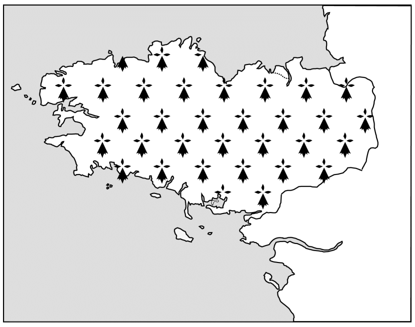
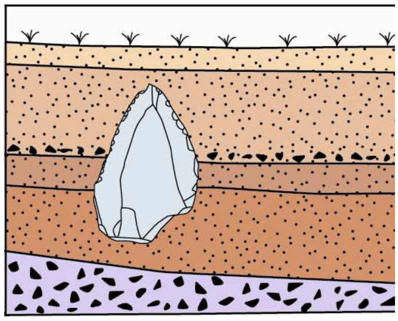
Subcommission on European Quaternary Stratigraphy



INQUA–
SEQS 2008



DIFFERENCES AND SIMILARITIES IN QUATERNARY STRATIGRAPHY BETWEEN ATLANTIC AND CONTINENTAL EUROPE

Conference Abstracts

Rennes – 2008

INTERNATIONAL UNION FOR QUATERNARY RESEARCH
INQUA SUBCOMISSION ON EUROPEAN QUATERNARY STRATIGRAPHY
UNIVERSITY OF RENNES 1, FRANCE
NATIONAL SCIENTIFIC RESEARCH CENTRE
LABORATORY OF ARCHÉOSCIENCES (UMR 6566)

INQUA–SEQS 2008 Conference

22-27 September, 2008, Rennes, France

DIFFERENCES AND SIMILARITIES IN QUATERNARY STRATIGRAPHY BETWEEN ATLANTIC AND CONTINENTAL EUROPE

CONFERENCE ABSTRACTS

Edited by J.-L. Monnier, J.-P. Lefort and G. Danukalova

UMR
Centre de Recherche en Archéologie
Archéosciences, Histoire

Rennes – 2008

Conference Abstracts. INQUA-SEQS, 22-27 September, 2008, Rennes, France. 69 pp.

Around 120 scientists from all over Europe have contributed to the conference with presentations about the stratigraphic record of Quaternary environments and dealing with climatology, glacio-isostatism, biostratigraphy, Quaternary fluvial systems and relationships between archeology and sedimentology. New views are expressed on the tectonic control of the Quaternary deposits in Western Europe and sea level changes. The theme of the last glacial-interglacial transition (broadly including the Holocene) ranges from palaeoglaciology to radiocarbon dating. New results from France, Netherlands, Austria, Switzerland, Russia, Italy, Croatia, Serbia, Bulgaria, Ukraina, Caucasus, Belgium, Lithuania and United Kingdom are given.

Editors: J.-L. Monnier, J.-P. Lefort and G. Danukalova

Edition and compilation by G. Danukalova

ISBN: in progress

Travaux du Laboratoire d’anthropologie de Rennes № 45

ISSN 0768-3685

ORGANISERS:

University of Rennes 1.
National Scientific Research Centre.
Laboratory of Archéosciences (UMR 6566), University of Rennes 1, France.
INQUA, International Union for Quaternary Research.
INQUA – Subcommission on European Quaternary Stratigraphy (SEQS).
SEQS – EuroMam and EuroMal.

***PROGRAMME COMMITTEE*:**

Dr. Mauro Coltorti, Siena, Italy.
Dr. Guzel Danukalova, Institute of Geology USC Russian Academy of Sciences, Ufa, Russia.
Dr. Wim Westerhoff, Netherlands Institute of Applied Geosciences TNO, Utrecht, The Netherlands.

***ORGANISING COMMITTEE*:**

Dr. Jean-Laurent Monnier (UMR 6566), University of Rennes, President of the SEQS meeting.
Dr. Jean-Pierre Lefort (UMR 6566), University of Rennes, Secretary of the SEQS meeting.

***HONORARY COMMITTEE*:**

Cathelineau, President of the University of Rennes 1.
Patrick Saubost, Regional Delegate of CNRS.
Dominique Marguerie, UMR Director, University of Rennes 1.
Luc Aquilina, CAREN Director, University of Rennes 1.
Max Jonin, President of SGMB.

CONFERENCE SPONSORED BY:

CONTENTS

PAPERS PRESENTED AT THE CONFERENCE

INQUA-SEQS 2008

LATE QUATERNARY RESPONSE OF THE MIDDLE LOIRE RIVER TO CLIMATIC AND ENVIRONMENTAL CHANGES (10 – 30 CAL Ka), VAL D'ORLÉANS, PARIS BASIN, FRANCE

Cyril CASTANET, Université Paris 1, Panthéon Sorbonne, UMR CNRS 7041 ArScAn – Equipe Archéologies Environnementales & UMR CNRS 8591 Laboratoire de Géographie Physique, 21 Allée de l'Université, 92023 Nanterre Cedex, France. *E-mail: cyrilcastanet@hotmail.com*

Manuel GARCIN, Bureau de Recherches Géologiques et Minières, 3 Av. Cl. Guillemin BP 6009 45060 Orléans Cedex, France

Michel LAMOTHE, Université du Québec à Montréal, Département des sciences de la Terre et de l'Atmosphère, Laboratoire de luminescence Lux, C.P. 8888, Succ. Centre-Ville, Montréal H3C 3P8, Canada

Anne-Laure CYPRIEN-CHOUIN, Université de Nantes, UMR CNRS 6566, Laboratoire d'Ecologie et des Paléoenvironnements Atlantiques, BP 92208, 44322 Nantes Cedex, France

Christian CAMERLYNCK. Université Pierre et Marie Curie (Paris 6), UMR CNRS 7619 Sisyphe, 4 Place Jussieu, 75252 Paris Cedex 05, France

Nathalie CARCAUD, Institut National d'Horticulture, 2 rue Le Nôtre, 49 000 Angers, France

Joëlle BURNOUF, Université Paris 1 Panthéon Sorbonne, UMR CNRS 7041 ArScAn – Equipe Archéologies Environnementales, 21 Allée de l'Université, 92023 Nanterre Cedex, France

In the study of the responses of the major hydrosystems in Western Europe to climatic and environmental variability during the Late Quaternary (10 – 30 cal ka), we studied fluvial archives of the Middle Loire River (the "*Val d'Orléans*", width: 8 km; length: 50 km, Lat.: 47°54 N; Long.: 1°54° W, Paris Basin, France). At this location, the watershed area is 37 000 km2 extending partly on the "*Massif Central*" (France). We adopted a multi-proxy approach in order 1/ to characterize significant climatic and environmental changes 2/ to analyse the fluvial responses to this variability. The proxies used are the modifications of the river patterns and of the fluvial processes, the periodic development of permafrost, the occurrence of aeolian deposits and the modifications of the vegetation cover. It required an integrated approach [surface morphology, morpho-stratigraphy (core drillings & gravel pits), sedimentology, geophysic, pedology, palynology, and archaeology]. The chronostratigraphic frame was established on the basis of IRSL and radiocarbon datings.

This study shows that, in the Loire River basin: 1/ the last deglaciation had for consequences strong amplitude oscillations of the solid and liquid discharges, 2/ the response of the hydrosystem to the deglaciation occurs approximatively between 19 and 11 cal. ka BP. During a first part of the Late Pleniglacial (from 28 to 19 cal. ka BP), the sedimentary balance is positive while the river had a multichannel pattern. The characterization of the development of continuous permafrost gives evidence of periglacial conditions attributed to the coldest phase of the Last Glacial Maximum. It coincides with the sea-level lowstand. From approximatively 19 to 17 cal. ka BP, an aggradation of the alluvial plain and a multichannel pattern of the river are interpreted as a period of an important solid discharge. The permafrost degradation is inferred from field observations. This episode coincides roughly with the sea-level rise ("meltwater pulse"). From approximatively 17 and 14 cal. ka BP (Oldest Dryas, H1 event), solid and liquid discharges decrease whereas aeolian processes increase (coversand deposits) in a context of “at least” deep seasonal frost and a probable increasing aridity. At the beginning of the Lateglacial, the modification of solid and liquid discharges causes a shift from a multichannel pattern to a pattern characterised by some large stable channels. The sinuosity of theses channel is low and a downcutting is noted (Bolling and Allerod). Near 12 cal. ka BP (Younger Dryas), the sedimentary accumulation rate is increasing while a “at least” deep seasonal frost is inferred from field observations. A second aeolian event with dunes formation is suspected. The Lateglacial / Holocene transition is characterized by a downcutting phase correlated with the fast climatic warming and the vegetation development of the Preboreal period.

The continuation of this study will allow a better understanding of, 1/ the reactivation of the hydrological cycle and 2/ the transfers of continentally material and water to the ocean from 28 to 10 cal. ka BP. It will allow besides to specify the reconstructions of palaeoenvironments and palaeoclimatic variability in the mid-latitudeWestern Europe during the last deglaciation.

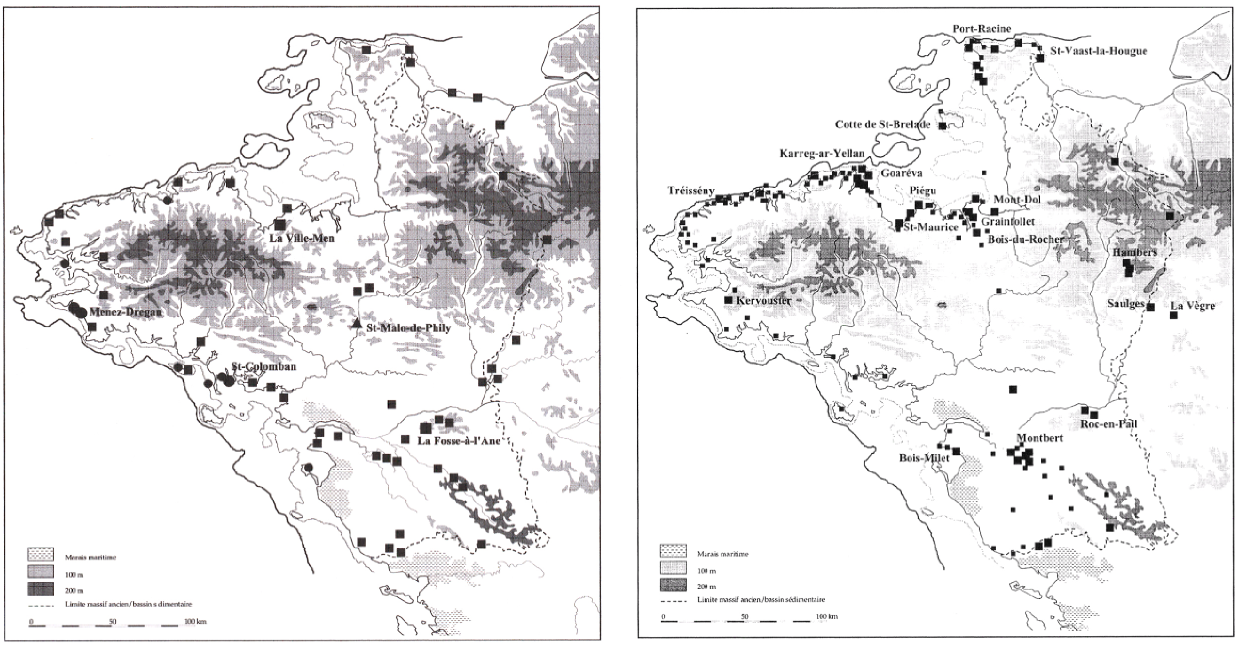
INQUA-SEQS 2008

ALLUVIAL TERRACES OF SARTHE RIVER DOWNSTREAM FROM THE CITY OF LE MANS: NEW RESULTS, NEW QUESTIONS

Yoann CHANTREAU, UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire» Laboratoire Archéosciences-Rennes, Université de Rennes 1, Campus de Beaulieu, bât. 24-25, 74205 CS, 35042 Rennes cedex, France, *Email: yoann.chantreau@univ-rennes1.fr*

One of the big problems for the Pleistocene period in the western part of France is the imbalance of the stratigraphic framework between sedimentary sequences identified in coastal areas (see Jean Laurent Monnier works) and in a continental context. Sites near the sea where outcrops are visible in coastal cliffs allow the identification of long and complete sequences, while those inland are still little known. This lack of information leads to an incomplete view of the geographic distribution for lower and middle Paleolithic sites (cf Préhistoire de la Bretagne by Giot and Monnier and below) in our area.

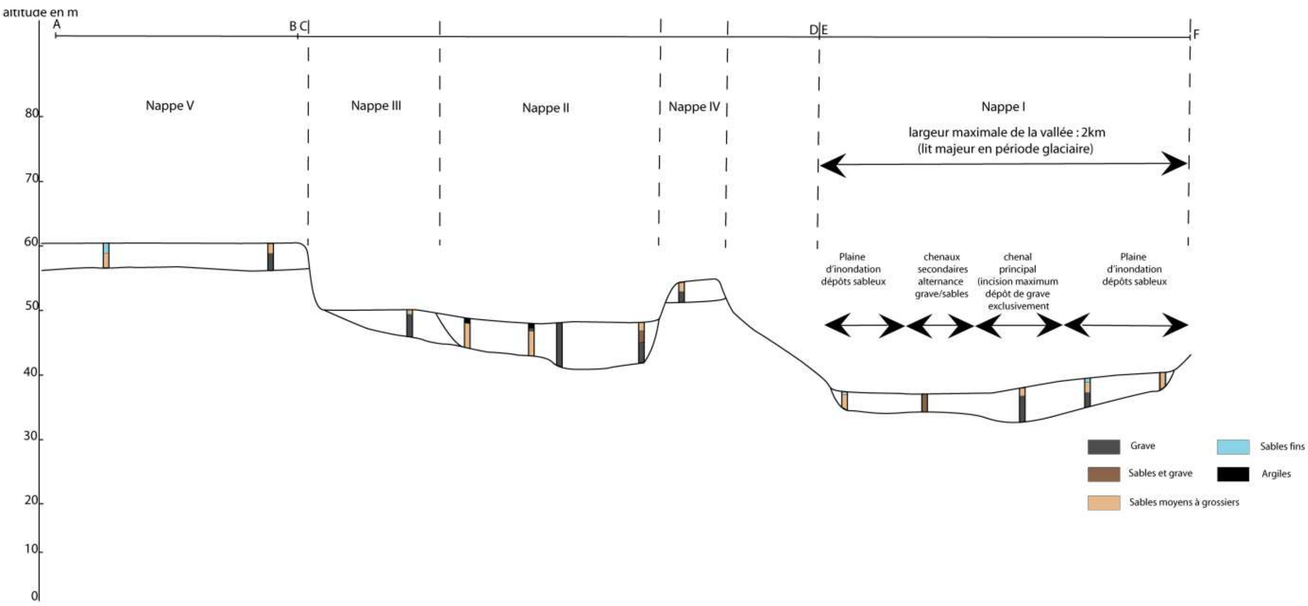
To try to fill in this lack of information about the continental area, researches are now being done about the terraces of the Sarthe River. These are in order to obtain a solid chronostratifical context for human settlements and stratigraphical data for lithics discovered only during surveys in this region.



Paleolithic sites in Brittany, in left low Paleolithic, in right middle Paleolithic
(from Prehistory of Brittany by Giot and Monnier)

The methodology used for this work is based on studies of topographic staircase level of the terraces of the Sarthe River complemented by stratigraphical and sedimentological data that allows us to identify the different characteristics of each level. Hundreds of drilling data and old stratigraphical section follow up characterizes the shape of the sedimentary sheets in 3D perspective.

In a small area located just downstream from the city of the Mans, seven levels have been identified in reference to the actual position of the river course from 72m to 43m above sea level. All the terrace levels seem to have recorded the same sequence from the lowest to the highest level for the filling of the alluvial valley. Coarse deposits have been identified in all the terraces with a normal granoclassement from pebble with sand matrix at the bottom to sand deposits at the top ; the same characteristics have been observed laterally and some lateral facies variation and a sectorization of the different deposits can be seen from the valley axis to the end of the alluvial plain in the 2 km large valley. Deposits in the middle of the valley are constituted essentially by coarse pebbles, where the main part of the flowing river is concentrated, whereas the edge of the valley is constituted by sandy deposits characterizing the alluvial plain. The river sediments seem to have been laid during cold wet period with a high flow regime, which can explain the relatively coarse deposits in all terraces. The only exception is terrace number five, where fine silt sediment is observed just above a coarse sand deposit level that may indicate a Tardiglacial period. To finish the sequence, the lowest terrace is topped by deposits from others contexts: eolian and slope deposits showing the climate variation in the Pleistocene period.



Valley transect of the Sarthe valley few km downstream from le Mans city

All throughout, the elevations of the different levels give us an idea of the relative chronology of the alluvial sheet with a correlation between age and elevation. Absolute datation by ESR techniques will be essential to place the different alluvial sheets in the Quaternary chronology (see Pierre Voinchet thesis 2005).

INQUA-SEQS 2008

MIDDLE PLEISTOCNE ICE LAKE HIGH STANDS IN THE NORTH SEA: HOW DO THEY CHANGE REGIONAL STRATIGRAPHICAL FRAMEWORKS?

Kim M. COHEN, Utrecht Centre of Geosciences / Dept. of Physical Geography, Utrecht University, PO box 80.115, 3508 TC, Utrecht, The Netherlands, *E-mail: k.cohen@geo.uu.nl*

Philip L. GIBBARD, Cambridge Quaternary / Dept. of Geography, University of Cambridge. Downing Place, CB2 3EN, Cambridge, United Kingdom

Freek S. BUSSCHERS, Deltares / TNO B&O *Geological Survey of the Netherlands.* PO box 80.0015 3508 TA, Utrecht, The Netherlands

Proglacial lakes have repeatedly formed along the continental margins of the Quaternary ice sheets of the Northern Hemisphere. Recent appraisal of such lakes the southern North Sea Basin (SNB), at repeated times of Middle Pleistocene glaciation of the area further north, tends to focus on the erosional impact of such lakes, opening the Strait of Dover and scarring the floor of the English Channel to the south.

We focused on the *depositional* impact of such lakes, in areas in between the Strait of Dover ‘exit’ and maximum-extent of the ice caps. Our study area comprises the Southern Bight (erosional, just as the Strait of Dover proper), the Netherlands (southerly depocentre in the North Sea Basin) and the Lower Rhine Embayment (area of fluvial deposition and terraced landscape along the margin of the North Sea Basin). Sequence stratigraphical principles for fluvial deposition along a basin margin, dictate major rivers to build out deltas during ice-lake conditions, and more importantly: predict the locations where such deltas would have formed, their chances of preservation, and the architectural position of such preserved fragments. We confronted the well-dated, well-mapped, well-documented Middle Pleistocene Rhine sequence in the Netherlands and adjacent parts of Germany – with the sequence stratigraphical translations of ice-lake theory. Indeed Rhine deposits occur with architectural properties that are most-simply explained by deltaic deposition during glacial-lake high stands at elevations some 20 to 30 m above interglacial MSL in Anglian/Elsterian times and around +10 to -5 m in Late Saalian ‘Drenthe Substage’ times.

Accepting the existence of glacial lake high stands, means abandoning a number of conventionally ‘inferred age’-models and derived claims on ‘tectonics instability’ in areas *north* of the Eifel volcanic dome and south of Elsterian glaciated area. The volumes of would be lake-deltaic deposits give an indication of the duration of the lake. Eifel volcanic dates constrain the age of deltaic deposition and hence timing of glaciation.

Rejecting the association of Anglian/Elsterian ice-lake drainage across the Calais-Dover sill above interglacial M.S.L., means that an alternative explanation must be sought for opening of the Strait of Dover. That alternative must explaining the removal of substantial volumes of Cretaceous and Paleogene chalk, sand and massive clays, over some 100-200 km length, a few kilometres in width and some 20-30 m average thickness, in extremely short time immediately following Scandinavian-British ice-coalescence (e.g. favouring extreme catastrophism). Or the area was already lowered to below MSL in the Cromerian before (rejecting accumulated evidence on peninsularity of Britain at that time). Our palaeogeographical scenarios that are based on the occurrence of glacial-lake high stands in Anglian/Elsterian times and again in Late Saalian time – though breaking with established traditions and conflicting with stratigraphical schemes for Cromerian and Elsterian times – is the most-conservative way of integrating ‘erosion recorded at Dover’ to ‘deposition recorded by rivers along the North Sea basin’.

INQUA-SEQS 2008

BIOSTRATIGRAPHY OF THE UPPER PLEISTOCENE (UPPER NEOPLEISTOCENE) – HOLOCENE DEPOSITS OF THE BELAYA RIVER VALLEY, SOUTHERN URALS REGION (RUSSIA)

Guzel DANUKALOVA, Anatoly YAKOVLEV, and Eugenia OSIPOVA, Institute of Geology, Ufa Scientific Centre, Russian Academy of Sciences, K. Marx St., 16/2, 450077, Ufa, Bashkortostan, Russia, *E-mail: danukalova@mail.ru*

The characterized area is situated at the easternmost interior part of Europe and called the Southern Urals region. During the periods of cold climate, the region was a non-glacial area. Fluvial deposits are the main subjects for the correlation of varying sediment facies. These deposits characteristically occur in considerable thicknesses and contain organic remains. Deposits dating from the Late Neopleistocene (a unit of the Russian stratigraphic scheme, equivalent to the Late Pleistocene subseries; time interval is 0.135-0.001 Ma) and Holocene are preserved in the local region. Numerous key localities that expose Late Neopleistocene and Holocene deposits are described and contain mammal, mollusc and spore and pollen fossils. All these sites are located in the Belaya River valley in the terraces above the modern flood plain and in the caves in mountains.

The most part of published and unpublished materials on the stratigraphy of the Late Pleistocene of the Southern Urals region was summarized. Deposits of the different origin in the regional stratigraphic units were characterized. The more precise definitions of the stratigraphical scheme of the Southern Urals region are given. The Southern Urals subdivisions are correlated with the Western European stratigraphical schemes (Weichselian – Holocene interval).

