspergillus*, including many species which potentially pathogenic to human. An increase in the amounts of dark-colored fungi and sterile mycelium in the cultural layers in comparison with the background soils also takes place. Often sterile mycelia were detected as zygomycetes of genera *Mortierella* by molecular-generic analyses.

The growth of keratinolylic and coprophylic fungi can be used for distinct mycological indication of the presence, duration and intensity of ancient human impacts on settlements` territories. It was shown on example of settlements Gornoye Echo and Dgankent that the activity of fungal trophic groups from cultural layer was much higher than that in the background soil. In soil of Dgankent it was observed a different account and diversity of fungi decomposed urea into deposits` layers of a different years old.

It was very interesting that the cultural layers of investigated medieval settlements clearly differed in the total diversity and dominating species of microfungal communities from the fungal communities in the situated above and underlying soil horizons, in which the mycobiota developed under the influence of mostly natural soil-forming processes. So, the features of microfungal communities in cultural layer depends from the ecological conditions of this layer. Changing the properties of mycobiota of the cultural layer in comparison with background soils can be used to interpret the impact of this settlement.

For example, the specific features of mycobiota in the cultural layer was revealed in the intensively exploited settlement Gornoe Echo. On the other hand, no differences in the fungal communities comparing with zonal soils and the absence of keratinolytic microfungi were found in the cultural layer of fortress Por-Bajin. That can be determined because short-term or not intensive use of the fortress territory in the past. This preposition was confirmed by other data.

So, the mycological bioindication of antrpogeniocally transformed soils of medieval settlements is not only possible, but can be applied successfully to interpret the data of soil-archaeological researches on the types and intensity of human land use in the past.

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GEOARCHAEOLOGICAL AND ARCHAEOLOGICAL RESEARCHES AT KELAINAI – APAMEIA KIBOTOS (SOUTERN PHRYGIA)

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The project *Kelainai – Apameia Kibotos* is an international research project, which was supported in 2008-2010 by the *Agence Nationale de la Recherche* (France) and the *Deutsche Forschungsemeinschaft* and in 2011 by the *Russian Foundation for Humanities*; it is directed by A. Ivantchik (Bordeaux / Moscow), A. Von Kienlin (Zurich) and L. Summerer (Munich) in collaboration with M. Üyümez (Afyonkarahisar) (for details, see the web site of the project http://www-ausonius.u-bordeaux3.fr/axes/Kelainai/Home.html and [1, 2]). The project intends to produce an interdisciplinary study of the most important urban centre of Southern Phrygia Kelainai – Apameia Kibotos, modern Dinar (province Afyon, Turkey). This city was a royal residence in the Achaemenid period: a palace of Xerxes as well as a palace and paradeisos of Cyrus the Younger was situated here (Xen. An. 1,2,7-8). In the Hellenistic period, the city got the name of Apameia in honour of the mother of Antiochos Soter and continued to be a royal residence (Strab. 12,8,15; Liv. 38,13). In the Roman period, the city retained its economic importance: it is notably mentioned by Strabo (12, 8, 15) as being the second commercial centre of Asia, after Ephesus. Despite its historical importance, the city has never been the object of an in-depth archaeological study. Our project represents the first attempt at a systematic study of its ancient remains. We chose from the beginning to use GIS as a primary method of storage, presentation and analysis of data obtained during field survey. The survey allowed us to identify and research ca. 300 new archaeological objects and monuments, including tumuli, cemeteries, roads, settlements, architectural elements, inscriptions etc., which were inserted into the GIS. Geophysical surveys on the central hill Üçlerce, as well as in other parts of the ancient city, gave important information about its plan.

The future GIS was based on the high-resolution satellite photos taken in October 2006 by the QuickBird camera (resolution 0,6 m / pixel). These were complemented by other satellite photos we can find freely available on the website maps.google.com. The total consideration covers 200 km^2. These images were then processed and converted to Mercator WGS-84 projection (zone 36, northern hemisphere) to allow their joint analysis by the software ArcGIS. This treatment has allowed to use GPS receivers to move during surveys on the ground, especially when searching structures identified from satellite photographs, as well as to connect GPS receivers and GIS software for automatic charging of data (Waypoints, Tracks) using the software «MN DNR – Garmin». The satellite photos of the QuickBird were divided on the fields corresponding to the topographic maps at scale 1 / 10000. This will allow adding or replacing of the satellite photos by new, more detailed ones.

In addition to satellite images, GIS base map also includes a digital model of the Earth's surface in three dimensions. This model, based on detection by radar, was loaded from the ftp server of NASA (SRTM – Shuttle Radar Topographic Mission). It has created a TIN terrain model to study the territory and to assign three-dimensional coordinates archaeological artefacts. The third element of the base GIS is a series of topographic maps at scale 1 / 25 000 and 1 / 100 000. These maps have been processed so that they are consistent with the QuickBird satellite photos. We also took into account the plans published in the nineteenth century. We are aware of the low accuracy of the latter, they are nonetheless interesting for the names and the remains (now extinct) they refer to, as well as knowledge of the river system has changed from the nineteenth century. These maps have been corrected from the most recent data before being integrated with the rest of the equipment in the GIS.

After creating the GIS, the second stage of our work was the analysis of satellite photos and topographical maps together into a single system. This analysis resulted in the identification of numerous archaeological structures: settlements, *necropoleis*, buildings, roads etc. The presence of these elements has been verified by a field investigation and, if confirmed, documented in detail (description, photograph, address, etc.) and entered in GIS.

The third stage was an intensive survey on the ground. This systematic survey has revealed many new elements that have been documented in detail before joining the GIS database (the value of their coordinates have been calculated by GPS, they have a printed 1 to 4 m). The heights have been accurately determined using the TIN model. During the first three years of surveys about 400 objects and structures (identified, geo-referenced, documented) were recorded in the GIS.

The most important of them are:

- Numerous cemeteries which surround the modern city have been identified and described; their total surface area covers about one hundred fifty hectares. There are actively destroyed by illegal excavations.
- Tumuli in the region of Dinar forming small groups (2-6 monuments) or isolated mounds.
- Prehistoric tells (höyüks) partly reoccupied in the Hellenistic and Roman periods.
- Fortified settlements and villages dating to the Roman and Byzantine periods on the territory of the city of Apameia.
- Traces of grid division of land.
- Traces of ancient roads.
- Monuments and buildings visible on the surface, as well as ancient architectural elements and inscriptions dispersed in the modern city of Dinar [3].

The surveys of the surface were complimented by the geophysical surveys carried out in 2008-2010. Over 20 hectares have been surveyed by magnetic and geo-electric surveys with the use of different magnetometers and resistivity meters allowing to detect the remains buried on different depths. One of the most important surveyed site was the hill of Üçlerce, where the acropolis of Kelainai and Apameia was located. Picture of dispositions of values of vertical gradient of natural magnetic field of the Earth obtained there is typical for multi-layers site. Anomalies caused by features on surface and in subsurface layers are accompanied by disturbances of magnetic field caused by deeper buried features. A lot of narrow linear anomalies – typical for lines of stone foundations (marked with brown and yellow color) is visible on the map as well as large zones with higher and lower values in comparison with registered means values of magnetic field. The last ones are typical for thermo-magnetic effect producing dipole anomalies in the places where heavy burned features are buried. On the map there are visible anomalies caused by walls supported modern terraces (visible also on space photo forming background for magnetic map) and similar structures in the places situated in eastern part of surveyed field, on the border of the slope of the hill, where remains of defensive walls could be preserved. The same kind of linear anomaly is visible in southern part of the field going East-West and could be also caused by the remains of defense wall. In both place there are large stones visible partly on the surface especially in south-eastern corner, where round structure is visible on the magnetic map. The presence of linear, narrow, parallel anomalies registered in northern part of surveyed field could suggest the remains of oldest – Hellenistic city grid have been preserved here. Results of geo-electrical and magnetic prospection of all surveyed sites confirm usefulness of geophysical methods (especially used together) in gaining information on the place and archaeological context of detected features. Obtained data are used for planning of future excavations as well as a part of GIS system prepared for all of the surveyed sites in the region of Dinar [4, 5].

The GIS created in the frame of the project Kelainai – Apameia Kibotos includes the following layers, which are connected with each other.

1. Data of remote sensing of three types: low resolution (30 m / pixel), medium resolution (2 m / pixel) and high resolution (0,5 m / pixel).

2. Digital models of the Earth's surface in three dimensions including TIN model (Triangular Irregular Networks), GRID Model (Regular grid), Hill shade model and Vector model (horizontal every 10 m).

3. Layer of coordinate grids (from 1 / 10 000 to 1 / 100 000)

4. Layer devoted to the pottery collected in the course of the raster survey (fields of 40 x 40 m, the surface is c. 0,5 km^2).

5. Vector layers with the information about different categories of the identified ancient sites, monuments and objects including hyperlinks with their photos, drawings and descriptions. The data base of the GIS includes 418 objects (points, regions and poly-lines).

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HUMAN ACTIVITY REFLECTED IN THE UPPER DNIEPER BASIN, BELARUS

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Dnieper river and its catchment is the bigest river (700 km in Belarus) and drainage basin (105 000 km^2) in the Belarus. The study area is located in the temperate continental climate, with a domination of western circulation. The mean temperature of January and July oscillates between –7.5 and –8.5^{o}C and between 17.5 and 18.0^{o}C respectively. Annual precipitation, with a summer maximum, is 600-650 mm. All studied rivers have snow regime with a distinct snow-melt flood lasted some weeks (March-April) and sometimes summer rainfall floods.

Records from the deposits in selected river valleys of different orders were studied to reconstruct the Holocene phases of natural and anthropogenic environmental changes within the Upper Dnieper catchment.

The buried soils in the Dnieper valley are traces of an intensified river activity occurred at 5500-5000, 2100 and 1000 BP. A periodic increase of flood frequency, leading to an increase in mud sedimentation rate, caused fossilization of soils, which developed during the Early and Middle Holocene (since 9970 ± 560 BP) on the flood plains. Depending on the magnitude of the floods, fossilization of soils occurred on a lower (5040 ± 110 and 2130 ± 140 BP) or on a higher level (5450 ± 170 and 940 ± 90 BP) of the flood plain.Although the first human sites in the examined valley were established during the Mesolithic, distinct anthropogenic changes have been observed only since historical times, where fertile loess soils began to be intensively cultivated after these regions were occupied by Kiev Russia in the middle of the 9th century. The deforestation led to ar increase in flood frequency and magnitude during periods of cooler and wetter climate. As a consequence, soil burying on the higher level of the flood plain took place about 940 ± 90 BP, which was covered by sandy muds. The change of grain size composition of the muds was the result o intensified erosion on cultivated regions. Silty muds (Mz = 5.9-6.4 φ) deposited during most of the Holocene changed into sandy silty muds (Mz = 4.1-5.0 φ) during the last 1000 years.

The Berezina river formed a broad floodplain with numerous palaeomeanders, in many places occupying almost the whole width of the valley. Within the floodplain, numerous series of alluvia of various ages are found side by side in one level. Datings enabled to establish the timings of increased river activity. These timings, however, manifested themselves in a different way than in Dnieper valley. In this valley meanders were cut off around 3120 ± 40 BP and 340 ± 80 BP. Sometimes a change of sedimentation type took place in the infill of the palaeochannels when peats were covered with muds around 1000 ± 50 BP. Though the first human occupation sites occurred during the Neolithic, distinct anthropogenic changes have only been observed since historical times. Human impact was different and asynchronic in Dneper and Berezina valleys. In the Berezina valley, human activity began later – since the foundation of

Borisov in twelfth century – and was mainly limited to the nearest surroundings of the city. The upper part of the river basin was occupied, like at present, by vast peat bogs, swamps and compact forest complexes. A more intensive deforestation began only at the beginning of the nineteenth century. However, escalating human impact caused a process of river incision in the last centuries (after 340 ± 80 yr B.P.) downstream of Borisov. It has led to the formation of a lower floodplain here.

The underfit Drut river changed its pattern form braided to meandering in the Late Glacial because in the backwamp peaty silts and peats were deposited on the channel deposits since 11 085 ± 85 BP. A period of floods about 7600-7200 BP were recorded at two sites as cut offs and sandy intercalations in organic abandoned channel fill. This phase was not found or supported by dating at the other sites and valleys yet. The widespread changes of sedimentation pattern in the Late Atlantic occurred. The changes from organic sediments to clastic one in paleochannel fills of Drut River were dated at 5910 ± 60 and 5720 ± 65 BP. At about 1000 BP in the Drut river valley silty peat was covered with layers of gravelly sands deposited by series of large flood events.

Different sedimentary environment had existed in the valley of the Adrov river. There, freshwater carbonate deposits had accumulated in the lake or in the river valley under influence of specific groundwater regime since about 9000 BP until 3430 ± 115 BP, when these deposits were covered with continuous 1-m thick of overbank loams accomplishing the section up to its top. This record may probably be related with some environmental event caused change in the hydrological regime of single valley. It correlates temporally with regional phase of environmental change recorded in floodplain sediments in Central Europe at 3400-3000 BP. Also, quite thick deposits of freshwater carbonates, found in some valleys of small rivers of Belarus, represent relic environments, which had existed before about 3000 BP and have been unknown since that time.

Significant differences are seen in valleys of 3rd order. Floodplain alluvia in Pochalitsa and Neroplia valleys seem to be much thinner and include (from bottom to top) channel sands, buried soils and peats accumulated between approximately 2000 and 500 years BP, and overbank loams accumulated after ~ 500 BP. A cessation of accumulation of organic-rich sediments at ~ 500 BP and subsequent deposition of poorly sortedoverbank loams, most probably, were caused by deforestation due to the agricultural development within the small catchments. This conclusion is supported by the immediate appearance of pollen of the cultural *Cerealia* plants just above the boundary separating the peaty deposits from the loams in the Pochalitsa and Neroplia valleys. Also, the episode of soil erosion in the Neroplia valley is dated at 570 ± 45 and 510 ± 50 BP, where alluvial fan and overbank deposits, respectively, overlayed the floodplain peat and peaty loams. However, an appearance of the pollen of cultural plants and weed species in lacustrine deposits from the Neroplia Lake in this is dated at as early as 3500 BP, and the first peak of this pollen, reflecting quite wide-spread agriculture, is dated at about 2000 BP. The response of small fluvial systems to deforestation and agricultural development within their catchments seems to be pronounced with a considerable delay after the occurrence of anthropogenic landscape changes.

Discussion and conclusions. The phases of an increase activity of Dnieper river occurred at 5500-5000, 2100 and 1000 BP and reflected as buried soils on the flood plains. There are some phases or events also in Berezina valley (about 3.1, 1.0 ka BP, last centuries), Drut valley (about 8.6-8.0, 7.6, 7.2, 5.9-5.7 and 1.1 ka BP) and Adrov valley (about 3.4 ka BP) recorded as changes of sedimentation type on flood plain. The similar changes of sedimentation were dated in Neropla valley and Pochalitsa at 2.0, 0.5 ka BP and about 0.6 ka BP, respectively.

Already in earlier works a general uniformity of these phases in the Russian Plain and in Poland has been established. These phases occurred in periods with a cool and humid climate. As far as older phases are concerned, it is agreed by these authors that they are climatically conditioned. Subatlantic phases, however, were often connected with widespread human settlements such as the anthropogenic level from the 10th to 11th century in the Russian Plain. Yet, simultaneously in this period a distinct phase of cooler and wetter climate occurs which marked itself in the river valleys in Belarus and the Russian Plain, among others, by changes of sedimentation type on flood plains and by buried soils. Nevertheless, research in the valleys of the Berezina and Dnieper shows that this level is marked by an intensification of river activity, both in a natural river basin and in a basin strongly modified by human impact. It proves the overlap of climatic changes and human activity in the Subatlantic [1]. Human activity caused an increase in the rate of overbank sedimentation (soil burying on the higher flood plain level) and a change of grain size composition of muds in the Dnieper valley.

General remarks

- Fluvial deposits in the valleys of first and second order contain records on the regional-scale natural environmental changes (~ 8.6-8.0, 7.6-7.2, 5.9-5.7, 5.5-5.0, 3.4, 2.1, 1.1-1.0 ka BP, last centuries), which mark major episodes of stabilization/destabilization of the hydrological regime during the Holocene. Changes in the sequence and composition of fluvial deposits due to human impact are pronounced clearly only in recent (last millenium) deposits, although are seen in pollen spectra, minor changes in grain size characteristics and chemical content of the sediments.
- Fluvial deposits in the valleys of third order recorded river evolution only since the late Holocene (2.0 and 0.6-0.5 ka BP). At the same time the lacustrine deposits in these valleys contain the records of environmental changes in the entire Holocene. Changes in the sequence and composition of fluvial deposits due to human impact are pronounced clearly since ~ 500 years BP and are supported by the simultaneous episodes of colluviation and peaks of pollen of cultural cereals.
- Thick deposits of freshwater carbonates in some valleys of second and higher order tributaries are the evidence of relic environments that have not existed there since the end of Subboreal.

