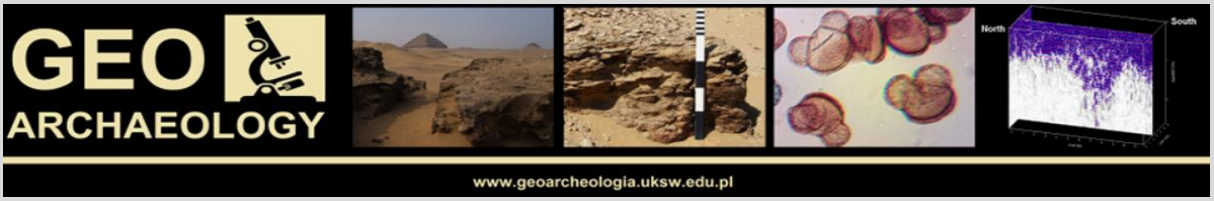

Institute of Archaeology, Cardinal Stefan Wyszyński University in Warsaw
Institute of Archaeology in Zagreb
Faculty of Geology, Warsaw University
Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb

The 5th Geoarchaeological Conference

Late Antiquity and Migration Period in the light of geoarchaeological records from the eastern Mediterranean, eastern Adriatic and adjacent regions

Under scientific patronage of the
Committee on Quaternary Research of the Polish Academy of Sciences
Croatian National INQUA Committee (Croatian Academy of Sciences and Arts)

The 2nd meeting of the International Focus Group on Northeastern African Quaternary Stratigraphy (NAQS) acting in the frames of INQUA Commission on Stratigraphy and Chronology (INQUA–SACCOM)

Zagreb, 23rd–24th October 2018

PROGRAMME
BOOK OF ABSTRACTS

Conference organized by

Institute of Archaeology, Cardinal Stefan Wyszyński University in Warsaw, Poland
Institute of Archaeology in Zagreb, Croatia
Faculty of Geology, Warsaw University, Poland
Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb, Croatia

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PROGRAMME

Tuesday, 23rd October 2018	
09:00-09:30	*Registration*
09:30-09:50	**Opening of the conference, welcome speeches** Institute of Archaeology, Zagreb (Katarina Botić) Head of the Department of Archaeology, Faculty of Humanities and Social Sciences, University of Zagreb (Marcel Burić) Vice-dean of the Faculty of Humanities and Social Sciences, University of Zagreb Institute of Archaeology, Cardinal Stefan Wyszyński University, Warsaw (Fabian Welc)
	Morning Session *(Session Chair: G. Lipovac Vrkljan/M. Burić)*
09:50-10:15	**F. Welc, A. Konestra, G. Lipovac Vrkljan** New evidence of the late Antiquity abrupt climate fluctuations recorded at selected archaeological sites located on north-east Adriatic coast
10:15-10:40	**M. Szymanek** Malacological indicators of the late Antiquity environmental conditions. Case studies of the Plemići (Zadar region) and Podšilo Bay (Island of Rab)
10:40-11:05	**A. Konestra** Settlement pattern modifications on the north-eastern Adriatic: the Island of Rab Roman rural sites case study
11:05-11:30	**K. Botić, G. Lipovac Vrkljan, A. Konestra, F. Welc** Late Antiquity climate induced landscape change? Case study of Crikvenica – Igralište site
11:30-11:50	*coffee break*
11:50-12:10	**Short poster presentation** S. Šuica, A. Azinović Bebek **Volcanic artefact from the late antique Crkvišće Bukovlje site (Karlovac, Central Croatia)** S. Gulyás, Cs. Balogh, A. Körösi, A. Marcsik, P.A. Kiss, B. Nagy, P. Sümegi **Subsistence of early Avar (6-7th centuries AD) communities in the Maros valley based on interdisciplinary investigations** T. Zs. Vári, D. Molnár, P. Sümegi **Anthropogenic and climatic signals in a Holocene raised bog from the central part of Transylvania** T. Törőcsik, P. Sümegi, B.P. Sümegi, S. Gulyás, D. Molnár, K. Náfrádi, T. Zs. Vári, G. Ilon, A. Torma **Anthropogenic and climatic signals in Late-Glacial and Holocene peat sequence from the western part of the Carpathian basin** I. Ožanić Roguljić, K. Turkalj, K. Jelinčić Vučković **The database of antique (Greek and Roman) archaeological sites of the Republic of Croatia**
12:15-12:35	*discussion*
12:35-14:00	*lunch break* *refreshments offered by the organizer*

Afternoon Session *(Session Chair: F. Welc, A. Konestra)*	
14:00-14:25	**S. Miko, O. Hasan, N. Ilijanić, K. Bakrač, D. Brunović, V. Hajek-Tadesse, I. Razum** Soil erosion and landscape change during the late Holocene in Dalmatia
14:25-14:50	**M. Jarak, A. Maričić** Cultural landscape and environmental frames – Investigations of a territory at the border of northern and middle Dalmatia
14:50-15:15	**A. Adamić Hadžić** The effects of climate change on the health of late antique and early medieval populations from the eastern Adriatic coast
15:15-15:45	*coffee break*
15:45-16:10	**D. Hruševar, K. Bakrač, S. Miko, N. Ilijanić, O. Hasan, B. Mitić** Multiproxy study of environmental changes during the last 2000 years – example from Blatuša mire, central Croatia
16:10-16:35	**T. Sekelj Ivančan, K. Botić** Dynamics of activities related to smelting economy during Late Antiquity and early Middle Ages – case study of Virje and Hlebine
16:35-17:00	*discussion*

