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27th EAA Annual Meeting (Kiel Virtual, 2021)

ABSTRACT BOOK

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144 THE EVER CHANGING COAST: INTERACTIONS OF PEOPLE, LANDSCAPES AND ENVIRONMENT ALONG EUROPE'S SEAS IN HIGH-RESOLUTION

Theme: 1. Widening horizons through human-environment interconnections

Organisers: Kristiansen, Søren (Department of Geoscience, Aarhus University; Center of Urban Network Evolution - UrbNet, Aarhus University) - Stamness, Arne (Norwegian University of Science and Technology The NTNU University Museum Department of Archaeology and Cultural History) - Verhegge, Jeroen (Department of Archaeology, Ghent University)

Format: Regular session

Our ability to understand human development along the coastlines of Europe is dramatically improving, both above and below the present sea level. Recent advances are based on improved understanding of past climate change, extreme events, biosphere interactions, and include precise records of sea-level variation since the last glacial period. These fast-developing records of key components of the Earth system have huge potential for improving our understanding of gradual changes, abrupt shifts and resilience in coastal societies from local to continental scales.

In this session, we invite contributions focusing on human-environment interactions along the changing shores of Europe's seas and lakes. Archaeological periods can range from Paleolithic to Modern, while scales can range from single site investigations to regional and continent-wide studies. Both marine-based and on-shore studies are welcomed.

Of particular interest are studies of coastal landscapes and archaeology using one or a combination of methods to investigate the human-environment interconnections. Examples are high-definition dating (radiocarbon, optically stimulated luminescence (OSL), geo-archaeology (coring, soil science, sedimentology), archaeological databases, geophysical mapping both on-shore and off shore (seismic, GPR, magnetic and electrical methods), and upscaling these using paleo-landscape modelling and remote sensing (lidar, aerial photography, optical and radar satellite data) approaches. Invited archaeological investigations can be both above and below the present sea level as long as they provide new knowledge of relevance for both the environment and humans living along the ever changing coasts of Europe.

ABSTRACTS:

1 LINDISFARNE LANDSCAPES: GEOARCHAEOLOGICAL APPROACHES TO HUMAN-ENVIRONMENT INTERACTIONS ON HOLY ISLAND (NORTHUMBERLAND, UNITED KINGDOM)

Abstract author(s): Kahlenberg, Raphael - Andrieux, Eric - Bailiff, Ian (Department of Archaeology, Durham University) - Lloyd, Jeremy (Department of Geography, Durham University) - Shillito, Lisa-Marie (School of History, Classics and Archaeology, Newcastle University) - Milek, Karen (Department of Archaeology, Durham University)

Abstract format: Oral

The Holy Island of Lindisfarne is a small tidal island in North-East England and is well-known as the scene of one of the first Viking raids on the British Isles in 793 AD. It had an eventful history, both in terms of cultural changes and landscape evolution. During the periods that are best attested in the archaeological and historical records, from the Anglo-Saxon period (5th to 11th centuries AD) onwards, it has seen phases of high religious and economic importance but also temporary abandonment. At the same time, profound changes in vegetation, land use and dune formation took place. While these developments are well-studied in the north of Lindisfarne around the Anglo-Saxon Period settlement of Green Shiel, little paleoenvironmental data is available for the rest of the island, including the parts immediately adjacent to the presumed location of the early medieval priory, the village and the castle.

This paper presents the first results of an interdisciplinary study combining geophysical prospection (electrical resistivity tomography and ground-penetrating radar), coring and multi-proxy analysis of palaeosols and sediments, including phytolith and foraminifera analyses. It is likely that medieval soils are preserved at various locations across the island, sealed by layers of aeolian sand which accumulated during the Little Ice Age (16th-19th centuries AD) and reach a thickness of up to 40 cm. Peaty deposits below these palaeosols suggest a transition from a wetland environment to drier conditions. This observation raises the question of whether parts of coastal wetlands on Lindisfarne have been actively reclaimed under monastic control in (early) medieval times. If this dating and the anthropogenic character of the processes can be confirmed, our study will shed new light on how Lindisfarne's landscapes have been used, transformed and perceived while the island was home to one of England's most influential monasteries.

2 LUMPS AND BUMPS! RECONSTRUCTING A BURIED LANDSCAPE USING LEGACY DATA AT TRONDHEIM, NORWAY

Abstract author(s): Cadamarteri, Julian (NIKU - Norwegian Institute for Cultural Heritage Research)

Abstract format: Oral

The medieval city of Trondheim, Norway is situated on a river bend promontory in the delta estuary of the river Nid in the middle of Norway. The river and the promontory created an ideal harbour in the Viking and medieval era. Situated in a river delta means that the landscape is shaped by the river, erosion and landslides in the river valley as well as the sea and isostatic sea level change. The medieval city centre is today a seemingly flat level area, today's topography reflects 1000 years of levelling and infilling masking the natural landscape underlying the urban area. Since the early 70s data on the height of the natural subsoil have been regularly

documented in connection with archaeological excavations in the city centre. Leading to a database of over 1500 measurements. Converting the data to xyz coordinates makes it possible to build a GIS terrain model of the delta landscape through interpolation. The natural landscape lies underneath up to 5 m of cultural layers and the terrain model makes it possible to understand the original landscape which the earliest human occupation took place in and the landscape the city was founded in during the viking age. The model also enables a new understanding of medieval use of the promontory and the medieval town plan in relation to the landscape, hydrology and vegetation. The model shows that the human occupation up through the iron and medieval age adapted to the landscape in a greater degree than earlier appreciated.