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BEACHROCKS OF CHAMOLIA, EAST ATTICA

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The study of Chamolia beachrocks, along with their correlation with stratigraphic data from boreholes, aim to reveal the palaeoenvironmental conditions of the study area. The study area, Chamolia beach, lies in the eastern coasts of the Attica Peninsula (eastern Greece), located near the coastal area of Vravron Bay, in the vicinity of the homonym archaeological site.

For the purposes of this study, the mapping of the coastal and submarine parts of the beachrocks in Chamolia was accomplished along with measurements concerning their depth, width and thickness. The beachrocks extend from sea level to a depth of -60 cm. Furthermore, beachrock samples were studied and analyzed by SEM in order to characterize the nature of the constituents. The mineralogical composition of the beachrocks studied is dominated by calcite and subsidiary dolomite, followed by trace amounts of detrital quartz.

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MAN IN A FLUVIAL LANDSCAPE: GEOARCHAEOLOGY OF THE VYCHEGDA RIVER VALLEY, NORTHERN RUSSIA

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River Vychegda 1131 km long is the major right tributary of the Severnaya Dvina River. Its catchment lies in the north-east of the Russian Plain in southern parts of the Arkhangelsk Region and Komi Republic. The river has a highly mobile free meandering channel in easily erodible alluvial banks. In the Holocene, river channel had continually changing its position in the valley bottom. The river was cutting older floodplain and terraces and formed new floodplain areas whose morphology depended on the type of river channel and hydrological regime. High variability of riverine landscapes not only influenced the occupation of the valley by humans, but also determines the set of methods used in archaeological studies.

Presence of small communities of ancient population is detected in the Vychegda River valley periodically since the Mesolithic [1]. During each period of occupation new groups of people colonized new unpopulated areas, which gives the opportunity to study forms and mechanisms of human adaptation to changing landscapes. Opportunities for reconstruction of simultaneous riverain landscapes are given by a succession of abandoned river channels and traces of their development, which constitutes a record of geomorphic development of the river valley.

In this study we use the combination of archaeological and scientific (palaeochannel study, palaeogeomorphology, geochronology, *etc*.) data to establish factors of river valley colonization by humans, their preferences in choosing locations for settling, sanctuaries and burials. Detailed research program and preliminary results have already been published [2], and here we focus presumably on archaeological interpretation of the earlier obtained data on river valley development.

Geocoding of 180 archaeological sites has revealed their uneven spatial distribution within the river valley. We distinguish five sections with different concentrations of sites and information potential: (1) Yagkodzh village – Pozheg vill. (42 km along the river; 18 sites including two settlements with six dwellings); (2) Myeldino vill. – Lebyazhsk vill. (68 km; 32 sites including 13 settlements with 68 dwellings); (3) Podtybok vill. – Kortkeros vill. (72 km; 64 sites including 28 settlements with 96 dwellings, 8 burial ground with 80 burials); (4) Ozel vill. – Syktyvkar city (12 km; 16 sites including 12 settlements with 60 dwellings; one burial ground with 24 burials); (5) Sysola River (Syktyvkar city) – mouth of River Vychegda (Kotlas city) (325 km; 45 sites, four settlements with seven dwellings, four burial grounds with 279 burials). The first two sections are located in the upper river course, the third, fourth and partially the fifth section – in the middle course, and the most part of the fifth section lie in the lower river course.

Different sections of river valley had different history of human colonization. In Section 1 archaeological sites are dated to the Bronze Age, Early and Late epochs of the Iron Age (III – late I millennium BC). Mostly abundant population in Section 2 was in the Mesolithic (IX-VII millennium BC), Bronze Age (III – early I millennium BC) and to a less extent in Early Iron Age (VIII c. B.C. – V c. AD). In Sections 3 and 4 archaeological sites of all periods and types have been found. In view of such archaeological abundance and variability unexpected was geomorphological instability of this valley stretch: it is characterized by the highest activity of river migrations and reworking of valley floor, which means that archaeological objects must be subject to destruction by river erosion. Finally, the longest and least abundant with archaeological sites Section 5 documents only two periods: the Mesolithic – Early Neolithic (IX – VI millennium BC) and Late Iron Age (late I – early II millennium AD).

The above data correlate well with the routes of ancient and medieval people penetration to the Vychegda valley and further to the north. In the Mesolithic and Early Neolithic two directions of colonization occurred: from south-west (cultures of central Russian Plain) and from south-east (cultures of the Kama Region and Middle Urals). In both cases there are waterways connecting the Vychegda River with the source regions: in the first case the lower Vychegda River is linked with the Upper Volga Region via the Severnaya Dvina and Sukhona Rives, in the second case the convenient pass exists between the Vychegda left tributaries – rivers Kel'tma and Nem with right tributaries of the Kama River. The south-western route was still functioning in the mid-Neolithic till it finished in the middle of the V millennium BC. In final Neolithic, the Bronze Age and Early Iron Age, cultures of the Vychegda Region were directly or indirectly linked to the Kama Region population (cultures of porous ceramics, Ananyinskay and Glyadenovskaya cultures) and, probably, the Trans-Urals Region. These periods are particularly poor represented in archaeological sites of the Lower Vychegda. Functioning of the south-western route was resumed only in medieval times by the Old Russian colonization and missionary activity. It is evident from relatively large necropolises at the Lower Vychegda and its right tributary River Vym', while synchronous burial grounds at the Middle Vychegda contain only few burials and settled places exhibit only one-two buildings or even temporary hunter houses. Overall, population of the Vychegda valley was at its top in the Bronze Age: the most number of settled sites is dated to that particular time and most of them are located at the Middle Vychegda.

The above data demonstrate both the influence of natural conditions on human colonization and the current level of the Vychegda archaeology studies. For example, absence of archaeological sites in the Lenskiy and Kotlasskiy districts of the Arkhangelsk Oblast' reflects only the poor state of knowledge. On the other hand, small number of known archaeological sites at some other places may result from inconvenience of local landscapes for ancient colonization. In this situation data of fluvial geomorphology, particularly processing geomorphological map of the valley, will promote more detail and purposeful surveying directed at discovering new archaeological sites. Location of known sites demonstrates high degree of selectivity according to morphological elements of the valley.

Archaeological sites of different epochs are located principally on sandy remnants of the 1st and sometimes – 2nd river terraces, near their edges oriented at the modern river or palaeochannels. Surface of terrace remnants had been reworked by wind action in the past and is characterized by aeolian morphology – dunes and closed depressions. These topographic features were actively exploited by ancient and medieval population in terrestrial planning of settled places – dwellings, workshops, burial grounds.

There are some regular features in choosing locations for settlements characteristic for different epochs. Mesolithic and Early Neolithic sites are located mainly at edges of the 2nd river terrace. Exceptionally they may locate in dry positions (dune tops) on the 1st terrace and on the floodplain. As a rule, colonized terrace edges were oriented at synchronous to them river channel. Population of the Mid-Neolithic and Bronze Age occupied terrace remnants with aeolian microtopography and made their dwellings in low positions – hollows, inter-ridge depressions, *etc*. Sites of the Iron Age have been found both on terraces and on floodplain ridges. The latter are studied poorly, therefore there are only few sites known in such locations. Burial grounds of that time are located exceptionally on dunes and are usually distant from the river and oxbow lakes.

The above observations refer mainly the middle and lower course of the Vychegda River – wide valley with the bottom highly reworked by lateral river migrations and characterized by a high relief landscape. Upper Vychegda valley has a different morphology. River channel here is more stable and heights of floodplain and terraces do not differ so much. Therefore archaeological sites of different periods occupy the same locations of river terraces. For example, population of the Vanvizdinskaya Culture colonized the area, which had been already settled earlier in the Mesolithic. In the middle and lower river course such situations are rare because valley morphology was changing actively, river channel was migrating constantly over the valley floor and these changes influenced availability of convenient places for organization settlements and burials.

Study of spatial distribution of archaeological sites has revealed that most populated during all epochs was the middle course of the river: it is characterized by the highest number and density of archaeological sites in spite of its highest rates of landscape dynamics due to river migration. At a relatively limited stretch it is rich with various elements of landscape: big and small watercourses, oxbow lakes, boggy palaeochannels, marshes, dry sandy highlands covered with coniferous forest. Such landscape diversity promoted exploitation of different natural resources – hunting, gathering, mineral resources, logging, *etc*. Concentration of different resources in a relatively small area allowed lowering physical and time expenses. The same kind of advantages gave oxbows and small rivers, which allowed using water transport. On the other hand, given the long and severe winters of the European North, those limited in area resources could not support large population for a long time. It was the reason why periods of ancient colonization were relatively short.

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YUGRA'S ARHEOLOGICAL MONUMENTS IN THE SYSTEM OF TOURISM DEVELOPMENT

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Now the government of Khanty-Mansiysk Autonomous Okrug – Yugra expends much effort for tourism to take the worthy place in the economy of our district as well as for the oil and gas production to do. The infrastructure is being created; various forms of support in the development of small and medium-sized business in tourism are put in.

Tourism industry as no other branch of the sector is interested in keeping the favorable ecological situation, cultural and historical monuments and traditions of the people occupying the region. Keeping and supporting the unique historical and cultural identity of the region is extremely important in any strategy of tourism development. Therefore irrespective of the fact what kinds of the directions of tourism will be developed in the district (sports, business, etc.) the historical and cultural heritage will act as a component of any round.

As the world experience shows, the organization of reserve museums or archaeological parks is the most effective way of keeping and using the archaeological heritage. These reserve museums give an opportunity of an active use of the monument, both in museum forms and within the scope of various scientific, educational, cultural and tourist programs.

The history and culture peculiarities of Khanty-Mansiysk Autonomous Okrug, the formation of system of identification and protection of historical and cultural objects have important differences from the European regions. In particular, there are not many monuments of architecture and monumental art in the district, but archaeological monuments and heritage of the indigenous small numbered peoples (Khanty, Mansi, Nenets people) considerably prevail. The archaeological monuments form 95 % from the general quantity of the objects being on the account.

The necessity of pointing out the territories with high concentration of archaeological monuments into the noteworthy places and historical and cultural reserves is caused by disappearing the system of heritage protection existing in the district. At the same time it becomes clear that the protection and use of some objects can't be effective off their historical and natural space. It is necessary from the point of view not only perception of a monument, but also from the point of view its viability (whether it is a natural system or an archaeological complex). That's why the creation of historical and cultural reserves and noteworthy places is urged to solve the questions of protection at the same time and the rational use of monuments of archeology, culture and nature.

There are some unique archaeological complexes in the territory of Khanty-Mansiysk Autonomous Okrug, which may be given the status of a noteworthy place, a natural and archaeological or ethno-archaeological park. One of such complexes is located in the territory of Khanty-Mansiysk district somewhere near the vicinities of settlement Sogom, on the coasts of the most picturesque lake House Rubbish (Domashniy Sor). Now more than 200 monuments of archeology are revealed there.

Most ancient monuments date back to the Neolithic era (the New Stone Age – the IV-III centuries BC). The monuments of that period are represented by settled complexes well-seen within the modern relief. Habitable constructions and amenities of an earth house type have been stored hitherto in a kind of cavities of various forms and size.

The next group is represented by the monuments of the Eneolithic era and the Bronze Age (the III-II centuries BC), which are also well-recognized according to their geomorphologic features of the relief. Archeological samples of that period are represented by tasty works of stone (scrapers, pikes, knife-edged plates) and expressive fragments of ceramic dishes.

The monuments of early Iron Age (the I century BC – the I century AD) are represented in rather greater quantity than the previous ones. At present only 30 of them have been discovered. Among them there are 18 sites of ancient settlements, 12 settlements and 1 burial ground. A settlement, as a rule, consists of 1, 2 or 3 constructions. Most of sites of ancient settlements are flat grounds, surrounded by self-defensive system across. They are earthworks-ditches and they are characterized, as a rule, by inconsiderable parameters; very often they are hardly imprinted in the relief. Forms of grounds are different: oblong-like, oval-like and trapezoidal-like. The size varies from the smallest of 14 * 18 meters to the largest of 70 * 35 meters.

More than 25 monuments preliminarily can be referred to the Middle Ages (the IV-XV centuries AD). Among them there are 6 settlements, 19 sites of ancient settlements and 1 burial ground. The materials of those monuments are represented by the woks of iron (knives, pikes) and ornaments of bronze and silver.

Written sources run that in the 17th century the natives inhabiting the basin of the river Sogom were included in Belogorskaya volost of Beryozovsky uyezd, but at the end of the century the volost was passed to Tobolsky uyezd.

Till the present time the basin of the river Sogom has been the residence of the natives – Ust-Irtysh Khanty, which maintain some traditional kinds of culture and household. For example, barrier fishing (fishing in staked up area on the river) and hunting upland game with a pressing trap – slopetz. There is a definite succession in sacred place worshiping. The sanctuary «Starik» (an old man) is one such places located on a significant archaeological site containing a layer of a Neolithic settlement and a medieval hillfort.

Elaborating and implementing programs of specialized tourism (ecological, archeological, ethnographic, etc.) connected with the heritage objects can contribute to realizing the strategy of rational use of historical and cultural heritage. This kind of tourism can suppose organizing and holding scientific forums and expeditions. In moderate amounts it can produce a considerable scientific, social and economic effect. Specialized tourism can be conducive to educational, school and regional natural history tourism.

The single-purpose scientific tourism foresees coming some separate groups of scientists, students or even citizens who are interested in archeology, ethnography, history, culture, nature’s territory, communication with local gurus, in working in archival depositories and gathering folk information.

The experience lets us suggest realizing different projects in the area of keeping and using some archeology significant monuments in Khanty-Mansiysk Autonomous Okrug – Yugra. The rapid economic progress determines a new strategy of using historical-cultural resource. The intensive development of some guarded historical-cultural territories is needed within a framework of long-term strategy in keeping and using objects of cultural heritage. On the ground of taking scientific measures in Khanty-Mansiysk Autonomous Okrug – Yugra the unique ethnographic, historical and natural complexes were discovered in every district of the Autonomous Okrug. Then the organizing of historical-cultural conservation areas of regional significance is possible. They are to be a supporting point not only in keeping and using historical-cultural resource, but also to be significant touristic big apples.

THE STRATIGRAPHY OF THE RIVERSIDE AREA OF KIEV PODOL (EXCAVATIONS AT THE 35, SPASKA STR.)

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Modern Kiev Podol (Lower town) is situated in the point of Dnieper and Pochaina confluence. Non-existent nowdays Pochaina creek was formed by Desna and Dnieper rivers, and filled up with Kiev streams (Syretskiy, Jordanskiy, Yurkovskiy, Glubochitskiy). In Old Rus' Kiev Pochaina served as natural harbor for river boats and ships, showing it's character only during spring floods.

Coincidence of the high-water Dnieper and Desna's overflow several times a century caused flooding of Podol area. Big overflow of 1931 was recorded at 97.73 m over Baltic see level, which would be barely enough only for flooding of coastal part of Podol. Therefore speed of Dnieper flow was also important. But archaeology shows that modern level of Podol area surface 7-12 m above the level of 10th century Podol town.

Usual Podol stratigraphy looks like «layer-cake» consisting of cultural layers, alluvium, and deluvium, which reaches maximum thickness closer to the Kievan hills. In contrast, north of the Podil area Obolon' stratigraphy does not differ from the normal flood plain. This phenomenon has got different explainations in the light of geomorphological features of the Podol formation [1; 2; 3].

Series of important stratigraphic sections were obtained by Podol excavations 1969-1976 [4, Fig. 2]. Test pit at the crossroad of Sagaidachnogo and Igorevskaya str. contained lower cultural layer deposited at 93.2 m over Baltic see height; pit at the 2, Kontraktova sq. – layer at 92.1 m; excavations on the Nizhniy Val – layer at 92.3 m; test pit at 4, Yaroslavlskaya str. – layer at 93.1 m. Eastwards of this line excavations at 25-27, Schekavitskaya str. discovered lower layer at 94.1 m; westwards, near hills, excavations at the Zhytniy market – layer at 93.4 m. The starting point of the Podol terrace formation in all excavations tend to mark the average values of 91.4-91.7 m over Baltic see level that is equal modern Dniper water level. Excavations of 2011 at the 35, Spasskaya str. (eastward Podol area near Pochaina bank) also traced river-bottom sand at the level of 91.34 m [5].

Stratigraphy data demonstrate that level of the Dnieper river of 9th-10th centuries roughly corresponded to modern (91,4-91,5 m), and the beginning of exploitation and colonization of Podol area started immediately, as soon as it's surface reaches the level of the Dnieper floodplain (92 m over the Baltic see level). The layers growth occurred not only due to the deposition of cultural remains, but also by deluvial washes from Kievan hills and removal of clay from the ravines which preserved the massive alluvial deposits and protected them from erosion.

The initial area of ancient Podol of late 9th – 10th century was significantly less than nowdays. M.A. Sagaydak proposed reconstruction of the image of 10th century Podol as wedge-shaped tongue tapering gradually to the Dnieper, based on the current city relief [6, Fig. 5, 7]. The oldest Podol wooden building discovered beneath the hills at Zhytniy market excavations (dendrochronological date 887 A.D.). Dates of wooden constructions from Kontraktova Square, Verkhniy and Nizhniy Val are 913, 900 and 901 A.D. that means that the settlement line went abroad Konstantinovskaya str. in early 10th century [1]. Excavations of 2011 on the 35, Spasskaya str. showed that in the early 10th century ledge below the line of Pochayninskaya str. still didn’t exist there, but the area was populated not earlier the end of 10th century.