Wednesday, 24th October 2018	
09:00-09:30	*Registration*
Morning Session *(Session Chair: M. Jarak, K. Botić)*	
09:30-09:55	**Zs. Rácz, E. Soós, Zs. Masek, A. B. Tóth** Transformation of settlement and subsistence strategies in the Carpathian Basin in the 5th-6th centuries AD
09:55-10:20	**S. Gulyás, Cs. Balogh, A. Körösi, A. Marcsik, P. A. Kiss, B. Nagy, P. Sümegi** Changes in subsistence and funerary practices from the mid-7th century AD in early Avar communities inhabiting the Maros valley SE Hungary in light of paleoecological and paleoclimate data
10:20-10:45	**M. Obremska, M. Szymanek, J. Nitychoruk, F. Welc** Environmental transformations during Roman and Migration Periods (100 – 700 AD) reflected in palynological data from selected lakes in the north–eastern Poland
10:45-11:10	**A. Zalat, F. Welc, J. Nitychoruk, L. Marks, M. Chodyka, Ł. Zbucki** Last two millennia water level changes of the lake Młynek (north-eastern Poland) inferred from diatoms and chrysophyte cysts records
11:10-11:30	*discussion*
11:30-11:45	Closing of the conference **F. Welc, K. Botić, L. Marks**
11:45-14:00	*lunch break*
The 2nd meeting of the International Focus Group on Northeastern African Quaternary Stratigraphy (NAQS) **acting in frames of INQUA Commission on Stratigraphy and Chronology** **(INQUA-SACCOM)** *(Session Chair: L. Marks, F. Welc)*	
14:00-14:25	**L. Marks**: New stratigraphic subdivision of the Holocene
14:25-14:50	**F. Welc**: 1.5 ka Bond event and its significance for geoarchaeology of the east Adriatic coast
14:50-15:15	**A. Zalat, F. Welc, J. Nitychoruk, L. Marks**: Climate change, environmental history and Human impact during the Late Holocene inferred from diatom analysis of the Qarun Lake, Faiyoum Oasis, Egypt
15:15-15:55	**L. Marks, F. Welc, A. Zalat, J. Nitychoruk, Zh. Chen, A. Salem, A. Majecka**: Environmental conditions in the Faiyum Oasis (Egypt) based on the Lake Qarun sediment studies and geoarchaeological research
15:55-16:55	*general discussion*
16:55	*Closing Meeting Gathering and Coffee*

ABSTRACTS

F. Welc,[1] **A. Konestra,**[2] **G. Lipovac Vrkljan**[2]

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New evidence of the late Antiquty abrupt climate fluctuations recorded at selected archaeological sites located on north-east Adriatic coast

Within project Roman Economy in Dalmatia (RED) extensive geophysical and geoarcheological survey was carried out in Podšilo bay (Lopar, island of Rab), Plemići bay (Near Zadar) and at St. Martin site and in the environs of St. Peter - Soline on the island of Krk. As a result of this research, many Roman structures have been discovered. All of them are located near the sea shore, like workshops and other kind of buildings. It is very interesting that all of them were covered by immense mass of the slope sediments. In fact, archaeological material in the vast majority of cases is displaced and intermingled, suggesting that the landslide processes have been initiated already in the distant past. However, the basic question remains when these processes were initialized, this is especially true for large-scale mass movements that have been identified in Plemići bay area. Without additional research (including radiocarbon dating), it is not possible to answer this questions at the moment. However, it is worth mentioning that in all of the studied profiles with landslides, sediments only contain fragments of ceramics from the Roman period, which may suggest that the intensification of the mass processes took place at the end or after the Roman period, but before the middle Age time, and probably should be linked to so-called 1 Bond climatic episode, which is dated to ca. 1.5 ka BP.

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Malacological indicators of the late Antiquity environmental conditions. Case studies of the Plemići (Zadar region) and Podšilo Bay (Island of Rab)

Malacological studies were conducted in three Croatian archaeological sites at Plemići (Zadar region), Podkućine and Barbat Port (Island of Rab). In general, the shell concentration was low in the sediments (178 specimens in 23 samples), but preliminary results of mollusc analysis appear promising (especially in Plemići) for palaeoenvironmental reconstructions.

Molluscs of Plemići with predominance of *Pomatias elegans* (Müller, 1774), *Rumina decollata* (Linnaeus, 1758) and *Helix cincta* (Müller, 1774) point to terrestrial conditions and warm maritime climate. They are typical of open landscape and calcareous substratum with the rock rubble. Maritime grasslands with some shrubs probably predominated in the vicinity of the site. The climate during the deposition did not differ significantly from today. Some admixture of marine species (single shells of *Cerithium vulgatum* (Bruguière, 1792) and *Donacilla cornea* (Poli, 1791)) may indicate a contact with marine deposits or some shell mixing, but it was noted only in one sample.

Considerable amount of marine taxa occur in Podkućine in the Podšilo Bay (9 terrestrial snail species and 8 marine snails and bivalves) and in the Barbat Port (6 terrestrial and 3 marine snail species). Land snails may indicate open and dry conditions in both sites with some shrubby areas, but palaeoenvironmental interpretation is limited by the size, volume and the number of samples. Although the contact with marine layers cannot be excluded, the occurrence of marine species in Podkućine may be connected with the human activity in the site. *Ostrea edulis* (Linnaeus, 1758) and *Cerastoderma glaucum* (Bruguière, 1789) are eatable and often found in archaeological sites, whereas based on archaeological data *Spondylus gaederopus* (Linnaeus, 1758) was tradeable and used to produce some jewellery (e.g. bracelets).

A. Konestra[1]

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Settlement pattern modifications on the north-eastern Adriatic: the Island of Rab Roman rural sites case study

The period from the end of the 3rd c. CE onwards is generally marked by changes in the political and economic organisation of the Roman Empire, which are not always easy to pinpoint archaeologically on a site-wide or regional level, especially in those areas that did not participate directly in major historic events. In fact, while there are general trends for late Antique settlement evolution, each region shows different developments, sometimes even opposite to those of neighbouring ones.