3 LARGE-SCALE POST-BATTLE TREATMENT OF DEAD IRON AGE WARRIORS IN DENMARK: COASTAL, SETTLE AND LAND-USE CHANGES

Abstract author(s): Hertz, Ejvind (Museum Skanderborg) - Munch Kristiansen, Søren (Geoscience, Aarhus University)

Abstract format: Oral

Coasts along the sea have always attracted people but also the coasts of lakes have been attractive. Just after the birth of Christ a large scale battle took place in East Jutland, Denmark after which thousands of human bones was deposited along the coast of a small lake, present-day Alken Enge, next to larger Lake Mossø as evidence the post war aftermath. Here a sandy coastal spit system evolved in the centuries before the birth of Christ and was around the bone sacrifice at the first half of the first century AD a very prominent in-land shallow, calm water with sandy beaches cut by a small stream with deeper water. These special landscape elements are probably the reason why the sacrifice was performed right here in Alken Enge.

The traces on-site are especially indicators to new rituals of sacrifice of minimum 380 individuals, while as example, pollen studied indicates that the post-battle land-use rapidly transformed from grazing and farming into forest after the deposition of the dead warriors. In a regional perspective, conflict related sacrifices continue from 200 to 450 AD in another small lake upstream in the Illerup valley, now with a focus on the weapons and warrior's personal equipment. These rich weapon sacrifices in the small lake, with no clear evidence of white beaches, have their example in the way the Romans treated equipment from conquered armies, but with a special variant with sacrifices in lakes in Southern Scandinavia. Throughout an approximately 500-years period following the sacrifice at Alken Enge the Illerup Valley have in the local communities collective memory hence been perceived as a "Sacred Valley" to which was brought large and significant sacrifice to the gods while, at the same time, the land-use was intensified and the near settlement structure seems to disappear.

4 NIDA COASTAL SITE IN AEOLIAN ENVIRONMENT. NEW RADIOCARBON AND ANTHRACOLOGICAL DATA FOR CHRONOLOGICAL REINTERPRETATION AND ENVIRONMENTAL RECONSTRUCTION

Abstract author(s): Pilkauskas, Mindaugas (Lithuanian Institute of History) - Peseckas, Kęstutis (Nature Research Center)

Abstract format: Oral

Investigations at Nida Stone Age settlement on southwestern coast of the Baltic Sea counts almost two centuries. During this long research period the knowledge about the site changed with new data available. Extensive radiocarbon dating indicates that it has been inhabited during the period of 3500 – 2500 cal BC. This period can be divided into Subneolithic and Neolithic epochs, represented by shell tempered and mineral/grog tempered pottery respectively. The site is situated at the Curonian Spit a narrow peninsula (0.5 – 5 km width) which separates Baltic Sea from the Curonian Lagoon and is composed mainly from aeolian sand. Currently, Nida Stone Age site is further away from the sea or lagoon shores, but the latest research which included intensive boring, GPR profiling and stratigraphy analysis lets us to draw a conclusion that during Subneolithic and Neolithic the site was on the shore of Curonian Lagoon.

Excavations were renewed in 2020. Aims of the latest research at the site were firstly to gather samples from stratified layers for age modelling and secondly to collect direct data on site paleoecology. A large collection of wood charcoals was obtained by hand-picking during excavations and from soil samples using flotation method. Anthracological analysis was carried out to determine the best samples for radiocarbon dating and to reconstruct past woodland composition.

The results from the latest research lets us cautiously reinterpret the previous notions of chronology and environment. New radiocarbon dates indicate different chronological view and together with freshwater reservoir age correction narrows down the Neolithic period of Nida settlement and distinguishes it from Subneolithic. Analysis of charcoals from cultural layer indicates different environment than previously thought with higher than expected percentage (>50 %) of deciduous broad-leaf trees (Quercus, Alnus, Acer, Corylus).

5 INVESTIGATING HUMAN-ENVIRONMENT INTERACTIONS USING ARCHAEOLOGICAL SHELL PROXIES: THE CASE OF THE FRANCHTHI CAVE AND ITS SUBMERGED NEOLITHIC SETTLEMENT

Abstract author(s): Theodoraki, Danaï (Römisch Germanisches Zentralmuseum - RGZM)

Abstract format: Oral

The molluscan record can provide significant evidence on prehistoric human-environment interactions, as the coastal foraging and early farming communities were closely connected with the immediate marine environment. Broad-scale paleoenvironmental and climate proxies have been widely used when addressing the subject of the liminal phase of the late Mesolithic towards the Early

Neolithic period. However, the shell record is able to contribute valuable site-specific evidence when employed as a paleoclimatic and seasonality proxy in order to investigate long-term trends and extreme short-term paleoclimatic events. This presentation is part of a PhD project that intends to examine the ways in which the inhabitants of prehistoric coastal sites in the Mediterranean that bear witness to this transition, such as the site of Franchthi in the Argolid in Greece, were affected by fluctuations in the local paleoenvironmental conditions and sea-level change in terms of subsistence and social practices using the archaeological shell record and inherent high-resolution paleoenvironmental datasets. Thus, environmental variability of the Mesolithic/Neolithic interface will be employed to illuminate important aspects of the coastal communities, while considering different scales of spatial and temporal analysis. Overall, the environmental proxy data of this on-going study have the potential of providing important information on the submerged agricultural landscape of the site.

6 THE MARINE PREHISTORY SAMPLER (MPS), SEARCHING FLINTS IN MOST UNREACHABLE AREA'S

Abstract author(s): Muller, Axel - Waldus, Wouter (ADC archeoprojecten) - Smit, Bjørn (Cultural Heritage Agency)

Abstract format: Oral

Collecting data about prehistoric occupation from submerged landscapes is common practice in Dutch archaeology. Especially in the west of the country, there are many examples of surveys in drowned landscapes, in areas that are reclaimed (polders). The last decennia, progress has been made in methods and practices for detecting late Pleistocene and early Holocene sites.

Fieldwork in areas that are still open water is very rare. But recent sand and gravel extraction and a commission from the Cultural heritage Agency of the Netherlands gave an opportunity to search for solutions or to improve existing methods and practices. In recent years there have been archaeological surveys of submerged landscapes in one of the large lakes of central Netherlands (Markermeer). In collaboration with important stakeholders, like the Cultural Heritage Agency of the Netherlands, a new sampling technic was developed for sampling areas of a submerged landscapes underwater. Due to this project progression was made in the practical challenge of collecting artefacts from a difficult to reach place (underwater submerged and covered prehistoric landscape), but also in the process of assessment and evaluation of survey data to get a better view of occupation and land use in submerged landscapes. Combined geoarchaeological research and newly developed large sampling methods results in mapping Mesolithic sites in, until recently, unreachable places.