Two pre-Rus’ Obolon’ settlements (existed from Neolithic time till 6th-7th centuries A.D.) define relatively safe altitude for the floodland terrace settlement at 94 m over the Baltic see level, exceeding usual spring rate of the Dnieper. Old Rus’ population started to use Podol terrace from the level of 92.1 m, probably trying to utilise the smallest new piece of land, which was formed near the harbor area.

The stratigraphic section of the 35, Spasskaya str. excavation (8 m depth) (Fig. 1) reveals at the depth of 7.6 m (91.34 m over the Baltic sea level) top of the multimeter stratum of homogeneous dense river-bottom dark-gray sand, investigated also by parallel geological drilling. Thin layer above consists of white sand of the ancient beach, precisely matching the modern Dnieper river level and containing groundwater stream. Layers of alluvial sand at 91.56-91.66 m was interspersed with very thin deluvial interlayers. But first deluvial horizon that marked traces of human activity (wood chips and charcoal) (Hor.25) was deposited at 92.20-92.24 m. Next two thick mixed sand layers (0.6 m) were formed in conditions of standing water. From Horizon 24 (92.94-92.84 m) till Horizon 15 (94.54 m) stratigraphy is characteristic pattern of alternation of thin loamy deluvium layers (Horizons 15-24) and alluvial sands. The share of the deluvium sediment (Horizons 15-25) was only 0.5 m of total 2 m accumulated during that period.

Presence of archaeological material traced starting from Horizon 20 (late 10th – early 11th centuries). And the oldest homestead N 1 with wooden carcass building at 35 Spasskaya str. was detected at Horizon 19 (93.64 m), which is barely reached the safe terrace level. Neighboring homestead N 2 was build at Horizon 18.

Horizon 14 (94.54 m) is very different from others. It was formed by black and brown very dense floodplain peat soils including numerous cultural remains (animal bones, pottery, various artefacts) and organics (wood, straw, grain, nuts shell, manure). Layer capacity of 0.4-0.6 m is divided into three chronological stratas, according to the contained archaeological material dated to the 1020-1040 A.D. Dense consistence of horizon blocked air access into the soil and allowed to preserve well wooden constructions, that above Horizon 14 could be traced only as wood rot or charred pieces and charcoals.

First cultural layer (0.1 m) based on the sandy loam (Horizon 13a) lies directly above Horizon 14. Above Horizon 13a (94.93-95.22 m) there is again picture of interchanging of deluvial deposits with alluvial sands that lasts up to 96.74 to 97.44 m in different parts of excavation pits. Cultural layers from sandy loam (Horizons 13a, 11,

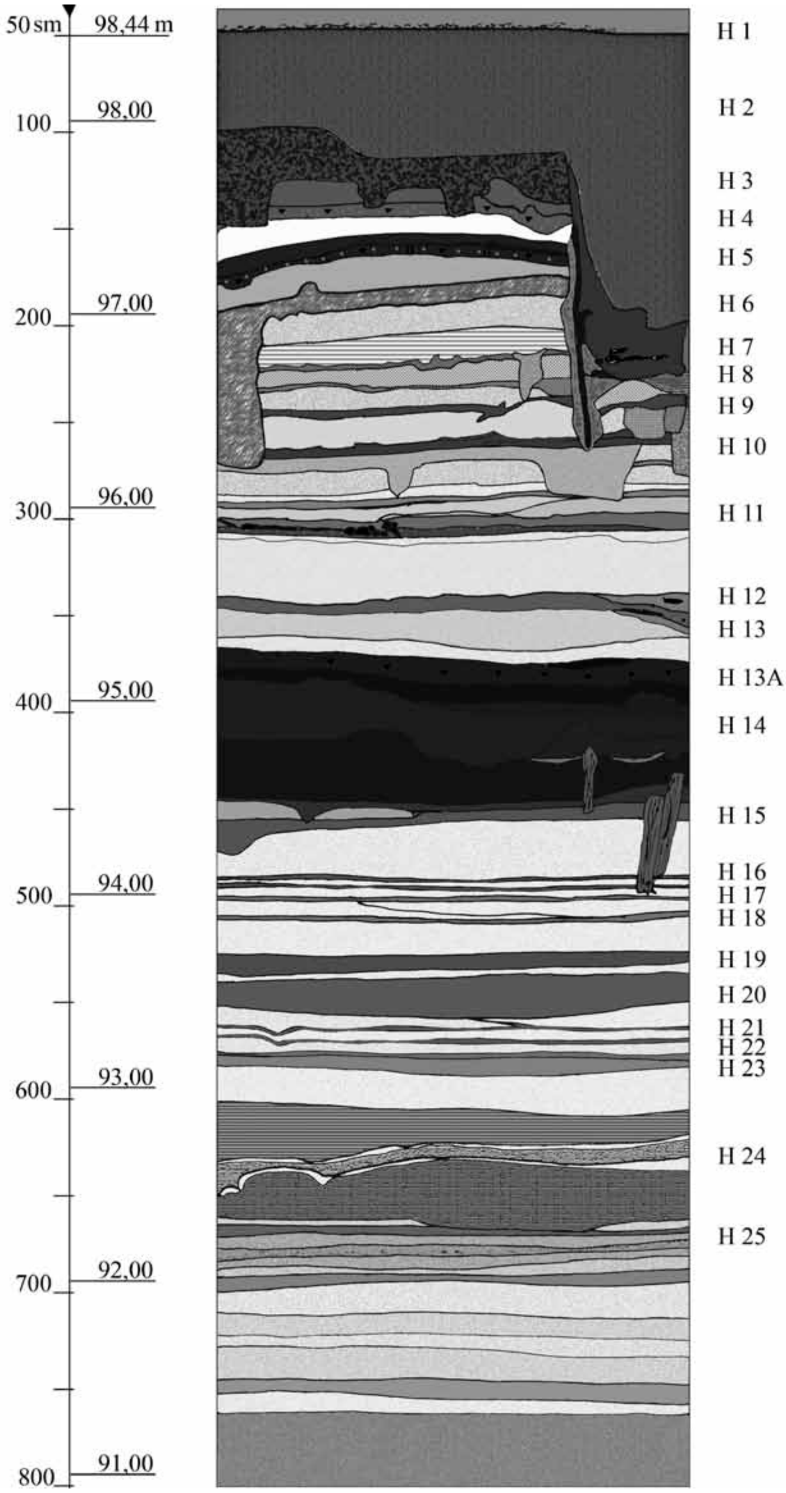

Figure 1. The stratigraphic section of the 35, Spasskaya str. excavations

10, 7 and higher) interchanged with layers of the deluvial loam (Horizons 13, 12, 8). New process of active layer accumulation covers the period from middle 11th till middle 12th centuries. Traces of deluvial washes cannot be observed after Horizon 8 (96.37-96.47 m). The latest alluvial strata (a layer of fine white sand 10-12 cm thick) is deposited at 97.64-97.84 m (Alluvium 4), that is equal to the highest overflow of 20th century (1931 – 97.73 m).

The most conspicuous sections of deluvium are Horizons 20, 19 and 12 (thickness 0.1-0.2 m), while the most notable floods (alluvium) after the appearance of homesteads are layers A20, A15, A12, A11, A8. In some cases (Hor. 20, 12, 8) big floods (A20, A12, A8) preceded deluvial washes. In other, like Horizon 19, preceding alluvial layer was very thin (A19), and below the Horizon 9 there was no sand at all. The most thick layer of sand A11 (0.3-0.5 m) (middle 11th century) covered also thick deluvial layer (Horizon 12), but was covered with «dry» cultural Horizon 11 on the basis of sandy loam. This picture shows that the wet years in Kiev did not always coincide with periods of high level of the Dnieper floods.

The most active processes of layer formation in the coastal part of Podil observed in the 10th – beginning 11th century. In 1020-1040 there was a period of stabilization, accompanied by the formation of humus floodplain soils. But in the middle 11th century started new period of wet years and an active sediment accumulation. As the terrace grew in the 12th century, the thickness of the alluvial layers become less, and before the end of the century the episodes of the alluvial depositions not repeated again. Earlier, to the beginning of 12th century dated last deluvial layers, that was probably due not only to climate change, but also due to the artificial control of beds of streams, coastal protection of which traced on Podol archaeologically.

In general, the surface of the investigated Podol district was formed by alluvial deposits of Dnieper floods, deluvial washes from Kiev hills and deposits of anthropogenic cultural layers. From the 9th – 10th centuries until the middle 13th century it grew up to 7 meters high from the starting point (from 91.34 m to 98.3 m).

Complex geomorphological situation has affected the character of the cultural deposits in this area. Every time river flood or deluvial spate from hills occurred, cultural horizon was covered with a sterile layer. This feature of the deposits growth transformed cultural horizons into «closed» complexes, stratigraphically separated from one another, that makes possible to date accurately not only archeological complexes but the geomorphic processes also.

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THE STATE OF MICROBIAL COMMUNITIES IN BURIED PALEOSOILS IN RELATION TO PREVAILING CLIMATES IN STEPPES OF THE LOWER VOLGA REGION

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Recent investigations have shown that the microbial communities of the steppe paleosoils buried beneath ground archeological monuments (kurgans) of different ages preserve a number of parameters inherent to them in the time of their burial. They can be used for reconstructions of prevailing climates for the respective time-windows. Among the important parameters of the microbial communities is their living biomass. Since a considerable part of the microbial communities are dormant cells including ultramicrobacteria, the search for methodical approaches that permits one to characterize the community most comprehensively irrespective to the physiological state of the microbial cells remains topical. For estimation of the total microbial biomass we used the method of extraction the microbial fraction with determination of it completeness [1], for estimation living microbial biomass we used the soil phospholipids' content. Phospholipids are necessary components of all living cells, after the death of the cell they are rapidly decomposed and do not belong to the storage products [2]. The aim of our work was to estimate the dynamics of living and total microbial biomass in the paleosoils buried beneath the kurgans of the Bronze and Early Iron Ages (5000-1800 years ago) in the Lower Volga basin, tracing the changes in the climatic conditions, in particular, the climate humidity.

The area studied was located in the dry steppe zone in the southern part of the Privolzhskaya Upland. The key object – Avilovsky mound set comprised the compact group of kurgans constructed in the Bronze Age (the boundary of IV – III mil. BC and III mil. BC, the Yamnaya culture; the late III mil. BC, the Catacomb culture) and the Early Iron age (AD I, the Middle Sarmatian culture; the second half of the II c – the first half of the III, the Late Sarmatian culture). The time of construction and, hence, the soil burial was dated back from the existing chronology and cultural-historical data on the development of steppe communities in the Eastern Europe for last 6000 years based on the artifacts typical for archeological cultures.

In the present-day chestnut soils the phospholipid (Pl) content was maximal in A1 horizon and decreased down the profile from 450 to 190 nmol/g. In A1 horizon of buried paleosoils the Pl contents varied from 28 to 36 % (paleosoils dated back to the Bronze epoch) and from 53 to 93 % (paleosoils dated back to the Early Iron epoch) of the current level. The reduction in the PL contents related to the time of the soil burial appears to be a result of the diagenesis in A1 horizon. In B1 horizon of the paleosoils the PL content amounted to 55-130 % of the current level; maximal and minimal amounts were found in the paleosoils buried 2000 and 4800 years ago, respectively. In B2 horizon of the buried paleosoils the Pl content was 78-113 % of the current level with maximum and minimum in the paleosoils buried 2000 and 4800 years respectively. In the paleosoils buried in the Bronze epoch the Pl content increased with the depth with its maximum in B2 horizon; in the paleosoils buried 2000 ago the Pl contents were comparable and somewhat higher than in the present day soils. In the paleosoils buried 1800 years ago the Pl content was lower in B1 horizon and similar to its present day level in A1 and B2 horizons. The temporal dynamics of the PL content in the pedochronosequences was similar in B1 and B2 horizons with relatively elevated levels in paleosoils buried 5000 and 2000 years ago. The average PL weighed content (A1 + B1 + B2) in the paleosoils was 48-90 % of the current level and its temporal dynamics in the pedochronosequences repeated the dynamics typical for B1 and B2 horizons with relatively elevated levels in paleosoils whose burial is referred to periods with a more humid climate 5000 and 2000 years ago.

Table 1.

The content of living microbial biomass calculated from the phospholipid (C-PL) content and its portion in the total microbial biomass (C-TMB) and soil organic carbon (Corg).

Horizon	C-PL (μg / g)	C-PL / C-TMB	C-PL / Corg
		%	
IV–III mil BC (~ 5000 years ago)			
A1	258	18.1	14.3
B1	300	62.5	16.7
B2	358	31.5	39.8
The first quarter III mil BC (~ 4800 years ago)			
A1	230	21.2	8.5
B1	205	15.0	11.4
B2	283	31.7	31.5
Late III mil BC (~ 4000 years ago)			
A1	296	15.3	8.4
B1	358	35.1	12.3
B2	359	25.7	18.0
AD I (~ 2000 years ago)			
A1	458	38.6	5.1
B1	481	44.8	6.7
B2	411	49.4	7.6
AD 2 half II – first half III (~ 1800 years ago)			
A1	759	81.4	5.8
B1	246	25.8	3.4
B2	338	27.8	6.3
Present time			
A1	867	15.3	6.8
B1	394	11.6	4.1
B2	363	8.5	7.9

The total microbial biomass including the cells at different stages of their life cycles, the dormant cells and nanoforms, and the cellular metabolites amounted to 5680, 3380, and 4250 μg C / g in A1, B1 and B2 horizons of the present day soil, respectively. In the paleosoils the total microbial biomass was 2.5-7 times lower than the recent level.

Using the literature data on the correlation between the phospholipid and organic carbon contents in the microbial cells the living microbial biomass was calculated in the units of organic carbon and compared with the total microbial biomass, and the total organic carbon content (table 1).

In the present day soil the portion of living microbial biomass in the total one was minimal in the present day soil (8.5-15.3 %). In the paleosoils it considerably exceeded the current level and varied from 15 to 50 % in different soil horizons. In some cases the share of living biomass was very high: in A1 horizon of the paleosoils buried 1800 years ago it was 81 %, in B1 horizon of the soil buried 5000 years ago it was 62 %. The living microbial biomass amounted to 4-8 % of the total organic carbon in the present day soil and in paleosoils of the Early Iron epoch (2000 and 1800 years ago); in the paleosoils of the Bronze epoch it reached 40 %. The results showed that the microbial community of the present day soil contained a variety of cells on different stages of their life cycle – actively metabolizing, dormant, dead, and mummified cells and cellular metabolites and substrates inseparable from the cell mass. They were fixed in the total microbial biomass. In the paleosoils the available organic carbon appears to be depleted, and the microorganisms become dormant or invalid due to the long-term burial of the soil. The share of carbon of the living biomass and total biomass remains relatively high.

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SLOPE SEDIMENTS AS INDICATORS OF ANTHROPOPRESSURE IN THE LIGHT OF RESEARCH IN CENTRAL POLAND

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Surfaces of slopes devoid of plant cover are very sensitive for activity of slope wash processes. Deforestation of slops results on the one hand from natural, mainly climate, changes and from human societies impact on the second hand and phases of slope wash activity are connected with cold climate periods and with periods of increases of human activity. Phase of climatic origin of intensive slope processes has been correlated with the termination of the Last Glaciation (Weichselian Glacial) and Eo-Holocene and phases of human origin have been recognized for Mezo- and Neo-Holocene and they are correlated with intensive settlement and economical activity in areas in question [1, 2, 3, 4, 5].

It is necessary to underline, that the human factor is responsible for environmental changes resulting in formation of environmental conditions suitable for initiation and development of slope processes. The human impact must be defined as an indirect processes factor. Reaction of slope system is often preserved in character of appropriate sediments and in some cases in erosive structures. Settlements dated to the Prehistory and to the Early Middle Ages are located in Central Poland usually at weakly inclined (not more than 3 degrees) slopes formed by sand. Such areas are appropriate for slope wash processes, that is the reason of occurrence of deluvial (in polish terminology) sediments at archaeological settlement sites. The sediments of discussed slope cover contain often artefacts of many kinds, i.e. ceramics, flints, stone tools, stones and ecofacts as well, as charcoals, seeds and corns.

The multidisciplinary geoarchaeological research has been undertaken in the Ner River catchment since few years as a part of archaeological investigations and research of environmental archaeology. They have been undertaken at dozen archaeological sites, most of them are represented by remains of prehistoric settlements intensively occupied since Bronze Age. At investigated sites, slope cover sediments have covered moderately inclined surfaces, which limited sites, and they have been uncovered at culmination part of site areas as well. In the paper the results of research at Wierzbowa site and Lutomiersk-Koziówki site have been presented.

The Wierzbowa site is located within the Warsaw-Berlin Pradolina in the Gnida River valley, tributary of the Ner River. At site, it has been discovered a wide spread complex of prehistoric sites, including: two cemeteries and relicts of few settlements of societies of the Trzciniec, the Lusatian, the Pomeranian and the Przeworsk Cultures - dated to the period since the Older Bronze Age to the Late Roman Period [6].