Table. Local stratigraphic divisions of the Southern Urals regions and their correlation with European schemes

Global Quaternary scheme Gibbard et al. (2004)			West European stratigraphic divisions (The Netherlands) Zagwijn (1998), Ravazzi (2003)	Russia Zhamoida et al. (2006)			Southern Urals region Danukalova at al. (2007)
System	Series	Subseries. Stages	Stages/ Informal Subdivisions	Series	Divisions	Links / Informal Subdivisions	Horizons
Quaternary	Holocene		Upper	Holocene		Upper	
			Middle			Middle	
			Lower			Lower	
	Pleistocene	Late	Upper Weichselian	Pleistocene	Neopleistocene	Upper	Kudashevo
			Middle Weichselian				Tabulda
			Lower Weichselian				Saigatka
			Eemian				Kushnarenkovo

INQUA-SEQS 2008

CONTRIBUTION OF MALACOLOGY FOR DATING THE PLEISTOCENE SUBMARINE LEVELS OF THE ENGLISH CHANNEL

Guzel DANUKALOVA, Institute of Geology, Ufimian Scientific Centre, Russian Academy of Sciences, K. Marx Str. ,16/2, 450077, Ufa, Bashkortostan, Russia, *E-mail: danukalova@mail.ru*

Jean-Pierre LEFORT, UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire» Laboratoire Archéosciences-Rennes, Université de Rennes 1, Beaulieu, CS 74205, 35042 Rennes Cedex, France, *E-mail: lefort38@yahoo.fr*

The Pleistocene conglomerate is a shelly and cobbly formation which as been only found South of the English Channel. It resulted from the cementing of beach deposits under loessic and siltic sediments at a time when the sea water was at a lower level. Study of the fauna included in this conglomerate allowed to separate three littoral shelly belts located between -24 and -54 m around the Channel Islands of the Normano-Breton Gulf, -40 and -65 m off Tregor and -52 and -80 m off Leon. A fourth belt but without fauna may exist at -93 m. These belts correspond with three regressive Pleistocene episodes. Comparison with Shackleton's sea level curve may help to date the three different beach deposits at around 105/110 Ka, 73/80 Ka and 30/57 Ka. These beaches were sealed by three loessic deposits around 103 Ka, 67 Ka and 18 Ka. We assume that there are at least three different Pleistocene conglomerates in the English Channel. The three conglomerates show some differences in the shells distribution, which could be partly related with the evolution of the water temperature.

The Pleistocene conglomerate is a poorly known formation which has been only sampled in the English Channel. It has never been sampled north of the Alderney-Ushant line and is consequently characteristic of the offshore area spreading between the mid-Channel and Northern Brittany. This formation has been successively dredged by G. Boillot (1964), P. Hommeril (1967), F. Hinschberger (1969) and J.P. Lefort (1969).The formation of this conglomerate has been at the origin of many debates during the sixties and it is only in 1969 that its origin has been firmly established (Lefort 1969).

It is now known that it resulted from the decalcification of loessic and siltic formations during one or various low standing episodes of regression of the English Channel. This calcareous conglomerate, which incorporates shelly fauna and cobbles of various origins, is never thicker than 25 cm (Bouysse BRGM internal report). Sandstones with calcareous cement, and considered as onshore equivalents, have been sampled in various places in Normandy (Guillaume 1948; Dangeard & Hommeril 1964; Hommeril 1964). Nowadays it is affected by submarine erosion and alteration which sometimes transforms the cement in a white and ductile paste. This observation suggests that it cannot corresponds with a very old geological formation. The purpose of this paper is not to investigate the conglomerate erosion but the various types of fauna associated with the coarse sediments which constitute this conglomerate. The final purpose of our study is to check if there are one or various conglomerates of Pleistocene age in the English Channel.

INQUA-SEQS 2008

QUATERNARY GEOLOGY OF THE LIZARD PENINSULA, SW BRITAIN

Peter EALEY, 8 Minster Fields, Manaccan, Helston, Cornwall TR12 6JG, United Kingdom, *E-mail: pealey01@tiscali.co.uk*

H.C. Leslie JAMES, Institute of Education, The University of Reading, Bulmershe Court, Earley, Reading, RG6 1HY, United Kingdom, *E-mail: h.c.l.james@reading.ac.uk*

The geology of the Lizard Peninsula, the UK's most southerly projection into the English Channel, is dominated by basic and ultra-basic rocks of the Lizard Ophiolite Complex, atypical to the rest of the Channel. Its Quaternary history dates back to at least the Paleogene, resulting in a relatively complete history, involving the deposition of the anomalous quartzose Crousa gravels, deep Tertiary weathering, possibly fault controlled uplift, development of the current drainage pattern, subsequent coastal modification by marine erosion prior to the deposition of presumed Mid to Late Pleistocene raised beaches, overlying solifluction diamictons and Late Pleistocene loess. The most important period of coastal erosion, including that of former headlands, outer rias, coves and bays, occurred prior to the Mid to Late Pleistocene high stands, which can be shown in the eastern sheltered areas of the peninsula to have rejuvenated an older weathered coastal slope.

The ubiquitous Late Pleistocene Lizard Loess, a UK lithostratigraphical formation, is much thicker (up to 5 m) in coastal exposures than generally recognised. Thick loessic diamicton sections are located along the serpentinised peridotite coast and on hornblende schist and gabbro headlands. Away from the headlands the gabbros exhibit deep (20 m) weathering profiles, gabbroic solifluction deposits and classic examples of two stage tor development, similar to the Cornubian granites, the loess being confined to thin superficial capping. The serpentinised peridotites by contrast are characterised by periglacial shaved surfaces and thick loessic diamictons, often accompanied by block fields. The currently accepted Late Pleistocene (15900 BP) age for the loess determined from an inland peridotite locality where the loess is thin, may not be representative for the thicker coastal sections. Indeed it is probable that the loessic diamictons on the serpentinites and other localities are contemporaneous with the gabbroic solifluction deposits.

INQUA-SEQS 2008

DETAILED OSL-SAMPLING OF A 7 M LOESS PROFILE WITH STONE AGE GRAVES

Markus FIEBIG, Institute for Applied Geology, University of Natural Resources and Applied Life Sciences, Peter Jordan-Str. 70, A-1190 Wien, Austria, *E-mail: markus.fiebig@boku.ac.at*

Frank PREUSSER, Geological Institute, University of Berne, Baltzer Str.1-3, CH-3012 Bern, Switzerland, *E-mail: preusser@geo.unibe.ch*

Ulrich SIMON, Thomas EINWÖGERER, Marc HÄNDEL, and Christine NEUGEBAUER-MARESCH, Prehistoric Commission of the Austrian Academy of Science, 1010 Vienna, Austria, *E-mail: christine.neugebauer-maresch@oeaw.ac.at*

Infant burials from the stone age (Upper Palaeolithic period) were discovered recently in Lower Austria at the site Krems-Wachtberg. The children bodies were covered with red ochre and decorated with ornaments and were therefore probably ritually buried. The study of the well-preserved human remains contribute to the study of the ontogeny of early modern humans as the living floor with the graves is radio-carbon dated at 26,580 ± 160 years before present (Einwögerer et al., 2006).

The living horizon is embedded in the lower part of a more then 7 m thick loess sequence (Fig.1 and 2). Altogether 33 samples for dating by Optical Stimulated Luminescence (OSL) have been extracted. The spacing of the samples is less then 25 cm. This offers the chance of very good stratigraphic control in a long continental loess profile from Lower Austria. The section will cover the transition of Marine Isotope Stage (MIS) 3 to MIS 2 and therefore covers the continental start of the Last Glacial Maximum. The OSL-data will be presented at the INQUA-SEQS meeting in France.

References:
Einwögerer, T., Friesinger, H., Händel, M., Neugebauer-Maresch, C., Simon, U. & Teschler-Nicola, M. (2006): Upper Palaeolithic infant burials. Nature Vol 444, 16. November 2006, doi: 10.038/444285a.

Fig. 1. Foto of the sampled section Krems-Wachtberg (Lower Austria). The living horizon is visible as dark brown layer in the lowest part of the wall. The loess sequence displays several greyish, yellowish and brownish coloured bands.

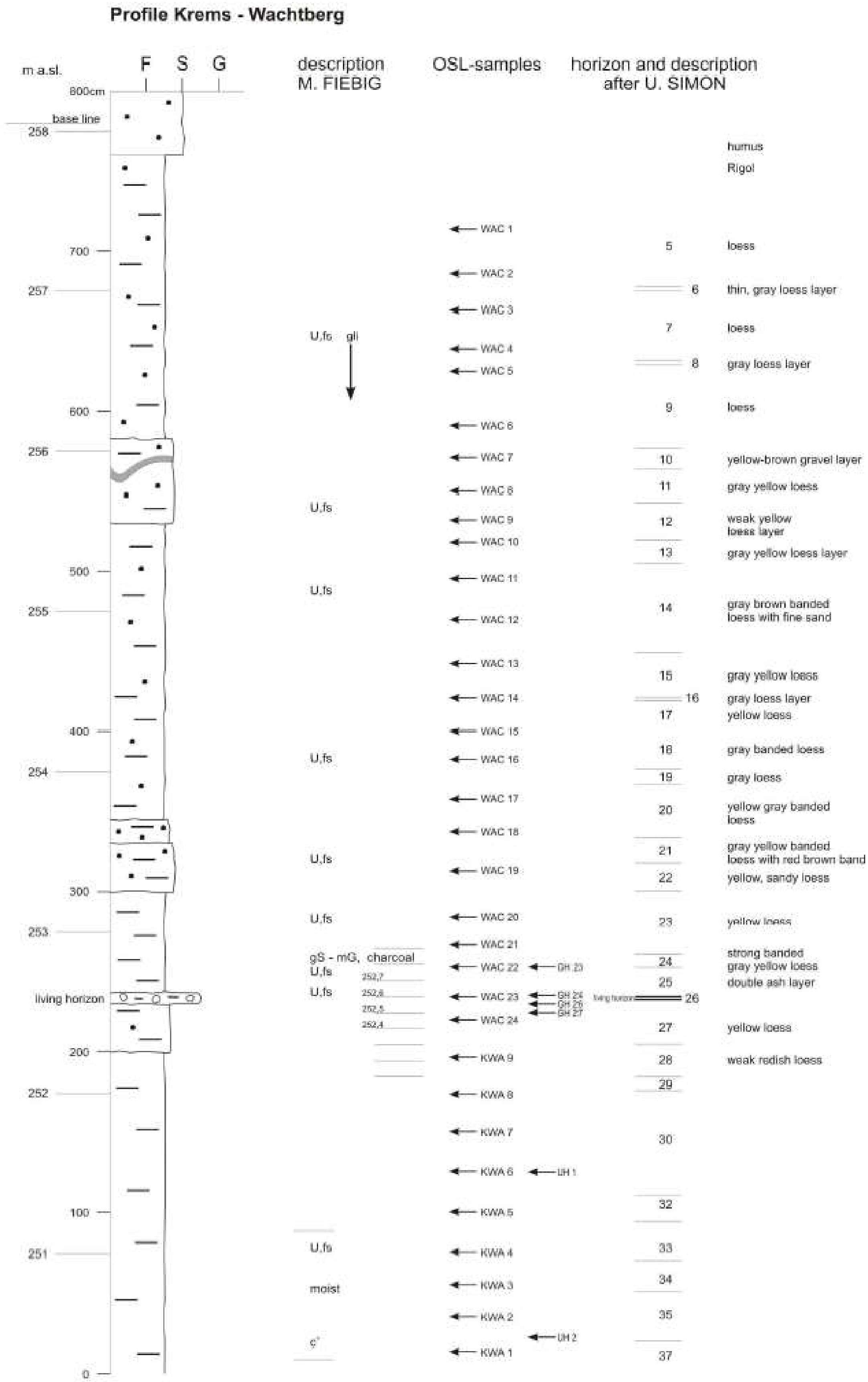


Fig. 2. Description of the loess profile. The loess of the sequence is mostly silt (U) mixed with fine sand (fs). Some layers are coarse sandy (gs) to medium gravely (mg) and contain mica (gli), charcoals and carbonate (c+).

INQUA-SEQS 2008

RECORD OF UPPER PLEISTOCENE AND HOLOCENE TECTONIC DEFORMATION ALONG THE NORTH-WESTERN ADRIATIC COAST

Alessandro FONTANA, Dipartimento di Geografia, Università di Padova, via Del Santo 26, 35123 Padova, Italy, *E-mail: alessandro.fontana@unipd.it*

Fabrizio ANTONIOLI, ENEA, via Anguillarese 301, 00123 Roma, Italy

Alessandro AMOROSI, Dipartimento di Scienze della Terra e Geologico-Ambientali, Università di Bologna, Via Zamboni 67, 40127 Bologna, Italy

Aldino BONDESAN, Dipartimento di Geografia, Università di Padova, via Del Santo 26, 35123 Padova, Italy

Giorgio FONTOLAN and Stefano FURLANI, Dipartimento di Scienze Geologiche Ambientali e Marine, Università di Trieste, via E. Weiss 2, 34127 Trieste, Italy

Kurt LAMBECK, Research School of Earth Sciences, Australian National University, Camberra, ACT 0200, Australia

Giorgio SPADA and Paolo STOCCHI, Istituto di Fisica, Università di Urbino “Carlo Bo”, Via Santa Chiara 27, 61029 Urbino, Italy

The north eastern Adriatic Sea represents the basin of the sedimentary inputs originated from the southern Alps; the NE Italian coastal plain consists of the distal sectors of Po, Venetian and Friulian plains and their late Quaternary evolution has been mainly related with the alternation of glacial/interglacial periods. However also the distal tectonic effect of both Alps and Apennines had played a constraining role in the stratigraphic evolution of the area.

A compilation of the MIS 5.5 high stand (~125 ka) sites spanning the coastline of Italy allows to draw a picture of the long-term vertical displacement pattern affecting the Central Mediterranean coasts since the Late Pleistocene (Ferranti et al., 2006). Using the same method 10 new data from the Northern Adriatic coast of Italy have been collected and provided new downlift rates. Some information are introduced in this research, whereas other data were obtained from deep boreholes described in literature. The new stratigraphical data were obtained from boreholes mainly drilled for the Geological Map of Italy as well as for the MOSE Project by Venice Water Authority.

From the Gulf of Trieste to the Po River Delta, the base of MIS 5.5 paralic deposits, which were sedimented around +6 m a.s.l., now lie respectively from 40 to 130 m below sea level.

This setting demonstrates a general subsiding trend, characterized by a westward increasing values from 0.3 to >1 mm/a; in the area of Venice the information provide a mean subsidence of 0.62 mm\a.

In the aim of calculating also the short-term rates of tectonic movements affecting the Northern Adriatic a combination of 30 radiocarbon datings from stratigraphic and geomorphologic indicators (e.g. peat of ancient salt marshes, lagoon deposits) and of 10 archaeological remains (e.g. piers, dock) that are well connected to Holocene sea-level markers were analysed. The stratigraphical information about the Holocene sea level position were obtained from lagoonal deposits found in boreholes between the Isonzo river and the city of Ravenna; other data have been supported by a detailed analyses of the abundant literature available for the Venice lagoon and its mainland.

In particular, the rates of tectonic downlift were calculated comparing the observed data with the predicted local sea-level curves generated from the two different geophysiscal models of Lambeck et al. (2004) and Spada and Stocchi (2007). These models considered the sea-level change along the Italian coast as the sum of eustatic, glacio-hydro-isostatic, and tectonic factors. The first is global and time-dependent, while the latter two are also affected by local variations. The glacio-hydro-isostatic part along the Italian coast has been recently predicted and compared with field data at sites not affected by significant tectonic processes (Lambeck et al., 2004).

The tectonic rates calculated with the Holocene indicators highlight values that in many sectors are fairly comparable to the ones calculated since upper Pleistocene, even if some differences are present.

It is important to remark that Pleistocene marine sediments do not outcrop in whole coast of the Adriatic, neither in the western nor in the eastern side of the sea, pointing to a long-term tectonic subsidence. Unfortunately, for the gulf of Trieste the position of the MIS 5.5 shoreline is still unknown; however, in some cores drilled in this sector, the Holocene tectonic subsidence reach lower values and this area of relative stability or weak uplift might result from the active growth of a NW-SE trending structural high recently detected across the gulf of Trieste using high resolution seismic profiling.

In the NW Adriatic coast (Friulian and Venetian plain) homogeneous negative movements have been measured. Holocene rates based on core analysis vary from -1.44 and -0.08 mm/a, with a mean of -0.64 and -0.72 mm/a using the Lambeck and the Spada-Stocchi model, respectively.

Two contrasting outputs for the Holocene tectonic rates result using the Spada-Stocchi (SS) versus the Lambeck (KL) model in the coast southern than Po river Delta. With the KL model, Holocene average subsidence rates are lower than the Late Pleistocene rates. In contrast, the SS model yields an average subsidence rate of ~1 mm/yr, similar to the longterm value. This difference stems from the different ice-volumes included in the two models. Although the idea that Late Pleistocene and Holocene subsidence rates be similar is appealing, as suggested by the SS model result, boreholes offshore the Po river mouth seems to indicate stability. Thus, a slowing down of subsidence as predicted by the KL model might be real.

INQUA-SEQS 2008

THE HOLOCENE EVOLUTION OF THE CANCHE ESTUARY AND THE INFLUENCE OF STORMINESS, PICARDY, FRANCE

Guillaume GOSSELIN, UMR 8157, Université Lille1, Bât. SN5, F-59655 Villeneuve d'Ascq cedex (France), *E-mail : guillaume.gosselin@ed.univ-lille1.fr*

Adrien PLUQUET, *E-mail : a.pluquet@hotmail.fr*

Murielle MEURISSE-FORT, CRAN, Université Catholique de Louvain, 3 Avenue du Marathon, B-1348 Louvain-la-Neuve (Belgium) & UMR 8157, Université Lille1, Bât. SN5, F-59655 Villeneuve d'Ascq cedex, France

Brigitte VAN VLIET-LANOË, Institut Universitaire Européen de la Mer, UMR 6538 Domaines Océaniques, France

Alain TRENTESAUX, UMR 8157, Université Lille1, Bât. SN5, F-59655 Villeneuve d'Ascq cedex, France

Michel PHILIPPE, Musée Quentovic, 8 place du Général de Gaulle, 62630 Etaples-sur-mer & UMR 7041 ArScAn, Maison de l'Archéologie et de l'Ethnologie de Nanterre, France

The Canche estuary is located in Northern France, at the northern edge of the Picardy coastal plain. This estuary which drains the southern slope of the Boulonnais is both tide- and wavedominated. The right bank of the estuary is partially constrained by a fossil marine cliff excavated in chalk and by a tectonic flexural zone. Toward the sea, below the littoral prism, a second flexural direction, parallel to the coastline is constrained by the subsidence of the English Channel. The infilling of the Canche estuary is analysed to understand its shaping as also its control by raising Late Holocene storminess. Our work is based on the compilation of 42 cores (technical help of the French BRGM mapping service) with pre-existing geological data base (BRGM) to improve the knowledge of the sedimentary record and refine the regional eustatic curve. These data were completed by grain size analysis and by 14 ^{14}C dating on shells (*Cardium edule*) and peat's to allocate in time morphological/sequence boundaries.

Along the right bank of the estuary, four storm beach ridges are stacked to the Paleo-cliff and have been constrained by ^{14}C AMS. The oldest one is located in elevation between +8 and +13,2m NGF; it consists of frost shattered flints and probably dates back to the Eemian (MIS 5e). The second one yielded an age of 3420 ± 50 Cal Yr BC (onset of the Subboreal) and reaches +6,5m NGF. The 2 others have been found by coring; the first one was found between -1 to -2,5m NGF (Subboreal/Subatlantic transition) and the last one between +2 +3m NGF from which the upper deposits have been dated at 1015 ±35 Cal AD (probably linked to the hurricane which occur around 900 AD from historical sources). A similar record, but less preserved exists on the left bank, at Villiers.

At the shore face, the sandy bodies mostly accumulated later than the Roman storehouse relicts preserved on the Subboreal/Subatlantic surface. This accumulation is thicker at the estuary mouth than the Atlantic body, although the sea level was higher during Atlantic (eustatic maximum). These sandy bodies were clearly accumulated by the successive stacking of offshore sands banks on low stand marine abrasion surfaces created by enhanced storminess, especially during the Merovingian Cooling and the Little Ice Age, as also the coastal dunes. The base of the last deposition (LIA) is dated from 1100 Cal AD.

The basement of present-day middle estuary is much older and accumulated from the end of the Boreal and during the Atlantic (ex-Calaisian), directly in connection to the shore face.

Rapidly this estuary was partly closed by a north-eastward prograding gravel and sandy point bar superimposed on a compound Paleo-point bar (Quaternary and Pliocene in age) responsible for a fining up of sedimentation in the middle and upper estuary. We find Atlantic sediments in core at the level of the present mouth but nothing at the same level under coastal dunes. Such a sedimentary progradation explain by the fluviatile influence. During the Subboreal regression, the formers units are incised by rivulets and this part of the estuary is gradually isolated by the coast by the build up of “old” coastal dunes and by the silting up under anthropological influence. The regressive ravinement surface during the early Subboreal, sealed by peat and the transgressive ravinement surface at the base of the Subatlantic (ex-Dunquerkian) are both observed at the coast and in the middle estuary. Here Merovingian and LIA deposits are limited to a silting up recently accentuated by agricultural practices.

This study was funded by the CPER “Estuaires” (contrat de Plan Etat Région – Région “Nord-Pas de Calais”) and now in the framework of INSU-RELIEF program.

INQUA-SEQS 2008

THE DYNAMICS OF PALEOCLIMATES, PALEOENVIRONMEMTS AND SMALL MAMMAL FAUNA AROUND LAKE BAIKAL (RUSSIA, SIBERIA)

Fedora I. KHENZYKHENOVA, Geological Institute, Siberian Branch of the Russian Academy of Sciences, 6a, Sakhjanovoi str., 670047 Ulan-Ude, Russia, *E-mail: khenzy@gin.bscnet.ru, khenzy@mail.ru*

The Baikal region is located in the centre of Asia on the territory of Russia and Mongolia. The territory of the region composes 1300 km from south to north, and about 1000 km from west to east. The total area is about 800000 km^2. This place is a unique model for researching of the geological development of our planet from the earlist stages of development (Archaean) to present days. The territory adjacent to Lake Baikal is a real mountainous country. All this determines the specific state of the Lake Baikal region and distinguishes it from any other geological structure known on the Earth. Baikal region consists from two different naturals zones: Fore-Baikal area and Transbaikal area. There is the combination of various landscapes in the centre of Asia (from mountain-tundra and mountain-taiga to steppe and semidesert).