In this presentation we want to show how the MPS was used to detect Mesolithic sites and discuss possibilities and limitations for use in other environments.

7 WASHED AWAY – THE IMPACT OF STORMS DURING THE LATE LITTORINA TRANSGRESSION PHASE ON PALAEO TOPOGRAPHY AND ARCHAEOLOGICAL SITES

Abstract author(s): Enzmann, Jonas (Lower Saxony Insitute for Historical Coastal Research)

Abstract format: Oral

It is known that storms could have a massive impact on the formation of coastal landscapes. Nevertheless, their remains are not often discussed in the archaeological community so far. Most sites from the Mesolithic period that are described well, show more or less undisturbed or fluvial influenced waste-layers in ancient shallow waters. At the site Strande LA 163 in the Baltic Sea near Kiel, Northern Germany the opportunity arose to study how archaeological material and palaeotopography is impacted by heavy storms. The site was discovered in 2011 nowadays at 6 m water-depth around 1 km in front of the modern coast. A first excavation campaign in 2012 and a survey in 2014 on the site dating to the aceramic phase of the Ertebølle-Culture had very promising results, which led to the current project. Under the title: „Subsistence strategies, settlement structure and communication during the terminal Mesolithic exemplified by a submarine micro-region in the Bay of Kiel” the German Research Foundation (DFG) granted a three years project to the Lower Saxony Institute for Historical Coastal Research (NIhK).

In four diving campaigns excavation, coring and geophysical data could be obtained and merged through a special measurement system that delivered a rarely achieved precision in underwater archaeology. On that basis C-14 dating, pollen analysis, find compositions and the progression of layers through different datasets could be discussed in detail. In the end it was possible to describe a site formation process in which sediments and finds from around 5300-5000 BCE were deposited in a depression around 5000-4800 BCE. Most likely a second eroded settlement phase after the storm event could be verified by few finds in the modern-day sand layer.

8 MAPPING THE CHANGING COASTLINE OF THE SWEDISH VIKING AGE SITE OF BIRKA THROUGH HIGH-RESOLUTION ARCHAEOLOGICAL PROSPECTION

Abstract author(s): Trinks, Immo (Vienna Institute for Archaeological Science, University of Vienna; Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna) - Wallner, Mario (Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna) - Nau, Erich (Norsk institutt for kulturminneforskning, Oslo) - Löcker, Klaus (Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna; Zentralanstalt für Meteorologie und Geodynamik, Vienna) - Doneus, Michael (Department of Prehistory and Historical Archaeology, University of Vienna; Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna) - Gabler, Manuel (Norsk institutt for kulturminneforskning, Oslo) - Hinterleitner, Alois (Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna; Zentralanstalt für Meteorologie und Geodynamik, Vienna) - Verhoeven, Geert - Klimczyk-Lugmayr, Agata (Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna) - Neubauer, Wolfgang (Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, Vienna; Vienna Institute for Archaeological Science, University of Vienna)

Abstract format: Oral

Background and Aim:

The UNESCO World Heritage Site Birka and Hovgården is located on the neighbouring islands of Björkö and Adelsö in Lake Mälaren, Sweden. Due to post-glacial rebound, the land has risen by up to six metres over the past 1,200 years, causing substantial changes to the coastline. A comprehensive archaeological prospection case study aims to explore the site to reveal buried settlement remains and Viking Age burials in unprecedented imaging resolution, while at the same time testing and advancing archaeological prospection techniques.

Material and Methods:

Remote sensing in form of aerial photography and airborne laser scanning as well as ground based non-invasive near-surface geophysical prospection methods have been adapted and utilised to collect extensive high-resolution datasets for archaeological prospection. A dedicated LiDAR survey was flown using a Riegl LMS-Q680i full-waveform laser scanner mounted in a Cessna 182 light airplane. The scanner acquired in average 12 points per square metre with up to 20mm ranging accuracy. Efficient motorised, ground-penetrating radar measurements were conducted with a motorised 16-channel 400 MHz MALÅ Imaging Radar Array on the ground. The collected datasets were integrated and analysed in a GIS using a specially developed toolbox.

Results:

A highly detailed digital terrain model has been generated from the LiDAR data after removal of vegetation and modern constructions using the SCOP++ software package (TU Wien). Topographically corrected georadar depth-slices have been computed to map and image the subsurface in-depth. The post-glacial uplift of the land has been reconstructed using both the digital terrain model as well as the subsurface information derived from georadar measurements.

Conclusions:

The large-scale archaeological prospection approach revealed not only numerous buried archaeological remains and permitted the mapping of the topography of the World Heritage Site in unprecedented resolution, but provided detailed information on the changing shoreline and corresponding human-environment interactions.

9 DETECTION, VISUALIZATION AND ANALYSIS OF PALAEO-BEACHES FOR HIGH-RESOLUTION CHRONOLOGICAL AND SPATIAL ARCHAEOLOGICAL INVESTIGATIONS – GEOPHYSICAL CASE STUDIES FROM NORWAY

Abstract author(s): Stamnes, Arne (NTNU University Museum, Department of Archaeology and Cultural History) - Kristiansen, Søren (Department of Geoscience, Aarhus University)

Abstract format: Oral

A combined landscape- and geoarchaeological approach has great potential for illuminating the interaction between land-water divides and for landscape reconstruction. Such “landscape gradients” where elements meet were often preferred locations for settlement and human activity globally. In addition to the archaeological information, large scale, high-resolution geophysical surveys have tremendous potential as a source of paleoenvironmental information by detecting former beach ridges, palaeochannel systems, palaeotopography and geomorphological processes, as well as providing information on relative chronology of archaeological observations and landscape changes.