The site occupy a very poorly (not more than 3°) inclined surface of the valley slope formed by Plenivistulian sands and silts. The settlement were located in a very close vicinity of swampy floor of the Gnida River valley, partly occupied by peat bogs and in the area characterized by a high environmental geodiversity [7].

At the lower part of the slope at Wierzbowa site, the sandy slope wash sediments with subfossil cultural layers have been uncovered [8, 9]. The cultural layers have been recognized by grey-brownish colour and admixture of charcoal and numerous fragments of pottery. Some charcoals have been observed within whole slope wash cover, both in layers having artefact and beside them. The cultural layers were deposited within the slope wash sediments accumulated on the surface of valley slope, close to the valley floor and they partly cover the periphery of ancient valley floor as well. The higher cultural layer has been dated by archaeological finds to the La Tène Period and Roman Period and the lower cultural layer – to the Bronze Age and Hallstatt Period.

Sands of slope cover at Wierzbowa are typified by Folk and Ward [10] co-efficients: mean size of grains 1,75-2,00 in Phi (i.e. 0,25-0,28 mm), sorting index – 0,7-0,8 (i.e. moderately sorted). The relation between the mean grain size and the sorting index represents type II after Mycielska-Dowgiałło [11] characterized for deluvia sediments [12, 3]. The characteristics of the slope wash cover at Wierzbowa seems to be parallel to the so called «deluvial sands» [2, 4, 12]. The «deluvial sands» cover at Wierzbowa has been deposited as an effect of moderately intensive slope wash processes active on the partly deforested surface [8, 9]. The features of slope wash sediments are very similar to the basic sediments of the Plenivistulian sediments of the valley slope.

The beginning of accumulation of slope sand cover has been documented by archaeological records and by radiocarbon dating of underlying organic silt. Radiocarbon dating of those organic sediments – 3490 ± 50 BP (LOD 1182) and 3750 ± 50 BP

(LOD 1451) – documents the beginning of accumulation to the ca. 1900-1750 BC [7]. The time of initiate of slope wash cover accumulation has been documented by archaeological artefacts as well. It is proved by the discovery on the surface of organic silt of a very characteristic fragment of pottery representing so-called «Lodz Phase» [13] dated to ca. 1500-1250 BC [14].

The initiation of the accumulation of slope cover in Wierzbowa must be correlated with the Trzciniec Culture society activity resulting in deforestation of area. The slope under the study has been occupied by prehistoric settlements and was remaining under the prehistoric human impact almost from the Middle Bronze Age at least to the Late Roman Period. Any sedimentological factors proved changes in course of slope wash processes in prehistory have not been recognized [7, 8, 9].

The site at Lutomiersk-Koziówki is situated in the southern part of Ner River valley, very close to the small stream Zalewka River mouth. In the Ner River valley in Lutomiersk vicinity, dozen very interesting archaeological sites have been discovered. The one of the most interesting is complex of archaeological sites at Lutomiersk-Koziówki no 3. In this unique archaeological complex, numerous remains have been recognized - related to: Late Palaeolothic and Mesolithic camps, the Neolithic Funnel Backer Culture episodic settlement, and mainly to settlements of the Trzciniec Culture (Bronze Age), the Lusatian Culture (Bronze Age), the Pomeranian Culture (La Tène Period), the Przeworsk Culture (Late Pre-Roman and Roman Period) and Middle Ages (8^{th} / 9^{th} – 13^{th} c.) [15].

The settlements have been established at the alluvial fan of Zalewka River. The fan is a part of high terrace of the Ner River valley. The terraces has been divided in the surrounding of site by valley floor of the Zalewka River. The high terrace has been accumulated in the Plenivistulian, what is documented by appropriate TL dating. The area of terrace occupied by the site is partly restricted by huge Late Vistulian palaeochannels. The background of the site is formed mainly by no-organic medium- and coarse-grained sands.

Very thick cultural layers have been documented at all sites in the neighbouring of Lutomiersk [7, 13, 16, 17, 18]. At the upper part of the site, they are represented by brown and dark grey partly humus sands with reach admixture of charcoals and numerous fragments of pottery and other artefacts of the Trzciniec Culture in the bottom and of the Lusatian Culture in the higher level. The thickness of the discussed sand cover ranges to the 1 m. The sediments of cover is typified by mean size of grains 1,47-1,60 (i.e. 0,33-0,36 mm), sorting index – 0,7-0,8. The relation between the mean grain size and the sorting index represents type II [11] characteristic for deluvia sediments [12, 3]. The features of the sediments are typical for the slope wash cover of «deluvial sands» [2, 4, 12] deposited as an effect of moderately intensive slope wash processes. The origin of the sand cover is partly resulted from earthworks connected with establish of settlement objects deepen in the ground.

The analogous deluvial sediments have been recognized and elaborated at slopes (inclined les than 3°) limited the terrace occupied. They have covered the filling of Late Vistulian palaeochannel, Eo-Holocene overbank alluvia and subfossil soli containing artefact of the Trzciniec Culture. The thickness of described sediments achieve 1,5 m and they prove the long-lasting activity and impact of prehistoric and early historic societies at the area in question almost since from Old Bronze Age. Because of quite high admixture of organic substances at some levels we can distinguish «soli deluvia» after Sinkiewicz [1] within discussed slope cover. We have recognized subfossil soils horizons documented discontinuation of slope wash processes and pedogenetic activity connected with reforestation of the area. The recognized phases of pedogenesis have been correlated with the Early Iron Age and with the Old Roman Period, what is appropriate to the results of the archaeological research. Part of slope cover is most probably the result of direct earthworks and removing of older cultural layers.

The origin and development of slope covers discussed in the paper have been correlated with anthropogenic factor and with anthropogenic changes of the natural environment. We have recognized distinctive archaeological relicts of human activity at sites in question documenting periods of intensive activity of human societies. We can indicate the anthropogenic factor as an initiator of important environmental changes resulting in intensive slope wash processes. Accumulation of those deposits has been resulted from natural processes initiated although by anthropogenic factor during periods of intensive settlement and economic activity.

The slope cover sediments might be date by archaeological artefact. Simultaneously the slope cover sediments are the source for recognition of intensity of human impact and of economic activity of ancient societies on the one hand and for distinguish phases of hiatuses of settlement development as well.

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RESEARCH OF FOSSIL FOREST FROM THE WEICHSELIAN DECLINE IN THE WARTA RIVER VALLEY (CENTRAL POLAND)

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The subject of the interdisciplinary research undertaken at Kozmin site in the Warta River Valley is a horizon of the subfossil foresttrees within alluvial sediments. The study aims at reconstructing the environmental conditions in the river valley on the basis of the reconstruction of forest ecosystem changes. By integrating data of interdisciplinary studies the authors hope to establish the cause of the forest destruction by answering the question about secular or catastrophic nature of the event and also to provide information on palaeoclimate parameters.

The studied site Koźmin is situated in the lowland part of Central Poland, within the open pit area of the Miocene lignite exploitation of the Adamów Lignite Mine. Geomorphologically, it lies on the low terrace of a Late Weichselian age, on the western side of the Warta River Valley. The area of study was last time covered by the ice sheet during the Wartanian Stage glaciations. The Weichselian Cold Stage was an ice-free period there; the closest position of the ice sheet front (about 20 km) took place during the Last Glacial Maximum.

The well preserved tree remnants (fig. 1) with clearly visible rings occur within an organic unit, 0.5-0.3 m thick, which is usually consisted of organic silt, locally interlayerd with fine mineral material, in places, especially at the very bottom, with a peat material. The series rests on the Upper Pleniglacial alluvia. The organic series is covered by 2-3 m thick mineral deposits, mostly sandy and sandy-silty, achieving the present-day surface.

Figure 1. The forest remnants in the open test pit (2011)

At the beginning of the study the organic unit with tree remnants was investigated in the walls of the lignite excavation. A detailed research has been undertaken in 2010 and 2011, in the open test pit of about 160 square metres. Altogether the forest remnants have been documented in 7 levels every 5 to 10 cm. So far over 300 objects have been registered in the form of stumps, collapsed trunks and branches. According to preliminary macroscopic recognition, these are remnants first of all of pine and also birch. The most stumps are in the in situ position. They are situated in the organic unit and have well preserved root systems. Between the braided roots the assemblages of cones have been found. Some wood remnants are coated with bark. The length of the trunks reaches up to a few (i.e. 2-5 m) metres. Their diameters are locally over 0.2 m. In general the unit rather lacks of sedimentological traces of fluvial high energy conditions. Some trunks, especially those from the bottom of the unit of overbank deposits, probably were transported in a fluvial environment.

The stratigraphy of the organic unit was determined based on radiocarbon dating of the samples of the organic material and the tree trunks. The conventional dates of the trees obtained so far are: 10 310 ± 90 BP (Lod 1402), 10 660 ± 50 BP (MKL-1070), 10 710 ± 50 BP (MKL-1071), 10 730 ± 60 BP (MKL-1072). In general the pine forest represented by subfossil trunks was growing in the area in question in the period between 12 680 and 11 985 BP (prob. 68,2 %). The ^{14}C data of organic unit achieve results since 10 870 ± 170 BP (Lod 699) up to 9780 ± 110 BP (MKL-1077), i.e. 12 935 – 10 875 BP (prob. 68,2 %). The period of pine forest existents is generaly synchronic with the period of accumulation of organic sediments. In the light of the dendrological results obtained so far, forest has been destructed by an increase of water level and was fallen in a very short period of time no more than 20 years.

Sediments from the site are suitable to carry out anlayses of both the organic and mineral material and this way are promising to obtain palaeoclimate archives to assess the environment's response to global climate changes. Besides geochronological studies (radiocarbon datings of tree remnants and enclosing organic material, OSL datings of the mineral unit overlying the organic series) the following analyses are in progress: dendrochronological analyses, pollen analyses, plant macrofossils, palaeopedological analyses, Chironomidae, Cladocera, Diatominae, Testaceae, sedimentological properties, grain size composition.

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PREHISTORIC AND EARLY MEDIEVAL TRANSFER OF HUMAN IMPACT DOWNSTREAM SMALL VALLEYS; SUDETES MTS & NE LOESS FORELAND, POLAND

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In the zone of temperate climate, with widespread presence of running water, past or present human impact in natural environment may be transferred and «recorded» on long distances. Eastern Sudetes and their NE foreland are an example of such a phenomenon. Eastern Sudetes are the SE end of mid-mountain range of variscides in Central Europe. The mountain massif Hruby Jesenik (1200-1400 m) slopes down of 500 m to a Glubczyce less Plateau (220-340 m) located at its NE foreland. It is cut through by deep valleys with steep slopes (fig. 1). In earlier Pleistocene the Scandinavian ice sheet reached the mountains foothills. In the period of the last Scandinavian glaciation the ice margin was located 160-200 km north of the of the mountain summits. In the conditions of periglacial climate on summits and mountain slopes developed regolith covers. On mountain foreland a loess cover of few meters thick was deposited.

Holocene climate amelioration caused a succession of forest communities. At least 10,000 years ago undulated loess plateaus were covered with deciduous forests. On northern slopes of mountain massifs the lower vertical belt was covered by beech forest and the upper one – by spruce forests. The contemporary climate of this part of Sudetes is characterised by icy winters with long-lasting snow cover. The precipitations reach 1500 mm / year. On mountain foreland the summers are warm and rainfall reaches 800 mm / year which creates favourable conditions for vegetation.

Around 6000-5500 BC began the agricultural colonization of Central Europe [1]. The migration paths of the Neolithic farmers of western Linear Pottery Culture led through the Moravian Gate to the northern foreland of Sudetes and Carpathian mountain massifs. Here, high precipitation formed a dense network of local streams and created favourable conditions for large production of biomass. The tribes quickly inhabited the Glubczyce loess plateau, particularly in the period of the Funnel Becker Culture.

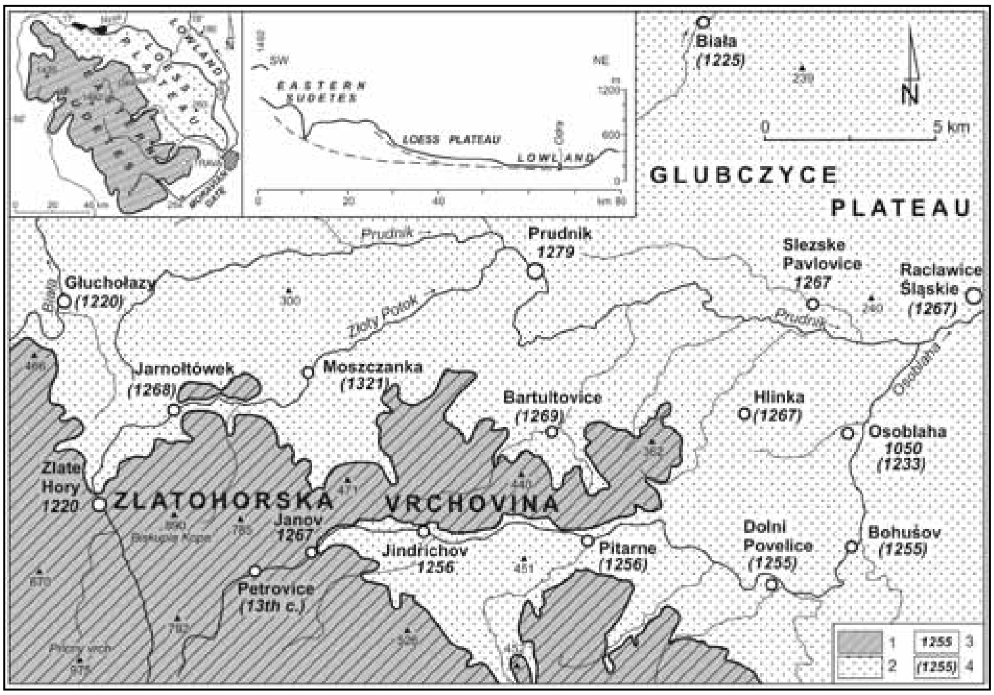
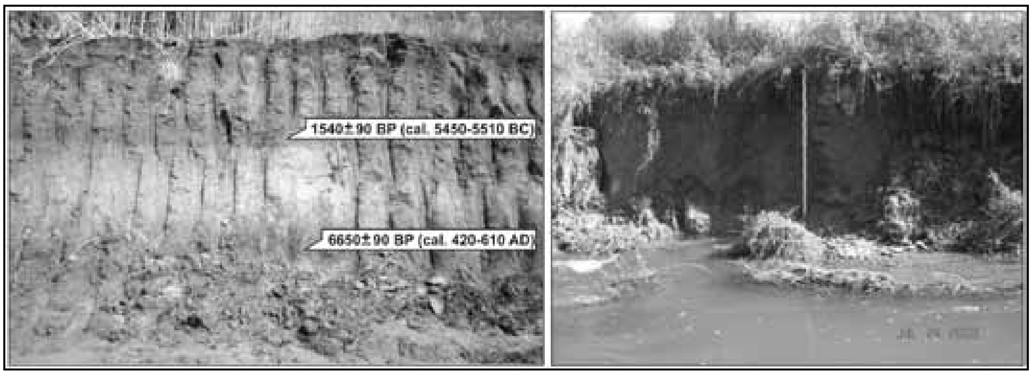


Figure 1. Location of the study area: 1. Mid-mountains, 2. Loess plateau, 3. Date of settlement location, 4. Date that settlement was mentioned

Colluvia infilling the dry valley heads and small valleys, cutting through a loess plateau, constitute the proof of agricultural exploitation of soil. In Biała, a town located 10-12 km away from Sudetes slope, in a clay-pit cutting through a small dry valley – Biała river tributary – two levels of fossil soils were detected, covered with clay colluvia (fig. 2 left) [2]. Lower level of the fossil chernozem soil were most probably formed at the bottom of a valley head covered with turf, within previously forested loess plateau. The ^{14}C radiocarbon dating determined that the age of its middle level is 6650 ± 90 BP (cal. 5721-5471 BP). This fossil soil is covered by clay colluvia, around 1.5 m thick, with the predominance of the < 0.05 mm fractions (up to 80 %). Colluvia were formed as a result of soil erosion due to agriculture on the slope of Biała river small tributary (fig. 2. left). In this part of the loess plateau Neolitic settlement appeared in the early Neolith, i.e. 6 000 years BP / 4 000 BC, and intensified in the period of the Funnel Becker Culture, around 3500 BC [3]. This probably lasted throughout Bronze Age and Roman influence until pre-Slavic Migration Period (375 AD). The upper level of the fossil soil was formed in the period of depopulation and probably re-forestation of the loess plateau in the Migration Period. The ^{14}C age of the middle part of this fossil soil is dated 1540 ± 90 BP (cal. 420-610 AD). The period of agricultural exploitation of soil in the Biała valley slope could have lasted 3500-3900 years. In this period the layer of 0,9 m-thick colluvia increased on average at the pace of 2,5 cm / century.



Fiure 2. Fossil soils in small valley infill near Biała (left photo) overbank fine deposits in lower course of Prudnik river (right photo).