Taking into account the evidence within a wider area, such as that of an island seen as a "closed context", it is perhaps easier to follow these modifications and patterns in the archaeological record. Taking as base for discussion the Roman rural settlement pattern of the island of Rab (Kvarner region, NE Adriatic), so far investigated by field reconnaissance, remote sensing, GIS and trial trenching, it is possible to preliminarily propose an evolution of the settlement and use of the countryside. While keeping in mind the aforementioned general trends, substantial modifications of this pattern are noticed probably occurring from the 5th-6th c. onwards. While the occurring changes, which seem to point to continuity only on certain sites, are noticeable elsewhere, what remains unclear is the reasons behind this settlement strategy.

Comparative archaeological examples from adjacent areas will be taken in consideration in the try to assess what could have induced this reorganisation in rural area settling, while other potential lines of research, such as those combing cultural and environmental factors, will be proposed.

K. Botić,[1] **G. Lipovac Vrkljan,**[1] **A. Konestra,**[1] **F. Welc**[2]

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Late Antiquity climate induced landscape change? Case study of Crikvenica – Igralište site

During Late Antiquity (4th – 6th c. AD) a change in climate is recorded. On a global scale, the decrease in temperature can be observed from the mid-4th century culminating in the pronounced negative peak around AD 450 which was accompanied by reduced solar activity. Predating the Bond 1 event, this episode might have been one of the causes of sediment deposition on the Roman site Crikvenica – Igralište, situated in the northern Adriatic region. Although the decrease in precipitation is documented globally, several pronouncedly wet years can be reconstructed in Europe from tree-ring records during the 4th and 5th c. AD. On a micro regional scale, as the modern records show, specific wet episodes with above normal precipitation levels can be expected in the observed region in Late Antiquity, which are not documented in available global proxies.

In archaeological records, sediment deposits caused by pronounced weather/climate influence are seldom minutely recorded causing the loss of information crucial for understanding the landscape in which the settlements were situated and its dynamic throughout time. By combining the archaeological record, new geophysical research and geological sampling, this loss of information can be reduced.

Thick sediment layers covering Crikvenica – Igralište site possibly indicate at least two episodes of extreme flooding which can be, with caution, dated to the 4th or the transition to the 5th c. AD: the existence of two graves from the 4th c. and reported stray finds from the 5th c. in the last thick layer of sediments are not enough to precisely date these events. It is, however, possible to imagine how great impact on the community in the wider area of Vinodol valley regarding agriculture/subsistence and roads/communications these episodes could have had.

S. Miko,[1] **O. Hasan,**[1] **N. Ilijanić,**[1] **K. Bakrač, D. Brunović,**[1] **V. Hajek-Tadesse,**[1] **I. Razum**[2]

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Soil erosion and landscape change during the late Holocene in Dalmatia

This paper examines the records from lake and marine cores for multiproxy evidence of environmental changes in the Eastern Adriatic region during the late Holocene. Focus is on data for the period termed as Dark Ages Cold Period (DACP) with starting and ending dates of AD 450 and AD 800 (Helama et al., 2017) and also for the evidence of the cold period from AD 536 to 660 termed the Late Antique Little Ice Age (LALIA - Büntgen et al., 2016) related to intensive volcanic activity. Human activities on the eastern Adriatic coast during various periods of late Holocene as recorded by marine and lake cores indicate forest clearance which caused advanced soil degeneration and increased erosion rates of different intensities. The unique characteristics of polygenetic Cambisols (eutric, distric, chromic) developed on karst bedrock with distinct high magnetic susceptibility and geochemical signatures of lithogenic elements (i.e. Al, Fe, Si, Ti, K, V, Cr, Ni) allow detection of erosion events and their intensities in dominantly carbonate rich Holocene marine and lake sediments. During the LoLADRIA project more than 20 dated cores from lakes, marine depressions and estuaries showed different periods of erosion in different Adriatic catchments and regions. Most of the lake cores offer higher resolutions (5-10 years) for paleo reconstructions than marine sediments (20 years). Evidences (magnetic susceptibility, geochemical, ^{13}C and ^{15}N of organic matter, palynological, grain size) of intensive environmental changes during the DACP were found in cores from lake sediments of Vransko jezero on Cres Island, Bokanjačko blato and Modro jezero and from marine sediments from the Novigradsko more catchments.

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Cultural landscape and environmental frames – Investigations of a territory at the border of northern and middle Dalmatia

At the territory near the mouth of the river Krka (Titus fl.), the areas of Lake Prokljan and Šibenik Gulf, very significant environmental appearances, mark the landscape. The territory makes a natural border between northern and middle Dalmatia. During the Late Antiquity several important archaeological localities existed here, e.g. the town of Skradin (Scardona) and insufficiently known settlement in present-day Bilice.

The paper contains data on environmental features and resources that can be recognized as natural basis for the development of settlements during the Late Antiquity and Early Middle Ages. It also contains discussion of the connections of the chosen territory with a broader district of Dalmatia. Defined sculptural workshops and origin of the church furnishings could be relevant in that respect.

The geological characteristics of the Krka River valley and surrounding areas are very versatile. Deposits surrounding the area of Krka River are comprised of sedimentary carbonates. Majority of the sedimentary rocks are of Cretaceous age. Eocene-Oligocene age deposits are also represented as Promina beds. The formation of Krka river canyon during the Upper Pleistocene and Holocene influenced the morphology and the landscape of that area. Recent morphology probably had big impact on the formation of the settlements in the investigated area.