The study of beach ridges, in particular, has the potential to provide additional information on relative landscape chronology and be used to create new relative sea-level curves, but often relies on singular ground-penetrating radar (GPR) sections and or visible beach ridges, sometimes detected by Lidar-analysis. Large scale, high-resolution geophysical survey examples demonstrate how a much more detailed impression of the temporal landscape development is achievable. Such high-resolution in 3D from the combined surface and subsurface investigations have to a large degree not been utilised for paleoenvironmental and -landscape mapping, as the survey parameters are often targeted to much larger scale but at a considerably lower resolution. A GPR approach, combined with terrain models derived from Lidar-data, provides new information on landscape developments. Therefore, it is applicable to study sites from all archaeological time periods and may be especially useful for lake and sea coastal areas next to or below the ice shields of the Last Ice Age.

This paper present examples from several archaeological coastal sites from Norway that demonstrate the archaeological possibilities and technical feasibilities of a high resolution and detailed view of the relative changes in sea level by revealing sub-surface paleo-landforms. This combined information can form the foundation for an integrative high-definition, multi-scalar understanding of human-landscape interactions, resilience-studies and large-scale settlement studies.

10 DESTROYED IN 1362 AND CONSERVED UNDER SEDIMENTS: INTERDISCIPLINARY INVESTIGATION OF SUNKEN MEDIEVAL SETTLEMENTS IN THE WADDEN SEA (NORTH FRISIA, GERMANY)

Abstract author(s): Majchczack, Bente (Christian-Albrechts-Universität zu Kiel; ROOTS Cluster of Excellence) - Blankenfeldt, Ruth (Zentrum für Baltische und Skandinavische Archäologie) - Hadler, Hanna (Johannes-Gutenberg-Universität Mainz) - Kloöß, Stefanie (Archäologisches Landesamt Schleswig-Holstein) - Wilken, Dennis (Christian-Albrechts-Universität zu Kiel)

Abstract format: Oral

The tidal flats, marsh islands and sand barriers of the southern Wadden Sea area of North Frisia (Germany) cover the extended remains of a sunken cultural landscape. From the Early Medieval Period on, settlers have occupied a natural landscape of marshes, river embankments and fenlands. With rising sea-levels and recurrent floodings, a systematic reclamation and cultivation, alongside with construction of extensive coastal protection measures set it from the 12th century and led to a fundamental transformation into a cultural landscape. Large-scale peat quarrying and drainage led to subsidence of the ground-level in many areas, creating an additional vulnerability of settlements and farmland towards flooding. This led to a pattern of destruction and land-losses through major storm surges, notably the extremely destructive flood of 1362, countered by adaptations like reclamation or abandonment. While past research largely depended on random finds, uncovered by tidal erosion, we approach the area with a combined geoarchaeological, geophysical and archaeological methodology to produce a high-resolution reconstruction of the landscape dynamic, the Medieval settlement patterns and land-use in an area, which is difficult to access with traditional methods. Areas with visible remains are mapped with drone photography and surveyed with metal-detecting. Magnetic gradiometry provides a detailed mapping of settlement structures beneath the present tidal flats, marine reflection seismics is added to characterize the underground structures. Vibracoring and geochemical sediment analysis is used for validation of structures and reconstruction of the palaeoland-scape. An integrated GIS-database is used to bundle the results to create a comprehensive visualization of the Medieval settlement landscape. The presentation brings forward the used methodology along with exemplary prospection results from the medieval town of Rungholt, drowned in 1362.

11 NURAGIC NAVIGATION AND LANDING POINTS: THE COAST OF TERTENIA (CENTRAL EASTERN SARDINIA)

Abstract author(s): Lopez, Giuseppa (freelance archaeologist)

Abstract format: Oral

This contribution is the result of the underwater and terrestrial archaeological prospections conducted along the coast of Tertenia (central eastern Sardinia), in the locality named "San Giovanni di Sarrala".

This site is marked by a historical anthropization. Its coastal landscape has geomorphological and hydrographic characteristics that make it an area of historical and archaeological importance in connection with the sea routes and in particular due to the landing points.

The availability of landing points needs to be referred to the ancient coastal geomorphology, to the technical characteristics of the boats, and to the navigation techniques widespread in the western Mediterranean during the Nuragic time (Bronze Age). This can be achieved through a comparison with the data coming from contemporary wrecks belonging to other civilizations with which the Nuragic one had intense relationships.

This contribution therefore aims to provide new knowledge based on archaeological data resulting from targeted prospections combined with evidence coming from geomorphological and paleo-environmental studies and considering man-environment interactions, particularly how man used the environment and adapted to it.

12 THE EVER CHANGING OLÉRON (FRANCE): A CHALLENGING PUZZLE FOR COASTAL ARCHAEOLOGISTS

Abstract author(s): Save, Sabrina (Amélie SARL) - Soler, Ludovic (Service archéologique départemental de Charente-Maritime; UMR 6566 PACEA) - Gandois, Henri (UMR 8215 Trajectoires; UMR 6566 CReAAH)

Abstract format: Oral

Invaded every summer by tourists, Oléron island, on the French Atlantic coast, is the biggest French island (174 km²) after Corsica. Its physiognomy is in perpetual evolution, with today's Oléron totally different from the Prehistoric one due to rising sea levels, the infilling of its multiple coastal lagoons, the creation of big sand dunes, recent urban development and the exploitation of its salt marshes. Some Prehistoric sites are now exposed on the intertidal zone, while others are stranded in the middle of the island whereas they once had direct ocean access. Trying to understand the human implantation strategy on Oléron disconnected from the island's geographic history results in non-sense.