The most significant transformation of the relief of arch uplit and Prabaikal depression happened in Neopleistocene (Atlas of Lake Baikal…, 2005). The most significant event in Middle Neopleistocene (approximately beginning from 300 Ka ago) was the glaciation of the Baikal mountain region. There was the large ice shield of over 400000 km^2 (Salop, 1967; Bukharov, 1996 etc.). Our data about small mammals: *Spermophilus undulatus* Pall., *Cricetulus* sp., *Lagurus lagurus* Pall. (predominant form), *Dicrostonyx* cf. *simplicior* Feifar, and *Microtus gregalis* Pall. Found at the Paleolithic Site Igetei testify temperate cold dry climate and spreading of steppes with local tundra biotopes in the Fore-Baikal region (Khenzykhenova, 1999). In Transbaikalia contemporaneous paleontological remains of *Marmota*, *Meriones*, *Lagurus lagurus*, *Lasiopodomys brandti* etc. testify arid climate and spreading of cold dry steppes (Erbajeva, 1978).

The mountain-valley glaciation continued to the end of Neopleistocene, when the Baikal depression was formed within about the same outlines of the modern Baikal and as result of tectonic and probably catastrophic block subsidence, there was formed Listvyanka Bay and the outlet of the Angara River in its modern shape.

The Late Neopleistocene great glaciation affected the changes of the environment. The Baikal rift zone was also subjected to the influence. On the Barguzin Ridge there was formed a large glacier with the area of 100 000 km^2 and about 1 km thick (Atlas of Lake Baikal…, 2005).

In the Fore-Baikal region non-analog (disharmonious) faunas of the mammals were found in the deposits of Late Pleistocene localities. They were represented by tundra- (*Dicrostonyx*, *Lemmus sibiricus,* and *Microtus* cf. *hyperboreus*), steppe- (*Marmota, Lagurus lagurus, Microtus gregalis*) and forest (*Clethrionomys rutilus* Pall., *C. rufocanus* Sundev., *Myopus schisticolor* Lill.) species. The recent areals of these species located in the different natural zones. The species composition of archaeological sites: Mal'ta and Bol'shoi Jakor' (24 000-10 000 years BP) in Prebaikalia indicate a gradual transition from the Late Pleistocene tundra-steppes to the formation of forest-steppes at the end of Pleistocene (Khenzykhenova, 1999). The paleontological data in Transbaikalia: *Marmota, Lasiopodomys brandti, Ellobius, Meriones, Allactaga* and other species indicate a wide distribution of dry steppes and arid climate. In the end of Pleistocene the distribution of forest- and meadow landscapes, and reduction of dry steppes began here. In the fauna the steppe species were predominant forms, but their areals very hard reduced (Khenzykhenova, 2008).

The ice masses “collapsed” the earth’s crust approximately to the depth of 400 m relative to its today’s location. The glacial unloading about 12-13 thousand years ago caused the intensive uplit of the earth’s crust due elastic properties of the lithosphere. The earth’s surface under the former glacier rose at a speed three-four times higher than that on the territory of the entire Prebaikalie. It was caused by the leveling of the gravitation field of the earth. The obtained data on the afterglacial uplit allowed to estimate the character of natural climatic changes in Prebaikalie (Atlas of the Lake Baikal …, 2005. During this time in the microtheriofauna the mountain form *Alticola* appeared as in the Fore-Baikal region (Bol’shoi Jakor’ site) as in Transbaikalia (Studenoe-2).

So, the climate changes in the Baikal region followed by significant reorganisation in faunal communities.

INQUA-SEQS 2008

IMPORTANCE OF GASTROPOD MOLLUSK FAUNAS FOR PALEOECOLOGICAL RECONSTRUCTIONS AND ZONATION OF THE MIDDLE PLEISTOCENE CONTINENTAL DEPOSITS OF THE CENTRAL RUSSIAN PLAIN

Peter KONDRASHOV, A.T. Still University of Health Sciences, Kirksville College of Osteopathic Medicine, Kirksville, MO, 63501 USA; Paleontological Institute of the Russian Academy of Sciences, Moscow, Russia, *E-mail: pkondrashov@atsu.edu*

Freshwater and terrestrial gastropod mollusks have key importance in paleoecological reconstructions. They can be used to identify glacial and interglacial events and can be efficiently used in biostratigraphy and zonation of the Pleistocene continental deposits.

Although the central Russian Plain is famous for its extensive middle Pleistocene series, knowledge of gastropod mollusk fauna of this region have been limited. Significant collections including tens of thousands of specimens have been recently collected from the upper Don Basin. Here preliminary data are presented on geological distribution of gastropod mollusks and their importance for climatic and paleoecological reconstructions and zonation of the middle Pleistocene deposits of the central Russian Plain.

Studied gastropod mollusks came from four major horizons of the Russian middle Pleistocene. The age of each of these horizons had been previously defined using small mammal data. The Ilyinian horizon (MIS 17-18) is known by the strata of Iliinka, Veretio, Novokhopersk, and Moiseevo localities, which deposits underlie the Donian till. This horizon is early middle Pleistocene in age. The deposits of Muchkapian (MIS 15) and Ikoretsian (MIS 13-14) horizons are located between the Donian till and the Oka (=Anglian) till. These deposits are best represented by the strata of Volnaya Vershina, Kuznetsovka, and Mastuzhenka localities. The Ilyinian, Muchkapian and Ikoretsian horizons belong to the Tiraspolian faunal assemblage. The Likhvinian horizon (MIS 11) is known by the deposits that overlie the Oka till and is late middle Pleistocene in age. The mollusk fauna from this horizon is best known from such localities as Log Shtempelevski, Donskaya Negachiovka, and Shekhman. Gastropod mollusk faunas from the studied horizons differed significantly.

The fauna of the oldest, Ilyinian, horizon includes a number of extinct species, not known from younger deposits, most notably *Parafossarulus priscillae*, *Tanousia krasnenkovi*, *Viviparus diluvianus*, an archaic *Gastrocopta (Sinalbulina)* sp. nov., and *Borystenia intermedia*. All of these species, except the last one are restricted to the Ilyinian horizon. The distribution of these species varies within this horizon as well. *Parafossarulus* is restricted to the oldest Veretio fauna. Terrestrial gastropod species in most cases can not be directly used as index fossils and are not as useful for biostratigraphy as freshwater gastropods, but they are excellent indicators of the climatic conditions. The use of land gastropod mollusk data helped to establish warm and cold phases during the pre-Donian glaciation period and differentiate three substages in the Ilyinian horizon, the Veretio, the Novokhopersk, and the Moiseevo. The presence of clausilids, *Trichia*, and *Gastrocopta* in the deposits of the Veretio locality indicates warm interglacial conditions. The Novokhopersk mollusk fauna also contains many of the extinct archaic species found in the Veretio locality. The terrestrial gastropod fauna of Novokhopersk is intermediate and indicates a more temperate climate, as on the one hand it includes such species as *Trichia hispida* and on the other it includes *Pupilla muscorum*, *Vallonia tenuilabris*, and *Vertigo alpestris*. The two latter species are rather rare. The Moiiseevo fauna, known from the strata directly underlying the Donian till has a very low gastropod mollusk diversity and mostly includes species typical for cold, preglacial conditions, such as

Vertigo alpestris, Vertigo geyeri, and *Vallonia tenuilabris*. *Vertigo alpestris* and *Vallonia tenuilabris* are much more abundant than in the Novokhopersk fauna.

The Tiraspolian mollusk faunas from the Muchkapian strata differ significantly from the Tiraspolian faunas that are known from the deposits below the Donian till. Muchkapian fauna contains only one extinct gastropod mollusk species, *Borysthenia intermedia*, that persists from the beginning of the middle Pleistocene into the Muchkapian horizon. *Viviparus fasciatus* is known from most middle Pleistocene localities both below and above the Donian till. Overall the Tiraspolian mollusk fauna resembles the Western European mollusk fauna of the Cromerian s.l. in containing extinct *Borysthenia, Tanousia, Litoglyphus*, and viviparids.

The boundary between the Tiraspolian faunas and the Likhvin fauna is marked by the disappearance of extinct species, when *Borysthenia intermedia* is replaced by the extant species *B. naticina*. The Likhvin mollusk fauna is rather diverse, but includes only extant species. Rich pulmonate mollusk fauna that indicates favorable environmental conditions is known from several localities of this age. It contains abundant *Acicula polita, Carychium* spp., *Discus ruderatus*, and *Vertigo antivertigo*. A similar change is observed in European middle Plaeistocene faunas between the Cromerian and Hosteinian faunas that is marked with the disappearance of extinct gastropod species.

In conclusion, the Tiraspolian stage (including Ilyinian, Muchkapian, and Ikoretsian horizons and their substages) and Likhvin horizon can be differentiated based on their molluskan faunas. The mollusk fauna of the Tiraspolian stage corresponds well to the fauna of the Cromerian complex s.l. of Western Europe and differs significantly from the younger Likhvinian fauna that corresponds to the Holstenian of Western Europe.

INQUA-SEQS 2008

CONTRIBUTION TO THE CHRONOSTRATIGRAPHY OF THE LOWER PALEOLITHIC SITE OF MENEZ DREGAN 1 (Plouhinec, Finistère, France). CORRELATIONS WITH GWENDREZ CLIFF PLEISTOCENE DEPOSITS

Marine LAFORGE and Jean-Laurent MONNIER, UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire» Laboratoire Archéosciences-Rennes, Université de Rennes 1, Beaulieu, CS 74205, 35042 Rennes Cedex, France, *E-mail*: *marine.laforge@univ-rennes1.fr, jean-laurent.monnier@univ-rennes1.fr*

Bernard HALLEGOUET, Université de Bretagne Occidentale, Département de Géographie, Faculté des Lettres Victor-Ségalen, 20 rue Duquesne, B.P. 814, 29285 Brest Cédex & UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire», France, *E-mail*: *bernard.hallegouet@univ-brest.fr*

The archaeological site of Menez Dregan 1 proves to be essential to apprehend paleoenvironmental variations of the Western Europe. ESR and TL datings carried out on sediments, heated quartz and flint of the site are discrepant. The 100 000 year gap between those datings raises the issue of Menez Dregan 1 chronology.

The present work attempts to cope with the issue of the dating of Menez Dregan 1 by means of a sedimentologic and stratigraphic study.

Actually, the stratigraphy of the site is important, in spite of a weak sedimentary balance. However, the proximity of a section with a large sedimentary record (Gwendrez cliff) enables to attempt correlations between the different deposits by means of a sedimentologic study applied to sandy marker beds (dunes).

This study is based on the three following sedimentologic approaches: granulometry, grain quartz morphoscopy and heavy minerals.

The analyses focused on the sandy fraction of sediments with the aim of getting closer to the originally deposited ones. The ensuing results added to stratigraphic observation lead us to propose correlations between the sandy layers.

Thereby new elements allow to draw up a more precise chronostratigraphy of the site of Menez Dregan 1 and contribute to the validation of radiometric datings.

INQUA-SEQS 2008

THE CONTROL OF THE MOHO ON THE QUATERNARY SEDIMENTATION AND ON THE LOCATION OF THE RAISED BEACHES IN FRANCE AND AROUND BRITTANY: CONTRIBUTION OF GEOLOGY AND GEOPHYSICS

Jean-Pierre LEFORT, UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire» Laboratoire Archéosciences-Rennes, Université de Rennes 1, Beaulieu, CS 74205, 35042 Rennes Cedex, France, *E-mail: lefort38@yahoo.fr*

The variations in thickness and nature of the sediments deposited in Brittany during Pleistocene and Holocene times mainly depend on the following parameters:

1/ The short wavelength basement rejuvenations, which disturbed the sedimentation continuity, are at the origin of local stratigraphic disruptions. This phenomenon is less clearly expressed when a Mesozoic or Cenozoic cover exists like in the Paris Basin. A good example can be found in the St Brieuc Bay on both sides of the active Quessoy-Vallet fault.

2/ The climatic variations can be also responsible for drastic changes in the nature of the sediment deposits. In Brittany, the loess formations accumulated when strong winds blowing from the northwest swept the Mesozoic and Cenozoic limestones which constitute the floor of the English Channel during low stand stages of the sea. On the contrary the various warming episodes are marked by fossil beaches now preserved as shelly conglomeratic formations nowadays located underwater.

3/ The existence of long wavelength Moho undulations and their impact on the control of the raised beaches and on the location of the uplifted and subsiding zones has never been evidenced before. This became only possible when new softwares developed by Lefort and Agarwal provided a new tool to better understand the relationship between the Moho undulations and the surface topography. These studies are based on gravity data. They now clearly explain why some areas which are still in uplift conditions were partly eroded or are characterized by the deposition of thinner formations. Other regions which show a continuous subsidence are also observed. These phenomenons are either related with the still active Alpine orogenesis or by the rejuvenation of structures created during the opening of the Bay of Biscay during the Mesozoic but now still active under the compressions associated with its actual closure. These particular areas show a typical wavelength spacing of 220 Km and crosscut in Brittany, which explain the complexity of the distribution of the Pleistocene raised beaches.

4/ The tide loading phenomenon associated with the changes in the thickness of the water column related with the everyday tides in the English Channel and in the Bay of Biscay acted in a very spectacular way during the Pleistocene every times the sea level changed. Theoretical calculations show that the rate of uplifts and subsidences changed dramatically during this period of time. This explain why the rate of the deposition of the sediments during the Quaternary was so often disturbed in Western Europe.

We must take account of all those parameters when discrepancies are observed when one compare the differences and similarities existing between the Atlantic and continental Europe stratigraphy.

INQUA-SEQS 2008

DINARIC GLACIATION – A FORMAL PROPOSAL OF A NEW MODEL

Ljerka MARJANAC, Croatian Academy of Sciences and Arts, Institute of Quaternary paleontology and geology, A. Kovacica 5, 10000 Zagreb, Croatia, *E-mail: ljerka@hazu.hr*

Tihomir MARJANAC, University of Zagreb, Faculty of Sciences, Division of Geology, Horvatovac 102a, 10000 Zagreb, Croatia

Philip D. HUGHES, Geography, School of Environment and Development, The University of Manchester, Oxford Road, M13 9PL, United Kingdom

Pleistocene sediments in the coastal part of Croatian eastern Adriatic clearly show that a very extensive glaciation occurred in the area of Dinarides (Dinaric Alps) during the Early Pleistocene.

Extensive low-latitude glaciation is documented by ice-contact sediments and proglacial and periglacial sediments and features, studied on the islands Krk and Pag, on southern Velebit Mts. and its foothills as well as in Ravni Kotari and Bukovica. Further south in Montenegro secondary carbonate cements within moraines yield ages of c. 400,000 years, providing minimum ages for the moraines which may correlate with similar Middle Pleistocene glacial deposits in Greece ascribed to marine isotope stage (MIS) 12. The lowest glacial deposits so far found in Montenegro occur at altitudes as low as 200 m. Older and lower glacial deposits of Early Pleistocene age may be present in Montenegro but no evidence has yet been found, possibly because of poor preservation. Nevertheless, there is clear evidence from both Croatia and Montenegro of extensive Middle and possibly Early Pleistocene glaciations – far more extensive (Fig.) than Late Pleistocene Würmian glaciation.

A Dinaric glaciation model is probably applicable to other regions in the circum-Mediterranean.

Karst relief interferes with glacial, which makes interpretation difficult. Superimposed alpine type glaciation of Late Pleistocene Würmian glaciation in high mountains of Dinaric Alps may have misled previous researchers.

The authors, thereafter, propose here a new formal name for the large-scale glaciation of karst regions **– Dinaric glaciation**.

Arguments:

- a need to define a single model to embrace all observations of geological processes, sediments, deformation structures, sediment distribution and geomorphology of the studied region
- the fact that glaciation of a large karst area is rare, known only from U.K. and circum-Mediterranean region
- the fact that geology of bedrock often defines characteristics of geological processes important for understanding and interpreting the same processes and their products
- peculiarity of karst imposes a need to set it into glaciation model in order to explain its paleohydrology for the purpose of understanding present hydrogeologic conditions
- karst in the Dinarides is older than the glaciation, documented by karstified clasts in the moraines and moraines lying over karstified substrate.

Characteristics defining the Dinaric glaciation model:

- ice tongues descended from a large ace cap,
- primary snow and ice accumulation occurred across a large area,
- secondary accumulation was only local but significant,
- ice cover generated frequent avalanches (avalanche sediments) and accumulation of large alluvial fans (alluvial fan deposits formerly interpreted as scree),

- valley glaciers occupied inherited mountain valleys, and channels between mainland and islands,
- ice tongues descended as low as -50 meters, and crossed Velebit channel reaching Pag and Krk islands,
- in proglacial lakes deposited silts, sands and clayey silts (varved sediments),
- floating icebergs produced dropstones in lacustrine sediments,
- permafrost is documented by kettle-forms and sediment wedges representing icewedge casts,
- ice retreat initiated glaciofluvial sedimentation – a sandar envrionment,
- ice advance produced glaciotectonic features, like reverse faults in the base of a till,
- very large erratic blocks (25 - 50 m the largest),
- estimated length of Novigrad glacier is over 50km, coming from north-east (region of high mountains in Bosnia and Herzegovina),
- at least two episodes of ice advance and ice retreat,
- medial moraines on Velebit Mt. up to 100 m high and 2-3 km long,
- roche moutonée nearly 30 m high and 500 m long,
- subglacial karstification formed funnel depressions on the very top of the relief,
- subglacial waters disappear in karst underground and cause immobility of an ice cap,
- silt from glacial milk deposited in karst caverns and caves,
- due to predominating limestones and dolomites, moraines have low matrix content,
- moraines' matrix is often washed out by waterflows disappearing in karst underground,
- postglacial karstification of moraines and moraine blocks destroyed glacial striations
- after ice retreat there remain glacial high mountain lakes
- glaciers stagnate due to ice cover reduction, and snow stayed in poljes but they do not have
- function of a cirque.

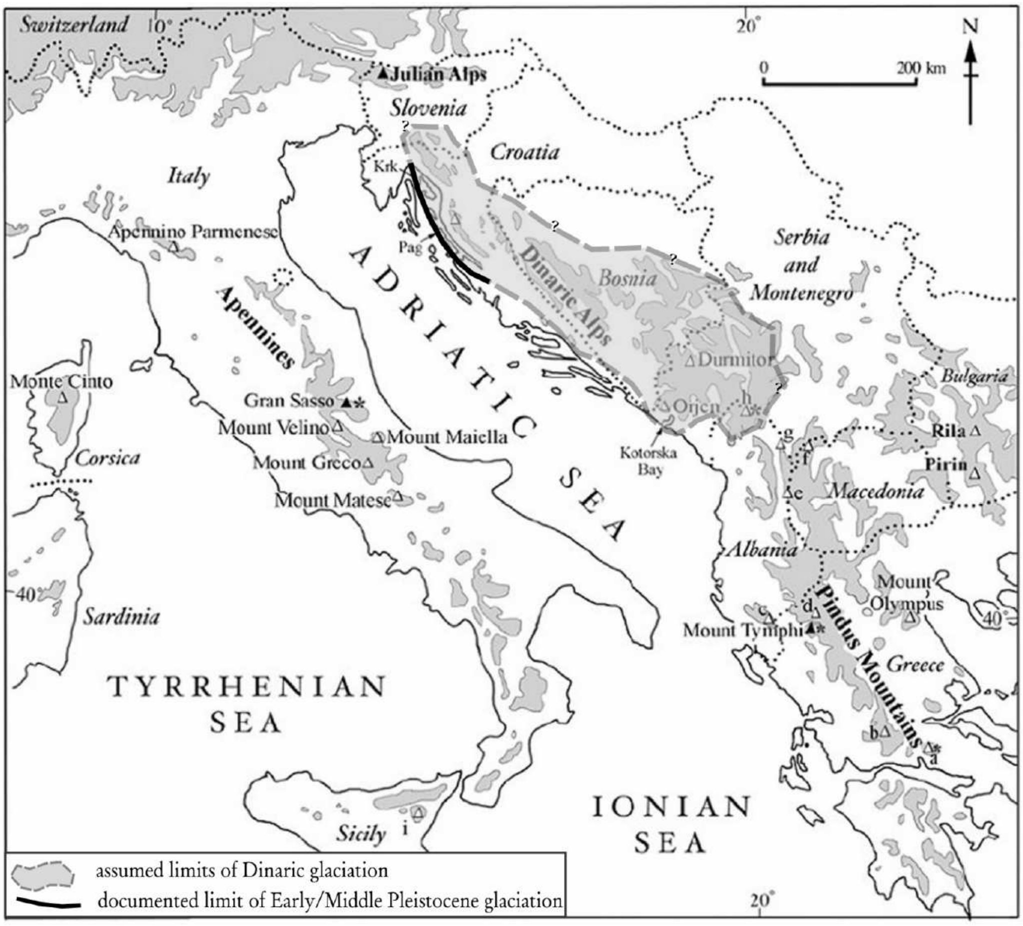


Fig. Possible extent of Dinaric glaciation

INQUA-SEQS 2008

LATE PLEISTOCENE SMALL MAMMAL FAUNAS FROM THE CRIMEAN MIDDLE PALAEOLITHIC SITES: ECOLOGY, ENVIRONMENTAL RECONSTRUCTIONS

Anastasia K. MARKOVA, Institute of Geography, Russian Academy of Sciences, Staromonetny 29, Moscow 119017, *E-mail: nature@online.ru*

The rich small mammal faunas related to deposits of seven multilayered Middle Palaeolithic sites of Western Crimea (Starosele, Kabazi II, Kabazi V, Chokurcha I, Karabi Tamchin, Buran-Kaya III, Suren I) have been analyzed during the complex archaeological, geological and palaeontological studies (Chabai et.al., 1999,2004, 2005; Markova, 1999, 2004, 2005) (Fig.).

The materials from these sites cover the time interval between the Mikulino (=Eemian) Interglacial and 25 kyr BP. More than 10 thousands small bones were analyzed. That permits to distinguish the principal features of small mammal fauna species composition during the different intervals of Late Pleistocene.