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The effects of climate change on the health of late antique and early medieval populations from the eastern Adriatic coast

Climate change is not a new phenomenon. Our planet's climate has been constantly changing throughout history. Seven cycles of glacial advance and retreat have been recorded in the last 650,000 years. New studies show that in our recent past there were so-called mini ice age periods. One, from the 13th to the19th century AD, the other in the 6th and 7th centuries AD. Human population can adapt to abrupt climate changes, but at a price. With changes in climate, come changes in economy, agriculture, environment and human health. The purpose of this study was to determine if the 6th and 7th century little ice age raised frequencies of two non-specific markers of subadult stress – cribra orbitalia (CO) and linear enamel hypoplasia (LEH) – in the early medieval populations from the eastern Adriatic coast. To do so, a comparative analysis between the late antique (2nd – 5th c. AD) and early medieval (6th – 9th c. AD) series was conducted. The results show that adults from EM series exhibit significantly higher rates of CO than adults from LA series. Subadults also exhibit higher CO rates in the EM series, but without statistical significance. LEH values are almost identical in both samples. Higher rates of CO in the EM series, especially in adults, suggest that little ice age, among other contributors such as increased parasite loads and higher frequencies of acute and chronic infectious diseases, caused deterioration of human health in the early medieval period. Analysis by sex suggests that this deterioration was not uniform and that females, as is evident by their significantly higher frequency of the co-occurrence of CO and LEH, were more susceptible to subadult stress than males.

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Multiproxy study of environmental changes during the last 2000 years – example from Blatuša mire, central Croatia

There is little known from the point of view of environmental and climatic changes on the epoch of Late Antique and the successive Dark Ages. The amount of archaeological evidence in the continental biogeographical region of Croatia during this period is still scarce and needs to be improved. However, it was a dynamic period of human history which changed the map of Europe in the sense of borders, language, politics, economy and religion. In our research, we discuss the environmental changes and vegetation dynamic caused by natural forces or human impact. The study is focused on plant cover reconstruction of the colline area in central Croatia (Sisačko-Moslavačka County, commune Topusko and Gvozd), and the trophic/hydrologic regime of "Đon močvar" mire near Blatuša village from where the sediment core was taken. The results of the pollen and non-pollen palynomorphs, together with the micro and macro charcoal, are presented on diagrams plotted by PolPal software and show the replacement of *Alnus-Fagus* forest with non-arboreal palynological taxa, and increase of *Quercus* trees during Migration period. At the same time, there is no evidence of primary anthropogenic indicators. Later, during the Little Ice Age, the share of non-arboreal taxa became even greater than in the earlier period, and *Carpinus* became the dominant tree in the woodland. Cerealia pollen is found only at the end of the Late Middle Age, though the continuous curve of *Juglans*, as evidence of arboricultural activity, appeared earlier in the late 13th century, and continuous weed curves as evidence of farming/pasture activity from the end of the 14th century. The shares of arboreal pollen, anthropogenic indicators, charcoal particles and palynological richness point to the different intensity of anthropogenic pressure, which is most pronounced in the period from the High Middle Ages to the present. Charcoal particles are evidence of regional and local fires as essential factors in succession processes, even though their origin (natural vs. anthropogenic) is still questionable.

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Dynamics of activities related to smelting economy during Late Antiquity and early Middle Ages – case study of Virje and Hlebine

In the frame of the TransFER project *Iron production along the Drava River in the Roman period and the Middle Ages: Creation and transfer of knowledge, technologies and goods (IP-06-2016-5047)* financed by the Croatian Science Foundation, multidisciplinary investigations are carried out on sites where primary iron ore process was identified. These are the positions in the Drava valley near which the oolithic iron ore layer is naturally renewed by regular flooding. On two of these positions, Virje and Hlebine, archaeological of various furnaces for iron smelting and adjacent facilities investigations were carried out. Radiocarbon dates and movable archaeological finds confirm the existence of life on these sites during the Late Iron Age, Late Antiquity and Early and developed Middle Ages, while the iron smelting activity took place here during the Late Antiquity and Early Middle Ages. It is, however, interesting to notice a short break in the work of these workshops around AD 600 caused, on the one hand, by historical events in this area and, on the other hand, possibly by some other factors. Namely, that is the time when the extremely dry and cold conditions prevail. Shortage of precipitation could certainly have affected the natural deposition of iron ore in this area, and iron production itself could have continued at some other unexhausted positions for a short period of time. At the example of Virje and Hlebine we can recognize how sensitive the relationship between human activities, economy and environmental conditions is.

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Transformation of settlement and subsistence strategies in the Carpathian Basin in the 5th-6th centuries AD

Our presentation will be kept about a quite new research project that aims to analyse settlements and burials from the 5th-6th centuries in the central and eastern part of the Carpathian Basin, with complex archaeological and natural scientific methods. Our investigations will focus on subsistence strategies: on settlement structures, households, diet, general health, as well as on their changes, respectively.

With regard to the historical and archaeological research of the Eurasian Migration period, the Carpathian Basin can be considered as a key area. This region was the centre of the Hunnic Empire in the midst of the 5th century, and consequently it became the territory of one of the first early medieval state formations, the Gepidic Kingdom. The main goal of our proposed project is to examine the lifestyle, the general health, and the dietary practices of the population of both the Hunnic and Gepidic periods, as well as the latter's respective temporal changes and regional patterns. Primarily, we have chosen site complexes within which contemporary settlements and burials were brought into light in the close vicinity of each other – which, at the same time, may have been used by the very same population. Thus, it will be possible to examine the onetime lifestyle from a spectre as broad as possible, with the methods of anthropology, archaeozoology, archaeobotany, and with isotope and organic residue analyses related to diet and mobility. Moreover, all at once we will be able to interpret the results of our comparative analyses in the light of the correlations of individual and community, and that of different communities, regions and timespans as well.

The fundamental issue of our investigations concerns the correlations between the transformation of political and social structures and the changes of lifestyle and subsistence strategies in the 5th-6th centuries AD.