Intertidal excavations, pedestrian and geophysical surveys, as well as palaeo-environmental coring in the coastal salt marshes are leading to first integrated archaeological and palaeo-environmental reconstructions of the island. Coastal lagoons on the western

coast started infilling around 4900 BP, with the development of peat bogs. Around 3200 BP some erosion processes, likely caused by storms, took place and the bogs became sealed from the ocean by the creation of sand dunes. On the eastern coast, new investigations revealed the coastal lagoons were deeper and never developed peat; they remained open water until sealed from the ocean, probably following the creation of sand dunes at a yet undetermined date, transforming the lagoons into salt marshes later exploited by humans. Nevertheless, some coastal areas remain inaccessible to our investigations. While sand dunes protect the archaeology by sealing it under meters of sand, they are also an obstacle to the detection of archaeological sites, engulfing Medieval villages and Prehistoric megaliths alike. We hope in the near future that new geophysical methods will allow us to detect these sand-submerged archaeological sites allowing us to complete our comprehension of human implantation on the coasts.

13 ENVIRONMENT AND SETTLEMENT IN A LONG TERM PERSPECTIVE: VIK, ØRLAND, CENTRAL NORWAY 600 BC – AD 1250

Abstract author(s): Ystgaard, Ingrid (NTNU University Museum; Department of Historic and Classical Studies, NTNU) - Gran, Magnar (NTNU University Museum)

Abstract format: Oral

Postglacial land upheaval combined with the flat landscape profile of the Ørland peninsula, central Norway, have led to profound transformations of the landscape ever since the peninsula rose from the sea c. 600+/-100 BC. An aim of a large-scale excavation project at Vik in 2015 and 2016 was to gain a coherent understanding of the relationship between landscape development, vegetation history, climatic change and settlement at Vik, Ørland, from the Late Bronze Age to the early medieval period. A generalized interpretation of geological, archaeological and botanical data from Vik suggests periods of intensive settlement and agriculture in the Pre-Roman Iron Age and Roman Iron Age, while the Migration Period was a period of decline. Settlement and agriculture nearly disappeared in Vik during the Merovingian and Early Viking periods, coinciding with re-vegetation of the landscape after the global climatic catastrophe of AD 536. A sheltered bay formed a safe harbor during the period from c. 400 BC to c. AD 600, when the bay eventually dried out and left the settlement at Vik in a less strategic position. Vik was re-settled very late, not before c. AD 950, possibly because of the extinction of the harbor. In this paper, land upheaval, vegetation history and settlement development at Vik are combined in a chronological scheme of ten phases.

14 EUROPE'S COASTS IN HIGH-DEFINITION BY CROSS-BORDER RESIDUAL RELIEF MODELING: THE NORTH SEA AND THE BALTIC SEA AS EXAMPLES

Abstract author(s): Kristiansen, Søren (Department of Geoscience, Aarhus University; Center of Urban Network Evolution - Ur-bNet, Aarhus University) - Stott, David (Moesgaard Museum, Højbjerg) - Maring, Peter (School of Culture and Society, Aarhus University)

Abstract format: Oral

Glacio-isostatic influences on past coastline dynamics and consequences for prehistoric societies have been studied for decades. Remote sensing is increasingly an essential tool for those attempting to identify and characterize features on the surface of Earth. In particular, the rapidly growing spatial coverage of Airborne Laser Scanning (lidar) data has enabled archaeologists to find many hitherto unidentified features. This is often focused on single sites or at local scale as data are difficult to handle. However, in coastal setting lidar data are particularly useful as they all allow to examine research questions across regional and national borders.

Here, we show the first examples of the archaeological possibilities of a cross-border, newly developed GIS layer where morphologies are mapped by residual relief modelling and detected on a large scale by looking for both landscape and archaeological features. This first example covers large parts of Northern Europe, namely Belgium, Denmark, Estonia, Finland, Germany (Brandenburg), Holland, Lithuania, Poland, Norway, and Sweden.

We will exemplify the usability of a combined residual relief modelling approach by focusing on a few famous archaeological sites, to highlight what new can be learned at local scales, and will also demonstrate how it works at the borders of national datasets, where cross-border archaeological comparisons have hitherto been difficult.

15 MAPPING PALAEO-SHORELINE IN THE PREHISTORY OF THE IBERIAN PENINSULA FOR THE ANALYSIS OF SETTLEMENT PATTERNS

Abstract author(s): Mejías-García, Juan Carlos - Fraile-Jurado, Pablo (University of Seville)

Abstract format: Oral

Due to the climatic conditions of the last Quaternary ice age, it has been recorded that sea level stayed some tens below current sea level in the period between 120,000 BP and 6,000 BP, reaching its minimum value of about -130 meters approximately 18,000 years ago, during the Glacial Maximum.

This drop in sea level and its subsequent rise to recover the current levels, did not occur linearly, taking place numerous periods of changes not only in the rhythm but also in the trend.

An algorithm that allows the calculation of the time that the currently submerged lands remained, emerged during that period, was designed in order to implement it in the coasts of the Iberian Peninsula. It also provides the determination of which palaeo-shoreline would correspond to any specific date within the study period.

From our radiocarbon dating database (integrated in the SIAC project - <http://arqgeogis.us.es/dataciones/>), with more than 10,500 records, have been taken chronological data, georeferenced location and functional typology of the prehistoric sites found within of the range of distance that facilitates access to marine resources.

This approach has allowed to determine the true and precise position and distance to the marine environment from prehistoric sites linked to the sea and exploitation of marine resources, establishing a first analysis of the distribution and relationship of dating sites from peninsular prehistory with respect to its corresponding palaeo-shoreline.