Now in the Crimea habituated 15 species of rodents, six insectivores and one Lagomorpha (Gromov, Erbaeva, 1995). We could distinguish comparable quantity of small mammals from the Middle Palaeolithic sites, but the species composition was different from the modern one.

Some of rodents (*Rattus rattus, R. norvegicus, Ondatra*) appeared in the Crimea only in the Holocene. Red squirrel *Sciurus vulgaris* was acclimatized in the Crimea in 1940 yrs (Gromov et al., 1963). Several species found in Middle Palaeolithic sites of Western Crimea now disappeared from this region.

The earliest site is Kabazi II. Here the older layers with Western Mousterian culture deposited during the Mikulino (=Eemian) Interglacial. The ancient man continued to habituate on this site during the early and middle Weichselian (Chabai, Richter, Uthmeier, 2005) The number of small mammals, which remains were found in Kabazi II, includes 13 rodents, one Lagomorpha and one Insectivora, what is comparable with species richness of modern fauna (Markova, 2005).

Small mammals from the older layers (Units VI and V) include: *Crocidura leucodon* – whitetooth shrew, *Spermophilus pygmaeus* – little suslik, *Marmota bobac* –bobac marmot, *Spalax microphtalmus* – Russian mole rat, *Ellobius talpinus* – northern mole-vole, *Dryomys nitedula* – tree dormice, *Apodemus (Sylvimus) flavicollis* – yellow-necked mouse, *Cricetulus (Cricetulus) migratorius* – grey hamster, *Eolagurus luteus* – yellow steppe lemming, *Lagurus lagurus* – steppe lemming, *Arvicola terrestris* – water vole, *Microtus (Stenocranius) gregalis* – narrow-skull vole, *Microtus (Microtus) obscurus* – Altayan vole. *Microtus obscurus, Spermophilus pygmaeus, Spalax microphtalmus, Ellobius talpinus, Arvicola terrestris* were the dominant animals in these layers. The species composition includes the forest and meadow-steppe animals what shows on more moderate and humid climate, than in later layers. Some forested or bushed areas were presented near the site during these temporal intervals, what was indicated by the finds of several forest species together with open landscape ones.

Later, during the deposition of Units IV-III, only steppe, semi-desert, meadow steppe, and few hydrogenous mammals inhabited the environments near the site. They includes *Lepus europeus* Pallas – European hare, *Spermophilus pygmaeus* – little suslik, *Allactaga major* Kerr – great jerboa , *Ellobius talpinus* Pallas – northern mole-vole, *Eolagurus luteus* Eversmann – yellow steppe lemming, *Lagurus lagurus* Pallas – steppe lemming, *Arvicola terrestris* L. – water vole, *Microtus (Microtus) obscurus* Eversmann – Altayan vole. Little suslik, northern mole-vole, and Altayan vole were the dominant species.

The cold-adapted animals were absent in all of the layers. Species composition from IV-III Units indicates the changing of climatic condition and some influence of glaciation. However, the global cooling only resulted in an increase in dry conditions and a decrease of forested areas at these latitudes.

The similar environments have been reconstructed by the materials from the cultural layers of the most Middle Palaeolithic sites from the Western Crimea (Starosele, Kabazi V, Chokurcha I, Karabi Tamchin, Buran-Kaya III, Suren I) related to the Middle and the beginning of the Late Valdai (=Weichselian).

The steppe, meadow steppe and semi-desert mammals were the dominant in these sites. Additionally to the mentioned above species the typical semi desert animals were distinguished in Buran-Kaya III site, such as *Stylopodus telum* and *Pygeretmus (Alactagulus) pumilio*. The cold-adapted animals were not distinguished in all of the sites. Only few forest small mammals were discovered. The forest animals are absent absolutely in some of the sites (Buran-Kaya III, Karabi Tamchin, Chokurcha I). In all other sites they are presented in very low quantity and in only in cultural layers, related to the interstedials.

Several of the mammals identified in the Middle Palaeolithic sites have now disappeared from this region: yellow steppe lemming is now found only in parts of Mongolia, China and in the Zaisan Depression. Narrow-skulled vole, which was very common during the Pleistocene on the Russian Plain and in the Crimea, now inhabits the Kazakhstan steppes and the tundra zone.

Bobac marmot also disappeared from the Crimea and now distributed in the easternmost steppe territories. Due the fact that the drop in temperature during the Valdai Glaciation did not inhibit them in any way, these animals were able to survive in the Crimea and on the central and southern parts of the Russian Plain. The different types of open landscapes represented the only prerequisite to ensure their survival. The restriction and changes of their distribution only occurred after human impact during the Holocene. The habitat favored by the modern Russian vole rat *Spalax microphtalmus* does not include the Crimea, and the remains of this animal were not found in the sites correlated with the different parts of Valdai Glaciation. This animal was found only in Units VI-IV at Kabazi II which corresponds to the Mikulino Interglacial. Later this mammal disappeared from the Crimea.

The climatic changes, influences by the Scandinavian ice-sheet, were smoothed in this region, and provided ancient humans with comfortable and rather stable conditions. Restricted forested and bushed areas were distributed in the Crimea, but they alternated with open landscapes which were very common here during different phases of Mikulino (Eemian) Interglacial, and were represented more noticeably during Valdai (=Weichselian) time.

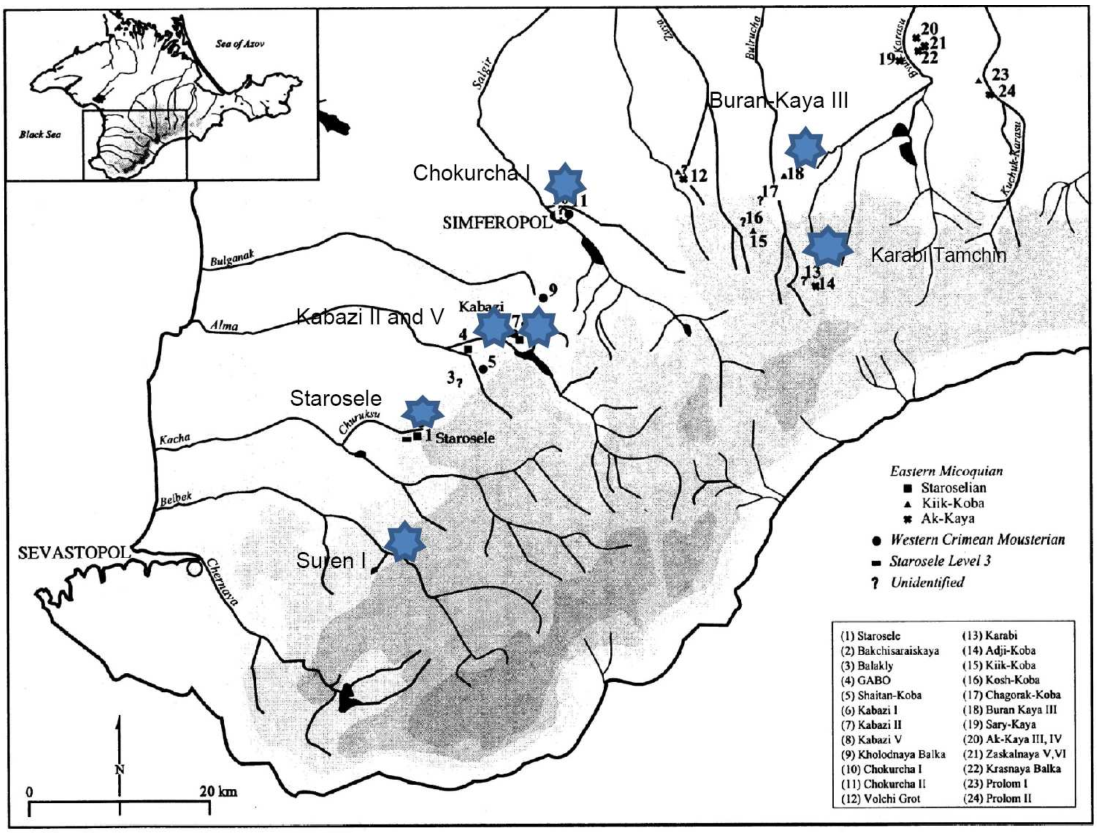


Fig. Geographical position of the Middle Palaeolithic sites of Western Crimea (after Chabai et al., 1999)

INQUA-SEQS 2008

LOESS STRATIGRAPHY IN THE VOJVODINA REGION, SERBIA

Slobodan B. MARKOVIC, Chair of Physical Geography, Univesity of Novi Sad, Trg Dositeja Obradovica 21000, Novi Sad, Serbia, *E-mail: zbir@im.ns.ac.yu*

Björn MACHALETT, Ulrich HAMBACH and Ludwig ZÖLLER, Chair of Geomorphology, University of Bayreuth, 95440 Bayreuth, Germany

Mladjen JOVANOVIC, Tivadar GAUDENYI and Tin LUKIC, Chair of Physical Geography, Univesity of Novi Sad, Trg Dositeja Obradovica 21000, Novi Sad, Serbia

Björn BUGGLE, Chair of Soil Physics, University of Bayreuth, 95440 Bayreuth, Germany

Eric A. OCHES, Department of Geology, University of South Florida, Tampa, FL, USA

William D. McCOY, Department of Geosciences, University of Massachusetts, Amherst, MA, USA

Ian SMALLEY, Giotto Loess Research Group, Waverley Materials Project, Nottingham Trent University

Thomas STEVENS, School of Earth Science and Geography, Kingston University, Kingston upon Thames

Vojvodina is a region in northern Serbia, located in the southeastern part of the Carpathian (Pannonian) Basin, and encompassing the confluence area of the Danube, Sava and Tisa rivers.

More than 60 % of this lowland area is covered with loess and loess-like sediments. Aeolian silt accumulation in Vojvodina began in the late early Pleistocene (Markovic et al., 2003). Northern Serbian loess deposits are among the oldest and most complete loess-paleosol sequences in Europe. These thick interstratified loess-paleosol sequences intensively investigated in recent years provide one of the most complete and most sensitive European terrestrial records of climatic and environmental changes during the Middle and Late Pleistocene.

The most detailed stratigraphic information comes from remarkable exposures on the cliffs of the right Danube bank from Vukovar to Belgrade and sections at Titel loess plateau. Those sections representing quite uniform loess stratigraphy because of mostly plateau depositional conditions (Markovic et al., 2006, 2007, 2008) similar to the ones in the central Chinese loess plateau (e.g. Liu et al., 1985; Kukla, 1987; Kukla and An, 1989). Markovic et al. (2008) designated the units by names following the Chinese loess stratigraphic system (e.g. Liu et al., 1985; Kukla, 1987; Kukla and An, 1989) but inserted the prefix “V”, referring to the Vojvodina region. Our stratigraphic model, based on investigations at various loess exposures in Vojvodina, uses lithologic and pedogenic criteria, MS variations, luminescence dating and amino acid geochronology as the primary bases for correlation (Markovic et al., 2006, 2007, 2008).

The destinct and characteristic magnetic susceptibilty variations recorded at key loess sections in Vojvodina provide important and significant similarities to the enviromagnetic records observed at other Eurasian loess sections. These open possibilities to extend the stratigraphic correlation across the Eurasian loess belt from China via Central Asia to the middle Danube Basin. Therefore presented stratigraphic model of loess-paleosol seqences in Vojvodina can be considered as the missing link between Europe and Asia and their past atmospheric circulation systems.

INQUA-SEQS 2008

FROM THE PENULTIMATE GLACIAL MAXIMUM TO THE PRESENT: SEDIMENTARY ENVIRONMENTS AND LANDSCAPE EVOLUTION IN THE LONG RECORD OF FIMON LAKE (BERICI HILLS, NE ITALY)

Giovanni MONEGATO, Dipartimento di Geoscience, Università di Padova, via Giotto 1, 35137 Padova, Italy. *E-mail: giovanni.monegato@unipd.it*

Roberta PINI and Cesare RAVAZZI, CNR-Istituto per la Dinamica dei Processi Ambientali, Laboratorio di Palinologia e Paleoecologia, Piazza della Scienza 1, 20126 Milano, Italy

Quaternary sedimentary successions of selected sites in the south-eastern Alpine foreland were drilled and studied with a multidisciplinary approach. This presentation focuses on the detection of the glacial maximum events in the south-eastern Alpine border during the two last global glaciations and on the landscape changes occurred during the last 160 ky. Fimon Lake is located within a hollow of probable karstic origin in the Berici Hills, a low range of carbonate relieves at the western border of the Venetian plain. During its evolution the lake has been influenced both by the fluvioglacial evolution of the plain and by the aeolian input, as well as by slope talus during the phases of forest contraction evidenced in the pollen record. Three different drillings, two of them reaching the weathered bedrock, enable the analysis of the lacustrine record; pollen-stratigraphical data indicate a long lived lacustrine/marsh environment fed by local drainage and by the Astico Stream during the spread of the outwash plain.

After a few meters of slope talus, fed by poorly vegetated slopes, the lacustrine sedimentation started at the MIS6 onset (160 ka BP) when the Astico outwash streams passed the threshold with the plain. The fluvioglacial input was confined to the outer margin of the basin, where the growing of the outwash fan determined the threshold of the lake level. A high sedimentation rate, related to colluvial and aeolian inputs, characterizes this period: autochthonous organic sedimentation was very scarce. During MIS6 relevant stadial/interstadial phases are detected in the pollen record and they are consistent with those already described for the Azzano Decimo site (Friulian plain).

A continuous record of the Eemian interglacial is preserved in the Fimon Lake core. Mixed biogenic and clastic sedimentation pinpoints to wetlands extended in the whole basin suggesting an interruption of open lake environment. Lacustrine conditions re-established later: the pollen stratigraphy shows a sequence of stadial/interstadial phases consistent with other circumalpine records. During the Late Pleistocene the development of conifer forests alternates with phases dominated by xerophytic scrublands under cold and dry climate conditions. Several woody species were present in the surrounding hills also during the cooling phases.

At the LGM onset (30 ka cal BP) the shape of the lake was different from the present one, with wide littoral sectors where organic sedimentation took place. Since 22,461±96 a ^{14}C BP the restored deep water conditions corresponded to the spread and the aggradation of the outwash plain related to the maximum extension of the Astico glacier. This seems synchronous with the first glacial maximum advance recognized in the Tagliamento end moraine system in the eastern part of the Venetian plain. During the LGM the deforestation in the Berici Hills was persistent, with high rates of xerophytes that climaxed at the H1 event.

During the Holocene the lake size decreased up to the historical reclaims that shaped the lake basin to its present-day configuration.

The comparison among different records of the south-eastern Alps indicates that the last two glacial maxima were more as pronounced as those of the central-western sectors, both for the glacier advances and for the sedimentation rates in the plain. The causes of these changes might be sought in the improving of the southern atmospheric airflows that fed the southeastern Alps during the cold phases.

INQUA-SEQS 2008

STRATIGRAPHIC AND STRUCTURAL EVIDENCE FOR THE PLIO-QUATERNARY ACTIVITY OF THE ARBA-RAGOGNA THRUST IN THE EASTERN SOUTHALPINE CHAIN (FRIULI, NE ITALY)

Giovanni MONEGATO, Dipartimento di Geoscience, Università di Padova, via Giotto 1, 35137 Padova, Italy, *E-mail: giovanni.monegato@unipd.it*

Maria Eliana POLI and Adriano ZANFERRARI, Dipartimento di Georisoerse e Territorio, Università di Udine, via Cotonificio 114, 33100 Udine, Italy, *E-mail: eliana.poli@uniud.it*

New stratigraphic, geomorphologic and structural data in the Friulian piedmont plain let to delineate the Plio-Quaternary activity of the Arba-Ragogna thrust-system. It belongs to the Plio-Quaternary front of the eastern Southalpine Chain (ESC), a S-SE verging thrust-belt in evolution from middle Miocene to Present showing fault propagation folding and fault bend folding as typical mechanisms of shortening. Geometric and cinematic characteristics of the Arba-Ragogna thrust-system were recognised both using structural survey both industrial reflection seismic profiles that show a S-SE verging and about WSW-ENE to WNW-ESE striking imbricate fan of medium to low-angle thrusts. The outermost is the Arba-Ragogna blind thrust.

The continental Plio-Quaternary succession of the Friulian piedmont plain is dominated by thick sedimentary bodies of coarse conglomerate and gravel related to the Tagliamento river, and the Cellina and Meduna streams. The inferred thickness of the succession is of several hundred meters, glacial deposits related to the Tagliamento end moraine system are present in the upper part of the succession. In thin lacustrine to fluviatile fine-grained sedimentary bodies, palynological analyses yielded biochronological elements that allow improving the chronology of the succession, as well as the radiocarbon and OSL data for the younger units.

Sedimentary units are bounded by angular unconformities and discontinuities ascribed to fluvial and glacial erosion. Outcrops are located in the deep fluvial incisions trenching the piedmont plain.

Geological and stratigraphic surveys in the piedmont plain highlighted that the outcropping succession has been deformed because of the activity of the Arba-Ragogna thrust-system.

Near San Pietro of Ragogna, located on the anticline ramp of the Arba-Ragogna thrust, the 45° angular unconformity between the Messinian steeply-dipping conglomerate and the upper Pliocene conglomerate (45°-dipping towards the SSE) testifies the long–lasting activity of the fault. The stratigraphic succession continues with other five units bounded by angular unconformities with tilting lowering towards the younger, as in the composite progressive unconformity model related to a growing thrust.

The whole succession crops out few hundreds of meters downstream, in correspondence of Ponte Creek, which is superimposed on the strike of the fault. Here the bounding surfaces show vertical displacements whose values decrease towards the top. In turn the surface of the east bank of the Tagliamento River shows a displacement of about 4 meters between the two sides of the valley of Ponte Creek. The surface corresponds to the outwash plain of LGM age and strengthened by radiocarbon dating of wood remains that yield a calibrated age of 23,283–22,574 a BP. This suggest a vertical slip rate of 0.17 mm/a.

Westwards, morphotectonic elements are present at the tip-line of the Arba-Ragogna thrust near San Zenone hill: the 3 m high and 400 m long Valeriano-Lestans tectonic scarp, ENEWSW striking, deforms the surface of the plain.

Here the plain is connected with the development of the Meduna alluvial fan during the LGM and the radiocarbon data of the surface is close to the 22 cal ka BP.

The Quaternary deposits described inside the Valeriano Creek, a Tagliamento tributary, evidenced a displacement between middle Pleistocene units cropping out in the hangingwall of the AR thrust with those in the footwall. All these units have been chronologically set using OSL and radiocarbon dating and pollen data.

Westwards of San Zenone Hill the lack of morphotectonic evidence in the surface of the plain as well as in the slopes of the main streams, could be connected both with the coarse characteristics of the deposits, related with the Cellina and Meduna alluvial fan and with the lateral termination of the thrust.

Evidences of Quaternary deformations are also present along the Solimbergo thrust located in the hangingwall of the Arba–Ragona thrust. Near Travesio, at the tip line of the Solimbergo thrust, the upper Pleistocene deposits (dated 20,000 a cal BP) are deformed forming a WSWENE tectonic scarp 500 m long. The Quaternary activity is also testified by the upstream tilting of 10° of middle Pleistocene conglomerates along the Meduna Stream in the correspondence of the topographic anomaly.

Recent studies have identified the active fault segments and the seismogenic sources capable to generate earthquakes ≥6 in the Veneto-Friuli region, which is one of the most seismic areas in Italy. The Arba-Ragogna source cannot be related to historical earthquakes and that indicates that it is one of the “silent” seismogenic source of the ESC front.

INQUA-SEQS 2008

SEDIMENTOLOGICAL APPLICATIONS TO CORRELATE ERODED PALAEOLITHIC LAYERS WITH LOCAL PLEISTOCENE STRATIGRAPHY. A CONTRIBUTION TO GEOLOGICAL DATING

Jean-Laurent MONNIER and Briagell HUET, UMR 6566, CReAAH «Centre de Recherche en Archéologie, Archéosciences & Histoire» Laboratoire Archéosciences-Rennes, Université de Rennes 1, Beaulieu, CS 74205, 35042 Rennes Cedex, France, *E-mail: jean-laurent.monnier@univ-rennes1.fr, briagell.huet@univ-rennes1.fr*

In Western France (area of the Armoricain Massif) many remains of Palaeolithic settlements are present between low tide and high tide level, preserved under sand beach. It is mainly Lower and Middle Palaeolithic in Pleistocene loamy layers which have been partially eroded by the sea level up rise during post-glacial periods. Generally a local stratigraphic sequence, more complete, can be observed at a short distance, on the cliffs. The question is how to correlate the archaeological layer with the local stratigraphy, and after to the regional chronostratigraphic scale.

Correlations between loamy layers are demonstrated by sedimentological analysis: apart from direct observations on the field, granulometry, morphoscopy of quartz grains and mineralogical analysis (heavy minerals) are systematically used.

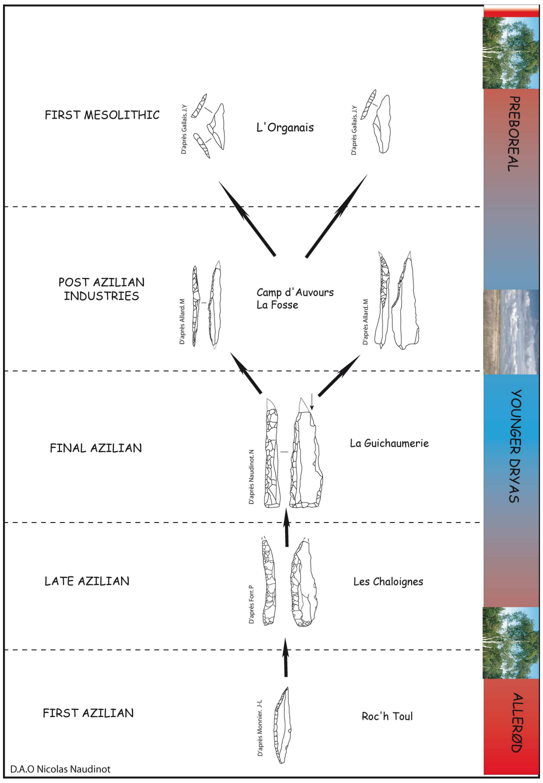
This method had been applied to several Palaeolithic settlements on the northern coast of Brittany. For example, in a first time it is possible to discriminate if the human occupation belongs to the Old Middle Paleolithic or to the Young Middle Palaeolithic, i.e. if it is before or after le last interglacial. When radiometric dating or complementary studies (as excavations) had been applied, chronological assessment had been generally confirmed. Even if OSL dating can be applied, it is useful to take into account chronostratigraphical data, because of the main sites which have been studied, according to this method, are: Piégu and Nantois at Pléneuf-Val-André, Côtes-d'Armor (Old Middle Palaeolithic), Les Gastines at St-Père-Marc-en-Poulet, Ille-et-Vilaine (Old Middle Palaeolithic), Goareva at Bréhat, Côtes-d'Armor (Young Middle Paleolithic), Roc'h-Gored at Carantec, Finistère (Young Middle Palaeolithic). Also an Upper Palaeolithic site (Plasenn-al-Lomm à Bréhat, Côtes-d'Armor) has been chronostratigraphicaly identified by the mean of sedimentological analysis.