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Changes in subsistence and funerary practices from the mid-7th century AD in early Avar communities inhabiting the Maros valley SE Hungary in light of paleoecological and paleoclimate data

According to available data Early Avar cemeteries in the Maros valley existed from the last third of the 6th (568 AD) till the mid-7th centuries (650 AD). During the mid-7th century these cemeteries were abandoned and new ones were opened in the inner areas of the Körös-Tisza-Maros triangle far away from the rivers. Based on documented burial practices these cemeteries are in close relationship with the Early Avar cemeteries of the Maros valley. Nevertheless, the composition of herded animals has also changed to a clear dominance of cattle from sheep and goat. A shift in subsistence from nomadic to a settled lifeway is also noted. To understand the potential environmental causes of these changes, paleoclimate reconstructions were done using proxy data gained via the analysis of freshwater and terrestrial mollusk, phytolith, charcoal remains retrieved from the graves complemented by regional and extra-regional data. As detailed archeotypochronology for the period of 6th-7th centuries is missing apart from the date of the Avar invasion (568 AD), an absolute chronology of the sites was constructed via Bayesian modelling of archeostratigraphically-controlled ^{14}C data yielding chronologies with an uncertainty of 7 (at 1 σ) and 15 years (at 2σ conf.). This enabled us to put the time of site use in a chronological framework suitable for paleoclimatic proxy studies. The period preceding the Avar Conquest (450-568) was generally characterized by cold and wetter summers in much of Western Europe known as the Late Antique Little Ice Age. Mollusk composition and proxies indicating solar radiation strength talks about the presence of a mild climate with strong continental influences marked by a strong Siberian High during this period in the Maros valley. These conditions persisted until the mid-7th century AD apart from smaller fluctuations. There is a major change from ca. 650 lasting until 720 AD. seen in the weakening of the Siberian High and a positive phase of Artic Oscillation yielding stronger westerlies and Jetstream bringing more cyclones from the Atlantic to Western Europe on a more southward storm track. Solar activity has also decreased marking the weakening of sub-Mediterranean influences bringing secondary late autumn rainfall peak to the area. As the watershed area of the Maros in Transylvania is lacking sub-Mediterranean influences in general, precipitation increases might have caused higher floods during the spring and the early summer. Taxonomic, isotopic (C, O) and trace element (Mn, Fe, Zn) analysis of freshwater mussel shells from two dated graves also indicate fluctuations of periods of still and moving water conditions on the Maros River floodplain. It must have had significant impact on the groundwater table of the GHP and the extension of inundated areas reducing the spatial extent of available pasturelands. This particularly must have affected sheep, which was a dominant element of the herds (40%) besides cattle (45%). Similar subsistence crisis has been documented for the Early Neolithic and Late Neolithic of the Middle and Lower Tisza valleys even at sites near Makó. Signs of the Late Antique Little Ice Age have been noted from the Migration Age for the Transdanubia site Szólád and the western margin of the Danube Tisza Interfluve. Our work has been supported by OTKA Grant 109510.

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Environmental transformations during Roman and Migration Periods (100–700 AD) reflected in palynological data from selected lakes in the north–eastern Poland

In the beginning of the last two millennia the vegetation in the region of north-eastern Poland was characterized by the dominance of mixed deciduous forests. The main components of these communities were *Quercus* (oak), *Carpinusbetulus* (hornbeam), *Corylusavellana* (hazel) with the lower share of *Tilia* (lime), *Fraxinus* (ash), *Ulmus* (elm), *Fagus sylvatica* (beech), *Piceaabies* (spruce). Human activity during the 100–400 AD (Roman Period) and then the decline of anthropopression during the Migration has impact on the plant communities and landscape transformation. These environmental responses are well expressed in palynological records. Our results display visible human pressure in region about 100–400 AD exerted by tribes related to the Wielbark Culture. The development of persisting settlements and agriculture took place at expense of surrounding hornbeam forests. This event is strongly visible in the pollen diagram in significant decline of *Carpinus* curve and the appearance of the curves of human indicators plants i.e.: *Rumexacetosa/acetosella, Plantago lanceolate* (grazed), *Artemisia, Plantago major* (ruderal) *Cannabis*, cereals (cultivated). Pollen spectra display clear differences between periods of different human pressure. Significant growth of contribution of arboreal pollen (AP), especially percentages of *Carpinus* pollen grains and the rapid decline of human indicators plants reflects the transition to the Migration period and might be related to cooler climate conditions forcing people to give up their settlements.

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Last two millennia water level changes of the lake Młynek (north-eastern Poland) inferred from diatoms and chrysophyte cysts records

A sediment core, 350 cm long recovered from Młynek Lake, northern Poland (Warmia and Masuria Region) was analysed with respect to their content of diatoms and chrysophyte cysts. The aim was to reconstruct the lake water level and climatic changes during the past 2500 years. The recognized diatom assemblages displayed marked floristic changes along the sediment core samples. The main change in diatom composition consists of a shift from an assemblage dominated by benthic *Fragilaria sensu lato* species through marked intervals to a planktonic one in distinct zones. A high proportion of benthic to plankton has been reported as indicative for lowering lake level during cold climate and long ice cover, and a shift from benthic to planktonic diatom taxa, reflecting rising water level with longest growing season and reduced ice cover on the lake during warm climate. Multivariate statistical analysis included hierarchical ascending clustering distinguished four diatom ecological groups. Each ecological group is containing dominant and distinctive diatom taxa that reflect marked environmental changes during the time of sediment deposition. The analysed core section was divided into eleven diatom zones according to the distribution of ecological groups and the variations in abundance of dominant species supported by 14C data. The results displayed a developmental history of Młynek Lake that can be divided into six main phases of alternating warm wet and cold dry shifts. A distinct dominance of planktonic eutrophic indicators diatoms accompanying with low abundance of chrysophyte cysts indicates an increase in the lake trophicity and a general trend for increasing anthropogenic impacts.