16 CHANGING MINDS, CHANGING COASTS

Abstract author(s): Hutchinson, Oliver - Newman, Danielle - Northall, Lawrence (CITIZAN / MOLA)

Abstract format: Oral

Changing Minds, Changing Coast is a community led pilot study mapping 100 years of coastal change as evidenced by the memories and photographs of the residents of Mersea Island, Essex. Funded by the National Environment Research Council (NERC) and developed by CITIZAN (The Coastal and Intertidal Zone Archaeological Network), the project aims to co-create a visual and aural history of the islands changing coastline using data gathered from the community under COVID secure conditions. A network of local contacts within the Mersea community provided over 300 images and documents from their personal archives. These were supplemented by a series of eight oral history recordings recounting the presence of archaeological features, topography and structure of the foreshore sediments, and the presence and absence of plant and marine life at two locations on the island. These indicators were used to interrogate the image data and investigate, amongst others, the scale and speed of coastal erosion, habitat loss and threats to coastal heritage around the island. Using this data set, covering a century on the island, the CITIZAN team cross-referenced and mapped the myriad changes in 20-year intervals from 1920 to 2020 to create a timeline of change. The combination of oral histories and personal archives brought a unique dimension to the study, shedding light on a range of issues to help better understand the human-environment interactions on the island. The project provides a model for archaeologists to work remotely with communities to document the impacts on coastal archaeology wrought by gradual changes and abrupt shifts in coastal morphology, whilst highlighting the resilience of coastal communities to their changing environment. It was achieved within a framework that puts the community at the forefront of creating a dataset valuable to a range of disciplines including archaeologists, geographers, marine biologists, and social historians.

17 ASSESSING THE METHOD OF DATING STONE AGE SITES WITH REFERENCE TO RELATIVE SEA-LEVEL CHANGE IN SOUTH-EASTERN NORWAY

Abstract author(s): Roalkvam, Isak (University of Oslo)

Abstract format: Oral

Reconstructions of the trajectory of relative sea-level change is frequently used to ascribe an approximate date to prehistoric sites and monuments that were situated close to the shoreline during their original use and occupation. The geologist W.C. Brøgger and his son, the archaeologists A.W. Brøgger, noted the close correspondence between Norwegian Stone Age sites and prehistoric shorelines in their respective theses of 1905. Ever since, this fact has been a defining element of Stone Age research in Norway. In south-eastern Norway the isostatic rebound has been more profound than corresponding eustatic sea-level rise, leading to a continuous and relatively rapid regression of the shoreline from as much as 200 m a.s.l down to its present level. Consequently, site activities in the region can be ascribed a fairly precise date-range based on reconstructions of relative sea-level change, provided the sites were in fact located on the shoreline when they were in use. However, despite its importance, there have been surprisingly few rigorous evaluations of the applicability and precision this method. I aim to conduct such an evaluation by investigating the agreement between site dates informed by relative sea-level change and independent dates achieved through radiocarbon dating. The study is based on around 50 sites from an area where we have good knowledge of the trajectory of shoreline displacement.

An assessment of this relationship can have major implications how we approach Stone Age sites where other means of dating are unavailable, and, as a consequence, the temporal framework on which our understanding of the period is based. Furthermore, since the method is only applicable so long as the societies in question have continuously settled on or close to the contemporary shoreline, adherence or deviations from this pattern also has direct implications for the socio-economic foundations of the societies in question.

18 IMPACT OF HOLOCENE COASTAL CHANGES ON PAST HUMAN COMMUNITIES: RESULTS FROM AN INTERDISCIPLINARY APPROACH IN THE GIRONDE ESTUARY MOUTH

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Abstract format: Oral

The current sea level rise induced by climate change may lead to challenges for coastal communities under pressure of intense coastal changes. In North-Médoc, comparable environment variations have been experienced by past human societies. The evi-

dence of human-environment interactions trapped in the Gironde estuary mouth sedimentary archives, can offer comparative systems for the current challenges. Consequently, the diachronic and long-term study of the correlation between human and environmental processes highlights the adjustment and adaptation capacities of coastal populations.

The North-Médoc Peninsula (SW France) is a triangular-shaped coastal area between the Atlantic Ocean and the Gironde estuary. During the last three decades, intense winter storms have uncovered sedimentary deposits containing numerous archaeological remains on the Amélie beach, located on the oceanic side of the North-Médoc. Coastal erosion in this area provides an opportunity to access a whole array of paleoenvironmental and archaeological data for analysis.

Since 2013, through four interdisciplinary projects: LITAQ, FAST-LITAQ, ECOREST and ESTRAN, surveys and analysis have continuously been conducted along the Amélie beach. They combine aerial photography, topography, micropaleontology, radiocarbon dating, sedimentology and archaeology. This interdisciplinary approach has resulted in a high-resolution chronostratigraphic reconstruction of the Amélie beach deposits. Human-environment interactions were analyzed for the past 8 ka years, which correspond to a Holocene sea level slowdown period. Three different scales were considered for this: from the structure to the territory to better constrain paleogeographic changes and settlement patterns. Archaeological and paleoenvironmental results have allowed the characterization of relative sea level variations in the area and the recognition of specific periods of environmental pressures and of human responses from the Neolithic to the Antiquity.

This reconstruction of long-term human-environment interactions makes it possible to sketch the evolution of adaptation strategies of human communities to coastal changes during the Holocene.

19 NATURE VS. NURTURE: THE SUBMERGED PALEO-LANDSCAPES AND LATE NEOLITHIC PILE-DWELLING IN ZAMBRATIJA BAY (CROATIA)

Abstract author(s): Jerbic, Katarina (Flinders University, Adelaide)

Abstract format: Oral

In global climate history, the period after the Last Glacial Maximum is known for a sudden increase in temperature, consequently leading to rapid rise of mean sea-levels which inundated low altitude landscapes worldwide. Sea-level rise significantly influenced the climate as well as the natural organisation of landscapes and human populations of the impacted areas. In the Northern Adriatic region, this influence was additionally amplified by the melting of the Alpine Glacier, whose melted ice was flooding the Northern Adriatic Basin slightly longer than the rest of the Mediterranean. Radiocarbon dated archaeological and paleo-environmental evidence from Zambratija Bay (Northern Adriatic) helped recreate a chronological timeline of local sea-level, environmental and social change since the time when the Alpine ice water was still flooding the landscape, until today. This evidence includes three seabed cores whose sediments heavily imply a change from freshwater, to brackish and to a marine environment in only 2500 years. A dendrochronological sequence derived from eleven wooden architectural elements found in situ revealed that around 4,200 BCE, a pile-dwelling was built there in a brackish environment and existed for at least 63 years. Furthermore, the stratigraphy of the seabed cores indicates that the site was abandoned by the time the environment fully changed to marine. These results revealed a new sociological aspect of the coastal societies in the Prehistoric Alpine Adriatic, indicating that they likely had highly developed subsistence economies and a deep understanding of seasonal activities within the environments they were inhabiting. The environments were changing so rapidly and intensely that the state of constant change must have been an incorporated part of everyday life. This paper shows the connections between the changes in natural and cultural history of Zambratija Bay by presenting evidence of resilience and sustainability of the population that occupied the prehistoric pile-dwelling.