Population of the loess plateau by Slavic tribes occured in 6-7th century AD [4]. Alluvial fans deposits covering peat at the mouths of the dissection of the valley sides indicate that the process began between as early as 540 and 700 years AD [5, 6]. Settlements within Glubczyce loess plateau are confirmed by historical sources to have occurred since at least the 11th century. This caused deforestation and spreading of crop cultivation in this period. In the NE area of Sudetes slopes the network of settlement was closely linked with gold mining (Zlate Hory 1220, fig 2), and later with exploitation and processing of iron ore. Forest cutting for charcoal production and cultivation of steep mountain slopes caused intense soil erosion. It was also a source of fine-grained sediment carried easily by mountain streams and deposited in their foreland River Prudnik, tributary of Osobłoga → Odra (fig. 2. right), with a drainage basin of around 290 km^2 in area, drains the north slope of Zlatohorska Vrchovina (350-975 m) as well as undulated south part of the loess plateau (240-350 m). Its lower reaches, before the correction of the channel, were characterised by anastomosing pattern. Shortening and deepening of the channel exposed the structure of alluvia. Coarse alluvia previously braided river were covered by an approximately 2-meter thick complex of overbank clay deposits (fig. 2. right). On the surface of coarse channel deposits there can be found roots of riparian vegetation, pieces of branches or tree trunks. Their radiocarbon age is similar, falling into the range of 1750-1460 BP (cal. 210-400 AD) – the period of declining Roman Empire. The youngest oak trunk, underlying fine overbank deposits, dendrochronologically felled in 613 AD indicates that their deposition of the overbank deposits began after the 7th century AD, i.e. in the period of Slavic tribes populating the loess plateau. Presumably the deposition of these sediments escalated in the period of intensification of settlement in the paleau at the turn of the 12th and 13th century. At the beginning of the 14th century it was as high as 30 people per square kilometre. Intense soil erosion within the mountain region of the river basin, linked with gold and metal ores exploitation and agriculture on valley slopes, was also a significant source of eroded soil supply from farmland.

10-16 km from the NE Sudetes slope, downstream of Osoblaha valley, there can be found distinct trances of intensified supply of fine-grained alluvia. They caused the formation of anastomosing channel pattern in widening of the valley. In other places organic backswamps or palaeochannel infill can be covered by fine-grained overbank deposits [5].

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SOIL AND CULTURAL LAYERS PROPERTIES OF ARCHAEOLOGICAL SITESIN CNA RIVER VALLEY AS A SOURCE OF PALAEOECOLOGICAL INFORMATION

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Introduction. Almost all non-forested landscapes, as well as the high intensity of the accumulation of alluvium, typical of the modern floodplain, there existed not always. Numerous facts show that the history of the Holocene floodplain landscape was complex, involves many stages with different character of natural and anthropogenic processes of pedogenesis. An extremely interesting phenomenon floodplain, which displays the history of the Holocene landscape are a series of buried soils, which can become a reliable source of information on the factors of their formation.

Therefore the aim of the study was the reconstruction of paleoclimate environment of historical time by analyzing the properties of soils and cultural layers of Davydov and Nicholskii settlements located in landscapes of Tambov region.

Objects and methods. In order to study the properties of soils and cultural layers of archaeological sites in the Cna river valley catena soils was laid down in the archaeological sites of ancient Nikol'skii and Davydov settlements (excavation director S.I. Andreev) and their surrounding landscapes.

Research methods included measurement of the magnetic susceptibility of soils and the determination of the isotopic composition of carbon, radiocarbon dating of soil humus, and mineral content of mineral and organic phosphorus (fig. 1).

Results. The study of the morphological properties of soils found that uncovered soils are polygenetic, because they contain a series of buried horizons and cultural layers. Among the buried horizons can be identified:

1) The cultural layers of Nicholskii and Davydov settlements, characterized by a dark color due to the accumulation of organic matter of a specific human nature containing coals.

2) The second humus horizons, preserved by subsequent plowing of the soil.

3) Horizons of iron and manganese hydrogenic accumulation, diagnosing pulsating rhythms of the hydrological mode of river floodplains and in time and marking the level of groundwater in different historical epochs.

Thus, the profile of the Davydov settlement section consists of the following parts (by S.I. Andreev): 1) the present day of the soil, 2) medieval cultural layer, and 3) the cultural layer of the Iron Age and 4) the cultural layer of the Bronze Age, imposed on buried chernozem meadow soil 5) buried soil of Eneolit. Diagnostic features of the hydromorphic periods in the past are the modern landscape and soil morphology of Davydov fort, which is now a 30-minute walk from the river crescent. Ortzand and concretions layers in the studied soils mark the level of groundwater – about 132 m above sea level. Now the water table is located at an altitude of 102 meters. If the modern edge of the river is about 110 meters and the height of the lifting of the capillary fringe – 5 m, the fluctuations in water level of the Davydov settlement area is not less than 15 m [1]. Soil catena in Nicholskii site revealed podzolic chernozem with signs of plowing the upper humus horizon is about 150 years ago (based on the age of the oak) on the third river terrace, and a composite profile of the second terrace, which consists of three parts: 1) alluvial soil profile of the present day 2) the cultural layer, superimposed on a profile 3) alluvial gray-humus soils with ortzands at the bottom.

Radiocarbon ages of soil formed on the 3 terrace is 1210 ± 70 years, indicating that the period of intensive accumulation of alluvium and increased hydromorphism was about in 8-9 centuries BC, and it is equal to the global wet episode in the history of the region. At the same time, the age of present day humus horizons on watersheds was about 2500-2600 years (2510 ± 50). The formation of strong, stable over time Middle Ages cultural layers spoke about the long interruption of alluvial processes in the Middle Ages within the first terrace above the floodplain, where Nikolskii settlement exists. The subsequent Little Ice Age period differents by high humidity of climate and increase of river level, as can be judged by the deposits of manganese and iron and the formation of ortzand. Location of the modern Nikolskii village in the central valley indicates a decline in ground water level and reduce the intensity of floods in the last 100 years. Indeed the cultural layer is formed in the thickness of malt and the top is covered with alluvial deposits and alluvial dark humus soil.

Bimodal distribution character of the magnetic susceptibility values in the profile reflects the presence of naturally buried humus horizons and zones of hydrogenic ferrugination. It is important to emphasize that the regressive nature of the eluvial-size distribution curves of magnetic susceptibility with a maximum depth of 25 cm confirms the conclusion of the plowing in the past and the loss of human horizon properties as a result of human development. Thus, the magnetic properties of the cultural layers of soils and minerals can serve as a criterion for the intensity of soil-forming processes.

The distribution of the total, mineral and organic P_2O_5 in soil profile is polymodal. The content of the organic, inorganic and total phosphorus increased by cultural layers, regularly increasing in ortzande. These facts are reliably diagnosed anthropogenic origin of the buried humus horizons, and that they belong to the cultural strata of the urban settlements.

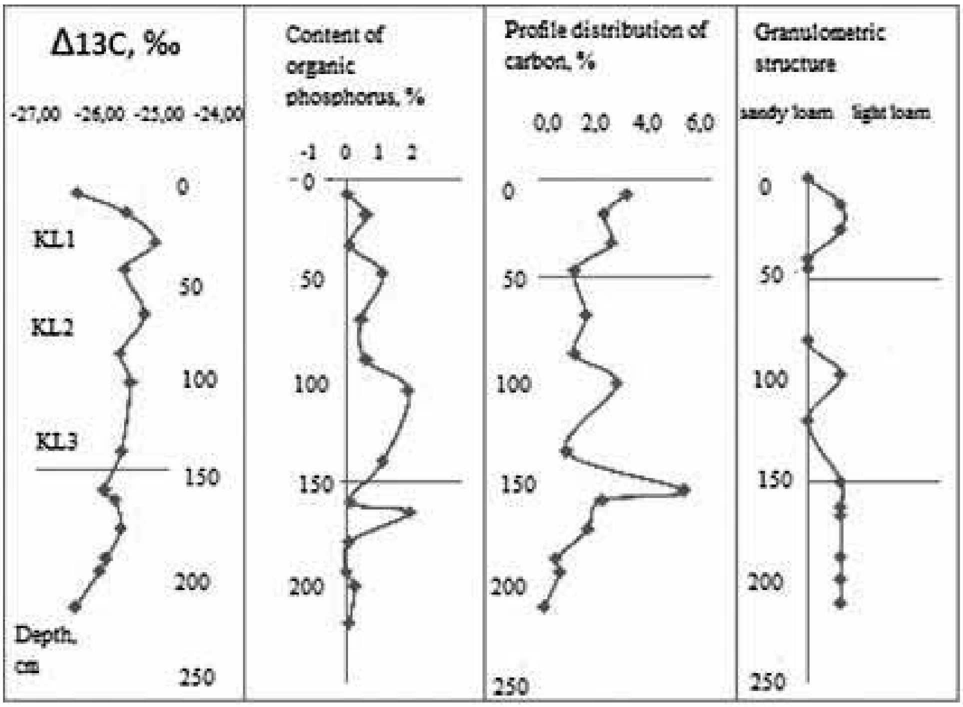

Figure 1. Some properties of the soil studed (Davydov settlement)

The isotopic curves for the soils of the Tambov region met for the first time. Distribution curves for the isotopes $\delta^{13}C$ / ^{12}C investigated soils profiles show that the cultural layers and buried soils formed under different climatic periods. Eneolit corresponds to the values of modern by a wet properties of climat $\delta^{13}C$ (-26, -27 ‰). Apparently this time indicates the formation of chernozem-meadow soils in Tambov lowland landscapes of drying in the Atlantic during the middle Holocene. The beginning of sub-Atlantic period and the Bronze Age has a more dry and temperate climate ($\delta^{13}C$- -26,5 ‰). The Iron Age is characterized by a more arid period of climatic history of the region (-25,1 ‰). The most severe values of the isotopic ratio observed in the Middle Ages (-24 ‰). Consequently, the medieval era of climatic by $\delta^{13}C$ values is far from modern. It is interesting to note that the boundaries of climatic periods, are due to an increase in the degree of hydration of climate, that is, the rise of groundwater levels in Cna landscapes and flooding of rivers. They are also corresponded to the changing cultural eras in the history of settlement in the region.

Conclusions:

1. It is established that the formation of soil on the high terraces of Cna began 1,200 years ago (9^{th} century), which corresponds to the presence of global humid episode at the beginning of historical time.

2. Soil formation epoch synchronous to stages of settlement in Cna river landscapes. Identified on the results of isotopic analysis it is observed that the climatic episodes boundaries clearly coincide with the change of historical cultures: populated of river valley corresponds to dry periods, and the rise of the groundwater level interrupts the development of settlements.

3. According to the results of isotopic analysis of soil humus and radiocarbon age it is revealed that the closest to the modern climatic period in this region was the Atlantic period of Holocene, rather than the medieval climate optimum, as previously thought.

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CARBON ISOTOPE COMPOSITION OF ARMENIAN PLATEAU VOLCANIC PLEISTOCENE PALEOSOLS AND PEDOSEDIMENTS OF THE ASHELIAN PALEOLITHIC SITES

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Armenian plateau is the part of Lesser Caucasus mountain system characterized by a massive folding-clumpy texture and strongly marked neogene-anthropogenic volcanism caused a process of soil-vegetable formations partially burying by lavas and piroclastic sediments [1].

Such soils were investigated on Armenian’s plateau (Lori region) in the excavations carried out by Armenian-Russian archeology expedition under the direction of Aslanyan S.A. (excavations by Lyubin V.P., Belyaeva E.V., Kolpakov E.N. (IHMC RAS)). Open pits and excavation walls represent the tefro-soil series and reflect the record of Pleistocene history events, such as climate change, ecological conditions change and therefore change of human habitat conditions. Archaeological excavations registered that the territory of modern Armenia was populated by people of early, middle and late Paleolithic Acheulian culture dated from 150 000 to 1 760 000 BP.

The objects of our investigation placed at an altitude of 1500 m in steppe zone named in literature as Lorean steppe. The modern soils of investigated territories (Muradovo, Karahach, Dashtadem and Kurtan sites) are mountain chernozems.

The evidence of past volcanic activity diagnosed not only by morphological indications (banks of ash and mud deposits), but also by high values of a magnetic susceptibility and high concentration of inorganic phosphorus forms.

The isotopic composition of organic carbon becomes lighter with increase of the depth and values of δC^{13} are close to -28 ‰ in all objects except for Dashtadem site profile (because of short profile); volcanic sediments had shown the same values.

The Karahach open pit wall covers the longest period of the Pleistocene among the researching objects and includes the ash sediments, dated by archaeologists as 1.7-1.9 million years BP [2] and buried by this ash soils. Thus, the sequence of the ash and subjacent pedosediments belong to the previous Earth paleomagnetic epoch that is older than Brunhes-Matuyama boundary. These soils and pedosediments have light-weight isotope composition of organic carbon (δC^{13} decreases with depth to -28.3 ‰) (fig. 1) and increasing magnetic susceptibility values (till 339 SGSM). Perhaps these data indicate the more ancient stage of this eruption or another eruption in general. The isotopic composition of organic carbon was correlated with the data of magnetic susceptibility, so that periods of high temperatures correspond to periods of rising volcanic activity.

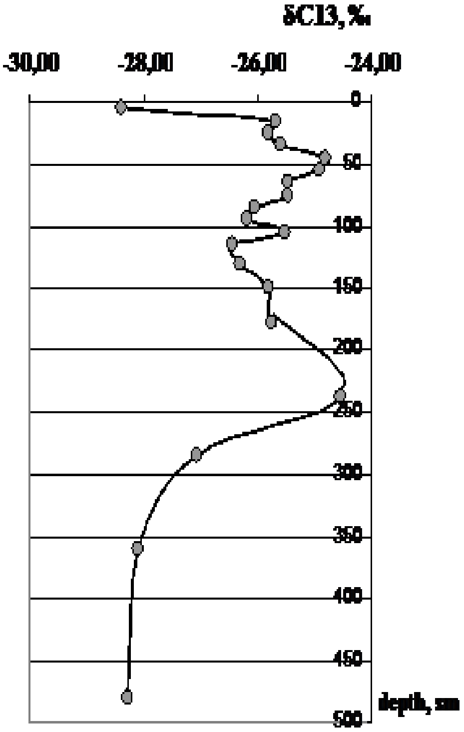

Figure 1. The isotopic composition of organic carbon of paleosols and pedosediments, Karahach open pit

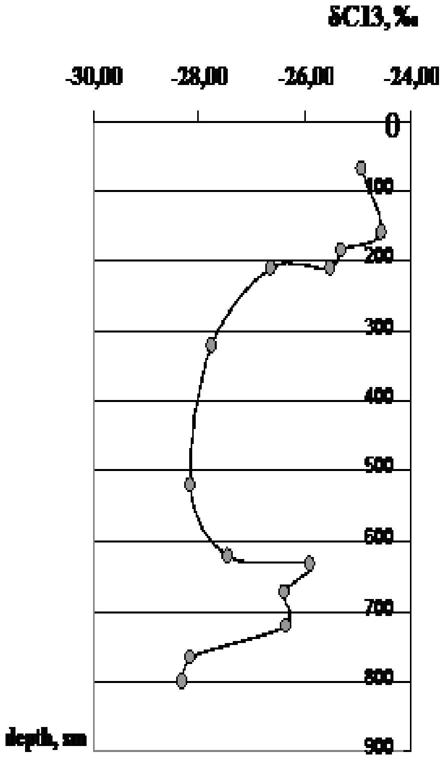

Figure 2. The isotopic composition of organic carbon of Muradovo site paleosols and pedosediments sequence.

The low-order sediments above the ash are not separate definitely by morphology as in the stratified archaeological site Muradovo, located a few kilometers from the Karahach open pit. The layers 2 and 3 from Muradovo site are being carbonated and therefore indicating arid phase of soil formation. On the other part the layer 3 contains obvious signs of high moisture stagnation: low magnetic susceptibility values, cold-colored and red spots of ferruginous compounds. Isotopic composition of carbonates carbon in the layer 3 varies widely (δ C^{13} = -9-19 ‰), describing the various hydrological conditions of its forming. The values of δ C^{13} for organic carbon range from -24.8 ‰ (at the top) to -26.5 ‰ (at the lower part of layer 3) (fig. 2).

Thus, the layer 3 contains tracks of directional cooling of climate, accompanied by an increase in humidity. In a layer 2 δ C^{13} values again become lighter to -25.7 ‰, describing the climate warming.

In layers 4-7 recorded increase volcanic activity and lightening of isotopic composition of organic carbon δ C^{13} = -28.3 ‰ in layer 7). The excavation in Kurtan open pit describes period of aridising of climate more particularly. Layers 2-6 contain various forms of carbonates with different isotopic composition of carbon (δ C^{13} = -10.0-25.2 ‰).

Layers 5 and 6 represent the sediments of volcanic sand with the values of δ C^{13} for organic matter are -26.5 and -28.1 ‰ accordingly. Findings of tools relate to the period 350000-170000 years BP, so the period of territory aridisation probably did not begin before this time.

The layers of the Dashdatem-3 site penetrated by chernozem soil forming processes. The values of organic matter δC^{13} changing with depth from -25.9 ‰ – in the upper layer to -25.2-24.9 ‰ – at the bottom. These layers are not carbonated, perhaps carbonates are located lower.