POSTERS' SESSION

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Volcanic artefact from the late antique Crkvišće Bukovlje site (Karlovac, Central Croatia)

Crkvišće near Gornje Bukovlje (Karlovac county, Central Croatia) is a late antique fortification, probably built in 4th century. Archaeological excavations from 2012 to 2018 covered church dated to 5/6th century, fortress and three objects. Findings of ceramic *tubulae*, which were the part of a heating system construction, as well as finely polished plate, point to residential use of the objects.

The polished plate was probably part of the inner house decoration. It is built of volcanic rock. In order to unravel the provenance of the volcanic material, the sample was subjected to petrographic and whole rock chemical analysis. It is a hydrothermally altered amygdaloidal basalt, with plagioclase phenocrysts set in dark green groundmass. Amygdals are composed of calcedone, chlorite and epidote. The primary mineral assemblage is replaced by albite, epidote, chlorite, actinolite, titanite and hematite.

Trace element pattern normalised to primitive mantle displays Nb, Ta, P and Ti depletion, accompanied by U and Pb enrichment. REE pattern normalised to chondrite is characterized by apparent LREE enrichment and HREE depletion. Overall geochemical characteristics point to supra-subduction tectonic setting. Possible source of material could be either volcanic rocks of the Lipari island (Aeolian arc) in the southern Italy (Peccerillo, 2005), or Neogene calc-alkaline basalts and basaltic andesites of the Inner Carpathian arc of the northern Hungary, Slovakia and Romania (Downes et al., 1995).

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Subsistence of early Avar (6-7th centuries AD) communities in the Maros valley based on interdisciplinary investigations

This presentation provides an overview of subsistence patterns of Early Avar Age communities inhabiting the Maros valley of SE Hungary during the 6-7th centuries AD via comparative analysis of the archaeology complemented by results of natural scientific investigations (557 graves of 22 sites). A stunning feature is the exceptionally high number of animal burials (928), which appear in two forms: as food or sacrifice. The sheer number of animal bones is a clear indication of a dominantly nomadic agro pastoral economic system. 37% had animal bones representing food remains with a prevalence of lamb. Sacrificial remains include dominantly cattle, sheep with a highly subordinate number of horses. Horn and bone tools made of red deer ribs and antlers highlight the importance of hunting. No tools indicating plant cultivation are known in the records. Yet, detailed analysis of textile remains attached to some iron tools attest the use and cultivation of flax and hemp.

To confirm and widen knowledge gained regarding subsistence archaeological data was complemented with information on bone geochemistry (trace elements of Mn, Zn, Cu; C, N, O isotopes). Wheat and other cereal produce have high manganese content resulting high concentrations of this element stored in the body and the bones. Values below 500 pp generally indicate a meat and dairy based diet. In Makó the average Mn concentrations ranged between 160-400 ppm. Zn is above 200 ppm, again indicating meat consumption. Cu ranged between 20-40 ppm. The $\delta^{15}N$ stable isotope values for the Avars at Makó ranged from 9.2-14.6 ‰. The general range is lower than that indicating freshwater fish in the diet congruently with the lack of fish bones at all sites. However, the $\delta^{15}N$ values indicate the use of secondary products of domesticated livestock. Individuals characterized by $\delta^{15}N$ values of a mixed diet or dominantly plant carb diet were missing from Makó. A similar trend is observed for the Late Avar Age population of Sajópetri. Individuals from the coeval Lombard cemetery at Szólád in Transdanubia, W Hungary and the Late Avar site of Sajópetri also had similar $\delta^{15}N$ values. Conversely, individuals at the baseline of a mixed diet and a dominantly plant carb diet are also present in large numbers. When we examine $\delta^{13}C$ values, mainline individuals from the coeval Lombard cemetery at Szólád have strictly lower values and well separated from the individuals of Makó Mikócsa site implying a dominantly C3 plant (barley, wheat etc.) diet. Conversely, the Early Avar Makó group had dominantly C4 plants in their diet (millet). This clearly corroborates the emplacement of millet porridge into the burial jars. As other Central European populations occupying the region utilized wheat and barley, both C3 plants, as staple crops the Avars of Makó were non-locals to the area. The Late Avar Sajópetri population occupies a mid-position between the two extremes indicating a somewhat similar, yet different plant-based diet from the Early Avar Makó group.

Geochemical, sedimentological analysis of soil (Corg, inorg, pH, EC, MS, grain-size, color, 8 elements) retrieved from jars of the Makó cemetery also aided elucidation of the nature of organic matter emplaced into jars. Spatial distribution of marker elements connected to the presence of flesh and cereal meals (Mn, Cu, Zn) in the pots were highly correlated with the amount of Corg. Elevated values of K, Mg helped identification of wood ash and burnt flesh, bone remains. Others (Ca, Mg) may indicate the burial of water bank plants (reed, bulrush). Our work has been supported by OTKA Grant 109510.

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Anthropogenic and climatic signals in a Holocene raised bog from the central part of Transylvania