A. INTENSIVE SYSTEMATIC SURVEYS OF PALAEOSPITS IN THE NARVA-LUGA KLINT BAY AREA: ANALYSIS OF METHODOLOGY AND RESULTS

Abstract author(s): Gerasimov, Dmitriy (Peter the Great Museum of Anthropology and Ethnography, Rus.Acad.Sci.) - Kholkina, Margarita (Saint-Petersburg State University; Russian Geological Research Institute - VSEGEI) - Muravev, Roman (Saint-Petersburg State University) - Danilov, Gleb (Peter the Great Museum of Anthropology and Ethnography, Rus.Acad.Sci.) - Kriiska, Aivar (Tartu University) - Nordqvist, Kerkko (Helsinki University)

Abstract format: Poster

In recent decades, palaeogeographical studies in the Narva-Luga Klint Bay area on the Russian-Estonian border have identified several generations of palaeospits, which formed mainly during the Litorina Sea stage (7800–2500 cal. BC).

In the beginning of the 2000s, forest fires destroyed large areas of pinewood on the Russian side of the territory. Forestry authorities cleaned the fire-damaged areas, which were then ploughed for planting new pine trees. The situation caused by the natural disaster presented a unique opportunity for archaeological surveys. During several field seasons, intensive and systematic surveys were fruitfully carried out in the territory of about 200 sq.km, and over fifty new Stone Age archaeological sites (prehistoric settlements and campsites) were discovered. The sites were associated with palaeospit formations and formed clusters.

The presence of large open areas allowed for proper transect surveys in several locations. In 2019, such a survey was conducted on the Galik palaeospit, where five Stone Age sites were already known at the time. About 300 km of transects was walked by a crew of students, investigating an area of 1 sq.km, meter by meter. Altogether 148 find spots with over 2700 artefacts were identified. The three largest concentrations were considered as remains of prehistoric settlements/campsites, but no cultural layer was associat-

ed with the rest of finds. These results, as well as those previously obtained in other palaeospits of the territory, make it possible to discuss ways of exploitation of coastal zones by prehistoric people in different phases of the Stone Age.

The study was supported by the Russian Science Foundation project № 17-77-20041 "The impact of global, regional and sub-regional natural factors on the development of coastal morphosystems of the eastern Gulf of Finland as a human living environment".

B. THE IMPACT OF SHORELINE CHANGES OVER MESOLITHIC POPULATIONS OF WESTERN IBERIA (11500 TO 7000 CAL BP)

Abstract author(s): Araújo, Ana Cristina (DGPC- Archaeosciences Laboratory, Lisboa; Research Centre in Biodiversity and Genetic Resources, CIBIO-InBIO; UNIARQ, Centre for Archaeology, University of Lisbon) - Costa, Ana Maria (DGPC- Archaeosciences Laboratory, Lisboa; Research Centre in Biodiversity and Genetic Resources, CIBIO-InBIO; IDL, Instituto Dom Luiz) - Costas, Susana (Center for Marine and Environmental Research - CIMA, Universidade do Algarve, Faro) - Naughton, Filipa (IPMA: Instituto Português do Mar e da Atmosfera, Lisboa)

Abstract format: Poster

Changes in shoreline are nowadays a major concern to populations living in coastal zones, forcing governments to act on climate change worldwide. Notwithstanding, variations in the shape and position of the coastline have occurred continually throughout our millennial history, though at different rates, with people adapting to the new environmental scenarios, creating innovative solutions, and developing new skills.

The Pleistocene-Holocene transition was concomitant to a rapid rise in mean sea-level due to global climate warming and consequent melting of ice caps. It was also a time of change in hunter-gatherer societies that become more dependent on the sea and its resources. These dynamics are well documented in the archaeological and geological records of the littoral areas of SW Iberia. From 11500 to 7000 cal BP, as sea-level rises, changes in human settlement and mobility patterns took place, although post-depositional processes may have contributed to distort traces of that distant past. These changes in the lifestyle of human societies separates the Early (11500-8400 cal BP) from the Late Mesolithic (8400-7000 cal BP). During this time span, people shift from mobile and dispersed groups occupying and exploiting the coastal environments, to more stable and clustered settlement, organised around the margins of estuarine areas formed during marine transgression.

The apparent abandonment of the coastal fringe seems to oversimplify the real distribution patterns of people during the Late Mesolithic, representing only the pattern observed along the northern coast. Indeed, the southwestern coast continues to be visited and exploited regularly during this later phase. According to our interpretations, geomorphological evidence suggests a sand depleted coast to the north that associated with its rapid retreat and inundation would have inhibit people from settling. Conversely, the southern coast was encouraged by a greater abundance of sand that would delay marine transgression, accommodating the Mesolithic groups.

C. PREHISTORIC HUMAN-ENVIRONMENT INTERACTIONS IN THE LINCOLNSHIRE FENLANDS: A GEOARCHAEOLOGICAL INVESTIGATION OF WILLOW TREE FEN

Abstract author(s): Derrett, Sally (Department of Archaeology, The University of Sheffield)

Abstract format: Poster

Researching the complex sediment sequences of the Fenlands of Eastern England reveals a dynamic environmental history of fluctuating marine and freshwater inundations throughout the Holocene. Archaeological evidence for long-term human land use and settlement is widespread on the boundaries of the Fenland basin, with the wetlands providing both challenges and opportunities for fen-edge communities.