Conclusions:

1. Collected data indicates the multiple abrupt changes of hydrological regimes, types of plant formations, and repeated volcanic activity over the past 1.9 million years.
2. Pleistocene soils from different paleomagnetic epochs contain the indications of different climatic environments, reflecting the gradual aridisation of climate and a decrease in temperature during the Pleistocene.
3. Noticed a close relationship of carbon isotope composition, magnetic susceptibility and inorganic phosphorus concentration.

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THE GEOLOGICAL SECTION IN MIKULINO AS A TOURIST ATTRACTION IN GEOTOURISM OF THE SMOLENSK REGION

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Nowadays we live in a yet another interglacial period which is called the Holocene age. Such an interglacial period lasts approximately for about 10 thousand years. On the basis of the rhythm which has been registered for the last 2 million years we can draw a conclusion that the next glacial period will come in 30-40 thousand years. However, there have been a lot of rumours, sometimes turning into a panic, caused by the so-called «global warming». Allegedly, due to an increased economic and technical activity of the society we all may face the threat of the climate warming with all the dramatic consequences it entails such as rise of the level of the world ocean, melting of the permafrost etc. Although the whole multi-million period of the Earth's development indicates that it was in such periods of warming that all existing forms of life thrived. Actually, what drastic bad changes can be caused by melting of the permafrost? They will start growing oranges in Yakutia. What will happen if the level of the world ocean rises? This will be not a natural disaster (there has already been great many transgressions in the history of the Earth), but a social catastrophe. There will be an urgent need to move out milliards of people from the coastal regions.

Nevertheless, to understand the true nature of the climatic processes which are taking place nowadays it is logical to analyze the climatic changes which were characteristic of the previous interglacial period about 90-100 thousand years ago. There already was a man – Homo sapiens – but he could in no way have the slightest impact on the nature.

The previous interglacial period is called Mikulinsky. It was named after the rural settlement Mikulino which is located in the Rudnyansky administrative entity of the Smolensk region. There A.V. Kostyukovich-Tisengausen, a geologist, found in 1923 and later explored a layer of peat, which was buried under the stratum of moraine (loamy soil with boulder which was brought by the last glacier [4, 5, 6]. By the present time there have been discovered and explored a lot of layers with the organic matter of the mikulinsky age on the territory of Europe.

We believe that the most representative are geological sections with mikulinsky depositions, overlapped with moraine. Why is it so? Because not overlaid, not isolated depositions covered by the ground can be «impure». There are four sections in the northern –western part of the Smolensk region. The sections are the following: the one in the rural settlement Mikulino, which gave the name to the stratum-type of the interglacial period [4, 5, 6]; the ones on the river Kasplya not far from the villages Nizhnyaya Boyarschina and Ryasna [2, 6, 7]; a comparatively recently discovered section on the territory of the national park «the Smolensk Lakeland» which is called the «Devil's Ditch» [1, 3, 4, 8].

The conditions of the above mentioned sections differ from each other significantly and thus they represent quite different objects for exploration.

In 2002 there was a lot of work done on cleaning the section in the rural settlement Mikulino in order to be able to show it to the members of the third All-Russian conference on studying the Quaternary period. Such cleaning work was absolutely necessary due to the fact that the section was completely covered with ground by the bulldozers that were used in the reconstruction of the monument to the heroic miners which was located in the vicinity. There was also a lot of work on the «Devil's Ditch» carried out by the students of the Smolensk University for the Humanities and the employees of the national park in the same year in order to open it for public demonstration. However, recently landslide and solifluction processes reduced all the undertaken efforts to nothing. Now this clearing work can be started from scratch.

The most available sections are located on the left bank of the river Kasplya near the villages Nizhnyaya Boyarschina and Ryasna. All the efforts are worth taking in order to find sufficient evidence of the fact that the climate in the Mikulinsky interglacial period did not change according to the still extant organic matter which was thoroughly examined. It should be taken into consideration that the Mikulinsky interglacial period was warmer than our Holocene period.

On the whole, we can draw a conclusion that all the statements about the global warming are impetuous and unproven.

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LATE PLEISTOCENE ARCHAEOLOGICAL SITES OF THE TUNKA RIFT VALLEY, CIS-BAIKAL REGION

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The Tunka rift valley extends sub-latitudinally for 200 km from the southwestern tip of the Lake Baikal to Lake Khubsugul. This part of Cis-Baikal region has been always considered highly promising area in terms of archeological sites, Paleolithic in particular. However, until recently, in spite of active archaeological digs, one stratified Paleolithic location – «Big Zangisan» – and some points for the detection of Pleistocene artifacts (Shabartai, Zaktui) have only been known in the Tunka rift valley (fig. 1) [1].

The faunal remains, together with Paleolithic-like artifacts, have been found during the study of the Late Cenozoic lithologic-stratigraphic cross-sections of the Tunka rift valley. The bone remains discovered in the Quaternary sediments have provided a basis for the first radiocarbon dating that made it possible to enlarge and detail the ideas of chronostratigraphic position of the archaeological materials in the investigated area.

Figure 1. A schematic map of the Tunka rift valley Stratigraphic, paleontological and archaeological site «Slavin Yar».

The «Slavin Yar» (fig. 2) is located in the Tora basin of the Tunka rift. The apparent thickness of composing alluvial sediments reaches 30 m at a more than 1 km long outcrop. The crystalline bedrock is overlain by the Pliocene ochreous boulder-pebble conglomerates, which in turn are overlain by a 20-m thick stratum of the Late Pleistocene, primarily alluvium sands saturated with various fossil flora and fauna and associated with several intensely cryoturbated buried soil horizons. The bone fragments of the Late Pleistocene fauna (*Mammuthus primigenius*, *Ursus sp.*, *Coelodonta antiguitatis*, *Equus sp.*, *Cervus elaphus*, *Capreolus sp.*, *Procapra gutturosa*) have been found at different depth levels of the cross-section. Charcoal found in the upper part of the buried pedocomplex at a depth of 8 m has provided a radiocarbon AMS date of 37790 ± 310 BP [2] and that found in another buried soil horizon at a depth of 11 m has provided a ^{14}C date of 45810 ± 4070 BP (IGAN 3133). The artifact – a high-form scraper made from a thin slice of the cortex of a large white vein-quartz pebble – has been found in the floodplain consertal sands at a depth of 10.9 m, i.e. directly above the layer whose radiocarbon age is 45810 yr BP (fig. 2, B1). The faunal remains identified as a humerus bone of fossil horse (*Equus* sp.) were already found in the sedimentary section at a depth of 19 m (fig. 2, B2). The edges of diaphysis are sliced at least eight times throughout the perimeter.

The sliced surfaces have deep scratch lines typical of an intentional slicing and shell-like fractures made in strokes from the interior part of the bone wall. So far, this is the oldest manifestation of human activity within the Tunka valley, reliably stratified and providing a basis of search for archaeological sites that belong to the Murukta time (MIS4) or, perhaps, even older.

Stratigraphic, paleontological and archaeological site «Zaktui Gully». The «Zaktui Gully» location is situated on an inclined piedmont plain on the eastern margin of the Tunka basin. The cross-section is at a distance of 700 m from the Paleolithic-like Zaktui artifacts' detection point [1]. The more than 4-m thick unit of loess-shaped, intensively cryoturbated deluvial deposits has been penetrated at the considered «Zaktui Gully» location. The bone bed found in the cross-section at a depth of 2.3-2.6 m has provided us with a rich paleontological assemblage. The bone of *Crocuta spelaea* yielded the ^{14}C date 35560 ± 300 BP, the bones of mixed-age *Mammuthus primigenius* also yielded ^{14}C dates of 33090 ± 250 BP, 33190 ± 240 and 36800 ± 1200 BP [2].

Four flint artifacts – a trihedral microplate (20 × 4 × 2 mm), a proximal segment of similar microplate (8 × 7 × 2 mm) and two microflakes of stone and rauchtopaz materials, – were found in coarse-grain sands at a depth of 4.2 m during the elutriation of sediments for definition of the checklist of the microteriofauna living in the area of study. Here, too, were found the fragments of a mammoth humerus and a bone of a woolly rhinoceros. The stratigraphic position of these finds in the cross-section suggests that they are older than a 2.3-2.6 m deep bone bed dated to 33-36 kyr BP.

Figure 2. «Slavin Yar» site. A. Lithologic-stratigraphic column from cross-section. B. Archaeological material: 1. a high-form scraper of vein quartz, 2. a split bone

Paleontological and archaeological site «Tuyana». A new archaeological site named «Tuyana» has been found on the eastern margin of the Tunka basin on the right bank of the Irkut River near the Elovsky intrabasin spur (fig. 3). Artifacts and numerous faunal remains have been discovered in situ in the scraped incision 6 m^2 in area and exposed on the surface debris of quarry walls later on. Loose formations quarried along the road are represented by two main subdivisions – weathered saprolitized gneiss-granites and its overlying Pleistocene member of indistinctly laminated sandy loams and loams of slope genesis.

The determination of fauna of large mammals has shown the presence of remains of hoofed and carnivorous mammals and birds in the assemblage. The information reported below is for the species: *Felis manul*, *Panthera spelaea*, *Martes zibellina*, *Equus* sp., and *Coelodonta antiquitatis*. Species in the Cervidae family include *Moschus moschiferus*, *Capreolus pygargus* and *Cervus elaphus*. The bones of *Bison / Bos* sp. are the most numerous. Therefore, the assemblage includes nine species of large mammals. The list of species is specific, the presence of woolly rhinoceros and cave lion indicate a Pleistocene age for the site, and considerable richness of cervids (especially the presence of musk deer) testifies to the interglacial character of the fauna.

Figure 3 «Tuyana» site. A. Lithologic-stratigraphic column from cross-section. B. Archeological material: 1. a wedge-shaped micronucleus-biface, 2. end scraper, 3. a pendant, 4. a piercing tool, 5. a fragment of bone with traces of drilling, 6. a fragment of cylindrical tool made of bone

Described below is an artifact documenting the micro-splitting technology serially represented in the «Tuyana» lithoindustry. Wedge-shaped microcore made of dark-gray flint (7 mm high, 17 mm long, 7 mm wide) (fig. 3. B1): wedge-shaped, showing a triangular contour, striking blade is smooth, bevelled at the edges, frontal facial processing of the laterals allows characterizing the tool as core-biface. The core front shows distinctly the signs of five slices oriented to obtain microplates. The signs of parallel slicing oriented to obtain microplates are also seen on the left lateral. The height of slicing signs along the front is 5-10 mm, the width is 1-2.5 mm. The angle between the striking blade and the front is 45°. The tool is admired for its perfect and graceful making and documents the development of techniques and methods involved.

The «Tuyana» artifact assemblage is characterized by the presence of macroforms represented by processed pebbles and quartz, quartzite and granite nodules in combination with developed technology for terminal-marginal splitting. The mode of occurrence of the cultural deposits and species determinations of fossils from the paleontological assemblage suggest that the new site can be reliably assigned to the Karga time (MIS3).

Because the upper middle Pleistocene microsplitting in North-East Asia enters only an active study phase [3, 4, 5], noteworthy is the discovery of a new archaeological site, even regarding that the Karga age of the «Tuyana» industry is yet relatively determined. The «Tuyana» meets all the criteria for geoarchaeological sites. Therminal-marginal microsplitting at the «Tuyana» and «Zaktui Gully» sites can be reliably assigned to the Karga age (MIS3). Technomorphological features and serial representativeness of the artifacts indicate the development and perfection of microsplitting strategy, and their associated Karga time interval assigns them to a specific geoarchaeological position. The discovered archaeological materials of «Tuyana» and «Zaktui Gully» together with the «Big Zangisan» industry form the «Tunka geoarchaeological area» whose basic feature is the combination of the Karga locations with lithoindustries representing a developed terminal-marginal microsplitting.

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REFLECTION OF HUMAN ACTIVITY IN CZARNA NIDA RIVER VALLEY, POLISH UPLANDS

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The river valley holds the potential to approach detailed record of climate changes and human activities. The aim of studies is reconstructing ancient alluvial landscapes and examine proxy data of environmental change (e.g. sediments, tree trunks, pollen) develop model of climatic and anthropogenic effect on fluvial system of the Czarna Nida valley during Lateglacial and Holocene. Czarna Nida river valley is an example of small river valley in low mountains and uplands – morphological zone of central Poland and all Central Europe.

The interdycyplinary research were done with complex of palaeogeographical methods as sedimentological, geomorphological maping, palaeobotanical, archaeological and historical sources, radiocarbon and TL datings etc.

The Czarna Nida river valley is situated south of Kielce in the swietokrzyski region, Poland (fig. 1). River with its length 63,8 kilometers and catchment area 1224,1 km^2 is a left-bank tributary of Nida river (upper Vistula drainage basin). It arises in Holy Cross Mountains by the confluence of Lubrzanka and Belnianka rivers and then cross Szydlowskie Foothills, a part of the Mesozoic margin of this mountains. Slope of the river is 6,5 ‰ in the upper and 1,3 ‰ in the lower section. Mean discharge near Tokarnia is 5,99 m^3/s with maximum during snowmelt flood in March (rise of water level up to 2,5 m). The detailed study area extends some 40 km downstream from Marzysz to Tokarnia. Alluvial terraces, flood plains and associated underlying deposit provide a record of Pleistocene-Holocene alluvial history. Units are differentiated but can be well perceived in surface morphology and aerial photographs.

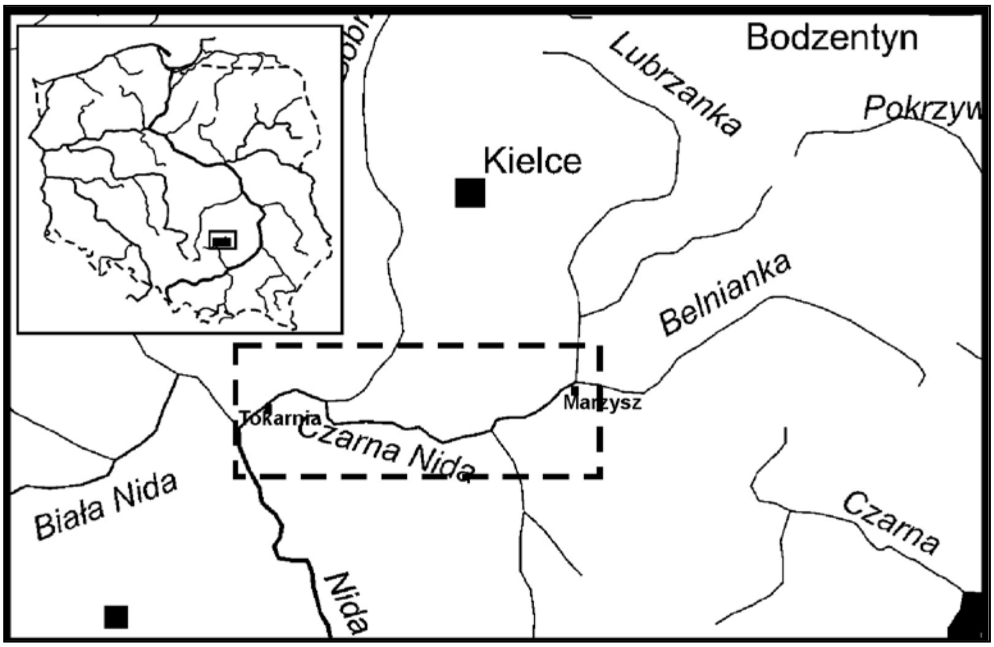

Figure 1. Location of the study area

Width of valley varies from 0.5-2.0 kilometers. Pleistocene terraces are preserved as narrow strips bordering the alluvial valley, e.g. above Ostrow. Terraces, 2 - 4 meters height, are erosional and accumulative-erosional, with deposit broadly horizontal of sand-gravel sediment left by braided river. Locally, eg near Ostrow and Nida, with relicts of sand dunes. Broad flood plain that generally stands 2-5 meters above water level, presents complex structure. In the valley floor, within one morphological unit, comprise alluvial inset fills of different age formed by the river of various channel pattern: large meanders, small meanders, multichannel. Pollen diagram of organic sediments fill large palaeomeander reflects vegetation changes in the valley caused by climatic changes since the Lateglacial and human impact since the Subboreal. The oldest cut of of palaeochannel was dated on 8120 ± 90 BP (Mala Wies) and peaty fill was cover with overbank deposits on 7680 ± 100 BP. The next small palaeomeanders was cut off on 6490 ± 80 BP (Kuby Mlyny 3) and on 2530 ± 80 BP (Kuby Mlyny 4). The flood (KM4 about 1530 ± 70 BP) and an increase of sedimentation rate during last millennium are reflected in the fill of these oxbow lakes. Buried soil on levee dated on 1230 ± 70 BP (Zbrza) documented the same tendency. Lateral migration of the river in this period showed subfossil trees dated on 1190 ± 120 BP (Wolica) [1].

The cut off and changes of sedimentation type on flood plain of Czarna Nida river correlate very well with phases of an increase of river activity (for example 8500–8000, 6600–6000 BP) distinguished for the Centraleuropean rivers [2]. However some of them must (for example 7680, 2530 BP) be connected also with local events what is typical for small catchments and rivers as Czarna Nida. An increase of sedimentation rate near the river channel in the last millennium occurred as a reflection of Iron Age metallurgy.