This work focuses on the paleoenvironmental and paleoclimatological analyses of the undisturbed core sequence of 8,6 meters extracted from the Lake Feneketlen (*Tăul fără fund)* sphagnum peat bog located in Magyarbagó (Băgău), Romania, which covers the last 8600 years based on radiocarbon dating. Based on these analyses and with the help of the radiocarbon dating it was possible to reconstruct the climatic factors and anthropogenic impacts on the local environment. The sedimentation rate correlates with the development of the peat bog, and the peat accumulation correlates with the local climatical factors, especially with the humidity. The undisturbed core sequence has above 90% organic matter content all along excluding the erosion horizons. Human interventions (building, woodcutting, pasturage, husbandry, farming) and changes in the local climate, vegetation, and environment increase the rate of the erosion and decrease the rate of the accumulation. The carbonate content highly correlates with the non-organic matter content. The formation of the valley started with occlusion and non-organic sediment accumulation, and it slowly evolved into a peat bog during a dry and cold climate. The first sign of anthropogenic effect came during Neolithic by the Transylvanian Körös culture, the second by the Linear Pottery culture. During the Copper Age, the peat accumulation stopped so drastically, that clayey and silty bedrock sediments with high carbonate content formed. At the end of the Copper Age (Cucuteni-Trypillia culture), a lesser erosion horizon formed than before. Not that much after a more significant and longer erosion horizon appeared in the Bronze Age when the Coţofeni-Weitenberg cultures were present. After this erosion horizon between ca. 4200-3700 cal BP years the overall temperature got cooler, because of this the vegetation period cooled down, and it decreased the evapotranspiration, and as a result of the cool and wet climatic conditions the water table of the peat bog increased. Therefore the central lake system extended in the analysed peat bog and a water layer formed (450-405 cm) in the peat layer sequence. The peat accumulation commenced by developing a new floating mat on the lake surface. Hence a thick peat layer got deposited with over 91% organic matter content, a maximum of 8% non-organic matter content, and a maximum of 1% carbonate content from the end of the Bronze Age to the end of the Iron Age (Le Tène, Hallstatt, Dacian cultures). A double erosion horizon appeared during a dry and mild climate at the time of the Romanian Empire and at the time of the Migration Period. The peat bog regenerated and kept accumulating peat till the climate changed into cool and wet when another water layer formed (100-90 cm) like during the Bronze Age. The lake inside the valley developed into a peat bog once again, and its accumulation got disturbed by the washed in bedrock sediments and the human erosion factors. By our data there were no human settlements in the immediate vicinity of the bog, written sources from the Middle Age confirm this.

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Anthropogenic and climatic signals in Late-Glacial and Holocene peat sequence from the western part of the Carpathian basin

This work focuses on the palaeoenvironmental, geoarchaelogical and bioarcheological analyses of the undisturbed core sequence extracted from the one-time peatland at Mezőlak–Szélmező in the Marcali Basin lying in the southern part of the Little Hungarian Plain and the interpretation of these analyses regarding human settlement and paleoenvironmental – paleoclimatological valuation. We sought an answer to the question of whether traces of human activity could be noted in the area's Holocene vegetation and environment and if so, to determine the nature of this activity and date it within the Holocene. The analyses of the Mezőlak core revealed an infilling oxbow, reflecting the transition from the fluvial phase to the reed-bed cover. The succession, however, cannot be regarded as a typical example of a "classical" infilling succession because micro-climatic and local hydrologic factors greatly influenced it. The area had a fluvial stage at the end of the Pleistocene during the Late Glacial phase. Paludification began during the Late Glacial/Postglacial transition: a common club-rush sedge marshland evolved first, which was later replaced by reed-beds with stands of tufted sedge As a result of a warmer and drier climate, the reed-beds became homogenous and the peat decomposed. Lack of a pedogenic level points to the influence of an increasingly continental climate or the shift of the paleochannel. This zone coincides with the period ranging from the appearance of oak to the appearance of beech (11. 6-9.2 ka cal BP). As a result of climate improvement and growing precipitation a floating mat marshland emerged. Societal upheaval around the peatland strongly changed the microenvironment and vegetation of the peatland surface from the Bronze Age onwards resulting in increasing erosion rates and decreasing arboreal vegetation. Erosion peaked near the Late Migration Age within Hungarian conquest, after which much of the peatland was transformed into sedge peat. According to environmental historical and climatic data, we aimed to reconstruct the expected environmental changes of forested areas in the Western part of the Carpathian Basin.

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The database of antique (Greek and Roman) archaeological sites of the Republic of Croatia

The project *The database of antique archaeological sites of the Republic of Croatia* of the Institute of Archaeology (BAZA) has been online since 24th May 2018 when it was set on the web site of the Institute (http://baza.iarh.hr/public/locality/map). As a source of data the available literature is used together with knowledge gathered from the Institute's scientific activities and data stored in the archives of the Institute of Archaeology. The aim of the project is creating a database of Greek and Roman archaeological sites as the foundation for science, culture, preservation of Croatian heritage, as well as the presentation of cultural tourism. BAZA is based on archaeological sites in Croatia that are either known from the literature or by field research, with the aim of creating tools that provide easier access to the data needed for future scientific research, heritage management and the creation of professional and scientific projects that fundamentally represent archaeological heritage. The database is enriched with information about archaeological sites that are attractive enough to become a tourist destination.

The 2nd meeting of the International Focus Group on Northeastern African Quaternary Stratigraphy (NAQS) acting in the frames of INQUA Commission on Stratigraphy and Chronology (INQUA–SACCOM)






Zagreb, 24th October 2018

ABSTRACTS

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New formal stratigraphic subdivision of the Holocene

A formal subdivision of geological stratigraphical units is conducted by the International Commission on Stratigraphy (ICS) which is the largest and oldest constituent scientific body in the International Union of Geological Sciences (IUGS). Its primary objective is to precisely define global units (systems, series, and stages) of the International Chronostratigraphic Chart that, in turn, are the basis for the units (periods, epochs, and age) of the International Geologic Time Scale; thus setting global standards for the fundamental scale for expressing the history of the Earth. The most important in stratigraphy are geochronological ages that correspond to chronostratigraphic stages (concerning rocks of specified age). These stratigraphical units are defined by setting of their lower boundaries in Geological Stratotype Sections and Points (GSSP) that are global reference outcrops or boreholes (http://www.stratigraphy.org/).