Diachronic geoarchaeological analysis at Willow Tree Fen, in the relatively unstudied silt fens of south Lincolnshire, revealed a record of human-environment interactions in the landscape since the Late Mesolithic. The palynology and microcharcoal analyses reconstructed numerous fluctuating ecological zones which altered according to the shifting influences of marine and freshwater inputs. People's relationships with this dynamic environment were responsive and resilient, including evidence for pastoralism during dry periods and salt-making during periods of brackish marine conditions.

Despite a lack of peat sediments at the study site, the research has demonstrated the preservation capabilities of the roddon deposits in the Fenland, revealing a well preserved, long pollen sequence throughout the stratigraphy. The results demonstrate the potential for extending geoarchaeological analyses across much of the Fenland. Future research can address the bias of peat-land-focused investigations by extending palaeoenvironmental studies into areas which have been subject to extensive marine inundation and peat wastage.

149 BIOARCHAEOLOGY OF HEALTH, LIFESTYLE AND SOCIAL CHANGE IN THE LATER MIDDLE AGES

Theme: 5. Assembling archaeological theory and the archaeological sciences

Organisers: Robb, John (University of Cambridge) - Knüsel, Christopher (Université de Bordeaux)

Format: Regular session

Skeletal and molecular analysis are providing ever more powerful tools for investigating aspects of medieval society which historical records tell us little about. This symposium displays the range of modern studies, highlighting the productive nature of bringing together different kinds of data interdisciplinarily and the gains to be made by deep social contextualisation of bioarchaeological results.

This session showcases current research at the convergence of social history and bioarchaeology, for the later Middle Ages (from around 900 AD through about 1500) in Europe. The range of topics is great. Contributions may focus upon epidemics such as the Black Death and their social consequences; genetic profiles of medieval populations and their implications for kinship and mobility; diet and its social differentiation; human-pathogen coevolution; the biological correlates of social patterns such as gender, class and religious identity; aspects of daily life such as the organisation of work, social practices of violence, and hidden aspects of religious practice; and the osteobiographical narratives of ordinary people.

ABSTRACTS:

1 MUSLIMS UNDER CHRISTIAN RULE THROUGH THE ISLAMIC POPULATION OF VALL D'UIXÓ (CASTELLÓN, SPAIN)

Abstract author(s): Olivé-Busom, Júlia (Autonomous University of Barcelona) - Márquez-Grant, Nicholas (Cranfield Forensic Institute, Cranfield University) - López-Costas, Olalla (Group EcoPast (GI-1553), Universidade de Santiago de Compostela; Archaeological Research Laboratory, Stockholm University; Laboratorio de Antropología Física, Facultad de Medicina, Universidad de Granada) - Kirchner, Helena (Autonomous University of Barcelona)

Abstract format: Oral

From 711 and until the Christian conquest, a great part of the Iberian Peninsula was under Islamic rule and became known as Al-Andalus. This generated a new political and social order, the appearance of new forms of rural settlement and agricultural practices, and the migration of Arab and North-African populations. Once the Christian kingdoms conquered these lands, they imposed a new social and economic rule, the feudal order. The Andalusí people that remained in the regions under Christian rule became known as mudéjares. Their distribution was uneven in rural areas, and in many cases, their presence was the result of relocations dictated by the feudal power. Their status within the new Christian context is widely debated as several authors propose they were subjected to fiscal depredation and populational concentration and marginalisation.

One of the areas where mudéjares remained is modern-day Vall d'Uixó (Spain). During the Andalusí period, it consisted of a series of hamlets (qurá) that were organized around a fortress (ḥiṣn), the foundational date of which is placed on the AD 9th century. Through fossilized toponomy, it is believed that these hamlets had an Arab or Berber origin. Historical sources indicate that their Islamic population remained long after the Christian conquest (AD 1238) and until the Edict of Expulsion (AD 1609), concentrating most of the Islamic population of its region. Thus, this contribution presents the anthropological data gathered from 99 human skeletal remains from two of these hamlets. Our aim is to evaluate the physiological and occupational stress in the studied sample and its biological distance towards other Al-Andalus collections. Furthermore, samples from 7 skeletons have undergone aDNA analysis currently under study to further assess their possible Arab or North African ancestry.

2 LIVING AND WORKING IN AL-ANDALUS: AN OSTEOLOGICAL COMPARISON OF RURAL AND URBAN POPULATIONS FROM ISLAMIC SPAIN (11TH -15TH C. AD)

Abstract author(s): Charisi, Drosia (Department of Legal Medicine, Toxicology and Physical Anthropology, Faculty of Medicine, University of Granada) - Laffranchi, Zita (Department of Prehistory and Archaeology, Faculty of Philosophy and Literature, University of Granada; Department of Physical Anthropology, Institute of Forensic Medicine, University of Bern) - Milella, Marco (Department of Physical Anthropology, Institute of Forensic Medicine, University of Bern) - Jiménez-Brobeil, Sylvia (Department of Legal Medicine, Toxicology and Physical Anthropology, Faculty of Medicine, University of Granada)

Abstract format: Oral

The Islamic occupation of the Iberian Peninsula ("al-Andalus") from the 8th to the 15th centuries AD brought several changes in the daily life of the populations in this territory. However, it is unclear whether variability in local settings (eg. urban vs. rural contexts) triggered the adoption of different economic strategies, subdivision of gender roles and, therefore, daily activities. This study addresses this question by exploring differences in physical activity and gender subdivision of labor between urban and rural contexts in Southeastern al-Andalus. To this aim we performed an osteometric analysis of 152 adult individuals (n males: 75, n females: 77) from two cemeteries representing two social settings of Islamic Granada: La Torrecilla (rural) and Sahl ben Mālik (urban). Diaphyseal shape and product of diameters -as proxies for the directionality and intensity of bone mechanical loading respectively- were estimated from external measurements of long bones, and percentage absolute asymmetry in the humerus was calculated for both