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UPPER PALEOLITHIC SUBSISTENCE PRACTICES ON THE SOUTH OF THE RUSSIAN PLAIN (THE RECONSTRUCTION OF HILLY PALEOLANDSCAPES AND SETTLEMENT SYSTEM OF KAMENNAYA BALKA SITES)

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1. Hilly landscapes are the most favourable territories for inhabitancy of the Upperpaleolithic people. There are many possibilities for choice of the convenient places for base-camps and temporary camps, which had water, fuel, hunting and vegetation resources, had good field of vision around areas, ets.

2. Reconstructions of subsistence practice includes the next territories:

a) the living sites,

b) places of regular daily visits,

c) frequent one-day trips for hunting and gathering,

d) distant hunting expeditions with using short-lived camps.

Each type of the paleoreconstructions provides for embrace the corresponding square territories and producing them in scales, which permit to reflect the structures of the relief and their landscapes. Besides, every time the goals and tasks of the human employment of the territory were different, so this fact must be reflected in the legends of the maps and schemes of these reconstructions.

Usually, the territory of the living site reconstructed in scales about 1 : 10 – 1 : 100. The territory of regular daily visits, as a rule, spreads of first hundreds metres around the site. Paleoreconstruction produces in scale about 1 : 1000, 1 : 2000. The territory of frequent one-day trips for hunting and gathering, as a rule don't exceed radius of first ten kilometers around the site and have been reconstructed in scale about 1 : 25 000 – 1 : 100 000.

The territories of distant hunting expeditions with using short-lived camps can be spread in regions which were been situated far from base-camp on distance about several tens or first hundred kilometers. The goals of these expeditions may be various: getting stone raw-material, exchange, ets. Paleoreconstructions in this case produce in two scales:

1) observation scale about 1 : 100 000 – 1 : 500 000 envisages the discovery of the main directions of expeditions,

2) more detail scale reflects the situation in the area each of temporary camp and in whole coincides with analysis of territories of frequent one-day trips.

3. The reconstructions of subsistence practice must be accompanied by series of the additional reconstructions with different scales and goals. The most typical from them are reconstruction: of vegetation cover, animal world, methods of hunting and gathering, character of the domestic and manufacturing activities, density of the population in the region and possibilities of the functional differentiation of this population (mainly hunters or mainly fishermen, ets.)

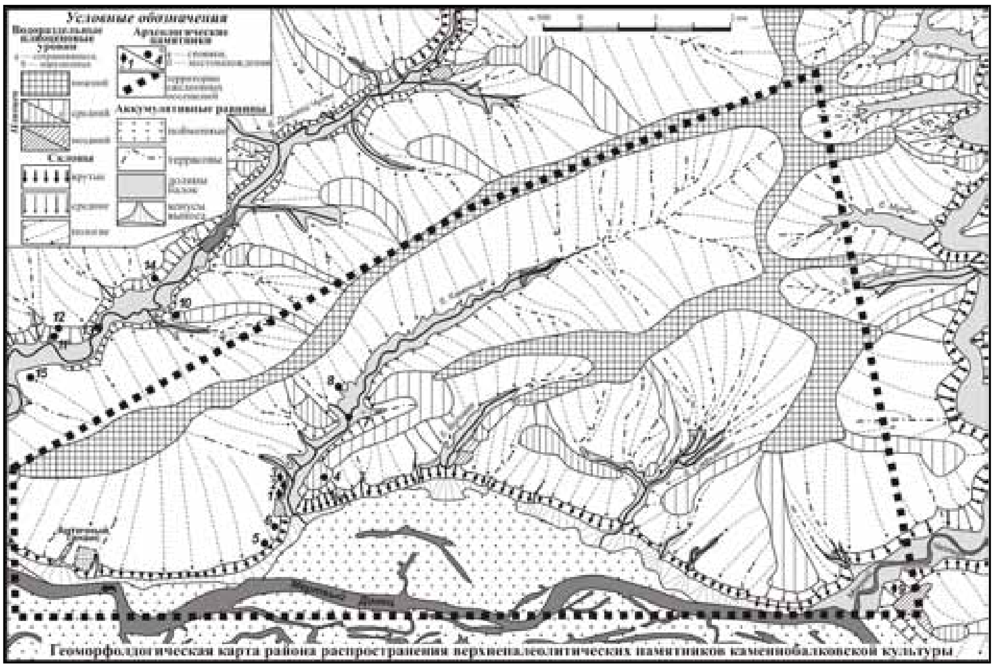

Figure 1. Map of spreading of the Kamennobalkovskaya culture sites. Triangle shows the territory of regular visits

4. The region of the Kamennaya Balka sites may be viewed as typical for the Upper Neo-Pleistocene of the whole northern part of the Azov Sea Area on the following parameters:

- the availability of dated and correlative analogues of all the subdivisions of the general scale of the Eastern Europe Upper Neo-Pleistocene;
- the presence of fauna dated exposure of the Carangad sea (to be more precise estuary-sea) terrace practically unique in the northern part of the Azov Sea Area;
- palinologic dating of all the analogues of the subdivision of the Upper-Neo-Pleistocene (wurm) glaciation;
- archeological and absolute dating of the Late Valdaj deposits.

The combination of various and complete paleoecological and archeological data are the basement for constructing of the models of subsistence practices in any period of the inhabitance on the sites.

5. The study of the spreading of the sites of the kamennobalkovskaja archeological culture permits to suggest the following model of the region settlement: basic-site located on the quite high board of the ravine (the height under bed-river paleo Don were 60-70 m at 22 000 BP, 50-60 m – 16-16 000 BP, 40-50 m – 12000-13000 BP) with several small «satellites» not far from it – hunting and gathering camps situated on the surrounded territory. Today there have been stated rather a big number of sites with poor and destroyed cultural layers.

Analysis of the distribution and composition of faunal remains from the base-sites of the kamennobalkovskaja culture show that the butchering of the prey did not take place at the sites. According by the well-known ethnoarcheological data we may suppose existence of the special hunting «kill-sites» «and butchering places».

6. Geomorphological analysis of a vaster territory permitted to outline the region of possible regular visits which was determined by the size of a average daily hunting and gathering outing and- included part of the alluvial flood plane of the paleo-Don and hollow hilly right-bank upland adjoning it from the north. The mentioned upland unites old (Pliocene) water-sheds limited the basin of the Kamennaya Balka, and the wide bed situated between these water-shelds, a narrow Pleistocene insertion of the middle and upper course of the modern ravine being deepened into this bad. This territory had the form similar to triangular; the eastern rib this speculative triangle was submeridional 10-15 km long, the north-western was diagonal extending for 15-20 km and the southern was determinated by the location of the deep branches in the flood plain of the paleo-Don. We may suppose that the total area of this territory hardly exceeded 150-200 km^2.

7. Apart from such regularly visited territory the inhabitants of the Kamennaya Balka used resources from more distant regions-flinty raw materials were delivered from the valley of the Mius river situated to the west at distance of 120-150 km. Territories of economic activities of inhabitants of the Kamennaya Balka were large enough but used with various frequency.

8. The epochs of the settlement of the sites were relatively warmer, forest landscapes prevailing or presented in significant quantities; it determined the character of economic activity of the sites inhabitants. In the composition of the hunting prey were found both the steppe and the forest species. New tracological experiments show that the high percent of tools had been used for working by wood. Obviously that wood had been used for various economic and domestic activities and also for constructing of dwelling, wind-barriers and ets.

9. The archaeological researches of the cultural layers permit us to say about complexity of the base-site planning including the manufacturing zones and living places

with easy ground-dwellings. The quantity of living places which had existed simultaneously give us the opportunity to estimate the quantity of inhabitants on the site in the appointed period its being. At the site Kamennaya Balka II (the main cultural layer) we can with confidence to say about 5 simultaneous living places, so, it's mean that there were about 50 residents. According the richness of cultural layer, compose of planning, quantity of faunal remains (the results of dental cement analysis show that hunting took place during whole year) and the availability of stabs-anvils that could serve as a grater proves the use of vegetable food resources we may say about rather settled and stable inhabitance people in this area.

The time of existence of the kamennobalkovskaya culture was very long – from 21 000-22 000 to 12 000-13 000 BP, that testify to the stable cultural adaptations these people to natural life of this area.

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PILES AND BONES IN LOAMY RIVER BANKS – GEOARCHAEOLOGICAL RESEARCH ON THE GENESIS OF THE OUTSTANDING MULTIPERIOD DWELLING SITE OF VEKSA IN THE SUKHONA BASIN

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The multiperiod settlement remains by the confluence of the River Vologda and its small tributary River Veksa represent a key site for the reconstruction of prehistoric and historic cultural developments in the North-Eastern European forest zone. The archaeological complex is situated in Vologda district in the southern part of Vologda province c. 20 km east of the province's eponymous capital in the Upper Sukhona basin. Extending along the left bank of the River Vologda, its upper part west of the mouth of the River Veksa is called Veksa, while the lower part of the complex east of the tributary's mouth is called Veksa III. Initial archaeological investigations at Veksa started in 1981. Since 1993 the excavation and survey works at the site have been organized and directed by N.G. Nedomolkina of Vologda State Museum. The exceptional importance of the Veksa sites is due to the clearly stratified, up to 3 m thick sequence of archaeological layers starting in the 6th millennium cal BC and covering all periods from the Early Neolithic via the Eneolithic, Bronze Age and Early Iron Age through to the Early Middle Ages. In Veksa, 14 chronologically and culturally distinct stratigraphical units have been identified, and in Veksa III, five such units can be distinguished [1, 2]. In addition, the archaeological importance of the sites is enhanced by the excellent preservation conditions of organic materials especially in the lower, waterlogged layers.

In 2007, a small research programme of AMS radiocarbon dating and statistical analysis of Neolithic pottery was the first step in developing a cooperation with German partners [3], and in September 2011, a first joint field campaign of Russian and German archaeologists and geographers took place. The aims of this campaign which lasted one week encompassed a geomorphological landscape analysis based on drillings, a topographical survey of the surface relief and terrestrial archaeological remains, and the collection of dendrochronological and osteological samples to assess the potential for further scientific analyses. The work was funded by the German Science Foundation (grant no. HA 2961 / 3-12) and the International Office of Greifswald University.

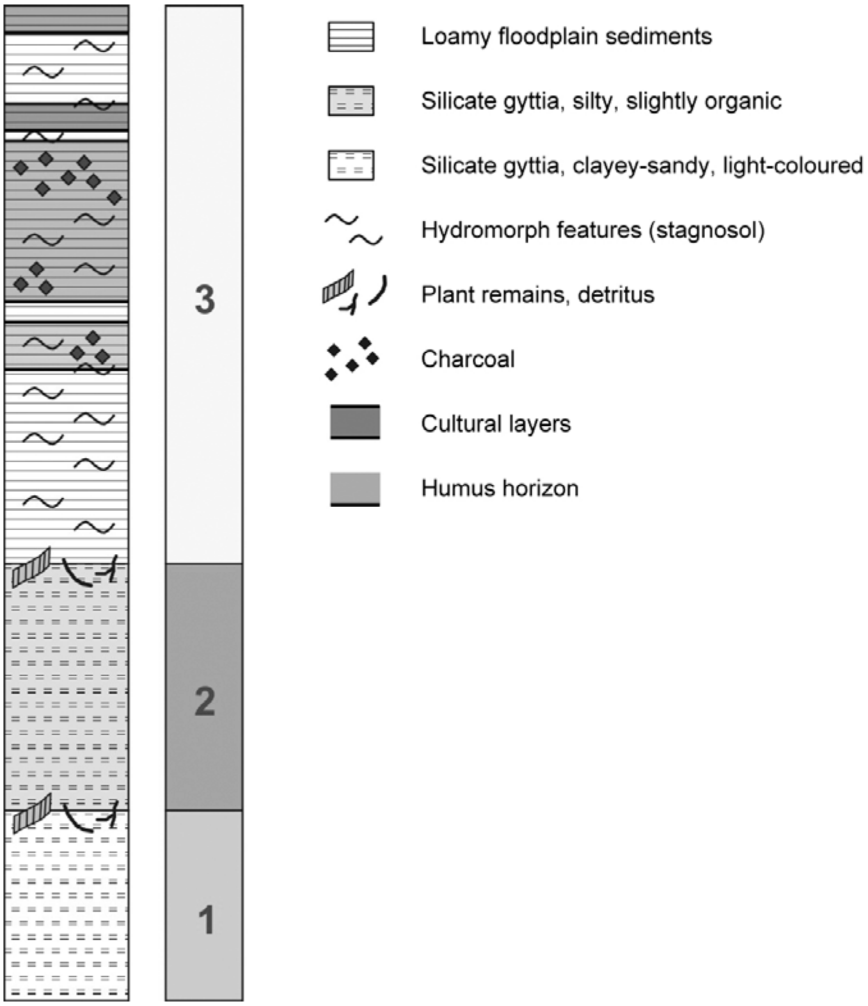

Figure 1. Standard profile of the sedimentological sequence at Veksa III compiled on the basis of 15 drilling cores

The geomorphological landscape analysis was carried out by driving core equipment reaching depths up to 8 m below surface and offering the possibility to sample cores of 5-8 cm diameter. A total of 15 drillings were put down in the area of old excavation trenches close to the River Vologda and in a loose grid across the adjacent meadows north of the river course. The aim was to investigate the general sedimentological sequence and to record the extension of the archaeological layers. All

15 drilling cores show the same basic stratigraphic structure and can be described as a standard profile consisting of three sedimentological units (fig. 1):

1) The lower part of the stratigraphy is formed by a silicate gyttia which generally starts at the fourth meter below surface. These light brown to grey clayey sediments with thin sandy/silty layers have been deposited in a large lake with high sediment influx and are interpreted as the lacustrine sequence of an extensive Valday Late Glacial palaeolake which had developed during the deglaciation of the last glacial maximum in what is now the Upper Sukhona basin.

2) A distinct change in the substrate marks the transition to an organic silicate gyttia. These sediments which vary in thickness between 1-2.5 m consist mainly of silt and show dark to olive grey colours. They are characterized by interbeddings of organic layers with abundant plant remains especially at the transitions between the upper and lower horizons. Mollusc remains are detectable in small numbers. The deposits are interpreted as lacustrine or calm fluvial backwater sediments with (seasonal?) sediment influx. They probably bear witness to the advancing infill of the basins during the Early to Mid Holocene.

3) The upper part of the stratigraphic sequence at Veksa consists of loamy floodplain sediments. These clayey to silty deposits vary in thickness and reach between 1.2-3 m below the surface, with a slight incline from the river being noticeable. Gleyic and stagnic soils with iron concretions up to 2 m below surface are the result of a remarkable annual alteration of the ground water table. Apparently the hydrological regime has been characterized by annual flooding already for a very long time with siliceous material from the sediment load of the river leading to a successive heightening of the floodplain. An accumulation of humous soil contents from the vegetation cover does not seem to have been relevant or has been compensated by strong mineralization. All archaeological layers are associated with these floodplain sediments, reaching up to 3 m below the ground surface. They are well recognizable by their grey to black colouring and frequently contain large amounts of charcoal. Preservation of botanical macrofossils and pollen is to be expected mainly in the lower regions where the cultural layers are located in reductive water-saturated environments, while in the uppermost 1.5 m below surface, preservation of organic materials is limited due to the periodical dry-falling of the sediments. Archaeological dating places this uppermost part of the geomorphological stratigraphy in the Mid to Late Holocene.

A special feature in Veksa III is the existence of well-preserved wooden piles in the lower part of the bank of the River Vologda. Stratigraphical evidence as well as a radiocarbon date suggest that at least part of these timbers stem from the Neolithic period [4]. During the field campaign in September 2011, very low water levels had led to the exposure of the wooden remains thus enabling the recording of their location on a 3D topographical plan (fig. 2). A total of 1.802 piles and rods were documented, among them 786 with diameters between 0-3 cm, 402 with diameters of 3-5 cm, 569 with diameters of 5-10 cm, and 45 with diameters of 10-15 cm. The smaller rods form dense localized concentrations and might represent the remains of fish traps. In contrast, the posts with diameters between 5-15 cm are distributed over larger areas and are partly arranged in straight parallel lines. The lower ends of these posts have been pointed with axe blows. At the moment, possible interpretations of these structures include constructions for fishing as well as building remains or platforms for buildings. Further research including absolute and dendrochronological dating as well as excavation is needed to better understand this outstanding archaeological complex.

In addition to the fieldwork described, the Russian-German cooperation also included a pilot study on archaeozoological material from Veksa III carried out by U. Schmölcke, Schleswig. Three small complexes (two from previous excavations of Neolithic layers and one from surface collection in September 2011) were analysed, and all three attested to a typical mixed hunting-fishing economy, with beaver and large forest ungulates dominating the assemblages and wild fowl and fish also present. The excellent state of preservation would also enable a systematic assessment of cut marks, breaking patterns and other traces of modification (gnawing) in future studies.