Proposals for the first formal geological subdivision of the Holocene Series/Epoch are the result of over a decade of labour by members of the joint Working Group of the Subcommission on Quaternary Stratigraphy (a subcommission of ICS) and INTIMATE (Integration of Ice-core, Marine and Terrestrial Records) Members International, led by Professor Mike Walker (University of Wales, UK). The proposed subdivision of the Holocene has been ratified unanimously by IUGS. The new formal subdivision of the Holocene Series/Epoch into three stages/ages and their corresponding subseries/subepochs is defined as follows:

1. **Greenlandian** Stage/Age = Lower/Early Holocene Subseries/Subepoch
   Boundary Stratotype (GSSP): NorthGRIP2 ice core in Greenland (coincident with the Holocene Series/Epoch GSSP, ratified 2008); age: 11,700 yr b2k (before AD 2000).
2. **Northgrippian** Stage/Age = Middle/Mid-Holocene Subseries/Subepoch
   Boundary Stratotype (GSSP): NorthGRIP1 ice core in Greenland, Global Auxiliary Stratotype: Gruta do Padre Cave speleothem in Brazil; age: 8326 yr b2k.
3. **Meghalayan** Stage/Age = Upper/Late Holocene Subseries/Subepoch
   Boundary stratotype (GSSP): Mawmluh Cave speleothem at Meghalaya in India, Global Auxiliary Stratotype in the Mount Logan ice core in Canada; age: 4250 yr b2k.

These divisions are defined by GSSPs which means that they are fixed in time in sedimentary sequences. The terms Greenlandian Stage/Age, Northgrippian Stage/Age, Meghalayan Stage/Age, Lower/Early Holocene Subseries/Subepoch, Middle/Mid-Holocene Subseries/Subepoch and Late/Upper Holocene Subseries/Subepoch therefore have formal definitions and boundaries. A formal publication of the justifications and definitions of each of the divisions will follow soon.

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1.5 ka Bond event and its significance for geoarchaeology of the east Adriatic coast

So-called Bond events are North Atlantic ice rafting episodes that are tentatively linked to climate fluctuations in the Holocene. Eight such events have been identified so far. Bond events were previously believed to exhibit a quasi c. 1,500-year cycle, but the primary period of variability is now put at c. 1,000 year.

The fifth cold event, which occurred between 300 and 600 AD, is also known as Dark Age or Migration Period Cooling. This climatic event marked the transition from Late Antiquity to the Early Middle Ages, and most probably initiated a strong human migration between the years 300 and 700 AD in Europe. Most paleoclimatic data shows a clear cold peak around 400 AD, and the number of low temperature anomalies of all six cold events was observed during this period in the European area. In this time rather warm conditions existed in Africa. The frequencies of the glacier advances increased remarkably in Alps. At that time solar activity noted a negative peak. It is a paradox that despite the large number of historical and archaeological sources, the period of decline of the Roman Empire and advent of the Migration Period is very little known from the point of view of the environmental and climatic changes, which without a doubt, had a huge impact on the cultural and political changes taking place at the time - often described as societal collapse of the Old Word.

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Climate change, environmental history and Human impact during the Late Holocene inferred from diatom analysis of the Qarun Lake, Faiyoum Oasis, Egypt

A detailed diatom study of four cores obtained from Qarun Lake at the north of Faiyum Oasis was achieved to reconstruct the environmental history and human impacts during the late Holocene. Diatom analysis of the studied cores sediments revealed marked changes in lake water levels and a series of fluctuations between fresh and brackish episodes. The distribution pattern of the recognized diatom assemblages and multivariate statistical analyses distinguished fourteen diatom ecological groups, which reflect the environmental history of the lake that mainly related to climatic changes and anthropogenic effects during the late Holocene. The results signify that the late Holocene hydrological system of the Faiyum Oasis was active, variable and mainly affected by human activities through different civilizations from the New Kingdom to the present. The diatom record revealed five phases of lake development, which were represented by oscillations between relatively deep freshwater lake during humid-wet periods, and shallow brackish water conditions that prevailed in warm-arid episodes. Abrupt change in the Qarun Lake has occurred during the last century, since the lake has changed from highly brackish water to saline, which was characteristic for the last phase of lake evolution. The salt build-up in the lake is indicated by increasing abundance of mesohalobous and polyhalobous diatom taxa, which indicate a significant rise in salinity of the lake due to a great reduction of fresh water from adjacent areas, as well as an increased evaporation process due to a warm dry climate. Increasing pollution and eutrophication of the Qarun Lake waters was recorded in the last phase of the lake development. Rising salinity and high nutrient loading due to human activities has allowed for the growth of the diatom community of the marine affinity in recent times.

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Environmental conditions in late Antiquty in the Faiyum Oasis (Egypt) based on the Lake Qarun sediment studies and geoarchaeological research

The Faiyum Oasis in Egypt is located to the west of the Nile Valley and about 100 km to the southwest of Cairo. The oasis is separated from the Nile Valley by a wide discontinuous ridge, but in the Holocene it was connected with the Nile through a passage, occupied at present by the Bahr Yousef and Hawara Canal that supplied with freshwater, especially during flood seasons. A drilling FA-1 in the northern part of the oasis and located at the southern shore of the Qarun Lake in 2014 supplied with a core, 26 m long, that is a continuous high-resolution record of environmental and climate changes through the Holocene. The core was subjected to a multiproxy analysis that enabled to establish an age model for the environmental transformation of the lake (Marks et al., 2018). A fragment of the core (depth 4.0 – 3.4 m) dated at 1.5 – 1.2 cal ka BP (500 – 800 AD) represents the late Antiquity record of the lake sedimentary environment during the so-called Birket Qarun Phase. It is expressed by deposition of beach loose shell sediment mixed with grey sludge silt and enclosed gastropod and ostracod assemblages indicate a drop in lake level and salinity of 14–25‰, with carbonate bicarbonate rich water, seemingly due to farming and changes in water supply from the Nile. This phase is a termination of the so-called Birket Qarun Phase of the lake, expressed by significant transformation of its sedimentary environment due to intensive input of mineral material, caused by scarce vegetation cover. Enhanced salinization of the lake indicates that freshwater supply of the oasis was drastically restricted, presumably both by lower seasonal floods in the Nile Valley and by limited restoration of the man-made water canal, dug primarily at about 2.3 cal ka BP (300 BC).

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