INQUA-SEQS 2008

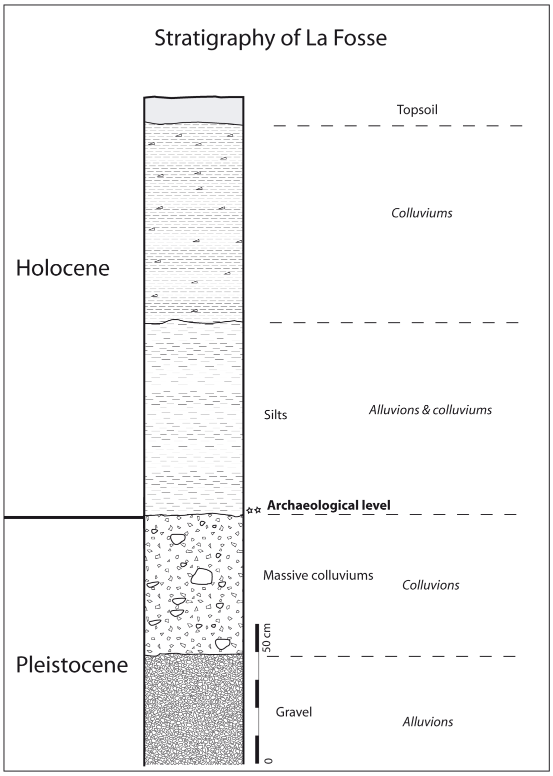
A LATE TARDIGLACIAL SETTLEMENT IN A MEANDER OF THE MAYENNE RIVER AT LA FOSSE (VILLIERS-CHARLEMAGNE, MAYENNE, FRANCE): A NEW OVERVIEW OF THE PLEISTOCENE / HOLOCENE TRANSITION IN WESTERN FRANCE

Nicolas NAUDINOT, UMR 6566, CReAAH « Centre de Recherche en Archéologie, Archéosciences & Histoire » Laboratoire Archéosciences-Rennes, Université de Rennes 1, Beaulieu, CS 74205, 35042 Rennes Cedex, France, *Email: nicolas.naudinot@univ-rennes1.fr*

Tardiglacial prehistory is a brand new discipline in western France. Studies of those cultures were behind the time for a long period despite some famous excavations like the cave of Roc'h-Toul (Guiclan, Finistère) by Le-Hir at the end of the 19th century (Le-Hir, 1874; Laplace, 1957; Monnier, 1980). When tardiglacial studies increased in other areas and especially in the Paris basin, western France tardiglacial still looked like a desert. The big turnover was the discovery and the excavation of an important Azilian settlement in Les Chaloignes in 1999 (Mozé-sur-Louet, Maine-et-Loire; Marchand and Sicard, *in press*). From this time investigations about those cultures has really began (Marchand et al, 2004). In this paper we will especially focus on the end of the period, at the transition between Pleistocene and Holocene, around 9500 cal. BC after the Azilian techno-complex and just before the first Mesolithic industries. For a long time, those industries were considered as Magdalenian because of the numerous long regular blades associated with small straight back micro-blades. Thanks to the lithic technology analysis of old collections like Le Camp d'Auvours (Saint-Mars-la-Brière, Sarthe; Allard 1982, Naudinot, 2004, 2006, *in press*) and new discoveries like La Fosse (Villiers-Charlemagne, Mayenne; Naudinot, 2007), despite the lack of dates, we are able today to draw an overview of this period in Western France and begin to connect those results with the rest of Western Europe.



Chrono-cultural chronology of the Tardiglacial in Western France



Stratigraphy of La Fosse

La Fosse is localized in a little alluvial plain, close to the biggest meander of the Mayenne River. The first artifacts were discovered in surveys by Bernard Bodinier in 2000. This site constitutes now one of the best references to study those groups because of a typological and technological homogeneous lithic industry in an unperturbed context exceptional in the area. People settled on a Younger Dryas layer characterized by massive colluviums from the slope. After the occupation, because of his situation, the site was sealed by a succession of fine colluviums deposits and overflowing silts resulted in progressive sedimentation which is exceptional in the area. Even if we still do not get absolute dates, this position of the archaeological level in the stratigraphy confirmed our chrono-cultural attribution of those industries to the Younger Dryas/Preboreal transition. The lithic assemblage shows perfect similarities with those studied in contemporaneous sites of the area such as at Le Camp d'Auvours. That is, both industries show similar production of regular micro-blades designed to manufacture straight back truncated points and big blades both extracted from well shaped nuclei. At La Fosse, the discovery of a typical ahrensbourgian point raises the question of an eventual link or influences with societies of the northern Europe plains. The good preservation condition of the archaeological levels allows us to perform new studies like spatial analysis or tools use wear study. Those new elements, in connection with lithic technology and raw material procurement study, constitute a good framework to start characterizing techno-economics and social patterns even if many questions remain.

Excavation of La Fosse in 2008

INQUA-SEQS 2008

DEVELOPMENT OF THE QUATERNARY MOLLUSCS FAUNA IN THE EASTERNMOST CONTINENTAL EUROPE (THE SOUTHERN URALS REGION)

Eugenia OSIPOVA and **Guzel DANUKALOVA**, Institute of Geology, Ufa Scientific Centre, Russian Academy of Sciences, K. Marx St., 16/2, 450077, Ufa, Bashkortostan, Russia, *E-mail: myrte@mail.ru, danukalova@anrb.ru*

Molluscan fauna in the easternmost part of Europe passed three main stages of the development during the Quaternary: Early Eopleistocene, Late Eopleistocene – Early Neopleistocene and Early Neopleistocene – Holocene (Tabl.).

The Early Eopleistocene stage corresponds with the Tyulyan time and warm climate. Molluscan assemblage consists of rare terrestrial (2) and numerous freshwater (22) species. Relic Pliocene species were numerous and represented by: *Viviparus tiraspolitanus* Pavl., *V. achatinoides* Desh., *V. baschkiricus* G. Ppv., *Bithynia croatica* Brus., *B. spoliata* Sabba, *B. vucotinovici* Brus., *Lithoglyphus decipiens* Brus., *L. naticoides* Fer., *Corbicula fluminalis* (Müll.), *Unio pavlovi* G. Ppv., *Potomida sturi* Hörn., *P. neustruevi geometrica* (Bog.).

The Late Eopleistocene – Early Neopleistocene stage is characterized by modern terrestrial (11) and freshwater (33) species of molluscs and by the presence of not numerous warm stenothermic Pliocene species. Relic Pliocene species existed in this complex were represented by *Viviparus achatinoides* Desh., *V. baschkiricus* G. Ppv., *Lithoglyphus decipiens* Brus., *Corbicula fluminalis* Müll., *Unio chasarius* Bog., *U. apsheronicus* Alizade, *Microcondylaea apsheronica* Tshep., *Bogatschovia scutum* Bog., *B. subscutum* Tschep., *Pseudosturia caudate* Bog., *P. brusinaiformis* Modell. and *Potomida sturi* Hörn.

The Early Neopleistocene – Holocene stage is characterized by terrestrial and freshwater molluscs of modern shape and consists of 20 terrestrial and 35 freshwater species.

During The Quaternary period fauna of mollusks transformed from the warm Pliocene assemblage to the moderate modern one. The development of fauna was gradual when warm Pliocene species disappeared step by step from the molluscan assemblages at the different stages and quantity of terrestrial and freshwater molluscs increased.

Table. Stages of the development of the Quaternary mollusks in the Southern Urals region.

Global Quaternary scheme Gibbard et al. (2004)			West European stratigraphic divisions (The Netherlands) Turner (1998), Zagwijn (1998), Ravazzi (2003)	Russia Zhamoida et al. (2006)			Southern Urals region Danukalova at al. (2007)	Evolution of molluscs during Quaternary	
System	Series	Subseries. Stages	Stages/ Informal Subdivisions	Series	Divisions	Links / Informal Subdivisions	Horizons	Molluscan Stages	Characteristic of the molluscan stages
Quaternary	Holocene		Upper	Holocene		Upper		Early Neopleistocene – Holocene	Modern species of the terrestrial and freshwater molluscs
			Middle			Middle			
			Lower			Lower			
	Pleistocene	Late	Upper Weichselian	Pleistocene	Neopleistocene	Upper	Kudashevo		
			Middle Weichselian				Tabulda		
			Lower Weichselian				Saigatka		
			Eemian				Kushnarenkovo		
		Middle	Drenthe glaciation Cold Interval with permafrost			Middle	Elovka		
			Bantega interstadial Cold Interval Hoogeveen Interstadial				Klimovka		
			Cold interval with permafrost				Larevka		
			Holsteinian Interglacial				Belaya		
			Elsterian			Lower	Chusovskoi		
			“Cromerian complex”: Interglacial IV				Atasevo		
			“Cromerian complex”: Glacial C				Tanyp		
			“Cromerian complex”: Interglacial III Glacial B Interglacial II				Baza	Late Eopleistocene-Early Neopleistocene	Modern species of the terrestrial and freshwater molluscs with presence of not numerous thermophilic Pliocene species of *Viviparus*, *Corbicula*, *Lithoglyphus*, *Microcondylaea*, *Bogatschevia*, *Pseudosturia*, *Unio*
			“Cromerian complex”: Glacial A				Minzitarovo		
		Early	“Cromerian complex”: Interglacial I		Eopleistocene	Upper	Oktyabrsky		
			Bavelian				Blagovar		
							Dombarovka		
						Lower	Khlebodarovka		
			Menapian				Udryak		
			Waalian				Raevka		
			Eburonian				Tyulyan	Early Eopleistocene	Transitional fauna. Terrestrial and freshwater molluscs with numerous Pliocene species of *Bithynia*, *Viviparus*, *Corbicula*, *Lithoglyphus*, *Unio*, *Potomida*
			Tiglian (upper part)						

INQUA-SEQS 2008

PEDO-, LITHO- AND MORPHO-STRATIGRAPHY OF THE LAST GLACIAL/INTERGLACIAL CYCLE CONTINENTAL SEQUENCES IN THE APENNINES (ITALY)

Pierluigi PIERUCCINI and Mauro COLTORTI, Dipartimento di Scienze della Terra, Università di Siena, Via Laterina 8, 53100 Siena, Italy, *Email: pieruccini@unisi.it*

Last Glacial/Interglacial cycle continental sequences are commonly well preserved and scattered across most of the valleys of the Apennines. They can be regarded as UBSU (Unconformably Bounded Stratigraphic Units), bounded by unconformable surfaces that correspond to important phases of changing dynamics linked to climatic variations and their interference with tectonic uplift (terrace formation). The main unconformities are related to Interglacials and characterised by valley downcutting and/or paleosol formation, whereas Glacial periods are characterised by deposition of thick continental sequences. However, paleosoils are preserved also within the Last Glacial sequences, often related to Interstadials. Late Middle Pleistocene deposits are weathered on top by buried or relict paleosoil (MIS 5e) characterised by strong weathering of primary minerals, complete decalcification, rubefaction, clay illuviation and formation of deep profiles typical of long lasting period of warm and humid climate under dense vegetational cover. The end of Interglacial conditions is marked by severe truncation of this paleosol and arrival of fresh calcareous material, by means of slope, fluvial and aeolian deposition. The older Last Glacial paleosoils (MIS 5c-5a) are commonly still quite developed, although often their characters are inherited by the colluviation of the Interglacial paleosoil.

Younger Late Pleistocene paleosols are less structured, with thinner profiles, only partially decalcified, with colluviation features and steppic and/or vertic properties indicating shorter living warm periods, instability of the topographic surface and seasonal contrast. Their erosion and burial is related to the shifting to Stadial and slope unstability conditions.

The Holocene paleosols usually show a greater contain of organic matter and are strongly eroded and truncated, although when buried their general characters do not differ very much from the Late Pleistocene ones. On more stable surfaces such as fluvial terraces, the paleosoils are more developed up to the formation of Bt and locally embrional Bts horizons.

They reveal good soil forming conditions up to ca. 5000 y BP, that is a much shorter time span than the Last Interglacial. Human activity played a decisive role in the disturbance of the pedogenetic conditions as revealed by the concentration of burnt bones, fires and pottery found more frequently on top of the soils or inside overlying colluvial materials.

INQUA-SEQS 2008

FEATURES OF FORMER SEA LEVELS RECOGNIZED AROUND CHANNEL ISLANDS' CLIFFS, THEIR CORRELATION WITH ADJACENT NORMANDY AND SOME IMPLICATIONS OF THE ISSUES RAISED BY THEIR IDENTIFICATION AND NATURE

John T. RENOUF. Le Côtil des Pelles, La Route du Petit Port, St Brelade, Jersey, Channel Islands, *E-mail: johnrenouf@orpheusinternet.co.uk*

H.C. Leslie JAMES, Visiting Fellow, The University of Reading, Bulmershe Court, Earley, Reading, United Kingdom. RG23 7HN, *Email: hcljames@tiscali.co.uk*

The Channel Islands, located in the Normanno-Breton Gulf, possess a rich assemblage of geomorphological features related to past erosional events, mainly marine, with those at heights below 40 m NGF often characterised by associated sediments. Researchers of both British and French origin have described the different occurrences by assessing the problems of origin and age from both geological and physical geographical perspectives. In spite of these researches, it has not been until the recent recognition of a tectonically induced rise in the land surface, independent of eustatic sea level, over at least the last 500 k years – and probably significantly longer – that it has become possible to suggest realistic dating of the features between 50 m and some 6 m NGF, i.e. above the present high tide in islands which have a tidal range in excess of 10 m. Unfortunately the dates proposed have not yet been backed up by any independent dating method though results are awaited from samples collected.

During the course of the research, the range of features on Jersey being studied were accurately levelled using an EDM (electronic distance measurer) producing information on former sea levels at some 10 m, 18 m, 23 m and 38 m. The raised beach notch at 23 m at St Clement in Jersey has long been known but an early confusion over its actual height became perpetuated in the literature as it was incorporated with those ranging up to 38 m. The four heights, each represented by a range of sub-features (sand, pebbles, notches) spanning several metres, have been compared with those reported from the other islands and additionally studied by the authors in the other islands. A good comparative correlation was established.

Early on, during the detailed work on Jersey and particularly on Jersey's northwest cliffs, a considerable number of cliff profiles extending from island plateau – variously at heights between 80 and 130 m – down to shore platform below some 8 m, were characterized by sections which possessed a col to landward of a prominence.The EDM levelling showed that these cols were at heights which suggested their linkage to the four raised sea level features described. Once this connection/relationship was established, examination of cliffs around Jersey confirmed the occurrence of many such col-and-prominence features and subsequently the now predictable association was found widely in Guernsey and Herm based on examination of published contour maps. Furthermore, other col-and-prominence features of a like nature have been identified at heights well above that of those possessing known marine sediments or notches; one such example is at Belle Hougue Point midway along Jersey's north coast immediately above the well known and dated '8 m' MIS 5e beach has a slight col at *c* 110 m and a more pronounced one at *c* 120 m.

Access to digital data has not yet proved possible but should enable the full spectrum of associations to be identified and recorded with unprecedented accuracy. To date it has also not proved possible to discover a satisfactory origin for the feature beyond determining that it is closely connected to erosion at the related sea level of the time; certainly in the granitic rock terrains of northern and southwestern Jersey and the granodioritic and gneissic rocks of southern Guernsey and the granodioritic rocks of Herm, planar lines of weakness due to variations in relative joint numbers and strengths and also shear zones identify where the differences in erosion are located but offer no explanation on why the differences in height occur and are so pronounced and regular.

The four lower levels as identified (some 10 m, 18 m, 23 m and 38 m respectively) in the Channel Islands from present and earlier work can most persuasively be correlated with those reported from the Val de Saire in the northern Cotentin. From this, the same dates there proposed have been provisionally adopted here, i.e. 10 m representing MIS 5e, 18 m MIS 7, 23 m MIS 9 and 38 m MIS 11. The presence of a number of as yet imprecisely defined higher levels suggest that the so-called staircase of terraces defined for southeastern England and for Normandy may probably be correlated with these in whole or in part.

The recognition of the tectonic rise of the land over many hundreds of thousands of years will have considerable importance in future explanations of how the cliff lines of the Channel Islands and adjacent areas have been created, and over what time span. The origin of the present platform from which they arise – beneath shallow water at present – is also a question that needs addressing to determine whether it has been in existence longer than the Tertiary range that has been assigned to it.

One of us (JTR) has been much involved over the years with applying geological expertise to archaeological work and one issue which is of relevance to the present study is the effect that the creation of such cols has had on the location of barred promontories. It may be that different phenomena are involved but col-and-prominence features on both cliff profiles and their summits probably have a similar explanation; the series of such cols-and-prominences on the Jerbourg peninsula of southeastern Guernsey is particularly striking. In addition once the sea levels are known, the 'flats' or platforms associated with them have likely relevance to archaeology. On Jersey the siting of one of the island's important Neolithic passage graves, that of Le Mont Ubé in the southeast, is on a flat area – which may prove to have a col-and-prominence form – is at *c* 36 m which represents the oldest of the four sea levels identified above. It is more than likely that the Grand Monceau Neolithic monument on Herm sits on the same shelf.

INQUA-SEQS 2008

THE GROTTA GRANDE OF SCARIO (SALERNO, ITALY): A SPOT ON THE ARCHEOLOGY AND THE ENVIRONMENT DURING THE LAST INTERGLACIAL (OIS 5) OF THE MEDITERRANEAN REGION

Annamaria RONCHITELLI and Paolo BOSCATO, Dipartimento di Scienze Ambientali "G. Sarfatti" - U.R. Ecologia Preistorica, Università di Siena,Via delle Cerchia 5 - 53100 Siena, Italy, *E-mail: ronchitelli@unisi.it, boscato@unisi.it*

Federico MASINI, **Daria PETRUSO** and Giovanni SURDI, Dipartimento di Geologia e Geodesia, Università di Palermo, Via Archirafi 22 - 90123 Palermo, Italy, *E-mail: fmasini@unipa.it, dariape72@unipa.it, gsurdi@unipa.it*

Carla Alberta ACCORSI and Paola TORRI, Dipartimento del Museo di Paleobiologia e Orto Botanico, Università di Modena/Reggio Emilia, V.le Caduti in Guerra 127 – 40132 Modena, Italy, *E-mail:carlaalberta@unimore.it*

The Site. The Grotta Grande of Scario is a coastal cave located in the centre of Mediterranean region on the Tyrrhenian side of the Italian Peninsula. The morphology of the cave and the sedimentary processes were controlled by the eustatic fluctuations during the late Middle Pleistocene and the early Late Pleistocene. The cave was frequented by humans of Middle Palaeolithic culture. The site is located 2 Km from the village of Scario (Salerno, Campania, Southern Italy). The cave, which develops along a fault perpendicular to the coast line, is formed by two large chambers joined by a short corridor. The external chamber opens directly on the sea. Excavations have been carried on since 1979 by the University of Siena in collaboration with Soprintendenza Archeologica of Salerno. Six test pits have been excavated, the most significant of which are located close to the entrance of the cave (trenches A, F), while a third pit, whose study is in progress, is located along the corridor (trench C).

Stratigraphy. Two different series have been recognised in trench A. The older one (about 2,4 m thick) is represented by a marine conglomerate at the bottom, followed by continental sandy - silty deposits sealed by a stalagmite. An erosional surface cuts these deposits, followed by a red cemented breccia with alternating concreted archaeological and earth levels that represent the younger series (about 1 m thick). The occurrence of *Cladocora coespitosa* and *Spondylus* sp. within the basal conglomerate and a 135 ± 11 Ka dating (230Th/234U method) of the stalagmite suggests that the lower series of trench A may have formed during the interglacial-glacial cycle correlated to the OIS 7 – OIS 6. The retrieval of *Strombus bubonius* within the basal level of the younger sequence indicates that the deposition of this series possibly started during a high-stand phase nearly contemporaneous or slightly after the Eutyrrhenian (OIS 5e). The series of trench F (about 1 m thick) is more articulated and a very synthetic report is given here. The bottom is made up by a breccia level with *S. bubonius* and *Patella ferruginea* followed by a marine conglomerate on which a continental series is superposed. The continental deposits are mainly archaeological, and are sealed at the top by a tephra level. The discovery of a paleo-surface inhabited by humans within the continental levels is noteworthy. The occurrence of the warm molluscs assemblage in the basal level suggests that the deposition of this series also started after the Euthyrrhenian high-stand.

Archaeology. Trench F is particularly interesting for the presence of structures which organize the living space, both horizontally as well as vertically, in between them. These structures, rather rare in Middle Palaeolithic, testify to a settlement organization, with clean areas separated from spaces with waste products accumulation. A small stretch of wall made up of large stalagmite intentionally resting on a pile of stones, bones and ground separates in this area the cave atrium from a shallow tunnel, a sort of a little cave into the cave. Inside the tunnel there is an accumulation of stones, pebbles and pieces of concretion, lithic tools and bones along the two lateral walls; the central band is almost totally free of materials and completely free of charcoal. The lithic industry is characterized by the prevalence of calcareous knapped pebbles over the debitage products, only half of which being in flint materials. Just in the outside zone, in the both areas A and F, retouched implements (mostly lateral convex scrapers and transversal straight scrapers) appear together with flakes and more numerous cores. The Levallois system is present. The raw material used by prehistoric men was mainly flint pebbles but also jasper or quartzite are utilised; a small part of lithic industry is made out of bad quality flint lists, stratified in the limestone of the territory near the cave.