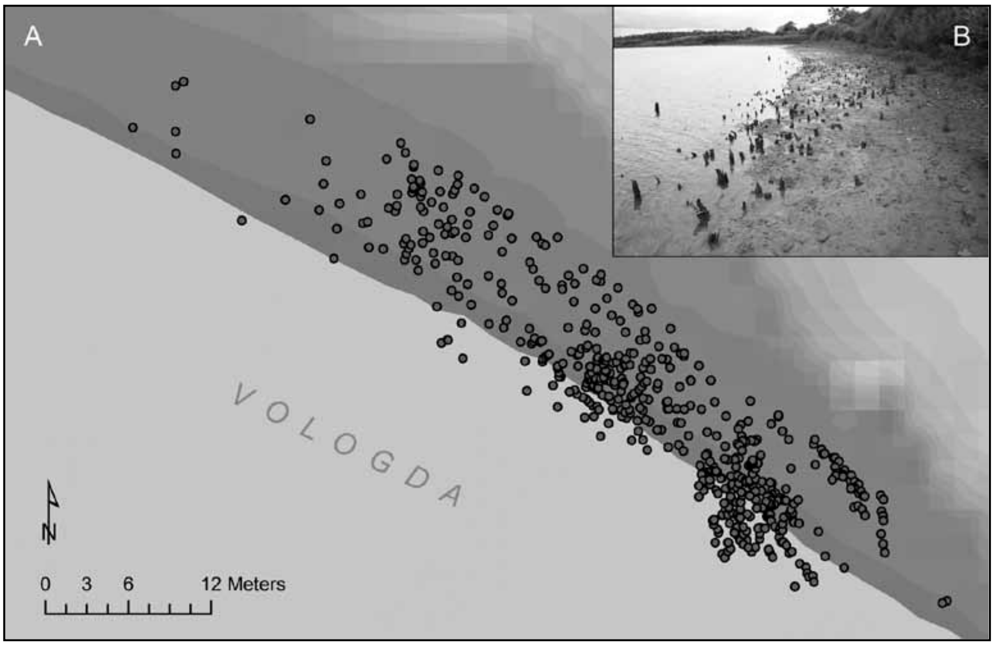

Figure 2. Topographical plan of part of pile concentration at Veksa III (A) and view of the same area from south-east (B; photo: I. Heit)

In summary, both the excavation results of the past years and the information gained in the survey campaign in September 2011 underline the exceptional potential of the archaeological sites by the mouth of the River Veksa for comprehensive multidisciplinary studies. Future excavation work will focus on detailed recording of the archaeological stratigraphy in a selected small trench from the surface down to the sterile subsoil and is planned to include scientific analyses of environmental information (pollen, botanical macrofossils, diatoms, animal bones), detailed absolute dating including dendrochronology, and isotopic analyses of materials such as human bone and pottery charred crusts. Geoscientific work will focus on regional landscape genesis, especially on the interplay of Holocene floodplain development and human occupation [5]. Therefore a denser drilling grid is necessary to gain a more detailed data set on the subsurface conditions in the vicinity of the Veska sites.

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PALEOENVIRONMENT IN THE LATE MESOLITHIC – EARLY NEOLITHIC AT ZAMOSTJE 2 SITE

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Zamostje 2 site is situated north of the Sergiev-Posad district, Moscow region, on the left bank of the Dubna river artificial channel (Volga tributary). The site is dated by the time-spent between the beginning of 7th to the middle of 5th millennium cal BC. Today the relief around the ancient site is not recognizable as in the later times it was evened by alluvial processes and peat formation. Virtually the site resides in the flood basin of the Dubna, which occupies some part of the ancient lake bed. The western edge is outlined with a lake bench, 130-135 m of absolute altitude, 1 km to the south-west from the site, the eastern edge of the basin with the same absolute altitude represents a terraced foot of kame hills, which are topped by Zabolotje, Kaloshino and Zamostje villages. Two km east from the site, remains of once vast Zabolotskoye lake were found; it is surrounded by swamped and overgrown lowland of the drained Sulat river. Terrace slopes are flattened, the relative altitude of its edge over the lowland accounts for ca. 1 m. Ancient Dubna beds are recognizable here and there on the swamped plain.

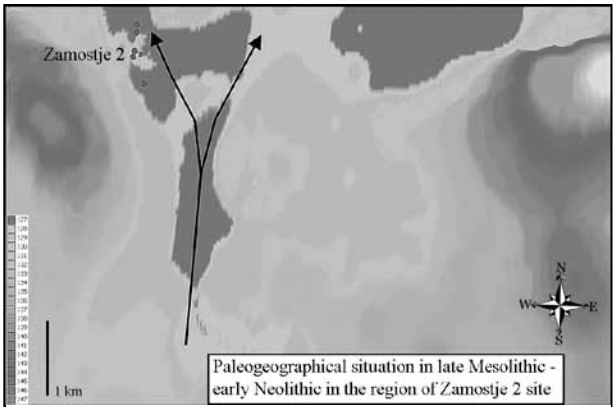

Figure 1. Paleogeographical situation in late Mesolithic – early Neolithic in the region of Zamostje 2 site (K. Mazurkevich)

During the Late Mesolithic and Early Neolithic, the site was repeatedly visited by groups of hunters-fishers, which left behind numerous stone and bone artifacts, ceramics, and remains of wooden fishing constructions [1].

Following the morphological analysis of the relief, we assume this area was a lagoonal shallow zone of paleolake opening to the north. In the south a ground connector might have existed. It divided two paleobasins connected by a creek. Paleobasin banks were in place of today's hills. In the picture (fig. 1) you will find the paleobasin contour, its coast altitude presumably was 128 m. It is proven by extended peat lands. In the site area you can find a cape entering the water basin. This cape led to formation of lagoon environment (gulf) and shallows (128-127 m), which are favorable for human activities. Apparently, the main stream direction coincided with the current direction of the Dubna.

Remains of human activities on the banks became the object of our study. Formation of cultural layers took place in regressive phases of the paleolake lifecycle. In these periods, human activities were linked to exploitation of the low flat bank exposed to weak waves or seasonal water level raising [2]. At different stages of the lake settlement, the coast line was changing its shape, it can be clearly observed in the southern part of the site. In the Early Neolithic it represented an area of intensive basin exploitation. This part of the site indicates fish traps, wicker fences as well as numerous wooden vertical piles dating to various time periods of the settlement [3].

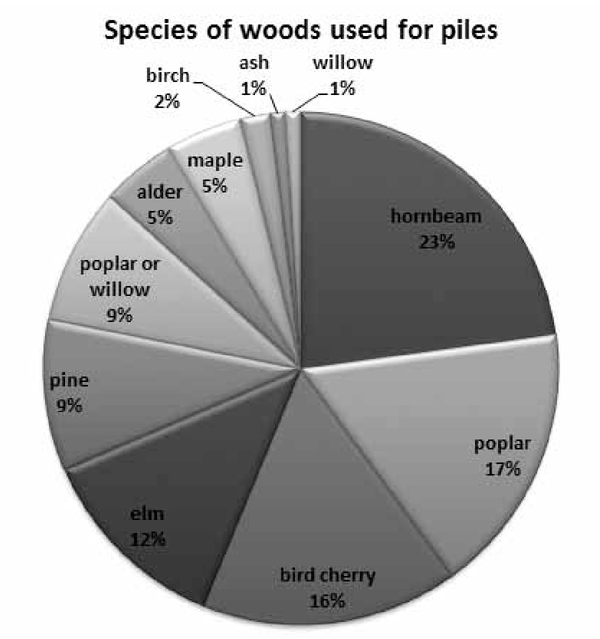

Figure 2. Species of woods used for piles at Zamostje 2 site. Late Mesolithic – Middle Neolithic

Due to favorable wood preservation conditions in the wet environment, we succeeded in reconstructing some usage specifics of plant resources in the surrounding. The Atlantic period began in this area with dominating birch and pine forests and a gradually increasing role of foliaceous trees (elm, linden, hazel, and alder). At the beginning of the 6th millennium cal BC, crisis conditions for growth of conifers forests emerged [2].

We analyzed 103 pieces of wooden piles used for construction (pile stakes) and made wood specie determinations (fig. 2). A majority of piles (65 %) were produced of poplar / willow, hornbeam *(Carpinus betulus L.)*, and bird cherry *(Padus racemosa Gilib.)*. Only some thin piles found were made of pine wood; moreover they were located in a very limited area. Hence, the locals preferred materials available in forests next to the basin.

All samples were produced of less than 15 year old forest, which had grown in unfavorable conditions with no anthropogenic impact. Dark color of the wood is typical for excessively humid locations. According to paleogeology data, it is to be supposed that the use of coniferous trees for any economic needs was rather difficult because of the specific wet conditions of the territory close to the lake. The only exception was on the surrounding hills, but the lack of necessary sand soils also prevented to the large growth of coniferous trees.

Apart from this, big straight trunks of pine trees (less frequently firs) were used for production of long slivers, i.e. material for fish traps and other constructions made of split materials. A structure composed of three adjoining fish traps is dated by ^{14}C to 6452 ± 43 BP, 6550 ± 40 BP и 6670 ± 80 BP, which allows to correlate him with an Early Neolithic settlement. An similar construction, found on the bottom of the contemporary Dubna river, dates to 7090 ± 70 BP. Slivers are characterized by rather wide and even annual rings, it proves the wood has been growing under favorable conditions.

A right-angled concentration of piles found during underwater excavation at the eastern Dubna bank is preliminary defined as a part of a household or housing structure with right-angular or square shape. It dates to the Middle Neolithic – 5544 ± 51 BP, 5580 ± 40 BP, 5630 ± 210 BP. The diameter of its piles is in the range from 7 to 10 cm. Trees are not more than 32 years old. Like the first case, rather young wood was used – no anthropogenic impact and better growth conditions, which resulted in wider annular rings.

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TOPONYMY IN THE STUDIES OF THE GEOHERITAGE AND TOURISM DEVELOPMENT OF THE MOUNTAINOUS REGIONS

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Research of any territory, its natural, historical and cultural characteristics implies the knowledge of toponyms, or the names of the local geographical objects – settlements, rivers and etc. Toponyms serve as territory markers and give the idea of the regional ethnic peculiarities, characteristics of its colonization and development of nature management. Each territory has its own toponymic system, which is as a rule represented by various groups of names, the most numerous of which are hydronyms (names of water bodies), oykonyms (names of settlements) and oronyms (names of relief forms). Depending on the regional characteristics each of these groups has a different number of elements; these elements appeared in different periods and functioned in a particular toponymic system. Oronyms and hydronyms which assign place names to certain objects are considered to be the most unchangeable names. This fact allows scientists to use the spacial toponymic system as an important source of information for regional studies, exploration of its landscape and geoheritage.

The natural characteristics of the mountainous regions provided the presence of various geological, geomorphologic objects which reflect the history of nature development including the periods of human activity. The objects of geoheritage (basseting, spas, mounds) are considered to be distinct elements of human development of new landscapes, scientific knowledge and their preservation show the peculiarities of nature management. Mountainous regions provide a splendid opportunity to analyze the interconnection of toponyms and objects of geoheritage, which underlined the natural, historical and cultural features of landscapes [1].

Our research was based on the toponymic approach to nature management in the Altay Region (within the territory of Russia) [2]. This mountainous region with unique nature has also got very interesting history of its development, it found its reflection in the regional toponymy. The Altay toponymic system is represented both by Turcic and Russian geographical names. This work is devoted mainly to the studies of Russian toponyms which appeared in the region at the end of the XVIIth and the beginning of the XVIIIth centuries when the Russians began to colonize Altay. The Russian toponymy of Altay in a broad meaning is understood as all the toponyms which, irrespective of their origin, are used in every day practice both oral and written [3]. The name Altay itself is usually translated into Russian as «golden mountains» (Alatun). There are other interpretations of this regional name: «multicoloured mountains» (Alyn-tau), «mountainous forest» (Al-taiga) [3].

Altay along with other regions was colonized along the river basins, therefore, the names of hydronyms are of special scientific interest. The Russian river names which appeared in the region only at the beginning of the XVIIIth century show the special features of the water bodies or the places where these bodies run, this fact became especially important for nature management. One can get the information about the river flow in such river names as the Bystrucha (The Fast River), the Tikhaya (The Still River) which is a tributary of the Katun, the Plesovchikha (a tributary of the Charysh), the Zvonchikha (a tributary of the Koksu). V.V. Sapozhnikov, a famous explorer, during one of his expeditions at the end of the XIXth century described the Zvonchikha as «the steep stream». The Peschanaya River (The Sandy River) describes the silt in its valley. A lot of hydronyms which contain adjectives «black-white», «still-fast», etc. appeared in the XIXth century. Quite often these names include the Russian words «black-white», which express the range of features of the river valley and the river itself (the colour of water and rocks in the valley, the characteristics of the river flow): The White and Black Anuy, the White and Black Berel, etc. The hydronyms that belong to this groups are spread all over Altay but outnumber other names in those regions where the Russian population is not so dense, rare or is not presented at all. It is typical for high-mountain and middle-mountain parts of the eastern and south-eastern Altay.

It is obvious that the Russian toponyms in Altay were superimposed on the indigenous river names and other geographical nominations. As a result the same rivers had several names in different languages. For example, the Russian river name «The Chernaya» (The Big) Biruksa coincided with the Turkic hydronym «the Karakem» («kara» – «black»). It should also be mentioned that quite often the indigenous and the Russian names of the same river denoted one and the same river characteristic. During the exploration of Altay in the XIXth century scientists began to restore and use in documents, including maps, the former (aboriginal) river names: the Bystraya River became the Turunda River, etc. [3]. The Katun, the main river in Altay which is closely connected with many objects of regional geoheritage, entered the Russian toponymic system under its aboriginal name which means «a mistress» in Russian.

The numerous lake names of Altay have the same patterns. For example, in the upper part of the Chulyshman there is Lake Gladkoe which is situated in the extended and practically flat part of the Oinoru valley. The plateau Ukok which has a lot of lakes is also famous for Lake Beloe, its water is of a white colour because of the silt which is brought here from the river Akalakha. Lake Prozrachnoe which lies in the upper reaches of the Haidun River (the basin of the river Koks) received its name due to its clear water. Lake Potainukcha (Hidden) is really hidden in one of the small turns of the Bashchelaksky Range. Lake Teletskoe is one of the biggest lakes in Altay, it can be compared with the Baikal by its natural characteristics and it also has a Turkic name, originated from the name of the tribe Telyosy which lived on its shores.

The Russian population of Altay had less influence on the relief names (oronyms) than on the regional hydronyms. The highest peak of Altay – Belukha (4506 m) is the most famous Russian name of regional geoheritage, it was given its name because of the ice-white cap. The Turkic names of this peak also show its features: Katyb-Bazhy (the top of Katun), Musdu-tuu (The Ice mountain), Uch-Ayry (The mountain with three arms») [4].

Among the most widely spread oronyms in the western and south-western parts of the region there are Russian names containing the word «belok», which were used by the aborigines to nominate high mountains covered with snow. The mountain ranges and peaks with this word are of great height: Taldinsky Belok (2013 m), Irkutsky Belok (2114 m). Kholodny Belki (2602 m). The Kamenny Belok Range (2300 m) with the peaks Bystrukhinsky Spil and Tesninsky Belok are famous for their steepness and rocky slopes. The Myakonky Range, on the contrary, is mildly sloping and has a flat watershed. In the south-eastern part of Altay where the Russian toponyms are very rare, within the South-Chuisky Range there is a very accurate name Taldurinskaya Ograda. This is a low range (not higher than 3000 m) which forms a narrow barrier between the glaciers Sophiysky and Bolshaya Taldura. In the South-Eastern Altay near Lake Dzhulkul there is the range Lednikovye Grivy, its name reflects the relief forms and their origin.

The name Griva Prokhodnaya indicates the presence of paths or a passage to other territories, the names Sosnovaya Sopka, Beryozovaya, Pleshivaya, Kedrovaya hint on the type of vegetation. One can also find positive nominations of relief forms, for instance, in the type or in the colour of rocks. This feature is expressed in the following names: Bely Bom (the rock of the white colour), the mountains Chernaya, Krasnaya, etc. The following oronyms reflect the history of the region and the geographical location of Altay: the mountains Pogranishnaya and Komandnaya (The Shapshalsky Range), Granuchnaya (The Kuminskie Belki).

The spread of the Russian toponyms, particularly oikonyms (which were not analyzed in the present article) and hydronyms have certain regularity. The number of Russian toponyms is rather low in the eastern and south-eastern part, where the Russian territory development was sporadic and linear but not areal as in the north-western and central parts of Altay. The geography of the Russian names is connected not only with the natural peculiarities of Altay landscapes but also with its location on the border with Kazakhstan, China and Mongolia, their proximity can often be found in the river and range names. That is why the eastern and especially south-eastern parts of Altay are characterized by the total absence of the Russian geographical names and the considerable number of toponyms in Asian languages which reflect the relations between nations.

The Altay geoheritage as well as other mountainous regions have become popular with tourists and tourist business recently. It is vital to study this heritage and understanding the value of its objects to preserve it. The regional toponyms give tourists the opportunity to see the area as if they are locals or explorers, it helps to understand better natural, socio-cultural, economic processes which took place in this territory in the past and may be still important.

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