Vertebrates. Mammals, birds, reptiles and amphibians remains have been found, but only mammals have been studied in the details. Trenches A and F yielded a fairly diversified large mammal assemblage. The ruminants are common in both trenches and include ibex, fallow deer, red deer and bison, while roe deer and chamois are present in trench A only. The occurrence of wild boar is sporadic. Scant remains document the occurrence of the straight tusked elephant and of a hippo in trench F, while a single specimen documents the forest rhino in trench A. Carnivores are rare: only the brown bear is represented by skeletal remains, while the probable occurrence of a hyena is documented by one coprolite found on the human occupational surface in trench F. Large mammal remains are concentrated within the archaeological levels. Small mammals are represented by more numerous remains and document a well diversified assemblage. The long tailed field mouse (*Apodemus sylvaticus*) is the dominant taxon. The water vole and the Savi ground vole are present in both trenches, while the bank vole (*Clethrionomys glareolus*) is present only in trench F. In trench A some pine voles (*Terricola subterraneus*) have been identified. The fat dormouse (*Glis glis*) occurs in both trenches but it is more represented in the lower levels of trench F associated with the common dormouse (*Muscardinus avellanarius*), while the garden dormouse (*Eliomys quercinus*) is present only in trench A. Among insectivores three species of mole, the lesser white toothed shrew (*Crocidura suaveolens*) and the bicoloured shrew (*Crocidura leucodon*) have been recognised in trench F, while only *C. suaveolens* and *Talpa europaea* have been so far identified in trench A. The hedgehog is a sporadic occurrence in trench F only. Eventually some bats also occur, which have still to be studied in the details. The changes in the relative abundance of small mammal taxa indicates a forested environment in the lower part of the continental deposits of trench F, as it is documented by the abundance of dormice and the occurrence of the bank vole. The landscape evolves towards more open conditions (perhaps related to more arid climate) in the upper portion of the F sequence. The occurrence of the hippo and the abundance of fallow deer remains confirms the temperate–warm climate in the lower deposits. The lower series of trench A lacks vertebrate remains, while vertebrates occur in the upper part of the younger sequence. The large mammal assemblage is here dominated by the ibex followed by the fallow deer and the roe deer. The sporadic occurrence of the chamois is noteworthy. Among small mammals the Savi ground vole is abundant, while the dormice are poorly represented. This assemblage seems to indicate a landscape that was locally less forested and cooler climatic conditions, that are likely posterior to the warmer forested environment in which the F trench series was deposited.

Palinology. Pollen was studied in both sequences of trench A (published data) and the analysis of trench F is in progress. In the lower A sequence pollen showed a forest landscape (*Abies*, *Juniperus* type, *Pinus,* deciduous broadleaves, *Quercus ilex* and other Mediterranean trees) and some shifts of vegetational belts possibly forced by minor climatic oscillations. In the upper A sequence pollen suggest that more significant climatic-depending vegetation changes had occurred and forest clearance was in progress. At the top the climate shifted towards cooler conditions and a dry steppe-like vegetation spread in the landscape.

Conclusions. The Grotta Grande record can be positioned within the climatic fluctuation posterior to the warm interglacial OIS 5e peak. Deposit of this interval are rather uncommon even in the Italian peninsula and therefore the integration of sedimentological, archaeological, faunal and palinological data provides an important piece of information to the puzzling reconstruction of the Late Pleistocene Mediterranean environments before the onset of the glaciation.

INQUA-SEQS 2008

MIDDLE PLEISTOCENE STRATIGRAPHY IN THE LIGHT OF DATA FROM THE BUIVYDZIAI SITE, EASTERN LITHUANIA

Vaida SEIRIENE, Petras SINKUNAS, Dalia KISIELIENE and Migle STANCIKAITE, Institute of Geology and Geography, T. Sevcenkos 13, LT-03223, Vilnius, Lithuania, *E-mail: seiriene@geo.lt*

During the Middle and Late Pleistocene the deposits of two interglacials: Butenai (Holsteinian) and Merkine (Eemian) are singled out in Lithuania. Some researches are distinguishing one more - Snaigupele (Drenthian-Warthian) interglacial consistent with MIS 7 (Marine Isotope Stage) and dated approximately to 240-190 ka based on the luminescence (TL, OSL) dating. The presence of Snaigupele Interglacial has been discussed by many authors and is still open to debate. The sediments of this age have been discovered mainly in eastern part of Lithuania in several sections. Buivydziai outcrop is one of possible key section for solving this problem. The exposure presents 70-80 m sediment thickness of Middle and Late Pleistocene, characteristic for the area of maximum extent of Last Glaciation. The interglacial is presented by gyttja layer of 3-3.5 m thick which occurs at the lowermost part of the section. These sediments have a meaning as parastratotype of Snaigupele Interglacial so far. Four layers of tills have been recorded in the Quaternary sediment sequence there.

Recent investigations were initiated in order to clear up the stratigraphical position of the interglacial sediments and to obtain new palaeogeographical information. Pollen, macrofossils, diatom, lithological, isotope ($\delta^{18}O$ and $\delta^{13}C$) studies and Optically Stimulated Luminescence (OSL) dating were carried out.

Pollen composition of Snaigupele Interglacial according to O. Kondratiene investigations of the stratotype section (Snaigupele-705) is closest to Merkine (Eemian) interglacial. However the abundance of *Corylus* and broad-leaved trees is approximately twice smaller. *Tilia* curve behaves unusually forming an earlier and reduced maximum than in Merkine Interglacial.

Alnus appears and spreads simultaneously with broad-leaved trees (exept *Carpinus*), much earlier than the *Corylus. Quercus* has two optima: at the beginning of the climatic optimum of the interglacial and at the beginning of *Carpinus* expansion. All these characteristic features were also observed in pollen diagram recently compiled on new data except of few differences: the second optimum of *Quercus* is not very distinct; *Picea* appeares in much higher quantities during all interglacial.

Plant macrofossils obtained have some similarities with Merkine (Eemian) as well as with Butenai (Holsteinian) ones. The main characteristic features are: 1) prevailance of coniferous trees during all the period studied: the beginning of interglacial is dominant by *Larix* cf. *decidua* and the climatic optimum – by *Pinus sylvestris* L.; 2) slight increase in broad-leaved trees (*Tilia, Carpinus* cf. *betuloides, Frangula alnus*); 3) presence of extinct species such as *Caulinia lithuanica* Risk., *Azolla interglacialis* Nikit., *Hypericu*m ex gr. *coriaceum* Nikit.

Diatom flora is characteristic of slightly oligotrophic – eutrophic gradually overgrowing palaeobasin. Species of *Cyclotella kutzingiana* var. *schumannii* has distinctive features in frustules morphology comparing with recent ones. Species *Cyclotella radiosa* var. *lichvinensis*, which became extinct at the end of the Middle Pleistocene are present as well.

Finally, two samples from the lacustrine sand deposits just below the interglacial gyttja were taken for Optically Stimulated Luminescence (OSL) dating. Dating results show 300.5 ± 20.9 (TLN 1664-075) and 317.3 ± 21.8 ka (TLN 1665-075) age. According these data investigated sediments can be attributed to MIS 9.

This study was supported by Lithuanian National Science and Studies Foundation within the project V-08014.

INQUA-SEQS 2008

PALEOVEGETATION OF THE RUSSIAN PLAIN IN THE HOLOCENE ATLANTIC OPTIMUM BASED ON PALYNOLOGICAL DATA

Aleksandra SIMAKOVA, Geological Institute, Russian Academy of Sciences, Pyzhevsky 7, Moscow, Russia, *E-mail: simak2001@mail.ru*

The Holocene Climatic Optimum occurred in the final stage of the Atlantic period and is determined by different authors as the interval between 6000 and 4800–4600 yr ago.

New palynological characteristics for the Atlantic Optimum from alluvial-draw and pit deposits of the Kramskoi Log, Senovaya, Podol'e, Pokrovka and Ricasikha sections (Panin, et al., 2001; Sycheva et al., 2002; Zaretskaya et al., 2007) located on the Russian plain, are available. Based on the studied objects and published palynological records the paleovegetation cover on the Russian plain during the atlantic optimum was reconstructed.

In the northernmost regions forest tundra was represented by alternating areas of moss–underbrush tundra with *Betula nana* and *Salix* and of sparse taiga vegetation (pine–birch formations on the Kola Peninsula and spruce–birch formations on the Baidaratskaya Guba coast).

In the southern area up to 57–60º N, wide territories were occupied by taiga coenoses. The pine–birch and larch forests with *Picea*, *Abies*, and subordinate *Alnus, Tilia, Corylus*, and *Ulmus* were distributed in the northern part of the Russian plain. The area south of 66º N was occupied by pine–spruce forests with *Tilia, Corylus, Carpinus*, and *Quercus.*

To the south, up to 52-55º N, mixed forests were widespread. Coniferous–broadleaved and broadleaved forests were developed in the west. Mixed forests with elements of meadow forest steppe prevailed in the east of the Russian Plain (east of ~30º E).

In the frame of the mixed forest zone were the areas of taiga vegetation inherited from more ancient epoch and located on the Moscow, Privolzhskaya, Neman and Central Russian highlands and in river valleys.

The forest-steppe zone extended on the north approximately at 250–300 km from modern borders. The forests were represented by pine-broadleaved coenoses and the open areas, by meadow and grass steppes. South of 50º N forest-steppe assemblages have got more xerophile character. The forest areas reduced but did not disappear. The Black Sea, Sea of Azov, and western Caspian Sea regions were occupied by *Artemisia*-Poaceae and Chenopodiaceae-*Artemisia* steppes alternating with pine-broadleaved forest with *Alnus, Corylus, Carpinus* and *Quercus.*

Semidesert and steppe plant assemblages were located in the lower reaches of the Volga River and in the Caspian Sea region.

The landscape conditions of the Holocene Atlantic Optimum were warmer and dryer than modern ones in the north and in the central parts of the Russian Plain. Climatic parameters in southern areas of the Russian Plain were close to modern or more soft due to insignificant humidifying (Klimanov, 1982; Kremenetskii, 1998).

The greatest diversity of flora is revealed in the highlands and dissected territories which played a role of refugia during the previous glacial time. Here, the species of various ecological attribution could be present.

This study was supported by the Russian Foundation for Basic Research, project № 06-05-64049a.

INQUA-SEQS 2008

IMPLICATIONS ON THE SEDIMENT AGE FROM PLIOCENE/PLEISTOCENE BOUNDARY IN DAUMANTAI OUTCROPS

Petras SINKUNAS, Dalia KISIELIENE, Valentas KATINAS, Migle STANCIKAITE and **Vaida SEIRIENE**. Institute of Geology and Geography, T. Sevenkos 13, LT-03223, Vilnius, Lithuania, *E-mail: seiriene@geo.lt*

Daumantai outcrops are situated on the right bank of middle Šventoji River north-east Lithuania where sediment sequence nearly 30 m thick is exposed. Prepleistocene sediments with the sedimentation break lying on Devonian sandstone passes to Pleistocene ones and are covered with glacigenic deposits on uppermost part. The sediment sequence is an intriguing object due to the Pliocene/Pleistocene boundary thought to be embedded. The sedimentary environments and stratigraphy of these deposits from two outcrops have been discussed for a long time. Study of pollen, plant macrofossil, grain-size, mineralogy, geochemistry and sediment structures was applied there repeatedly. All the investigators suggested the idea to fix the Pliocene/Pleistocene boundary in this sediment sequence on the results of different analysis types.

According to the plant macrofossil data, the sediments sequence can be subdivided into several intervals, differing both in species composition and encountered quantity of the plant remains. The lowermost part of the sediment sequence is characterised by heterosporic plants, tipical for Pliocene, i.e. *Salvinia glabra* Nikit., *Salvinia intermedia* Nikit., *Azolla pseudopinnata* Nikit., where *Salvinia intermedia* is more typical for the first part of Pliocene. *Salvinia aphtosa* Wieliczk., *S. tanaitica* Dorof., *Pilularia pliocenica* Dorof., *Sparganium noduliferum* DC., *Dulichium vespiforme* C. et M. Reid, *Scirpus longispermus* Dorof., *Hypericum tertiaerum* Nikit., *Naumburgia subthyrsiflora* (L.) Reichb, *Potamogeton* cf. *planus* Nikit. are also recorded by some authors. Thus, the Pliocene macroflora consists of extinct species mainly. The vegetation type is based on the palynological data where tree pollen composes 70-80 % of the total with the predominance of Pinus. Recorded composition of the vegetation cover indicates the gradual deterioration of the climate typical for the Pliocene / Pleistocene transgression. It is confirmed by extinction of the warm-demanding exotic species.

According to the recent magnetic polarity stratigraphy the normal polarity directions were obtained from the upper part of the sediment sequence interpreted as representing the lowermost part of the Brunhes Chron (< 0.78 Ma). A zone of reversed-polarity dominance is recorded in the lowermost part of the sequence which is possible to interpret as representing the Matuyama Chron. Also a thin zone of normal polarity is recorded in this interval to be interpreted to represent the Jaramillo subchron. The interpretation of magnetic polarity records obtained from the lowermost part of the sequence barely correspond to the palaeobotanical data, so the interpretation of the zone of normal polarity to represent the Olduvai can be discussed.

This study was supported by Lithuanian National Science and Studies Foundation within the project V-08014.

INQUA-SEQS 2008

THE IMPORTANCE OF HORSE REMAINS FOR THE LATE MIDDLE PLEISTOCENE BIOSTRATIGRAPHY OF THE BRITISH ISLES AND CENTRAL EUROPE

Eline VAN ASPEREN, PALAEO, Department of Archaeology, Biology S Block, University of York, York YO10 3DX, *E-mail: envanasperen@palaeo.eu*

Over the last decades, researchers have become increasingly aware of the complexity of the Quaternary glacial-interglacial cycles. Correlation of sites with (sub)stages of the oxygen isotope record and with other sites has proven to be difficult. In order to be able to address questions that go beyond analysis of single sites it is necessary to have a rigid chronological framework.

For the British Isles, a biostratigraphic framework has been developed for the late Middle Pleistocene, incorporating geological, faunal and floral evidence. For the mammalian faunas, in particular, each interglacial stage was shown to have a characteristic fauna.

The caballoid horse lineage undergoes a size reduction and morphological changes over its temporal range. These trends are well-documented for the Late Pleistocene. For the late Middle Pleistocene, the picture is less clear, in part because it has proven difficult to date archaeological and palaeontological sites from this period relative to each other. The robust and generally accepted biostratigraphic scheme for the British Isles provides an opportunity to address the evolution of the caballoid horses in the late Middle Pleistocene. Thus, the potential use of caballoid horse remains for biostratigraphic purposes can be assessed.

Horse remains from the British Isles prove to be significantly different in morphology between oxygen isotope stages. These results can be compared with data on horse remains from central European (Benelux, Germany, Poland) sites. It has proven difficult to provide relative dates by other methods for many of these sites, and biostratigraphy may be crucial in establishing temporal correlations between sites.

Various statistical techniques can be utilised to assess differences between sites due to temporal and spatial differences in horse morphology. Morphological differences can aid in diagnosing the age of the stratigraphical layer that these remains originated from.

Furthermore, these differences may also provide ways of investigating questions regarding ecophenotypic influences on morphology, the role of migration and the effects and timing of insularity and geographic isolation. Morphological variation, especially variation due to climatic oscillations in temperature and humidity – the degree of oceanity / continentality, glacial-interglacial cycles and sea level changes – can be studied by comparing trends in horse remains from the British Isles and western and eastern continental Europe.

This research is supported by the European Commission under the Marie Curie Actions of the Sixth Framework Programme (PALAEO, MEST-CT-2005-020601).

INQUA-SEQS 2008

THE MID-EEMIAN COOLING : ORBITALLY FORCED SEA ICE EXTEND AND ITS INFLUENCE ON THE THERMOHALINE CIRCULATION

Brigitte VAN VLIET-LANOË and H. BELLON, UMR 6538 Domaines Océaniques, IUEM , Place N.Copernic, 29280 Plouzane, France , *E-mail: Brigitte.vanvlietlanoe@univ-brest.fr*

Valérie ANDRIEU-PONEL and Emmanuel GANDOUIN, IMEP – UMR/CNRS 6116 – Université Paul Cézanne, Bâtiment Villemin Europole de l'Arbois – BP 80 F 13545 Aix-en-Provence cedex 04, France

Patrick AUGUSTE, Viviane BOUT-ROUMAZEILLE, Murielle MEURISSE-FORT and Guillaume GOSSELIN, UMR 8157, Université Lille 1, Bât. SN5, F-59655 Villeneuve d'Ascq cedex, France

Dominique CLIQUET, UMR 6566 – Civilisations Atlantiques and Archéosciences, Drac / SRA 13 bis rue. Saint-Ouen, 14052 Caen Cedex, France

Nathalie COMBOURIEUX-NEUBOUT and Hervé GUILLOU, Laboratoire CEA-CNRS-UVSQ Domaine du CNRS, Bât. 12, Avenue de la Terrasse, 91198 Gif sur Yvette, France

Agust GUDMUNDSSON, JFS Geological Services Raudagerdi 31, 108 Reykjavik, Iceland

Charles VERPOORTER, UMR 6612 Laboratoire de Planétologie et Géodynamique, 2 rue de la Houssinière, B.P. 92208 44322 Nantes Cedex 3, France

The cooling complex event known as the Mid Eemian Cooling (MEEC 122-117ka) (Maslin, 1998) is mostly record in North-Western Europe and Euro-Siberian Arctic, both by vegetation and glaciers. It is never recorded inland in Northern and Southern America. In Africa, it is mostly recorded by the development of aridity. Specific features are recorded in NGRIP and GISP ice cores but not in Vostok nor EPICA. It is characterized by two thermal minima peaking at 122-120 ka and 119-117 ka respectively separating a marine high stand at 125 ka (about 6m above the MSL) and a second at 116 ka, close to the MSL.

This complex is characterized by the formation of an ice sheet with an extension similar to the Younger Dryas one in Iceland , with a Southwestern calving Vatnajökull (Van Vliet-Lanoë et al., 2007) and a thinning of 200m only of the Greenland Ice sheet (Tarasov & Peltier, 2003). Sea ice re-extended from 80°N to 45°S along the southern coast of Brittany as suggested by the evidences of walrus, ice rafted basaltic cobbles from SW Iceland (Hallefouet et al., 1988; Hallegouet & van Vliet-Lanoë, 1989; Van Vliet-Lanoë et al., 2006) and southward vegetation shift (Müller & Kukla, 2003) in Europe. In southern Europe, it is marked by aridity without marked cooling (Gandouin et al., 2007) and a chilling of the Mediterranean sea (Kallel et al., 2003).

Coupling data provided by published marine deep-sea cores over the world – with land records, especially along the Northern Atlantic and – with recent shifts in the thermohaline circulation (THC) related with the end of the Little Ice Age and the Global Warming, we are able to propose:

(1) a major deflection of the Gulf Stream due to the disappearance of the surface Irminger Current responsible for the first cold event of the MEEC probably boosted by orbital forcing with a limited impact in southern oceans

(2) a second event due to orbital asynchronicity (3 ka), mostly marked in the Southern Ocean and by aridity on Southern Africa but not clearly evidenced in Vostok ice core, probably also related to a temporary sea ice re-extent in the cooling trend initiated from 128 ka recorded in the Southern Ocean. This cooling trend is delayed from 115 Ka in the Northern Atlantic.

These observations suggest that the THC was not switched off after the Eemian Thermal Optimum.

INQUA-SEQS 2008

USE OF TEPHROCHRONOLOGY IN LATEGLACIAL SEQUENCES FROM EASTERN FRANCE

Anne-Véronique WALTER-SIMONNET and Gilles BOSSUET, UMR 6249 CNRS Chrono-Environnement, Université de Franche-Comté, 16 route de Gray, F-25032 Besançon cédex, France, *E-mail: anne-veronique.walter@univ-fcomte.fr*

Anne-Lise DEVELLE, CEREGE, Europôle Méditerranéen de l'Arbois, F-13545 Aix-en- Provence, France

Carole BÉGEOT, Pascale RUFFALDI, Jean-Pierre SIMONNET, Aurélie LEROUX and Chantal WACKENHEIM, UMR 6249 CNRS Chrono-Environnement, Université de Franche-Comté, 16 route de Gray, F-25032 Besançon cédex, France

Thierry ADATTE, Institut de Géologie, rue Emile Argand, Université de Neuchâtel, Neuchâtel, Switzerland

The Lateglacial, i.e. the interval between the end of the last deglaciation and the Holocene (ca 15,000-11,500 years) is characterized by an alternation of climate changes with very rapid transitions. For this time, the establishment of independent and accurate chronologies is crucial to correlate environmental and climatic changes as reflected in biotic and abiotic signal from continental lacustrine sediments. The use of tephras, which are instantaneous and time-synchronous atmospheric deposits, as time-parallel markers allows to build independent regional and inter-regional high precision correlations. During the Last Termination, many different volcanic provinces were active in Europe (e.g. Iceland, the Eifel, the French Massif Central, Italy). Considering the situation of these eruptive points, North-Western Europe, and especially Eastern France, lies in the center of this area.

Study of the record of the climatic variations occuring in western Europe since twenty thousands years leads to the discovery of tephras levels and « cryptotephras » in sediments cored in lakes from the Jura and Vosges mountains, and the Swiss plateau. Some of these levels are invisible to the naked eye. Their detection was obtained using magnetic susceptibility measurement or systematic investigation.

Our observations allow to complete the western boundary of the southern distribution of the Laacher See Tephra (ca. 12,900 yr, Eifel, Germany). This tephra has been already described in others lacustrine sequences from the Jura and the western and northern Europe. In the sites we have studied, the volcanic glass shards show geochemical compositions comparable to those of the middle and upper phases of the eruption which provide new geographical limits for the different phases of the eruption. Other tephra levels, never described in this region until then, have been detected and characterized. Two very discrete tephra levels, only observed in sites from the Jura and the Swiss plateau, present ages, mineral assemblages and plagioclase chemical compositions close to those of tephras that were emitted by the Puy de la Nugère (Chaîne des Puys, France) during the Alleröd (about 13,300 yr). Sites from the Vosges mountains are characterized by the occurrence of the rhyolitic Vedde Ash (ca. 12,000 yr, from the icelandic Katla volcano), deposited during the Younger Dryas.

Occurences of the Laacher See Tephra and the Veede Ash in in the same records from the Vosges and Jura mountains bring to the fore high variation of the sedimentation rate at the Allerød-Younger Dryas transition.

Our data show the importance of the Laacher See Tephra and the Vedde Ash. They occurrences in Lateglacial sediments from same sites permit to develop very precise chronology, and thus establish correlation of the Allerød-Younger Dryas transition, which they flank. They also allow to bridge the chronological gap between sedimentary sequences from Northern and Central Europe and those from Southern and Western Europe by providing so far “missing” radiocarbon dating for this time interval.

INQUA-SEQS 2008

EARLY PLEISTOCENE FLUVIAL HISTORY OF THE RHINE-MEUSE IN THE SOUTHERN NORTH SEA BASIN (NETHERLANDS)

Wim WESTERHOFF,TNO Geological Survey of the Netherlands, The Netherlands

The fluvial history of the south-eastern part of the Netherlands shows interplay of three main river systems: Rhine, Meuse and smaller rivers draining the central and northern part of Belgium. Downstream of their confluence, north of Aachen, deposits of Rhine and Meuse are mixed in the both the Pliocene and Early Pleistocene. Due to a marked change in the lithological and petrographical composition the Upper Pliocene and Lower Pleistocene deposits of the Rhine-Meuse system can be mapped separately from deposits supplied by to the northeast draining in Belgium originating rivers.

Recently revised lithostratigraphical schemes in Germany and the Netherlands resulted in a consistent lithostratigraphical framework that strongly constrains the interrelationship of the fluvial deposits supplied by the Rhine, Meuse, and the Belgian rivers. Tectonics and sea-level movements had a strong control on the Early Pleistocene sedimentation pattern. Up to 120 m thick fluvial deposits occur in the generally subsiding Roer Valley Graben, one of the main tectonic structures in the southern Netherlands. This sequence of fluvial deposits is interrupted by a wedge of shallow marine deposits. However, the general picture of the sedimentation pattern is that the ratio between accommodation space and sediment supply is low during the larger part of the Early Pleistocene. A feature probably related to the position of the southern part of the Netherlands at or nearby the hinge line of the North Sea Basin. In particular during periods of low sea-level, sediments of the Rhine-Meuse system bypassed the southern Netherlands and were deposited further to the north in the North Sea Basin. As a result, the preserved fluvial sequences appear to be discontinuous and may reflect only fragmentary parts of the Early Pleistocene. North en north-westward of the Roer Valley Graben the Rhine-Meuse system became part of the vast fluviodeltaic system of the Eridanos. This major fluvial system originated in the Baltic area and transported huge amounts of sediments into the North Sea Basin from about the Middle Miocene until its starvation at the end of the Early Pleistocene.

It will be discussed that a reliable subdivision of the Early Pleistocene in pollendefined stages and substages is hampered by the innate fragmentary fluvial record of the Rhine-Meuse.

OTHER PAPERS ACCEPTED BY THE EDITORIAL BOARD

INQUA-SEQS 2008

RESPONSE OF THE MIDDLE AND LATE PLEISTOCENE (MIS 6-2) RHINE-MEUSE FLUVIAL SYSTEM TO FENNOSCANDIAN GLACIATION: IMPRINTS OF PROGLACIAL LAKE FORMATION AND GLACIO-ISOSTATIC CRUSTAL MOVEMENTS

Freek S. BUSSCHERS, 1: Deltares/TNO Built Environment & Geological Survey of the Netherlands, P.O. Box 85467, 3508 AL Utrecht, the Netherlands. 2: Department of Paleoclimatology and Geomorphology, Faculty of Earth and Life Sciences, Vrije Universiteit, the Netherlands, *Email: freek.busschers@tno.nl*

Kim M. COHEN, Utrecht Centre of Geosciences, Department of Physical Geography, Faculty of Geosciences, Utrecht University, Utrecht, the Netherlands

Ronald T. VAN BALEN, Department of Paleoclimatology and Geomorphology, Faculty of Earth and Life Sciences, Vrije Universiteit, the Netherlands

Cees KASSE, Department of Paleoclimatology and Geomorphology, Faculty of Earth and Life Sciences, Vrije Universiteit, the Netherlands

Jakob WALLINGA, Netherlands Centre for Luminescence dating (NCL), Delft University of Technology, Faculty of Applied Sciences, Delft, the Netherlands

We present new data from the late Middle and Late Pleistocene record (Marine Isotope Stages 6-2) of the Rhine-Meuse fluvial system in the Dutch sector of the southern North Sea Basin. Quartz OSL-dating and pollen-data allowed time-correlation of fluvial degradationaggradation cycles and channel belt migration to phases of proglacial lake formation and glacio-isostatic crustal movements that are known be related to Fennoscandian glaciations.

Proglacial lake formation

Enigmatically elevated proglacial Rhine-Meuse sediments suggest that during the late Middle Pleistocene Drenthe glaciation (MIS6), the Rhine-Meuse fluvial system entered a vast proglacial lake that existed in the southern North Sea area south of the coalescing Scandinavian and British ice-sheets. The lake covered the entire southern North Sea area and had shoreline positions close to the current sea-level. We postulate the lake level to indicate the elevation of a saddle along a former drainage divide to the southwest of the North Sea Basin (Strait of Dover and Southern Bight) consisting of Cretaceous-Jurassic and/or Tertiary strata. We identified the development of a deeply incised valley during the terminal phase of the Drenthe glaciation, to represent the first Pleistocene Rhine-Meuse palaeovalley that continued through the Dover Strait. The valley, of which initial formation started due to spillage over the saddle, reflects the final down cutting event of the Strait of Dover to depths below interglacial sea level, allowing exchange of marine waters between the English Channel and North Sea during the following sea-level high stands (MIS5e, MIS1) postdating the proglacial-lake event.

Preliminary results from the northern Netherlands suggest that more proglacial lake phases existed in the MIS12-7 timeframe although better chronological control is needed to place these in a correct chronostratigraphic framework.

Glacio-isostatic uplift

Geophysical models that use ice limit data for input and sea-level field data for calibration, predict glacio-isostatic uplift of the foreland area around the late MIS3/MIS2 ice margins. We found indications that the Rhine-Meuse system was strongly influenced by this glacioisostatic controlled forebulge upwarping. Upwarping-controlled lateral valley tilting deflected the Rhine-Meuse channel belts after 35 ka. We observed a phase of strong incision shortly after (30-24 ka) which is explained as ongoing response to the glacio-isostatic upwarping and adaptation of the Rhine's longitudinal profile in order to maintain equilibrium profile as it traversed towards the Dover Strait. During a later stage (24-16 ka) glacio-isostatic controlled incision was overruled by high climate controlled sediment input and initial glacio-isostatic subsidence of the area. Re-migration of channel belts towards the direction of the former uplift indicates that glacio-isostatic forebulge collapse influenced Rhine-Meuse palaeogeography until far into the MIS2/1 timeframe.

INQUA-SEQS 2008

THE PLIO-PLEISTOCENE RISE OF THE APENNINE CHAIN: STRATIGRAPHIC, GEOMORPHOLOGICAL AND CHRONOLOGICAL DATA

Mauro COLTORTI, Dipartimento di Scienze della Terra, Università di Siena, Via di Laterina, 8, 53100, Siena, Italy, *Email: coltortiunisi.it*

The Apennines are made up of detachments and eastward thrusted nappes emplaced during the Late Miocene-Early Pliocene. Thrust-top basins developed during this period and are preserved in various parts of the chain along the Tyrrhenian (Tiber, Arno, Garfagnana, Gubbio, etc.) as well as the Peri-Adriatic side (Peri-Adriatic basin).

Their stratigraphy and their sedimentary fills testify to the syndepositional paleoenvironmental changes moving from one side of the Apennines to the other. The Apennines, including the already deposited early Pliocene sequences were planated at sea level at the end of the Early Pliocene and then emerged. This moment marks the beginning of the evolution of the fluvial network. At first the mountain chain was still located along the Tyrrhenian side and generated a series of east-flowing rivers which extended across the area that later became the Apennine chain. In some peri-Tyrrhenian basins the sedimentary record is made of eastward trending alluvial fans up to the Late Pliocene. During the Early Pleistocene uplift movements accelerated, with the highest rates along the axis of the range. A series of NS and NW-SE westdipping extensional faults were activated, connected to the progressive opening of the Tyrrhenian basin. Only major east flowing rivers continued to cut across the opposing fault escarpments and at the end of the Early Pleistocene the present day watershed was almost defined. This phase of drainage development is locally supported by alluvial and lacustrine deposits in wind gaps. In the eastern side of the peninsula, these wind gaps correlated to the Middle Pleistocene alluvial terrace (1^{st} order) which confirms a very recent age of mountain building, extensional fault activity and river diversion. In the western side fault activity conditioned the deposition in a series of newly developed tectonic basins. Rivers continued to drain the eastern side of the peninsula and due to the interference of downcutting and uplift, convergent terraces were formed. River reversal occurred on the Tyrrhenian side, together with very large tectonic basins, some of which nowadays hold lakes. River captures are also widely documented.

INQUA-SEQS 2008

THE LATE PLEISTOCENE AND HOLOCENE SEDIMENTARY RECORD IN SARDINIA

Mauro COLTORTI, Dipartimento di Scienze della Terra, Università di Siena, Via di Laterina, 8, 53100, Siena, Italy, *Email: coltortiunisi.it*

Manfred FRECHEN, Leibniz Institute for Applied Geosciences, Stilleweg 2, 30655 Hannover, Germany, *Email: Manfred.Frechen@gga-hannover.de*

Egidia MELIS, PROGEMISA S.p.A., Via Contivecchi 7, 09122 Cagliari, Sardinia, *Email: egidia.melis@progemisa.net*

Danila PATTA, PROGEMISA S.p.A., Via Contivecchi 7, 09122 Cagliari, Sardinia, *Email: dpatta@tiscali.it*

Christine THIEL, Leibniz Institute for Applied Geosciences, Stilleweg 2, 30655 Hannover, Germany, *Email: christine.thiel@gga-hannover.de*

Sumiko TSUKAMOTO, Leibniz Institute for Applied Geosciences, Stilleweg 2, 30655 Hannover, Germany

Sardinia, located between the Tyrrhenian and Balearic basin, is well known for its Late Pleistocene sedimentary record. In fact the type sequence of the Tyrrhenian marine high stand, correlated to the MIS5e, is located in the Gulf of Cagliari. The MIS5e type sequence and other coeval beach deposits scattered all along the coasts of the island have been dated in the past with the Isoleucine Ephimerisation method. We re-dated most of these deposits with U/Th, 14C and OSL dating during work for the new geological map of Italy (CARG Project) and we have been able to establish that some of them are Holocene in age. Moreover, the mean elevation of the inner margin of the Tyrrhenian maximum high stand varies from ca. 12 m in the Orosei Gulf to sea level in the Calasetta beach in the S.Antioco Island. This suggests a noteworthy neotectonic activity of the Island that is usually considered stable. The sedimentary record during the rest of the Late Pleistocene is mostly represented by alluvial, slope and aeolian deposits. Organic horizons interlayered with alluvial deposits in northern Sardinia allowed us to establish a Late Glacial deposition. A similar chronology is documented for the alluvial fan deposition in the Orosei Gulf. In the latter area, these deposits overlie a thick sequence of stratified slope waste deposits that crop out close to the present day sea level and testify to the severe cold climatic conditions during the Pleniglacial.

Radiocarbon dating also indicates that aeolian deposition was mostly confined to the late Glacial and especially during the Younger Dryas. With the onset of the Holocene the valleys of the island underwent a widespread downcutting and a series of telescopic alluvial fans developed, especially along the foot-slopes of the Campidano and Cixerri basins. Rising sea level created a series of bays and pocket beaches. At Santa Reparata bay, in the northernmost tip of Sardinia, a marine notch younger than 5 ka is preserved at + 1 m asl. A similar notch, whose dating is in progress, seems to be preserved in the Tharros Peninsula (Oristano) at + 1 m on the south eastern side, progressively rising to + 7 m on the south-western side where it also generated a very coarse marine terrace. A series of beach ridges were also created along the coasts and in some cases we have been able to constrain their deposition to post-roman times. They are most probably related to the long-shore drifting of sediments coming from the soil erosion activated by widespread deforestation. Some of these deposits include beach ridges which for a long time were considered to be Tyrrhenian in age. An example is the Is Arenas ridge, to the rear of the Poetto, the most frequented beach in Cagliari. This was mostly due to the fact that the beach sediments reach an elevation of + 5-6 m asl. This high elevation, due to its very recent age, could hardly be explained by the presence of some neotectonic movements and has to be explained in the changes that occurred to the coastal dynamics.

INQUA-SEQS 2008

ELEPHANTS OF GENUS *PALAEOLOXODON* (MAMMALIA, PROBOSCIDEA) IN QUATERNARY FAUNAS OF SIBERIA

Irina FORONOVA, Institute of Geology and Mineralogy, Siberian Branch of the Russian Academy of Sciences, pr. Koptiuga, 3, Novosibirsk, 630090, Russia, *E-mail: irina_foronova@mail.ru*

During Pleistocene, elephants of genus *Palaeoloxodon* Matsumoto, 1924 were mostly spread in Western Europe as well as in India, Japan and China. Numerous remains of these thermophilic animals, connected with forest landscapes, were mostly found in Italy, Spain, Great Britain France, and other countries of Southern Europe.

Fewer fossils of these elephants were described in Early(?)-Middle Pleistocene sites of Eastern Europe (Southwestern Russia, Moldova, Ukraine), Kazakhstan and Turkmenstan as *Palaeoloxodon antiquus* (Falconer et Cautley) with subspecies, *P. meridionaloides* (V. Gromova), *P. turkmenicus* (Dubrovo) respectively. These finds correspond to deposits of Likhvin Interglacial (Singilian fauna) which is sinchronous to Holsteinian (North-Euoropean Scale) or the end of Late Galerian — beginning of Aurelian (Italy), the time of acme of paleoloxodont elephants in Western Europe.

As for Siberia, the finds of Palaeoloxodon are very rare. Singualar molars and their fragments were found on Aldan river (Lena river basin, Eastern Siberia) and on Irtysh and Ob’ rivers (Ob’ Plateau, Western Siberia). They were refer to species Palaeoloxodon namadicus (Falconer et Cautley) and dated as Early and Middle Pleistocene (Vangengeim, Zazhigin, 1969; Vislobokova, 1973).

Three molars have been recently found in Middle Pleistocene (supposed) deposits on Sharap river (one of Ob' river feeders) in Southwestern Siberia. These M^3 dex, M_3 dex and M^2 sin appear to be from the same skull. The M2 is heavily worn out, while both of last molars are in good condition, they are in initial phase of wearing. Only one plate in the rear part of the crown is broken on each molar. Parameters of upper and lower M3 are as follows: molar length: 280 and 330 mm; crown height: 250 and 200 mm; width: 80 and 85 mm, plate number: 16 and 17; average plate frequency 5.5-6.0 and 4.0-5.0 per 100 mm; highly folded enamel, average plate thickness: 2.0-2.5 mm.

These morphometric data, proportions of crown, high hypsodonty and low plate width differentiate these molars from ones of mammoth lineage, allowing to attribute them to genus *Palaeoloxodon*. Important fact is that in length and height of crowns these molars are similar to *Palaeoloxodon namadicus*, while in crown width and plate frequency they correspond to *Palaeoloxodon antiquus*.

Environmetal conditions in the region, where paleoloxodont elephants were most widely spread, and rare finds of their fossils in Siberia indicate that their expansion to the East and North of Eurasia were impeded by continental climatic conditions. During cold epochs (when open landscaped were predominant in most of the Europe and in Siberia) these elephants survived only in warm and moist forests of Southern Europe. During warm epochs these forests and paleoloxodonts were expanding to Middle and Eastern Europe and partly to Siberia. According V. Gromova (1965), they could been inhabiting softwoods of moderate type with pine, birch, alder and osier.

The recent find of *Palaeoloxodon* molars in Southwestern Siberia brings us to pay closer attention to expansion and existence of this branch of proboscideans in Northern Asia and environmetal conditions on the territory during that period.

INQUA-SEQS 2008

THE LATE QUATERNARY VEGETATION ADAPTATION FROM THE MIDDLE DANUBE LOWLAND TO THE DONETS RIVER BASIN

Natalia GERASIMENKO, Earth Sciences and Geomorphology Department, National Tarasa Shevchenko University of Kyiv, Glushkova str., 2, Kyiv, GSP 680, Ukraine, *Email: geras@gu.kiev.ua*

The Late Quaternary vegetational changes have been detected on the base of pollen data from the sections located along the latitudinal transect in Ukraine. The westernmost sites Gat', Sokyrnytsa and Shayan are situated in the Transcarpathia which is a part of the Middle Danube Lowland. The Sadzhavka, Mykulychyn and Lunka sites belong to the eastern foothills of the Carpathians. The Muzychi, Stari Bezardychi and Vyazivok sections are located in the Dnieper basin (Central Ukraine). The easternmost sites Kryva Luka, Novoraysky and Novotroitsky belong to the basin of the Donets river which is the Don tributary. The Quaternary framework of Ukraine (Veklitch et al, 1993) is used to subdivide the stratigraphic sequences.

The Mikulino (Eemian) pollen succession is detected in the Kaydaky unit, the first interglacial after the Dnieper glaciation (Rousseau et al., 2001; Gerasimenko, 2001). During the pre-temperate phase of the Last Interglacial, pine forest with few broad-leaved trees existed in the Transcarpathia. *Picea-Pinus* forest with an admixture of *Betula* and few broad-leaved trees spread in the Eastern Carpathians. Birch-pine forest-steppe occupied the central and eastern Ukraine. In the Middle Dnieper basin, the earlier phase (M1), characterized by spread of *Picea* and sedges, and the later *Pinus-Betula* phase (M2) are detected.

During the early-temperate phase, Quercetum mixtum forest occupied Western and Central Ukraine. In Eastern Ukraine, Quercetum mixtum formed patches within the forest-steppe belt. In the Carpathian foothills and Transcarpathia, the next phase is marked by spread of *Corylus, Alnus* and polydominant broad-leaved forest (*Quercus, Tilia* and *Carpinus*). In Central and Eastern Ukraine, the increase of *Corylus* was followed by reduction of forest and spread of meadow-steppe (*Carpinus* was absent here).

During the late-temperate phase, *Carpinus* dominated in the Carpathian and Transcarpathian forests, and *Corylus* still was abundant. The broad-leaved forest with a high share of *Carpinus* occupied Central Ukraine. *Carpinus* also grew in the forest-steppe belt which existed in Eastern Ukraine. In Western Ukraine, the next phase is marked by appearance of *Abies*. In the Carpathian foothills, it grew when *Carpinus* was still abundant. In the Transcarpathia, *Abies* appeared together with a spread of *Picea,* simultaneously with reduction of *Carpinus*. The characteristic feature of the Transcarpathia is a presence of *Fagus* which appeared at the end of the early-temperate phase and became more significant at the time of *Abies* appearance. During the post-temperate phase, *Picea-Pinus* forest with small admixture of broad-leaved trees existed in Western Ukraine. The boreal forest-steppe (*Betula-Pinus* forest included few *Picea*) existed in Central Ukraine. Eastern Ukraine was occupied by steppe (few broad-leaved trees occurred in gullies).

The Tyasmyn unit corresponds to the first Early Glacial stadial. Grass-sedge communities of arcto-alpine type (*Lycopodium lagopus, Diphazium alpinum, Botrychium boreale* and *Betula* sect. Nanae et Fruticosae) existed in the Transcarpathia. Grassland occupied Central Ukraine, whereas Eastern Ukraine was covered by dry steppe.

The Pryluky unit includes two interstadials and the second stadial of the Early Glacial (Rousseau et al., 2001; Gerasimenko, 2001). During the first interstadial, the Transcarpathia was occupied by pine forest with admixture of broad-leaved trees (including *Carpinus*) and few *Picea*. The share of *Picea* and broad-leaved trees (particularly *Fagus*) increased in the low mountains. Few *Abies* also occurred here. Mixed forest (pine, birch and broad-leaved trees including *Carpinus*) existed in

Central Ukraine. Eastern Ukraine was covered by forest-steppe (with few broad-leaved trees). The vegetation of the second Early Glacial stadial was similar to that of the first stadial. During the second interstadial, in Western Ukraine forests included much less broad-leaved trees than during the first interstadial. The share of *Picea* and *Alnus* increased. Birch-pine forest (with few broad-leaved trees) existed in Central Ukraine, and forest-steppe occupied the Donets area.

The Uday unit corresponds to the Early Pleniglacial. In Transcarpathia and in the low Carpathians, the maximum spread of *Botrychium boreale*, arcto-alpine species of Lycopodiaceae, and the distribution of shrub birches indicate periglacial environments. Central Ukraine was covered by meadow-steppe and shrub-birch communities. Dry steppe occupied Eastern Ukraine.

The Vytachiv unit is correlated with the Middle Pleniglacial. In Transcarpathia and in the low Carpathians, *Betula-Alnus-Pinus* forest with few broad-leaved trees alternated with meadow-steppe. *Picea* grew in the low mountains (38,9±0,1 ky BP). In the sections of Central and Eastern Ukraine, three interstadials separated by stadials are detected. During the first one (41-47 ky BP) and the second one, birch-pine forest with small admixture of broad-leaved trees and *Picea* existed in the Central Ukraine. Meadow-steppe occupied Eastern Ukraine. During the third interstadial (30-34 ky BP), meadow-steppe also spread into Central Ukraine. The stadials had periglacial steppe vegetation, with cryophytes in Central Ukraine and with domination of xerophytes in Eastern Ukraine. Meadow herbs, *Pinus, Alnus* and arboreal *Betula* were typical for the cool interstadial 27-28 ky BP, detected in Central Ukraine.

The Bug unit corresponds to the first half of the Late Pleniglacial. Meadow-steppe of arcto-alpine type existed in the Transcarpathia and in the low Carpathians. Two phases of vegetational development are detected in Central and Eastern Ukraine. During the earlier one,the role of mesophytic herbs was significant in Central Ukraine, grassland occupied Eastern Ukraine. During the late one, grassland covered the Central Ukraine and dry steppe existed in the east. In Central Ukraine, shrub *Betula* and *Alnaster* grew at both phases. During the earlier Bug phase, there were four short periods of the spread of *Pinus*, arboreal *Betula, Alnus* and few *Picea* (forest-steppe).

The Dofinivka unit is the Middle Pleniglacial interstadial with ^{14}C-age between 18 and 15 ky BP (Gozhik et al., 2001). In the east Carpathian foothills, birch forest with small admixture of *Picea* alternated with shrub birch communities and meadows. In Central and Eastern Ukraine, dry steppe vegetation occupied plateau, birch and shrub birch grew in valleys. Shrub birch was more abundant in Central Ukraine. In South-Eastern Ukraine, few broad-leaved trees existed in gullies (the Amvrosievka site).

The Prychernomorsk unit corresponds to the end of the Late Pleniglacial. In the east Carpathian foothills, meadow-steppe spread at the expense of reduction of arboreal vegetation. A proportion of both xerophytic and arcto-boreal elements increased in steppe communities. *Betula* sect. Nanae et Fruticosae dominated over arboreal birch. Central and Eastern Ukraine were covered by steppe with prevalence of *Artemisia* (particularly in the east). The proportion of arboreal vegetation represented mainly by *Betula* sect. Nanae et Fruticosae, was very low.

The Late Pleistocene latitudinal vegetational changes in Ukraine demonstrate that during all time units, proportion of arboreal and herbaceous mesophytes, as well as general proportion of arboreal vegetation decreased from west to east. Thus, continentality of climate increased in this direction during both warm and cold periods. During stadials, cryophytes were more abundant in Western and Central Ukraine. Eastern Ukraine was evidently too dry for their spread. *Picea* did not grow in eastern Ukraine for the same reason. *Carpinus* reached Eastern Ukraine only during late-temperate phase of the Last Interglacial and during first Early Glacial interstadial. *Abies* and *Fagus* appeared at some phases only in the Carpathians and Transcarpathia. Dry steppe vegetational type appeared during the first stadial of the Early Glacial in Eastern Ukraine and during the end of the Early Late Pleniglacial in Central Ukraine. In the low Carpathians, the proportions of herbaceous xerophytes became noticeable at the end of the Late Pleniglacial.

INQUA-SEQS 2008

EXPLOITATION OF STRATIGRAPHIC, SEDIMENTOLOGICAL AND GEOARCHEOLOGICAL DATA IN NORTHERN FRANCE, COTENTIN AND BRITTANY: SIGNATURE OF STORM SURGES AND THEIR PROBABLY ANTHROPOGENIC IMPACT

Murielle MEURISSE-FORT, Inès LEROY and Laurent VERSLYPE,CRAN, Université Catholique de Louvain, 3 Avenue du Marathon, B-1348 Louvain-la-Neuve, Belgium, *E-mail: murielle.fort@yahoo.fr*

Guillaume GOSSELIN, MR 8157, Université Lille1, Bât. SN5, F-59655 Villeneuve d'Ascq cedex, France

Brigitte VAN VLIET-LANOË, Institut Universitaire Européen de la Mer, UMR 6538 Domaines Océaniques

Michel PHILIPPE, Musée Quentovic, 8 place du Général de Gaulle, 62630 Etaples-sur-mer & UMR 7041 ArScAn, Maison de l'Archéologie et de l'Ethnologie de Nanterre, France

High resolution stratigraphic, sedimentological, eustatic and palaeo-climatic data were originally obtained on coastal dunes of northern France (Wissant bay, Boulonnais and Picardy). This study is constrained by more than 60 new radiocarbon dating, by calibration of old data sets (for a total of 290 dating used) and by decompaction of peats and mud from core samples (Meurisse, in press).

This work allowed establishing a regional chronostratigraphic framework, which is then applied to the coasts of the North Sea, the English Channel and the French Atlantic. This intercomparison study allowed the reconstruction of a palaeo-environmental sequence of events then translated in terms of a sequence stratigraphy of the Holocene sedimentary prism (Meurisse, in press).

One of the main important features of this work is the evidence of an increase in frequency and violence of storms since the Roman times. This period is characterized by the build-up of the coastal dunes and by sporadic marine inundations under storm surges (e.g. characterized by interstratifications of dune and marine sands, often compacted). These events are generally mistaken for a true transgression, in the use of the traditional Dunkerquian transgressions model (Meurisse, in press).

After the definition of this first general chronostratigraphic context and the evidence of storms impact, we have integrated palaeo-ecological, archaeological and historical data. To combine these different sources, we have maintained our study in several spatial and temporal scales. This step will be leading to precise the chronological context of the coastal evolution, notably in the most recent periods. The fluvial dynamic and the progressive silting up of estuaries (e.g. in Picardy or in Cotentin), considerably limit today the navigation and the direct exchanges between populations. However, from the Bronze Age to the Modern Period, these coasts had been used as a link between the populations of British Isles, and those of the continent and of northern coastal domains. For this communication, we will focus our topic in three major cultural periods, on a regional scale: the old Protohistory, the Early Middle Ages (VI-Xth centuries) and the transition between Middle Ages and the Modern Period.

The new bores prospecting always associated with radiochronological and sedimentological data have contributed to refine the chronostratigraphic sequences, in a first time on a regional scale and, in a second time, on the more global context of the Western Europe.

The present acquisition of palaeo-ecological data will first precise the main phases of marine inundations on studied sites. In a second time, they will be used to characterize the specific/local influence of storm surges (e.g. in coastal marshes).

At the same time, the exploitation of old maps, notably by the study of anomalies in parcel boundaries or modifications of coastline or of river layout, contribute to “modelize” the morphological evolution of the valleys, coastal marshes/mires, and dune complexes. The joint review of these sources opens several perspectives. Writing documents (e.g. terriers, hagiography, diplomatic), selected for their land and hydrographic information’s, supply specific elements on the palaeo-morphology of the present estuarine zone. Finally, the crossed supplies of these different disciplinary contribute to precise the palaeo-environmental evolution of coastal sites and to develop an environmental interpretative context for the old and more recent archaeological discoveries.

INQUA-SEQS 2008

SOME CONSIDERATIONS ON THE CHARACTER OF MARINE ISOTOPE STAGE 7 IN CONTINENTAL RECORDS

Frank PREUSSER, Institut für Geologie, Universität Bern, Baltzerstrasse 1+3, 3012 Bern, Switzerland

A basic concept in continental Quaternary stratigraphy has been the assumption that interglacials occur with a ca. 100 ka-cyclicity. Furthermore, in loess palaeosol sequences each horizon representing modern soil development is often interpreted to represent full interglacial conditions. Combining the two assumptions given above and “counting from the top” of “interglacial soils” appears to be a straightforward option to “date” loess records. A similar approach has also been applied to continental pollen records. However, this approach has the major drawback that it is not independent and neglects evidence that has been provided from long and high-resolutions lacustrine (pollen), marine and ice core records. In particular, the structure of Marine Isotope Stage (MIS 7) (190-250 Ka) is significantly different from the proceeding (MIS 9) and following (MIS 5) warm stages in the isotope record.

The problem discussed above will be demonstrated based on evidence from different continental records and be compared with archives from the deep sea. It will be concluded that MIS 7 may, at least under some circumstances, represent up to three periods with interglacial environmental conditions. As a consequence, the whole chronological concept often applied in continental Quaternary stratigraphy may be, at least partially, invalid.

INQUA-SEQS 2008

BATS (CHIROPTERA, MAMMALIA) AS AN INDICATOR OF HUMAN ACTIVITY AND DINAMICS OF ENVIRONMENT CONDITIONS IN PALEOLITH TIME (ON EXAMPLES OF ALTAI AND CAUCASUS SITES)

Valentina V. ROSSINA, Paleontological Institute Russian Academy of Sciences, Profsouznaya str., 123, Moscow, 117997, Russia, *E-mail: ros@paleo.ru*

The landscape and climatic changes, denoted in Northwest Altai and Norh Caucasus at the end of Middle Pleistocene, were accompanied by the transformations in the mammal community Nadachowski, Baryshnikov, 1991; Agadzanyan, 2003, Dupal, 2004) and in the bat fauna in particular. During the archeological diggings of the Altai and Caucasus Paleolithic sites the numerous chiropteran records were collected.

During our observation of more than 9000 bone records of bats from paleolithic sites of Northwest Altai (Denisova cave, Caminnaya cave, etc.) was established, that Late Pleistocene bat community consisted of not less than of 8 species: *Myotis blythii*, *Plecotus aff. auritus*, *Eptesicus nilssonii*, *M. dasycneme*, *M. petax*, *M. brandtii*, *M. ikonnikovi* and *Murina leucogaster*. Bones of bats were collected mainly as a result of natural death of animals from winter hibernation colony. In morphology the majority of fossil specimens are identical to modern species, only the some Pleistocene forms are larger.

From the beginning of Upper Pleistocene to Holocene in fossil community of bats occured the increasing of the portion *Myotis blythii* – a species which distribution is connected with open landscapes. It evidences to gradual expansion the area of open type biotopes and reduction large forests during this period. That proves to be true by results of the analysis structure of communities other small and large mammals, and data of pollen analysis also (Malaeva, 1999). In the Denisova cave at the time than Paleolithic man began to exploit the cavity was noted by sharp falling of bat colony number because of the smoke produced by human fires.

In Holocene time there was a second turning-point in history of bat fauna Northwest Altai: as a result of increase in the area of large forests and reduction of steppe landscapes the portion of *M. blythii* has decreased in community of cave bats. Finally the bat fauna has got the modern character of typically taiga type. Thus, the landscape, climatic and anthropogenous factors have appeared defining for community bats of Altai.

Our studying of Late Pleistocene bats from the Matuzka cave of Northern Caucasus has shown, that fossil fauna have consisted of the following species: *E. serotinus; Vespertilio murinus; Nyctalus noctula; N. leislerii; M. blythii; Barbastella barbastellus; P. auritus; Rhinolophus ferrumequinum; Miniopterus schreibersii; Pipistrellus pipistrellus; P. nathusii; P. cf. kuhlii; Hypsugo savii; Myotis brandtii; M. nattereri; M. bechsteinii; M. emarginatus*.

The degree of safety of bones, structure and rations of different bat species indicate that pallets birds of prey were the main source of fossil material from Matuzka cave. *E. serotinus* and *V. murinus* are the most numerous species in the taphocenosis. Apparently because these species are presently the major hunting objects of owls (Schmidt, Topal, 1971; Ruprecht, 1990, 2005; original date).

The influence of the Paleolithic humans on cave-dwelling bat community was insignificant apparently because the Mousterian man used Matuzka cave as a short-term shelter for humans during hunting (Baryshnikov, Golovanova, 1989; Golovanova et al., 1995).

The curves of population dynamics of various vertebrates in the Matuzka orictocenosis have shown a clear correlation between the proportion of bats and rodents inhabiting different Pleistocene biotopes. The curves for bats has positive correlation with the proportion of rodents of mountain forest formations and negative correlation with the proportion of rodents living in open landscape, such as a mountain-steppe and shrub-and-grass (Fig.). This probably indicates that birds of prey periodically changed food objects, as owls do in the years of rodent population depression. When birds of prey captured more rodents of open landscape, the proportion of bats in their diet decreased, and vice versa. Accordingly to the population dynamics of bats is indirectly influenced by landscape and climatic changes in the area of Matuzka cave. During the time when the degree of forestation surroundings increased, the number of bat bones in pellets birds of prey increased. And on the contrary, the increase of patchiness of biotopes and expansion of the open landscapes attracted reduction of a portion bats in a diet birds of prey.

In the Mikulino interglacial (= Eem in the Western Europe) the chiropteran fauna of Matuzka cave was the richest and included thermophilic *Rh. ferrumeqiunum* and *Miniopterus schreibersii*. The stratigraphic ranges of these bat species mark the boundary between the Mikulino Interglacial and Valdai glacial period (= Wurm) on the Northwestern Caucasus. The finds of *Pipistrellus* cf. *khulii* and *H. savii* are also characteristic fauna association with that time.

The Valdai glaciation is characterized by a slightly poorer and less numerous bat fauna, which included *Myotis nattererii*, *M. emarginatus* and *M. bechsteinii*, and is distinguished by well-pronounced fluctuations of the proportions taxa. The proportions of psychrophilic faunal elements, such as *Plecotus auritus* and B. *barbastellus*, noticeably increased. So, the landscape-climatic factor has appeared defining for structure of chiropteran fauna Matuzka cave.

Thus, the general dynamics of the Chiroptera fauna reflects the changes in landscape and climatic conditions in the working area. In this sense the analysis of the structure fossil bat assemblages not only additional information on environmental changes, but also some cases, can be used as an independent criterion of such changes. In addition, the analysis of faunal structure of Pleistocene bats provides to important stratigraphic results and particular elements of the bat fauna can be used as biostratigraphic markers of time boundaries in Late Quaternary sediments.

This study was supported by the Russian Foundation for Basic Research (project nos. 08-04-00483-a).

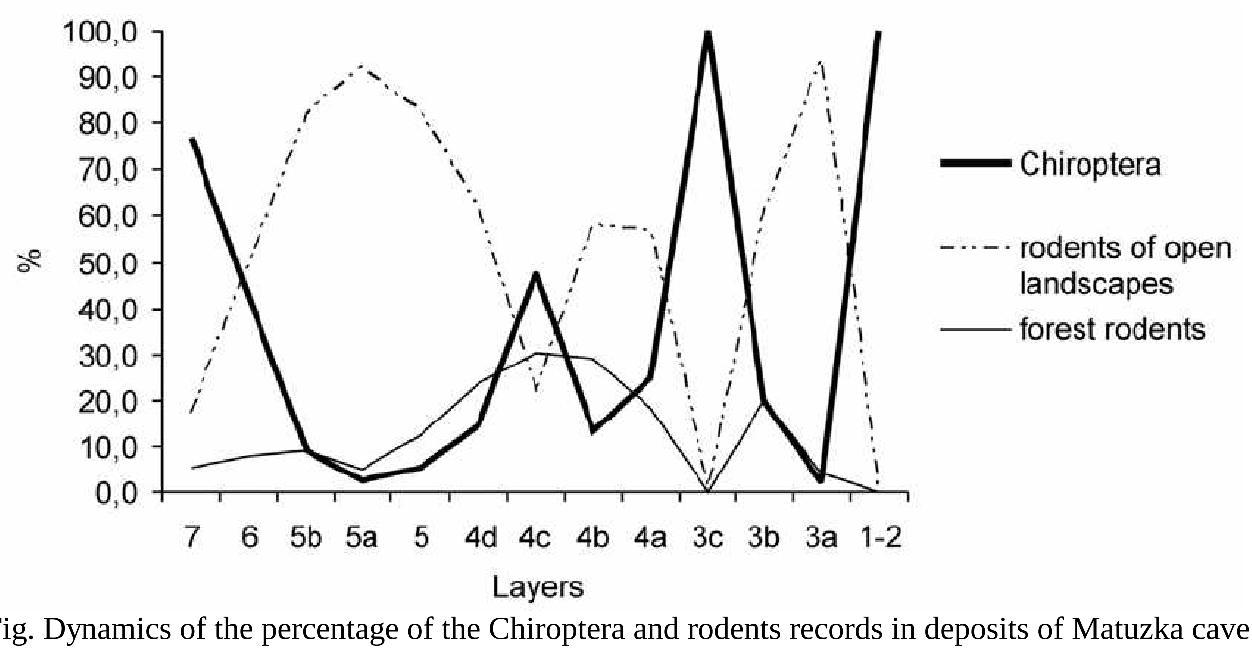


Fig. Dynamics of the percentage of the Chiroptera and rodents records in deposits of Matuzka cave

INQUA-SEQS 2008

LAKE SEDIMENTS IN THE RILA MOUNTAINS (BULGARIA): PALEOENVIRONMENTAL ARCHIVE OF POSTGLACIAL VEGETATION AND CLIMATE CHNAGES

Spassimir TONKOV and Elissaveta BOZILOVA. Laboratory of Palynology, University of Sofia, Dragan Tsankov 8 blvd., 1164, Sofia, Bulgaria, *E-mail: tonkov@biofac.uni-sofia.bg, bozilova@biofac.uni-sofia.bg*

The postglacial environmental changes in the Rila Mountains (2925 m), the highest massif on the Balkan peninsula, were traced by complex investigation of lake sediments with application of pollen analysis, plant macrofossil determination and local radiocarbon chronology. Additional information was obtained by geomorphological mapping of the glacial relief forms. The local cirque glaciers had retreated above 2300-2500 m ca. 20000-8000 years ago and clay silt was deposited in the subalpine lakes. In the course of the lateglacial stadials on vast areas at high-mid altitudes was distributed open mountain-steppe herbaceous vegetation dominated by *Artemisia*-Chenopodiacea-Poaceae species with isolated stands of *Pinus* and shrubland of *Juniperus* / *Ephedra*, which partly retreated during the interstadial complex Bølling/Allerød. Rock glaciers were also formed during the Younger Dryas stadial. At low altitudes (800-1000 m), in places with favourable microclimate, were preserved groups of deciduous and coniferous trees. The Holocene vegetation succession was triggered by the rapid amelioration of the climate, following four basic, chronologically welldelimited stages: a)11500-7900 cal. yrs. BP – pioneer forests of Betula with groups of *Pinus* (*P. sylvestris, P. peuce, P. mugo*) and below them mixed *Quercus* forests; b) 7900-5400/5200 cal. yrs. BP – formation of a coniferous belt dominated by *Pinus* and *Abies* when the climate changed to higher precipitation, milder winters and cooler summers; c) 5400/5200-3000 cal. yrs. BP – final establishment of the last tree immigrants (*Fagus, Picea*) and first indications of the anthropogenic impact; d) 3000 cal. yrs. BP till present – establishment of the modern vertical vegetation zonation and profound destructive changes in the natural forest cover. The paleoenvironmental record had archived the main cimate changes in postglacial time – the dynamic lateglacial oscillations, the abrupt 8.2 ky event and its regional consequences on the vegetation and the human societies, the Holocene optimum, the general cooling trend after 2800 cal. yrs. BP and the impact of the Little Ice Age in medieval time.

INQUA-SEQS 2008

TIMING OF MASSIVE "FLEUVE MANCHE" DISCHARGES OVER THE LAST 400 KYR: INSIGHTS INTO THE EUROPEAN ICE SHEET OSCILLATIONS AND THE EUROPEAN DRAINAGE NETWORK FROM MIS 10 TO 2

Samuel TOUCANNE, Sébastien ZARAGOSI, Michel CREMER, Frédérique EYNAUD, Jean-Louis TURON, Jacques GIRAUDEAU, Antoine TESSIER, Université Bordeaux 1, UMR 5805-EPOC, avenue des Facultés, F-33405 Talence, France, *E-mail: s.toucanne@epoc.u-bordeaux1.fr*

Jean-François BOURILLET, IFREMER, GM/LES, BP70, 29280 Plouzané Cedex, France

Viviane BOUT-ROUMAZEILLE, PBDS, Université de Lille 1, France

Philip L. GIBBARD, Department of Geography, University of Cambridge, Cambridge, CB2 3EN, United Kingdom

During Pleistocene glaciations, the presence of the European Ice Sheet (EIS), combined with sea level lowstands, has strongly modified the fluvial drainage directions of the western and central European rivers flowing northwards. The French, Dutch and German rivers indeed flowed into the Bay of Biscay (NE Atlantic Ocean), via the 'Fleuve Manche' palaeoriver, during periods of coalescence of the Fennoscandian and British ice sheets in the northern North Sea.

High-resolution multi-proxy study of long-piston cores retrieved in the Bay of Biscay (Armorican margin) allows us to reconstruct 'Fleuve Manche' palaeoriver discharges. Mass accumulation rates (MAR) have been estimated based on robust age models performed using oxygen isotopic composition of benthic foraminifera (d18O), CaCO3 content, abundances of the polar foraminifera Neogloquadrina pachyderma (s) and radiocarbon dates. MAR and XRF Ti/Ca ratio reveal that the most significant increases of the terrigenous input onto the Armorican margin occurred within the mid-MIS 6 (ca. 155 ka) and at the beginning of the Termination I (ca. 20 kyr – MIS 2). We suggest that net losses of mass of the EIS occurred during these periods in response to the precession forcing which increased both the Northern Hemisphere (NH) summer insolation and the seasonality. The substantial retreats of the EIS induced substantial increases of the 'Fleuve Manche' discharges and seaward transfer of terrigeneous material into the Bay of Biscay. Besides to detect large-scale reorganisations of the EIS within the mid-MIS 6, our results indicate that an extensive advance of the EIS as far as the southern North Sea basin occurred during the early MIS 6 up to force the meltwater to flow southwards through the Dover Strait. We assume that this major ice advance probably corresponds to the Drenthe glaciation and we suggest that the extreme 'Fleuve Manche' discharges detected between ca. 160 and 150 ka could indicate the retreat of the ice sheet between the Drenthe and Warthe advances. The sharp decrease of the NH summer insolation between 150 and 140 ka could indeed favour a re-growth of the EIS in the latter phase of the MIS 6. As a result, the Drenthe and Warthe glaciations could occurred within the ca. 175-160 ka and the ca. 150-130 ka intervals, respectively, the first occurring at the onset of the glacial MIS 6 and the second probably retreating during the Termination II (ca. 130 ka).

Because no significant 'Fleuve Manche' discharges were detected during the Termination II, we assume that the meltwater from the ice margin likely flowed northwards through the North Sea basin in the latter part of the MIS 6, implicating that continental ice did not covered the North Sea basin during the Warthe glaciation. Such a pattern corroborates the geological evidence which suggests that meltwater from the southern ice margin drained via the Aller-Weser marginal valley towards the North Sea during this period.

'Fleuve Manche' discharges during the MIS 10 and MIS 8 were significantly lower than during the MIS 6 and MIS 2, indicating either that continental ice were restricted to the mountainous areas or that the Rhine-Thames drainage system flowed northwards. Our data do not support the occurrence of one or more megafloods that reached the continental slope of the Bay of Biscay during the last 400 kyr.

AUTHORS INDEX